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ACTA ORTOPÉDICA BRASILEIRA

INSTRUCTIONS TO AUTHORS

(Reviewed April 2022)

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The journal *Acta Ortopédica Brasileira*, official organ of the Department of Orthopedics and Traumatology, Faculdade de Medicina da Universidade de São Paulo (DOT/FMUSP), operates under a continuous publication model of bi-monthly issues (Jan/Feb, Mar/Apr, May/Jun, Jul/Aug, Sep/Oct, and Nov/Dec) with an English version. The titles, abstracts and keywords are published in English and Portuguese.The publication follows entirely the international standard of the International Committee of Medical Journal Editors (ICMJE) - Vancouver Convention - and its uniform requirements [http://www.icmje.org/]. Submitted papers are sent for peer review evaluation to decide whether they should be published or not, suggesting improvements, asking the authors for clarification and making recommendations to the Editor-in-Chief. The editor(s) and/or reviewer(s) responsible for approval of the manuscript will be identified in the accepted articles. The concepts and statements contained in the papers are the sole responsibility of the authors.
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Type of Article	Abstract	Number of words	References	Figures	Tables	Maximum number of authors allowed
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Update / Review*	Non-structured, up to 200 words	4.000 Excluding abstract, references, tables and figures	60	3	2	2
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c) The full name of each author (no abbreviations) and their affiliation (hierarchical units should be presented in ascending order, for example, department, college/institute and university. The names of institutions and programs should be submitted preferably in full and in the original language of the institution or in the English version when writing is not Latin (e.g. Arabic, Mandarin, Greek);

d)The place where the work was performed;

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ACKNOWLEDGEMENTS: Authors can acknowledge financial support to the work in the form of research grants, scholarships and other, as well as professionals who do not qualify as co-authors of the article, but somehow contributed to its development.

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DISCUSSION: Emphasize new and important aspects of the study and the conclusions that derive from it, in the context of the best evidence available. Do not repeat in detail data or other information mentioned elsewhere in the manuscript, as in the Introduction or Results. For experimental studies it is recommended to start the discussion by briefly summarizing the main findings, then explore possible mechanisms or explanations for these findings, compare and contrast the results with other relevant studies, state the limitations of the study and explore the implications of these results for future research and for clinical practice. Link the conclusions with the goals of the study, but avoid statements and conclusions that are not supported by the data, in particular the distinction between clinical and statistical relevance. Avoid making statements on economic benefits and costs, unless the manuscript includes data and appropriate economic analysis. Avoid priority claim ("this is the first study of ...").

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ACKNOWLEDGEMENTS

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b) Books: Author(s) or publisher(s). Book title. Edition, if other than the first one. Translator (s), if applicable. Publication site: publisher; year. Ex.: Diener HC, Wilkinson M, editors. Drug-induced headache. 2nd ed. New York: Spriger-Verlag; 1996.

c) Book chapters: Author(s) of the chapter. Chapter heading. Publisher (s) of the book and other related data according to previous item. Ex.: Chapman MW, Olson SA. Open fractures. In: Rockwood CA, Green DP. Fractures in adults. 4th ed. Philadelphia: Lippincott-Raven; 1996. p.305-52.

d) Summaries: Author(s). Title, followed by [abstract]. Journal year; volume (supplement and corresponding number, if applicable): page(s) Ex.: Enzensberger W, Fisher PA. Metronome in Parkinson's disease [abstract]. Lancet. 1996;34:1337.

e) Personal communications must only be mentioned in the text if within parentheses

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g) Electronic material: Author (s). Article title. Abbreviated Journal title [medium]. Publication date [access date followed by the expression "accessed on"]; volume (number):initial page-final page or [approximate number of pages]. URL followed by the expression "Available from:"
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nov 8];21(3):197-205. Available from: http://periodicos.puc-campinas.edu.br/seer/index.php/transinfo/article/view/501

h) Data Sharing: Pavezi N, Flores D, Perez CB. Proposição de um conjunto de metadados para descrição de arquivos fotográficos considerando a Nobrade e a Sepiades. Transinf. [Internet]. 2009. Available at: https://doi.org/10.1590/S0103-37862009000300003. Write [dataset] immediately before the reference so we can identify it properly as a data reference. The identifier [dataset] will not appear in the published article.

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LEVELS OF EVIDENCE FOR PRIMARY RESEARCH QUESTION: Access the following link.

The sending of manuscripts

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http://asapbio.org/preprint-info
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Levels of Evidence for Primary Research Question[a]

(This chart was adapted from material published by the Centre for Evidence-Based Medicine, Oxford, UK. For more information, please visit www.cebm.net.)

	Types of study			
Level	**Therapeutic Studies Investigating the Results of Treatment**	**Prognostic Studies – Investigating the Effect of a Patient Characteristic on the Outcome of Disease**	**Diagnostic Studies – Investigating a Diagnostic Test**	**Economic and Decision Analyses – Developing an Economic or Decision Model**
I	High quality randomized trial with statistically significant difference or no statistically significant difference but narrow confidence intervals	High quality prospective study[d] (all patients were enrolled at the same point in their disease with ≥80% of enrolled patients)	Testing of previously developed diagnostic criteria on consecutive patients (with universally applied reference ''gold'' standard)	Sensible costs and alternatives; values obtained from many studies; with multiway sensitivity analyses
	Systematic review[b] of Level RCTs (and study results were homogenous[c])	Systematic review[b] of Level I studies	Systematic review[b] of Level I studies	Systematic review[b] of Level I studies
II	Lesser quality RCT (eg, < 80% followup, no blinding, or improper randomization)	Retrospective[f] study	Development of diagnostic criteria on consecutive patients (with universally applied reference ''gold'' standard)	Sensible costs and alternatives; values obtained from limited studies; with multiway sensitivity analyses
	Prospective[d] comparative study[e]	Untreated controls from an RCT	Systematic review[b] of Level II studies	Systematic review[b] of Level II studies
	Systematic review[b] of Level II studies or Level I studies with inconsis tent results	Lesser quality prospective study (eg, patients enrolled at different points in their disease or <80% followup)		
		Systematic review[b] of Level II studies		
III	Case control study[g]	Case control study[g]	Study of non consecutive patients; without consistently applied reference ''gold'' standard	Analyses based on limited alternatives and costs; and poor estimates
	Retrospective[f] comparative study[e]		Systematic review[b] of Level III studies	Systematic review[b] of Level III studies
	Systematic review[b] of Level III studies		Case-control study	
			Poor reference standard	
IV	Case series[h]	Case series		Analyses with no sensitivity analyses
V	Expert opinion	Expert opinion	Expert opinion	Expert opinion

[a] A complete assessment of quality of individual studies requires critical appraisal of all aspects of the study design.
[b] A combination of results from two or more prior studies.
[c] Studies provided consistent results.
[d] Study was started before the first patient enrolled.
[e] Patients treated one way (eg, cemented hip arthroplasty) compared with a group of patients treated in another way (eg, uncemented hip arthroplasty) at the same institution.
[f] The study was started after the first patient enrolled.
[g] Patients identified for the study based on their outcome, called "cases" eg, failed total arthroplasty, are compared with patients who did not have outcome, called ''controls'' eg, successful total hip arthroplasty.
[h] Patients treated one way with no comparison group of patients treated in another way.

SUMMARY

VOLUME 30 – Nº 5 – 2022

Original Article

FOOT AND ANKLE

ARTHROSCOPIC FOOT AND ANKLE SURGERY: BRAZILIAN SURGEON PROFILE
CIRURGIA ARTROSCÓPICA DO PÉ E TORNOZELO: PERFIL DO CIRURGIÃO BRASILEIRO
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DOI: http://dx.doi.org/10.1590/1413-785220223004e251626

HAND SURGERY

ANATOMICAL STUDY OF VOLAR FACE OF DISTAL RADIUS AND COMPARISON WITH THE SHAPE OF LOCKING VOLAR PLATES
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DOI: http://dx.doi.org/10.1590/1413-785220223004e257953

HIP

IMPACT OF COVID-19 ON MORTALITY AND HOSPITALIZATION IN OLDER ADULTS WITH HIP FRACTURE
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Diego da Silva Santos, Edivando Moura Barros, Nicole Dittrich Hosni, Bruno Francesco Scatigna, Guilherme Guadagnini Falótico, Edmilson Takehiro Takata
DOI: http://dx.doi.org/10.1590/1413-785220223004e255298

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DOI: http://dx.doi.org/10.1590/1413-785220223004e251150

ONCOLOGY ORTHOTICS

EPIDEMIOLOGICAL DISTRIBUTION OF SOFT PART TUMORS IN A TERTIARY HOSPITAL
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DOI: http://dx.doi.org/10.1590/1413-785220223004e257493

ORTHOPEDICS AND TRAUMATOLOGY

THE IMPACT OF MOTORCYCLE ACCIDENTS IN A REFERENCE HOSPITAL DURING THE COVID-19 PANDEMIC

IMPACTO NOS ACIDENTES MOTOCICLÍSTICOS EM UM HOSPITAL REFERÊNCIA DURANTE A PANDEMIA DE COVID-19

Aline Cremasco Rocha, Bruna Granig Valente, Henrique Carvalho e Silva Figueiredo, Guilherme de Oliveira Jorge, Carlos Augusto de Mattos, Cintia Kelly Bittar

DOI: http://dx.doi.org/10.1590/1413-785220223004e255862

PEDRIATRIC ORTHOPEDICS AND BACKBONE

STERNUM TOMOGRAPHIC EVALUATION IN PECTUS PATIENTS: ANALYSIS OF SAGITAL PARAMETERS

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DOI: http://dx.doi.org/10.1590/1413-785220223004e250612

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DOI: http://dx.doi.org/10.1590/1413-785220223004e257002

SHOULDER AND ELBOW

ANTEGRADE NAILING VERSUS LOCKING PLATE OF 2-AND 3-PART PROXIMAL HUMERUS FRACTURES

HASTE INTRAMEDULAR *VERSUS* PLACA BLOQUEADA NO TRATAMENTO DA FRATURA DO ÚMERO PROXIMAL EM DUAS E TRÊS PARTES

Gustavo Remigio Gomes, Rafael Almeida Maciel, José Inácio de Almeida Neto, Daniel Carvalho de Toledo, Carla Jorge Machado, Leonidas de Souza Bomfim

DOI: http://dx.doi.org/10.1590/1413-785220223004e256113

MORTALITY AFTER SURGICAL TREATMENT OF PROXIMAL HUMERUS FRACTURES IN OLDER PATIENTS

MORTALIDADE APÓS TRATAMENTO CIRÚRGICO DAS FRATURAS PROXIMAIS DO ÚMERO EM PACIENTES IDOSOS

Guilherme Grisi Mouraria, Rafael Vinicius Londero Quintino dos Santos, Fernando Kenji Kikuta, Daniel Romano Zogbi, Márcio Alves Cruz, Maurício Etchebehere

DOI: http://dx.doi.org/10.1590/1413-785220223004e254279

TRAUMA

THE IMPACT OF COVID-19 ON THE EPIDEMIOLOGICAL PROFILE OF FRACTURES

O IMPACTO DA COVID-19 SOBRE O PERFIL EPIDEMIOLÓGICO DE FRATURAS

Jonatas Brito de Alencar Neto, Erica Damasceno Oliveira, Márcio Carvalho Castelo Branco, Renan Galvão Ozório, Antônio Anderson Fonseca de Sousa, Maria Luzete Costa Cavalcante, Ramille Lima Araújo

DOI: http://dx.doi.org/10.1590/1413-785220223004e252472

USE OF THE INTERNET AND SOCIAL NETWORKS IN ORTHOPEDICS AND TRAUMATOLOGY AND PERSPECTIVE OF POST COVID TELEMEDICINE

USO DA INTERNET E REDES SOCIAIS NA ORTOPEDIA E TRAUMATOLOGIA E PERSPECTIVA DA TELEMEDICINA PÓS-COVID

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DOI: http://dx.doi.org/10.1590/1413-785220223004e252728

Review Article

ORTHOPEDICS

REVIEW OF ARTICULATED ELBOW ORTHOTICS FOR JOINT STIFFNESS REHABILITATION

REVISÃO DE ÓRTESES ARTICULADAS DE COTOVELO PARA REABILITAÇÃO DE RIGIDEZ ARTICULAR

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DOI: http://dx.doi.org/10.1590/1413-785220223004e254358

OSTEOMETABOLIC DISORDER

BRAZILIAN CONSENSUS STATEMENT ON VISCOSUPPLEMENTATION OF THE HIP (COBRAVI-Q)

CONSENSO BRASILEIRO DE VISCOSSUPLEMENTAÇÃO DO QUADRIL (COBRAVI-Q)

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ARTHROSCOPIC FOOT AND ANKLE SURGERY: BRAZILIAN SURGEON PROFILE

CIRURGIA ARTROSCÓPICA DO PÉ E TORNOZELO: PERFIL DO CIRURGIÃO BRASILEIRO

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ABSTRACT

Objective: To study the profile of the practice of arthroscopy among ankle and foot surgeons in Brazil and its evolution in recent years. Methods: Observational, cross-sectional study, using a survey sent to all members of the *Associação Brasileira de Medicina e Cirurgia do Tornozelo e Pé* (ABTPé) in 2017 and 2019. Results: In total, 75 surgeons participated in 2017 and 82 in 2019 and most had over 10 years of experience. Of these, 56 participants in 2017 (75%) and 68 in 2019 (82%) used arthroscopy. The number of specialists with no to five years of experience ($p = 0.027$) and who learned the technique during fellowship ($p = 0.007$) increased. The use of the 4.0 mm optics and 30° optics ($p = 0.040$) increased whereas the routine use of traction ($p = 0.049$) and radiofrequency ($p = 0.002$) decreased. The main pathology treated with anterior ankle arthroscopy was bone injury. The most frequent complication was neuropraxia. Conclusion: Most of the foot and ankle surgeons who use arthroscopy have more than 10 years of experience, performed anterior access, and are concentrated in the Southeast region of the country. The number of younger surgeons who learned the technique during fellowship increased. ***Level of Evidence III, Cross-Sectional Comparative Study.***

RESUMO

Objetivo: Mostrar o perfil da prática da artroscopia entre cirurgiões de tornozelo e pé no Brasil e sua evolução nos últimos anos. Métodos: Estudo observacional, transversal, realizado por meio de questionário eletrônico enviado para todos os membros da Associação Brasileira de Medicina e Cirurgia do Tornozelo e Pé (ABTPé) em 2017 e 2019. Resultados: Obtivemos 75 respondentes em 2017 e 82 em 2019; a maioria tinha mais de 10 anos de experiência. Dos respondentes, 56 realizavam artroscopia em 2017 (75%) e 68 em 2019 (82%). Foi observado aumento no número de especialistas com até 5 anos de experiência ($p = 0,027$) e que aprenderam a técnica durante o estágio de especialização ($p = 0,007$). Houve aumento no uso da ótica de 4,0 mm e 30° de angulação ($p = 0,040$), e diminuição do uso rotineiro de tração ($p = 0,049$) e de radiofrequência ($p = 0,002$). A principal patologia tratada com artroscopia anterior do tornozelo foi o impacto ósseo, e a complicação mais frequente foi a neuropraxia. Conclusão: A maioria dos cirurgiões de pé e tornozelo que utiliza artroscopia tem mais de 10 anos de experiência, usa o acesso anterior e concentra-se na região Sudeste do país. Foi observado aumento no número de cirurgiões mais novos e que aprenderam a técnica durante o estágio de especialização. ***Nível de Evidência III, Estudo Transversal Comparativo.***

Keywords: Arthroscopy. Ankle Joint. Orthopedics.

Descritores: *Artroscopia. Articulação do Tornozelo. Ortopedia.*

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INTRODUCTION

Ankle and foot arthroscopic surgery was first performed by Burman[1] on cadavers in 1931. Takagi[2] later modified it, successfully describing the ankle arthroscopic access system for the first time in 1939. However, it was not until the 1970s that arthroscopy started becoming an important tool to diagnose and treat lesions in the foot and ankle.[3] Surgery by arthroscopic access has become increasingly frequent and popular among orthopedic surgeons. Ankle arthroscopy has developed parallel to the arthroscopic procedure of other joints, such as knees and shoulder. The surgery was initially described for treating loose joint bodies and bone and soft tissue injuries,[4] but technological evolution and optics of increasingly smaller calibers and high image quality, associated with the use of multiple portals, allowed visualizing and treating several pathologies of the foot and ankle. More recently, studies[5-7] have developed posterior ankle arthroscopy and tendoscopy, which allowed excellent access to posterior ankle structures, to the subtalar joint, and to extra-articular structures. Other recent advances include arthroscopy of the midfoot and forefoot.[8]

All authors declare no potential conflict of interest related to this article.

The study was conducted at Instituto Vita.
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The method was first reported in Brazil in 1994 when Nery et al.[9] used it for treating anterior ankle impingement. Although arthroscopy has been increasingly used in recent years, Brazil has no surveys on the use of this technique.

This study aimed to show the profile of arthroscopic surgery among ankle and foot surgeons in Brazil and perform a comparative evolution between recent years.

METHODS

This study was approved by the Research Ethics Committee of our institution with registration on Plataforma Brasil under No. 11311119.4.0000.5404. All participants signed an informed consent form.

The research began by sending an email with a questionnaire (Figure 1) to all members of the Brazilian Association of Medicine and Ankle and Foot and Surgery (ABTPé) in 2017 and 2019, with 504 and 635 associates, respectively. After a month, a new email, now accompanied by a reminder on an instant messaging app (WhatsApp), reinforced the initial request. The questionnaire contained 21 questions about the practices of foot and ankle arthroscopic surgery. The questions were closed but allowed more than one answer, following a logical sequence and facilitating the completion of the questionnaire. They addressed the region of the country where interviewees worked, their years of surgical practice, use of arthroscopy and its characterization, site of arthroscopic training, anesthesia and the use of tourniquet, arthroscopic techniques used, number of surgeries performed per year, main indications and material used in anterior, posterior, and subtalar arthroscopy, use of radiofrequency, traction, and infusion pump, and main complications.

What region of the country do you work in?
- ☐ North
- ☐ Northeast
- ☐ Midwest
- ☐ Southeast
- ☐ South
- ☐ Foreigner

How many years have you been performing foot and ankle surgery?*
- ☐ 0 to 5
- ☐ 6 to 10
- ☐ 11 to 20
- ☐ Over 20 years

Do you use arthroscopy in the treatment of foot pathologies?*
- ☐ Yes
- ☐ No

If you answered no, please explain.
- ☐ I do not believe in the method
- ☐ I believe in the method, but I have no cases that present indications
- ☐ I believe in the method, but I did not undergo training to perform it.
- ☐ I believe in the method, but I do not have access to the necessary equipment.

Where did you seek theoretical knowledge in arthroscopy? (more than one answer is allowed)
- ☐ Books
- ☐ Articles
- ☐ Online videos and websites

Where did you undergo training in arthroscopy? (more than one answer is allowed)
- ☐ During fellowship in foot and ankle surgery
- ☐ Accompanying colleagues who are more familiar with the method
- ☐ Courses in Brazil
- ☐ Courses abroad

What type of anesthesia do you use for arthroscopy? (more than one answer is allowed)
- ☐ Locoregional without sedation
- ☐ Locoregional with sedation
- ☐ Spinal anesthesia

Do you use routine tourniquet for arthroscopy?
- ☐ Yes
- ☐ No

What arthroscopic techniques do you usually use? (more than one response is allowed)
- ☐ Anterior ankle arthroscopy
- ☐ Posterior ankle arthroscopy
- ☐ Subtalar arthroscopy
- ☐ First metatarsophalangeal arthroscopy
- ☐ Small joint arthroscopy
- ☐ Tendoscopy

How many arthroscopic surgeries do you usually perform per year?
- ☐ Up to 5
- ☐ 6 to 10
- ☐ 11 to 20
- ☐ 21 to 40
- ☐ Over 40

What pathologies do you usually treat with anterior arthroscopy? (more than one answer is allowed)
- ☐ Bone injury
- ☐ Soft tissue injury
- ☐ Osteochondral lesion
- ☐ Arthritis (tibiotalar arthrosis)
- ☐ Distal tibiofibular syndesmosis injury
- ☐ Chronic instability (ligament reconstruction)
- ☐ Fractures

What material do you routinely use in anterior ankle arthroscopy?
- ☐ 4 mm optics with 30° inclination
- ☐ 2.7 mm or 2.9 mm mini optics
- ☐ 70° optics

What pathologies do you usually treat with posterior arthroscopy? (more than one answer is allowed)
- ☐ Posterior injury
- ☐ Pathologies of the flexor hallucis longus
- ☐ Os trigonum resection
- ☐ Osteochondral lesion of the talus
- ☐ Arthritis (tibiotalar arthrosis)
- ☐ I do not perform posterior arthroscopy

What material do you routinely use in posterior ankle arthroscopy?
- ☐ 4 mm optics with 30° inclination
- ☐ 2.7 mm or 2.9 mm mini optics
- ☐ 70° optics

What pathologies do you usually treat with subtalar arthroscopy? (more than one answer is allowed)
- ☐ Osteochondral lesion
- ☐ Arthritis (subtalar arthrodesis)
- ☐ Tarsal tunnel syndrome
- ☐ Calcaneus fracture
- ☐ Posttraumatic arthrofibrosis
- ☐ Synovitis
- ☐ I do not perform subtalar arthroscopy

What material do you routinely use in subtalar ankle arthroscopy?
- ☐ 4 mm optics with 30° inclination
- ☐ 2.7 mm or 2.9 mm mini optics
- ☐ 70° optics

Regarding radiofrequency in arthroscopies:
- ☐ I find it unnecessary
- ☐ I find it necessary in some cases, but have no access to the material
- ☐ I find it necessary in some cases and have access to the material
- ☐ I use it in all cases

Regarding the use of traction in arthroscopies:
- ☐ I do not apply it
- ☐ I rarely apply it
- ☐ I routinely apply it

What kind of traction do you apply?
- ☐ Noninvasive, attached to the surgeon's body
- ☐ Noninvasive, fixed to the table
- ☐ Invasive

Regarding the use of infusion pump:
- ☐ I find it unnecessary, I use gravitational infusion
- ☐ I use it whenever the material is available
- ☐ I use it in all cases

What complications have you had in arthroscopies? (more than one answer is allowed)
- ☐ Dehiscence
- ☐ Infection
- ☐ Neuropraxia
- ☐ Poor reduction
- ☐ Pseudoarthrosis
- ☐ Synovial fistula

Figure 1. Questionnaire used for data collection.

Data analysis was conducted using the statistical program STATA v14.2 (StataCor, Texas, USA). Quantitative and qualitative descriptions of the answers for each item were included in the results. To compare the percentages obtained in 2017 and 2019, the chi-square test or Fisher's exact test were used. A 95% significance level was adopted.

RESULTS

In total, 75 of 504 members in 2017 and 82 of the 635 members in 2019 completed the survey (response rate of 15% and 13%, respectively). In both years, most participants were from the Southeast region, followed by those from the South (Figure 2). Most associates who responded to the survey had more than 10 years of practice in foot and ankle surgery (Figure 3).

About 40% of interviewees reported learning the technique in foot and ankle fellowship in 2017, increasing to 62% in 2019 ($p = 0.007$). The techniques most used by surgeons were anterior ankle arthroscopy, both in 2017 (59 surgeons, 79%) and in 2019 (73 surgeons, 89%), followed by posterior ankle arthroscopy also in 2017 (41 surgeons, 55%) and in 2019 (55 surgeons, 67%). Figure 4 shows the pathologies most treated with anterior arthroscopy.

The 4 mm optics with 30° inclination were the material most used routinely in anterior ankle arthroscopy in both 2017 and 2019. Table 1 shows a relative increase in the use of 4 mm optics by surgeons ($p = 0.002$).

Figures 5 and 6 show the pathologies most treated with posterior ankle and subtalar arthroscopy. Neuropraxia was the most frequently reported complication: 40 (56%) in 2017 and 41 (51%) in 2019 (Figure 7).

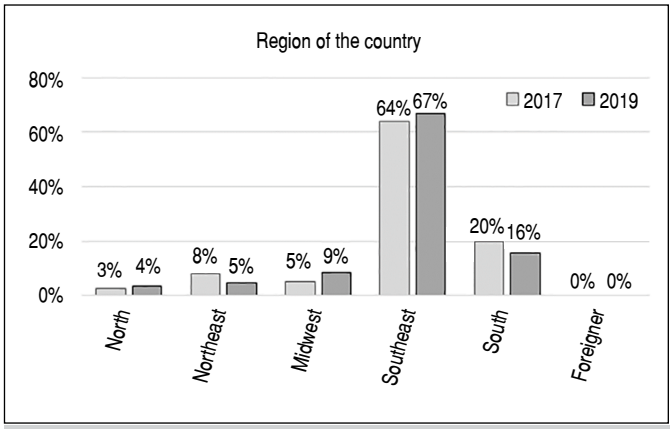

Figure 2. Working region of the participants ($p = 0.786$).

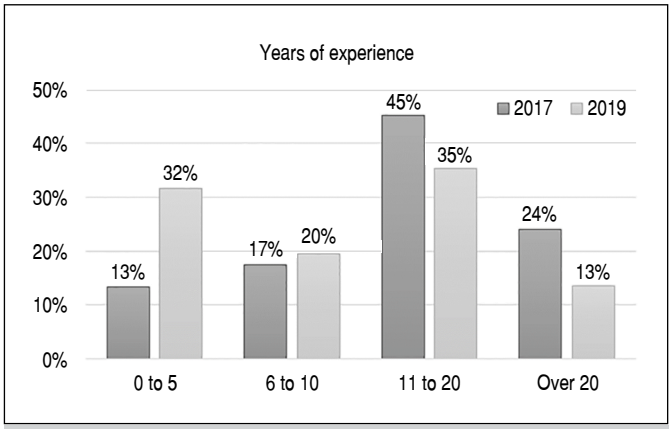

Figure 3. Time of experience in arthroscopy practice ($p = 0.027$).

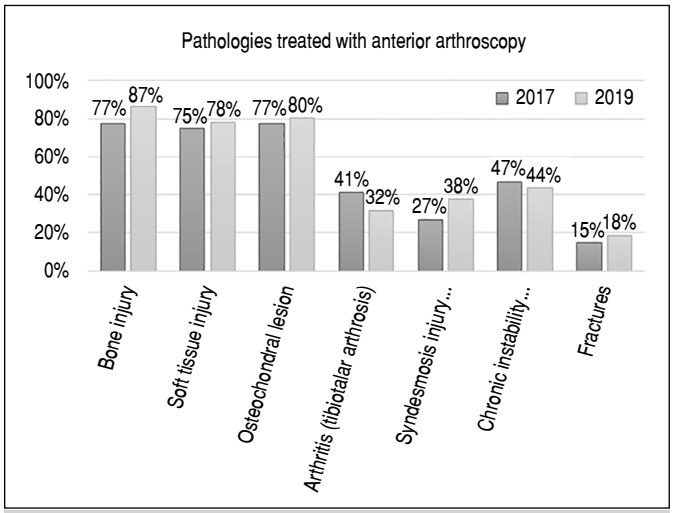

Figure 4. Pathologies most treated with anterior ankle arthroscopy. All items showed no statistically significant difference from 2017 to 2019 and the lowest p-value found was 0.192.

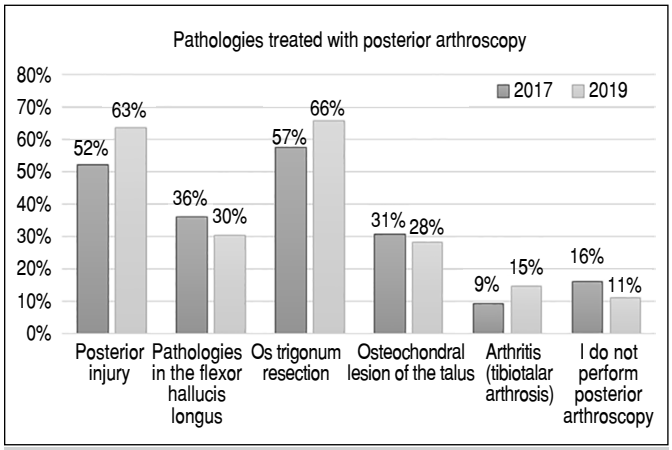

Figure 5. Pathologies most treated with posterior ankle arthroscopy. All items showed no statistically significant difference from 2017 to 2019 and the lowest p-value found was 0.099.

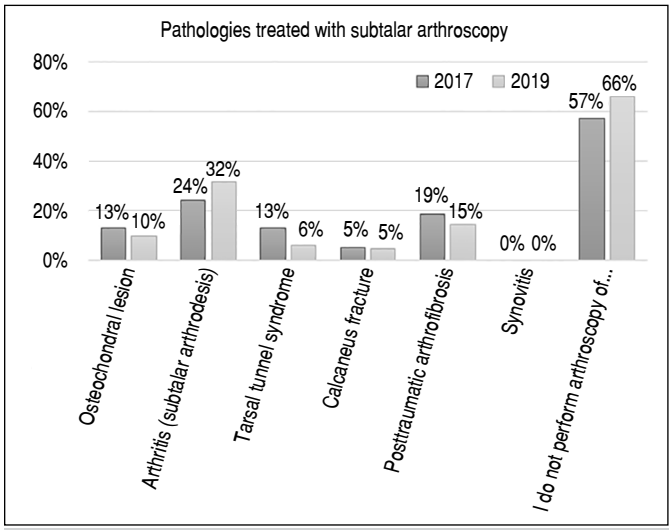

Figure 6. Pathologies most treated with subtalar ankle arthroscopy. All items showed no statistically significant difference from 2017 to 2019 and the lowest p-value found was 0.185.

Table 1. Surgeons' answers about arthroscopy.

Question	Alternatives	2017	2019	p-value
Performs arthroscopy	Yes	75%	83%	0.214
	No	25%	17%	
Reason for not performing arthroscopy	I do not believe in the method	9%	15%	0.379
	I believe in the method, but I have no cases that present indications	18%	0%	
	I believe in the method, but I did not undergo training to perform it	59%	62%	
	I believe in the method, but I have no access to the necessary equipment	14%	23%	
Anesthesia#	Locoregional without sedation	0%	0%	1.000
	Locoregional with sedation	16%	20%	0.435
	Spinal anesthesia	77%	80%	0.435
Tourniquet	Yes	93%	90%	0.548
	No	7%	10%	
Arthroscopic Techniques#	Anterior ankle arthroscopy	79%	89%	0.059
	Posterior ankle arthroscopy	55%	67%	0.076
	Subtalar arthroscopy	32%	33%	0.369
	First metatarsophalangeal arthroscopy	21%	18%	0.390
	Small joint arthroscopy	3%	10%	0.066
	Tendoscopy	28%	27%	0.505
Number of Arthroscopies per year	Up to 5	10%	20%	0.216
	6 to 10	20%	30%	
	11 to 20	29%	24%	
	21 to 40	19%	15%	
	Over 40	22%	11%	
Material used in anterior arthroscopy#	4 mm optics with 30° inclination	55%	70%	0.040*
	2.7 mm or 2.9 mm mini optics	33%	37%	0.398
	70° optics	0%	0%	1.000
Material used in posterior arthroscopy#	4 mm optics with 30° inclination	48%	60%	0.094
	2.7 mm or 2.9 mm mini optics	17%	16%	0.486
	70° optics	0%	0%	1.000
Material used in subtalar arthroscopy#	4 mm optics with 30° inclination	15%	20%	0.278
	2.7 mm or 2.9 mm mini optics	27%	22%	0.307
	70° optics	0%	0%	1.000
Use of radiofrequency	I find it unnecessary	9%	23%	0.002*
	I find it necessary in some cases, but I have no access to the material	14%	16%	
	I find it necessary in some cases and I have access to the material	70%	57%	
	I use it in all cases	7%	4%	
Application of Traction	I do not apply it	33%	40%	0.049*
	I rarely apply it	36%	47%	
	I routinely apply it	31%	13%	
Traction Type#	Noninvasive, attached to the surgeon's body	35%	38%	0.404
	Noninvasive, fixed to the table	27%	22%	0.307
	Invasive	0%	1%	0.522
Use of infusion pump	I find it unnecessary, I use gravitational infusion	24%	18%	0.665
	I use it whenever material is available	36%	42%	
	I use it in all cases	41%	40%	

* statistically significant p-values (< 0.05); # More than one response was allowed for these variables.

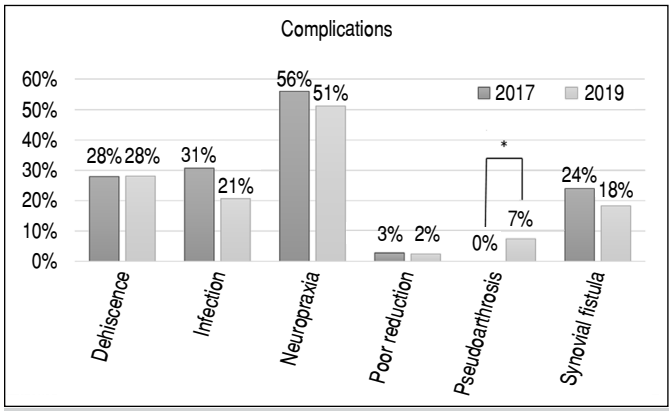

Figure 7. Main complications found in ankle arthroscopy (*p = 0.019). Other differences have no statistical significance.

DISCUSSION

Our study found that arthroscopy was most used by surgeons with 11 to 20 years of experience in both 2017 and 2019. However, the number of surgeons with zero to five years of experience performing this technique increased (p = 0.027). Knowledge of arthroscopic surgery during fellowship in foot and ankle surgery also increased between the two surveys (p = 0.007). Physicians also received training by taking courses in Brazil and abroad or by accompanying colleagues who already practice the technique. Most surgeons in this study believe in the method. Those who do not apply it indicated the lack of adequate training and access to equipment as major limiting factors for adopting the practice. This is the first study to trace the demographic profile of Brazilian surgeons and future studies can use our data to optimize and improve access to knowledge and new technologies.

Most participants were from the Southeast region of the country, with 48 surgeons (64%) in 2017 and 55 (67%) in 2019, followed by the South region, with 15 (20%) and 13 surgeons (16%), respectively. This distribution suggests greater access to arthroscopic technique in these regions, following the proportionality of ABTPé members in the country.

We found no epidemiological surveys on the prevalence of the use of anterior, posterior, or subtalar arthroscopy in Brazil in the literature. We observed that most surgeons who answered the questionnaire reported performing arthroscopic surgery. These data should be analyzed carefully since those who do not practice the technique may have been discouraged to fill out the questionnaire. Among the participants who reported performing arthroscopy, most performed anterior ankle access and few reported subtalar arthroscopy. Anterior arthroscopy is the most frequently performed surgery since it is technically simpler and has more indications than posterior and subtalar access.

The main indications for anterior ankle arthroscopy are bone injury, soft tissue injury, synovitis, loose bodies, osteochondral lesions, lateral ankle ligament repair and reconstruction, and ankle arthrodesis. Our data corroborate those found in the literature, which indicates bone and soft tissue injuries and osteochondral lesions as the main pathologies treated with this access.[3,10]

In their 1989 study, Ferkel and Fischer[11] recommended using mini-optics with 30° inclination. In our research, the most used material was the 4 mm optics with 30° inclination.[12,13] The use of this material increased from 2017 to 2019 (p = 0.04), likely due to the greater availability of the 4 mm optics and dissemination of the philosophy proposed by van Dijk and van Bergen in our country.[12]

The main indications for posterior ankle arthroscopy are osteochondral lesion of the talus, loose bodies, ossicle resection, osteophytes, synovial chondromatosis, arthrodesis, synovitis, and extra-articular structures such as Achilles tendon, flexor hallucis longus, os trigonum, and hypertrophy of the talar beak.[4,14] In 2000, van Dijk, Scholten, and Krips[15] introduced the posterior access with two portals and with patients in prone positioning, allowing

excellent access to the posterior ankle compartment, subtalar joint, and extra-articular structures. In our study, the pathologies most treated with arthroscopy were the os trigonum resection and posterior injury of the ankle, corroborating findings in the literature.[16,17] We also found that most surgeons use 4 mm optics with 30° inclination in posterior endoscopy.

Most Brazilian surgeons prefer to routinely use the tourniquet in arthroscopies, but more recent studies show no significant differences in the use of tourniquet regarding surgical time, joint visualization, and postoperative complications.[18,19]

Most participants consider using radiofrequency in some cases and have access to this feature. However, an increasing number of surgeons no longer uses it ($p = 0.002$), likely because of the high cost and adverse effects of the method, such as thermal lesions and capsular necrosis.[20]

Regarding the use of traction during ankle arthroscopy, most did not apply it or rarely applied it in both surveys. The routine use of this technique also decreased among surgeons ($p = 0.049$). The literature diverges regarding the use of traction, so surgeons should choose the method in which they are most experienced. Guhl[21] was one of the pioneers in developing one of the first traction devices for ankle arthroscopy, in 1988. In his 2016 study, Ferkel[22] analyzed the practice of noninvasive traction in relation to invasive traction.[23] Recently, authors such as Vega and Dalmau-Pastor[24] promoted performing ankle dorsiflexion instead of traction. Regarding the type of traction, our study found that most surgeons used noninvasive traction attached to the surgeon's body. This data is in line with the trend of less invasive procedures.

According to our results, most surgeons choose using infusion pump rather than gravitational infusion. The pump has advantages such as maintaining a constant and consistent flow and presenting a better distension and joint visualization.[25] Limitations to the use of infusion pump could include the lack of access to this material and its high cost compared to gravitational infusion.

The main complications found were neuropraxia, infection, and dehiscence, corroborating the 2013 study by Carlson and Ferkel[26]. In their study, the most frequent complications were neurological lesions, caused in different ways: incorrect access of the arthroscopic portal, prolonged or inappropriate traction, or excessive use of tourniquet. The correct delimitation of the site for the arthroscopic portal is essential to prevent superficial fibular nerve injury.[27]

Email surveys are faster and have an estimated cost of 5 to 20% of the cost of mail surveys. Moreover, answers can be more dependable than in surveys by telephone or mail.[28] We obtained a response rate of 15% and 13% in 2017 and 2019, respectively, comparable to the 20% response rate of postal questionnaires in the literature.[29]

This study presents limitations regarding the number of respondents and the short period (two years) among the surveys. Only the surgeons who perform arthroscopic procedures might have responded to the survey while those who do not were discouraged to participate. However, this is the first survey on the practice of foot and ankle arthroscopic surgery in Brazil and it contains demographic information, technical aspects, and trends of surgeons in Brazil, which can contribute to future studies on the subject. We believe that in a longer period these data will change with the improved practice and experience in arthroscopy among Brazilian orthopedists.

CONCLUSION

Most Brazilian foot and ankle surgeons who participated in the research perform arthroscopic surgery, have more than 10 years of experience in the specialty, usually perform anterior access, and are mainly gathered in the Southeast region of the country. We observed an increase in the number of surgeons with up to five years of experience and who learn the technique during fellowship. We also found a tendency to use 4.0 mm and 30° angulation optics and a decrease in routine traction and radiofrequency use.

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ANATOMICAL STUDY OF VOLAR FACE OF DISTAL RADIUS AND COMPARISON WITH THE SHAPE OF LOCKING VOLAR PLATES

ESTUDO ANATÔMICO DA FACE VOLAR DA EXTREMIDADE DISTAL DO RÁDIO E COMPARAÇÃO COM O FORMATO DAS PLACAS VOLARES BLOQUEADAS

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ABSTRACT

Objective: To evaluate the volar cortical angle (VCA), the variation in lateral and intermediate columns, the shape and pattern of the watershed line (WL) of the distal radius and its correlation with locking volar plates available. Methods: 27 human cadaveric radial bones of the Department of Morphology and nine locking volar plates of six different companies were analyzed. VCA were measured from lateral and intermediate columns and their corresponding values on plates, as well as comparing the relief of radius and plates. In the WL analysis, we compared the standard format found on the radius and its equivalent on plates and divided into four types: biconvex, convex, ulnar convex and plan. Results: VCA varied between columns of the distal radius extremity. The mean in the lateral column was 153.40 degrees and 146.06 degrees in the intermediate. Four of nine plates showed no variation in volar angulation. From 27 distal radius, 13 showed convex pattern and 12 had biconvex, whereas most plates (seven of the nine analyzed) were biconvex drawing. Conclusion: Radial bone anatomy was variable. The intermediate column was, on average, steeper than lateral column. Synthes®-2 plate presented the closest design to the anatomy of the distal end of the radial bone, followed by Newclip®-2 plate. ***Level of Evidence II, Anatomic and Descriptive Study.***

Keywords: Anatomy, Regional. Radius Fractures. Bone Plates. Radius.

RESUMO

Objetivos: Avaliar o ângulo palmar cortical (APC) da extremidade distal do rádio, sua variação nas colunas lateral e intermédia, o formato e o padrão da watershed line (WL) e sua correlação com as placas volares bloqueadas disponíveis no mercado. Métodos: Foram analisados 27 ossos rádios do Departamento de Morfologia e nove placas de seis fabricantes diferentes. Medimos os APCs das colunas lateral e intermédia dos rádios e seus correspondentes nas placas, além de compararmos o relevo do terço distal do rádio e das placas. Quanto a WL, comparamos o formato nas peças e seu equivalente nas placas, sendo classificados em quatro tipos: biconvexo, convexo, convexo ulnar e plano. Resultados: O APC variou entre as colunas do rádio, sendo a média da coluna lateral 153,40° e, da intermédia 146,06°. Quatro das nove placas não apresentaram variação na angulação volar. Dos 27 rádios, 13 apresentaram padrão convexo e 12 biconvexo, enquanto a maioria das placas (sete das nove analisadas) tinham desenho biconvexo. Conclusão: A anatomia dos rádios foi variável entre as peças, sendo a coluna intermédia mais inclinada que a coluna lateral. A placa Synthes®-2 foi a que apresentou relevo mais próximo dos achados anatômicos da extremidade distal do rádio, seguida pela Newclip®-2. ***Nível de Evidência II, Estudo Anatômico Descritivo.***

Descritores: *Anatomia Regional. Fraturas do Rádio. Placas Ósseas. Rádio (Anatomia).*

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INTRODUCTION

Fractures in the distal end of the radius are frequent in an orthopedic surgeon's routine, being responsible for 18% of all fractures.[1-4] They present a bimodal distribution, affecting mainly children between the ages 10 and 14 and women over 50, the latter related to bone fragility.[5]

Currently, several therapeutic options are available: plaster casts, external fixators, percutaneous pin fixation, and modern locking volar plates.[1,6]

Locking volar plates were introduced in clinical practice in the 1990s, showing excellent biomechanical results,[1,7] with fewer complications

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The study was conducted at School of Medical Sciences of Santa Casa de Misericórdia de São Paulo.
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related to soft tissues than dorsal plates[6,8-12] and allowing early wrist movement.[3,13] The main indications for locking volar plate treatment are: unstable extra-articular fractures (especially in osteoporotic bones), most articular fractures, and vicious consolidations of the distal third of the radius.[14]

Several studies demonstrate an incompatibility between plates and the anatomy of the radial distal end.[1,15] Most plates have a 155° palmar cortical angle (PCA) over its entire length, which is the angle between the volar lip cortical and the radial shaft. However, Bassi et al.[16] demonstrated 143° as the mean value, whereas Evans, Ramasamy and Deshmukh[7] demonstrated a 147° mean. Parameters such as the distal transverse relief of the radius and the watershed line (WL) design were less studied. The design of the implants used, and their positioning related to the WL may influence the occurrence of iatrogenic tendon injuries.[9,17]

Our objectives are to study the relief of the volar face of the distal end of the radius, especially the difference in the volar inclination between the columns and the WL shape, and to compare it with other locking volar plates in the market.

METHODS

After the Research Ethics Committee's approval (Opinion No. 1,226,567), we conducted a study with 34 pieces of radial bones from the Department of Morphology of the School of Medical Sciences of Santa Casa de São Paulo.

Bones with damaged features and or less than 21 cm of length were excluded, resulting in 27 bones.

Transparent adhesive tape was used on the radiuses to mark the anatomical references with a permanent pen without damaging the pieces. The length was measured and divided by three to calculate the distal third of the bone. A transverse line was drawn along the axis of the radius, passing through the largest diameter of the distal end of the bone. With the aid of a pachymeter, the midline of the radius was identified, connecting the midpoint of the distal end to the midpoint of the transition between the middle and distal thirds of the radius, in the coronal plane. Then, two lines parallel to the midline were drawn, which divided the transverse line into four equal parts, corresponding to the midpoint of the lateral and intermediate columns of the distal third of the radius (Figure 1). The WL was then drawn.

With the aid of a contour gauge (*General®, no. 337, USA*), the transcription of the radial volar face was performed at four points: a) longitudinal plane, in the midline of the volar face of the distal radius; b) longitudinal plane, at the midpoint of the volar face of the lateral column; c) longitudinal plane, at the midpoint of the volar face of the mid column; d) transverse plane, perpendicular to the long axis of the radius, 1 cm proximal to the radial volar edge.

We used a Sony® DSC-H70 digital camera with a tripod, at a standard distance, to photograph the volar face of the radiuses and the transcriptions with the gauge (Figure 2).

The images were evaluated using the AutoCad 2015® software, with measurements of the inclination angle of the distal surface of the radius in the volar plane of the lateral and intermediate columns and in the midline of the distal end. A line was drawn on the gauge corresponding to the shaft of the radius (A) and another line corresponding to the distal volar cortical of the radius in each column (B). The angle between these lines was measured and represented as PCA (Figure 3).

To delimit the WL, the bone crest present on the volar face of the radial distal third was drawn, considering the most prominent point. Points A (crossing with the lateral column) and B (crossing with the intermediate column) were identified. A straight line was drawn by joining points A and B to measure the WL angle (between the AB line and the midline of the radius) on the ulnar side of the radius (Figure 4).

Three classifications were created for this study, all performed by three orthopedists specialized in hand and wrist. One of them analyzed the WL design, dividing it into four types: I) biconvex; II) convex; III) ulnar convex; IV) flat (Figure 5).

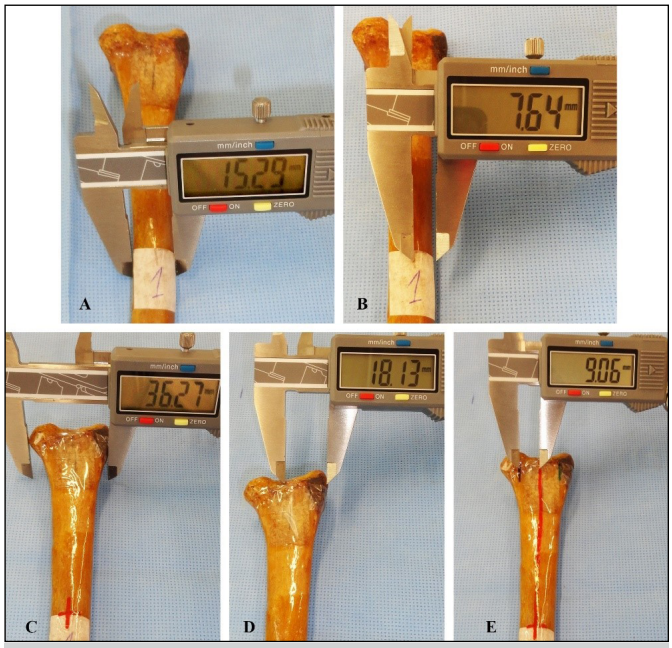

Figure 1. A) Measurement of the radial width; B) Midpoint identification; C) Measurement of the width of the distal epiphysis; D) Midpoint identification, where the midline passes; E) Identification of the midpoints of the lateral and intermediate columns.

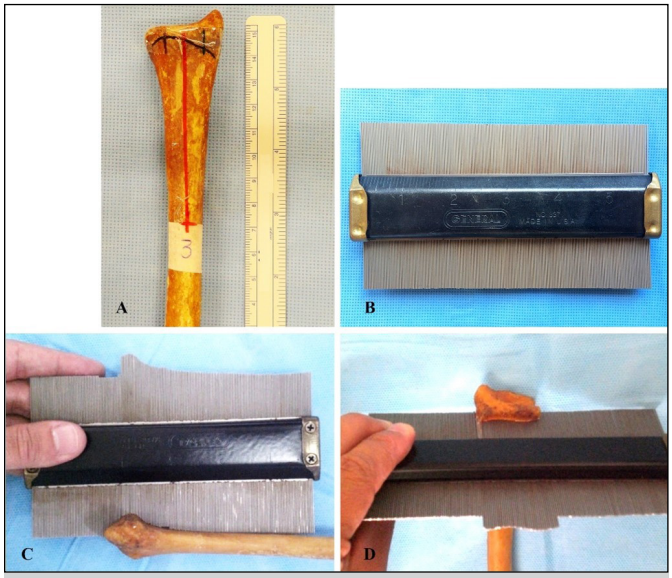

Figure 2. A) Radial volar face after marking the references; B) Contour gauge; C) Longitudinal transcription of the midline; D) Transversal transcription.

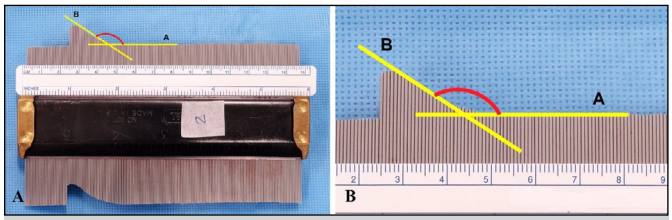

Figure 3. A) Measurement of the PCA in each column; B) Enlarged view.

The relief of the transverse cut to the axis of the radius was classified into four types: I) flat; II) concave; III) convex; IV) S-shaped (Figure 6). We analyzed the locking volar plates of Acumed®, Austofix®, Medartis®, Newclip®, Stryker®, and Synthes®, all supplied by their representing companies in Brazil, which agreed to participate in the study (Figure 7). The plates were photographed and, with the aid of AutoCad 2015®, the palm angles and distal inclination of each plate were taken (Figure 8).

For the distal end design of the plates, the classification was defined in 3 types: I) straight; II) biconvex; III) ulnar convex (Figure 9).

For this statistical analysis, the programs SPSS V17, Minitab 16 and Excel Office 365 were used. A significance level of 0.05 (5%) was adopted, and the confidence intervals were constructed with 95% of statistical confidence. We used the nonparametric Friedman test and the Wilcoxon signed-rank test (paired).

Figure 4. Measurement of the WL angle.

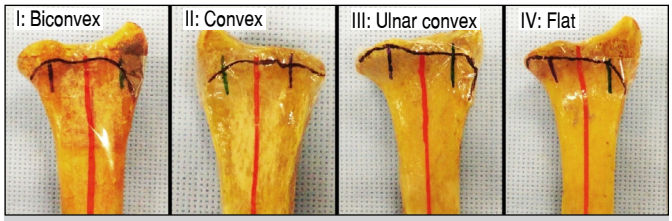

Figure 5. WL Classification.

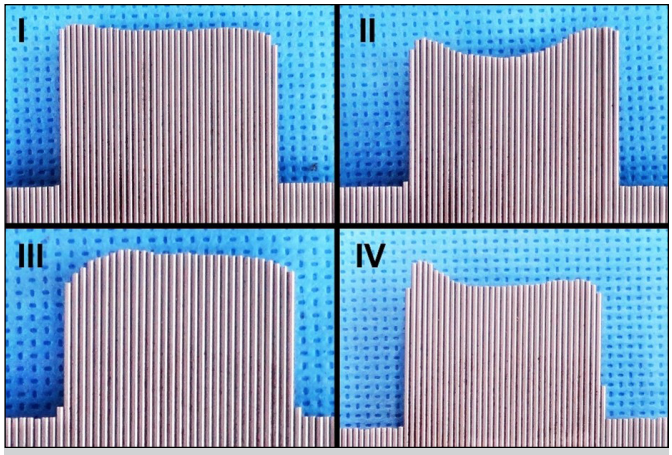

Figure 6. Classification of the transverse reliefs of the distal end of the radius.

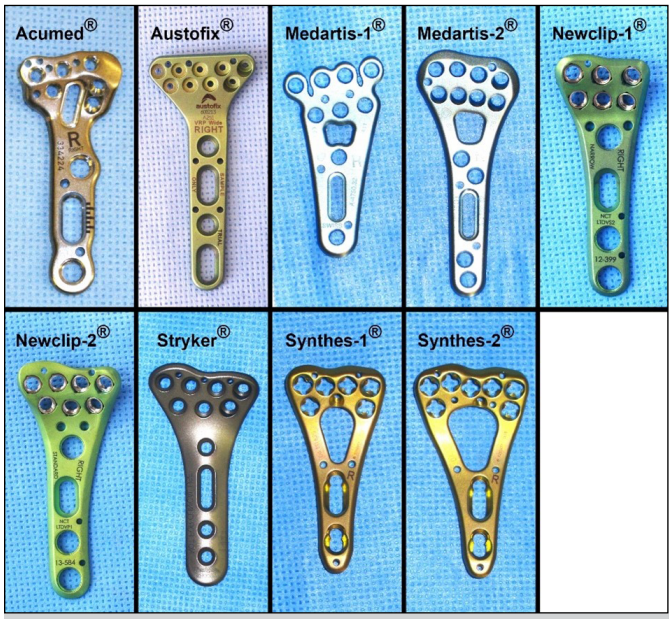

Figure 7. Plates evaluated in the study.

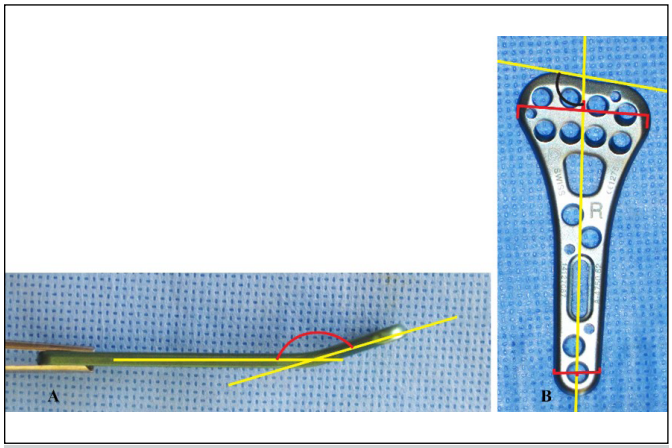

Figura 8. A) Measurement of the volar inclination angle of each plate (equivalent to the PCA of the lateral and intermediate columns); B) Measurement of the inclination of the distal end of the plate.

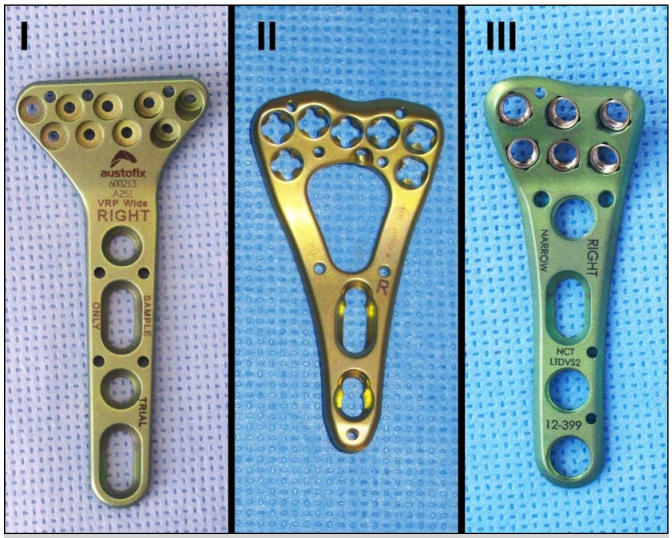

Figure 9. Classification of the design of the distal end of the plates.

RESULTS

Table 1 shows data measuring the PCA of the radius in the lateral, intermediate, and mid columns. We found statistical significance between the lateral and mid columns (P = 0.027), lateral and intermediate columns (< 0.001), and mid and intermediate columns (< 0.001) when compared by themselves, helped by the Wilcoxon test.
Regarding the transverse relief of the radius, we found 4 concave reliefs, 2 convex reliefs, 6 flat reliefs, and 15 S-shaped reliefs.
Regarding the WL design, we found 12 biconvex designs, 13 convex designs, 1 flat design and 1 convex ulnar design.
The mean WL angle of the radial bones was 95.2°. Table 2 provides this measurement and the equivalent angle of the plates.
Table 3 shows the plates, the measurement of the inclination angles of the ulnar and radial ends, and the design of the distal end.
Figure 10 shows the distribution of the angles of the radial and intermediate columns of the radios and the equivalent values of the plates.

DISCUSSION

Locking volar plates have been used in radial distal fracture treatment, presenting a lower degree of complication than other methods.[6,7,11,18] However, several studies demonstrate incongruity between the profile of the plates and the anatomy of the radial distal end.[1,15]
Some studies described the anatomical differences of the sexes regarding measurements and radial surface. These studies observed that the angles of volar inclination of the radius were greater in men.[7,19-21] Gandhi et al.[3] described that the PCA decreases with age, and men have a higher mean PCA, suggesting that current locking plates fit better in older women. Kwon et al.[11] studied differences between Caucasian and Korean individuals, noting that Koreans presented a greater width of the distal region of the radius compared to Caucasians, as well as Korean men when compared with Korean women. Cho, Kim and Kwak[21] also described the width of the distal epiphysis of the major radius in males. The absence of publications about radial shape differences in Brazilians supports the importance of the present study.
Rikli and Regazzoni[22] established the concept of the three columns by dividing the distal end of the forearm into: lateral column, formed by the radial styloid and sigmoid notch; intermediate column, formed by the semilunar notch and sigmoid notch; and medial spine, formed by the ulna, triangular fibrocartilage, and distal radioulnar joint. Based on this, we analyzed the PCA measurements in the lateral, intermediate, and central columns of the radius. The intermediate column showed significant mean inclination ($p < 0.001$), since the inclination is inversely proportional to the PCA. Evans, Ramasamy, and Deshmukh[7] also found differences in the lateral, intermediate and medial columns (149°, 145.9° and 146.2° respectively). However, they found different values from ours, with a smaller difference between them, since they obtained the three measurements more medially and closer between them. Gasse et al.[23] found 155.3° and 144.9° as the mean angle in the lateral intermediate columns, respectively, values closer to those found in our study. Im and Lee[20] found a greater inclination in the middle column (151.9 ± 7.6°) compared with the lateral column (156.1 ± 7.2°). Kwon et al.[11] also found values close to the studies of Im and Lee[20] and Kwak et al.,[19] in which the mean angle in the mid column was 3 to 10° wider than in the lateral column.
Analyzing the transverse plane was another way of evaluating the difference in relief between the columns. Most radial bones

Table 1. Data of cortical palmar angle (PCA) of the radius, in degrees, in the lateral, intermediate, and mid columns. P-value defined by the Friedman test, with statistical significance.

Profile (Bone)	Lateral	Midline	Intermediate
Mean	153.40°	156.20°	146.06°
Median	153.21°	156.39°	147.04°
Standard Deviation	8.35	7.89	6.99
Q1	148.16°	150.20°	139.79°
Q3	159.63°	161.86°	151.88°
n	27	27	27
IC	3.15	2.97	2.64
p-value	< 0.001		

Table 2. WL angle measurement, in degrees, on the anatomical pieces and plates.

RADIAL BONES/PLATES	WL Angle
Radial Bones Mean	95.2°
Medartis-2®	100.7°
Stryker®	98.9°
Newclip-1®	98°
Newclip-2®	97.8°
Synthes-2®	94.3°
Synthes-1®	90.9°
Austofix®	87.1°
Acumed®	84.2°
Medartis-1®	79.2°

Table 3. Measurement of the inclination angles, in degrees, of the radial and ulnar ends of the plates and design of the distal end.

PLATE	Radial volar inclination	Ulnar volar inclination	Design of the distal end
Acumed®	154.6°	155.9°	biconvex
Austofix®	162°	162°	flat
Medartis-1®	163°	163°	biconvex
Medartis-2®	160.9°	160.9°	biconvex
Newclip-1®	155.1°	151°	ulnar convex
Newclip-2®	156.9°	151.7°	biconvex
Stryker®	160.8°	160.8°	biconvex
Synthes-1®	159.8°	147.8°	biconvex
Synthes-2®	158°	149.5°	biconvex

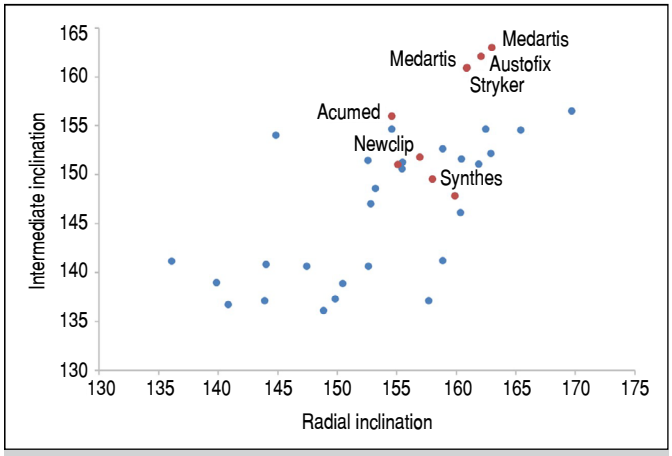

Figure 10. Distribution of the angles of the radial and intermediate columns of the radiuses and the equivalent inclinations of the plates.

presented an s-shaped pattern, with the intermediate column having the most swollen end.

In a study of seven types of locking volar plates, Oppermann et al.[15] demonstrated a palmar angle of the plates ranging from 155° to 161°, and they were straight plates that did not present differences in the radial and intermediate columns. These values do not coincide with those found in our study (ulnar inclination ranging from 147° to 163° and radial inclination from 154° to 163°), which may relate to different methods of measuring angles. Kwak et al.[19] compared the PCA of wide and narrow plates of three different manufacturers and observed variations between them: the distally wider plates (with five holes) present a greater inclination of the radial and intermediate columns. In our study, only two manufacturers provided two different plate sizes: Newclip® and Synthes®. The Newclip® wide plate presented the greatest inclination of the radial and intermediate columns, but compared with Synthes®, the narrow plate presented the greatest inclination of both columns. Medartis® provided two plates models, but both are straight, with the same inclination over the distal region.

Of the nine plates studied, four did not show differences between the columns. On the Acumed plate®, the inclination was slightly greater in the lateral column. We believe the inclination of the plate should be greater in the intermediate column. The plates that showed values closer to those of bone anatomy, in this parameter, were Synthes®-2 and Newclip®-2. Oppermann et al.[15] found a better adaptation to the anatomical profile on the Synthes plate®.

Regarding the WL, we believe that, except for a straight plate (Austofix®) and another one with a more irregular design (Medartis-1®), all would adapt well to the WL.

When comparing the WL with the distal inclination of the plates, the Synthes®-2 and Newclip®-2 plates presented an inclination closer to the one found in the bones, whereas the Medartis®-1 and Acumed® plates presented the most distant values from each other.

CONCLUSION

We conclude that the anatomy of the radial bones was variable between the pieces. The intermediate column presented greater mean inclination than the midline and side columns. The Synthes®-2 plate showed a relief closer to the anatomical findings of the distal end of the radius, followed by Newclip®-2.

Regarding the WL format, except for the Austofix® straight plate and another one with a more irregular design (Medartis-1®), all would adapt well to the WL. When comparing the WL with the distal inclination of the plates, the Synthes®-2 and Newclip®-2 plates presented an inclination closer to the one found in the bones, while the Medartis®-1 and Acumed® plates presented the most distant values from each other.

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IMPACT OF COVID-19 ON MORTALITY AND HOSPITALIZATION IN OLDER ADULTS WITH HIP FRACTURE

IMPACTO DA COVID-19 NA MORTALIDADE E INTERNAÇÃO DE IDOSOS COM FRATURA DO QUADRIL

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ABSTRACT

Objective: To evaluate the impact of the COVID-19 pandemic on hospital admission and mortality indicators in older adults with fractures of the proximal femur. Methods: Observational and retrospective study that took place from June 2016 to 2020. Patients of both genders who underwent surgical treatment for fractures of the proximal end of the femur, aged over 60 years, were included. Results: The population consisted of 379 patients, treated before (group 1; N = 278; 73.35%) and during the pandemic (group 2; N = 101; 26.65%). Higher mortality was observed in group 2 (N = 24; 23.8%) versus group 1 (N = 10; 3.6%), $p < 0.001$. The highest proportion of deaths in group 2 was maintained in patients aged 70-79 years ($p = 0.011$), 80-89 years ($p \leq 0.001$) and > 90 years ($p \leq 0.001$). In addition, the preoperative time and hospital stay were longer in group 2 compared to group 1 ($p \leq 0.001$). Conclusion: The present study demonstrated that the pandemic period increased the mortality rate and the preoperative and hospitalization time in older patients with femur fractures. Thus, the pandemic has affected the care of fractures of the proximal femur in older adults, which reinforces the need to adopt measures to reduce complications and mortality. ***Level of Evidence II, Retrospective Study.***

Keywords: COVID-19. Fractures, Bone. Aged. Hospitalization. Mortality. Femur.

RESUMO

Objetivo: Avaliar o impacto da pandemia de COVID-19 nos indicadores de internação e mortalidade hospitalar em idosos com fraturas do fêmur proximal. Métodos: Estudo observacional e retrospectivo, que ocorreu de junho de 2016 a 2020. Foram incluídos pacientes de ambos os sexos submetidos ao tratamento cirúrgico para fratura da extremidade proximal do fêmur, com idade acima de 60 anos. Resultados: A população foi composta por 379 pacientes, atendidos antes (grupo 1; N = 278; 73,35%) e durante a pandemia (grupo 2; N = 101; 26,65%). Foi verificada maior mortalidade no grupo 2 (N = 24; 23,8%) versus o grupo 1 (N = 10; 3,6%), $p < 0,001$. A maior proporção de óbitos no grupo 2 se manteve nos pacientes com 70-79 anos ($p = 0,011$), 80-89 anos ($p \leq 0,001$) e > 90 anos ($p \leq 0,001$). Os períodos pré-operatório e de permanência hospitalar foram maiores no grupo 2 em comparação ao grupo 1 ($p \leq 0,001$). Conclusão: Este estudo demonstrou que o período pandêmico aumentou a taxa de mortalidade e o tempo pré-operatório e de internação em pacientes idosos com fratura do fêmur. Dessa forma, a pandemia tem afetado o atendimento das fraturas do fêmur proximal em idosos, o que reforça a necessidade da adoção de medidas de redução de complicações e mortalidade. ***Nível de Evidência II, Estudo Retrospectivo.***

Descritores: *COVID-19. Fraturas Ósseas. Idoso. Hospitalização. Mortalidade. Fêmur.*

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INTRODUCTION

The emergence of severe acute respiratory syndrome caused by the coronavirus (COVID-19) in China late 2019 has generated a global pandemic, which exposes the health and well-being of the entire population, especially of older adults.[1] According to the World Health Organization, COVID-19 has affected more than 216 countries, with 204,644,849 confirmed cases and 4,323,139 deaths.[2] Infection caused by COVID-19 can be easily transmitted through the airways and has a wide clinical presentation ranging from a common cold to more severe respiratory syndromes.[3]

The highest mortality from COVID-19 occurs in older patients with multiple comorbidities, similar to the population at risk for the occurrence of fractures.[4-6] In orthopedic care, most surgeries are intended for the treatment of femoral fractures, which are the most frequent cause of deficiency in patients over 65 years of age.[1]

All authors declare no potential conflict of interest related to this article.

The study was conducted at Department of Orthopedics and Traumatology of the Paulista School of Medicine of the Universidade Federal de São Paulo.
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Femoral fractures are considered an important public health problem due to the long period of recovery and the possible emergence of complications that affect the quality of life of the patient with high economic and social impact.[4] In Brazil, femoral fractures have a trend of progressive increase in the number of cases. In the period from 2008 to 2018, femoral fractures in older adults were responsible for 478,274 hospitalizations and the expenditure of BRL 99.7 million annually to the Brazilian Unified Health System (SUS).[5]

The pandemic scenario drastically affects the usual treatments and protocols of elective and emergency services, including the care of femoral fractures, which is imposing the creation of plans for the reallocation of health resources to face pandemic demands.[6] Despite this change in the routine of health services, patients with femoral fractures still require emergency care.[6-8]

In the context of the pandemic, several studies have reported an increase in serious complications and mortality in patients with femoral fractures diagnosed with COVID-19.[1,7,9] However, few studies focused on investigating the impact of the pandemic on the epidemiology and clinical outcome of patients with femoral fractures, especially at the national level. Due to the scarcity of studies on the influence of COVID-19 on hospitalization indicators and clinical outcome, this study aimed to evaluate the impact of the COVID-19 pandemic on hospitalization and mortality indicators in older adults with proximal femoral fractures.

METHODS

Type of study

This is an observational and retrospective study, which was conducted in the Department of Orthopedics and Traumatology, Hospital São Paulo, Universidade Federal de São Paulo – Unifesp (EPM), São Paulo, Brazil. The study took place from July 2016 to February 2021, following the methodology guided by the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) initiative, a reference guide for observational studies.[10] This study was submitted to and approved by the Research Ethics Committee Unifesp/EPM (No. 1,890,165).

Inclusion and exclusion criteria

Inclusion factors were: patients of both sexes, over 60 years of age, who presented fracture of the proximal extremity of the femur (femoral neck and transtrochanteric) and underwent surgical treatment performed by specialized orthopedists, with more than 5 years of experience in the area. Patients who presented incomplete data, who did not undergo surgical treatment and those who could not be contacted and lost outpatient follow-up were not included.

Data collection

Data collection was carried out at two times: pre-pandemic period (July 6, 2016 to March 17, 2020) and during the pandemic (March 18, 2020 to February 17, 2021). The demographic characteristics of the cases were recorded. The number of cases, types of fractures, preoperative time, duration of hospitalization and postoperative clinical outcome were obtained through electronic medical records, telephone contact or via obituaries. Confirmation of infection with COVID-19 was obtained through the result of registered PCR, and the information was compiled for the approach of these patients. Data were obtained by preserving the identity of patients and reducing the leakage of information from medical records.

Management of fractures of the proximal femur

The anatomical classification of the fracture was performed in the emergency room by an orthopedist specialist and confirmed by the orthopedist coordinator at the surgical hospital. In the period before the pandemic, older patients were subjected to the management of fractures of the proximal femur prepared by the institution in 2016, which aims to optimize the surgical treatment within 48 hours of the patient's entry to obtain better outcomes and early hospital discharge. For surgical treatment, patients were subjected to cardiological evaluation in a separate room for surgical release. In the postoperative period, the clinical and orthopedic team offered follow-up aimed at the early discharge of the patient. However, during the pandemic, this flow was changed after the hospital was framed in the preferential care of COVID-19. Thus, the cardiological evaluation was relocated to the ICU and the clinical team was overloaded in the COVID-19 wards.

Statistical analysis

Descriptive statistics were presented in frequency, percentage, mean values and standard deviation. The chi-square test was used to evaluate the difference between proportions and the differences between continuous variables were obtained using the Mann-Whitney test. The results were analyzed by jamovi software (version 1.6.18.0) (Software Inc., USA), considering the significance level of 5% ($p < 0.05$) as statistically significant.

RESULTS

This study included data from 379 patients treated with surgical treatment for femoral fractures, which were grouped into two groups: patients treated before (group 1; N = 278; 73.35%) and during the pandemic (group 2; N = 101; 26.65%). The sample was characterized by having a higher proportion of female patients (N = 251; 66.23%), aged between 80-89 years (N = 153; 40.37%) presenting transtrochanteric fracture (N = 327; 86.28%). Regarding the type of fracture, a higher proportion of patients with neck fractures was observed in group 2 (N = 33; 32.70%) compared to group 1 (N = 19; 6.90%), with $p \leq 0.001$. However, no differences were observed regarding gender and age group (Table 1).

Mortality among patients treated before and during the COVID-19 pandemic

Regarding mortality before and during the pandemic, there was a higher mortality in group 2 (N = 24; 23.8%) compared to group 1 (N = 10; 3.6%), with $p < 0.001$ (Table 2). The same profile of increased mortality was observed considering the stratification of sex: male ($p < 0.001$) and female ($p < 0.001$).

In the analysis of mortality considering the age group (Table 3), a higher proportion of deaths was observed in patients treated during the pandemic in all age groups analyzed, 70-79 years (group 1,

Table 1. Demographic characteristics of patients undergoing surgical treatment for femoral fractures before and during the COVID-19 pandemic.

	Group 1		Group 2		Total		
	N	%	N	%	N	%	
Variables	**278**	**73.35**	**101**	**26.65**	**37**	**100**	**p**
Age	78.98	SD:9.55	78.87	SD:10.23	78.95	9.728	0.9927#
Sex							0.9023*
Male	93	33.50	35	35.00	128	33.77%	
Female	185	66.50	66	65.00	251	66.23%	
Age group							0.488*
60-69 years	55	19.80	25	24.80	80	21.11%	
70-79 years	73	26.30	23	22.80	96	25.33%	
80-89 years	116	41.70	37	36.60	153	40.37%	
> 90 years	34	12.20	16	15.80	50	13.19%	
Type of Fracture							< 0.001*
Transtrochanteric	259	93.10	68	67.30	327	86.28%	
Fracture of neck	19	6.90	33	32.70	52	13.72%	

Group 1: patients treated before the COVID-19 pandemic; Group 2: patients treated during the pandemic; #: Mann-Whitney test; *: chi-square test; N: sample number; SD: standard deviation.

Table 2. Mortality of patients undergoing surgical treatment for femoral fractures before and during the COVID-19 pandemic according to gender.

		Group 1		Group 2		p
		N	%	N	%	
Sex	**Death**	**278**	**73.35**	**101**	**26.65**	
Male						< 0.001
	No	92	98.92	26	74.29	
	Yes	1	1.08	9	25.71	
	Total	93	100.00	35	68.63	
Female						< 0.001
	No	176	95.14	51	77.27	
	Yes	9	4.86	15	22.73	
	Total	185	100.00	66	100.00	
Total						< 0.001
	No	268	96.40	77	76.24	
	Yes	10	3.60	24	23.76	
	Total	278	100.00	101	100.00	

Group 1: patients treated before the COVID-19 pandemic; Group 2: patients treated during the pandemic; chi-square test; N: sample size; $p < 0.05$: statistical significance.

N = 2; 2.7% *versus* group 2, N = 4; 17.39%, p = 0.011), 80-89 years (group 1, N = 27; 19.57% *versus* group 2, N = 10; 66.67%, $p < 0.001$) and > 90 years (group 1, N = 2; 5.88% *versus* group 2, N = 7, $p < 0.001$). However, considering the age group from 60 to 69 years (group 1, N = 1; 1.82% *versus* group 2, N = 3; 12.00%, p = 0.053), no significant differences were observed.

Regarding the time of care, group 2 had a longer preoperative time (4.97 days) and hospital stay (12.7 days), compared to group 1, which was verified 4.97 days and 12.7 days, respectively, with $p \leq 0.001$ (Table 4).

The causes of mortality were verified, and it was observed that in group 1 the main causes were: cardiorespiratory arrest (CRP) secondary to hydroelectrolytic disorder (17.6%), sepsis of urinary focus (17.6%), CRP of undetermined cause (17.6%), sepsis of pulmonary focus (14.7%) and other causes (32%). In group 2, the causes of death were: CRP of undetermined cause (36%); sepsis of pulmonary focus (24%); sepsis of undetermined focus (12%) and CRP secondary to hydroelectrolytic disorder (12%). Regarding the reasons found for the delay in surgical care, we found that in group 1 this was justified mainly due to the waiting for clinical stabilization (70%) and waiting for evaluation by a cardiologist (20%). In group 2, the main reasons for delay were: waiting for evaluation by a cardiologist (46.40%), waiting for clinical stabilization (32.10%) and delay in the arrival of material (14.20%) (Table 5).

Among the 79 patients tested in group 2, the results of the CRP test showed that 16 (20.25%) of the patients were COVID-19 positive. However, regarding mortality, no significant differences were observed (Table 6).

Table 3. Mortality of patients undergoing surgical treatment for femoral fractures before and during the COVID-19 pandemic according to age group.

		Group 1		Group 2		p
		N	%	N	%	
Age group	**Death**	**278**	**73.35**	**101**	**26.65**	
60-69 years						0.053
	No	54	98.18	22	88.00	
	Yes	1	1.82	3	12.00	
	Total	55	100.00	25	100.00	
70-79 years						0.011
	No	71	97.26	19	82.61	
	Yes	2	2.74	4	17.39	
	Total	73	100.00	23	100.00	
80-89 years						< 0.001
	No	111	80.43	5	33.33	
	Yes	27	19.57	10	66.67	
	Total	138	100.00	15	33.33	
> 90 years						< 0.001
	No	32	94.12	9	56.25	
	Yes	2	5.88	7	43.75	
	Total	34	100.00	16	100.00	

Group 1: patients treated before the COVID-19 pandemic; Group 2: patients treated during the pandemic; chi-square test; N: sample size; $p < 0.05$: statistical significance.

Table 4. Mortality of patients undergoing surgical treatment for femoral fractures according to the Polymerase Chain Reaction test for COVID-19.

	Group 1			Group 2			p
	N	%		N	%		
Time (days)	**278**	**73.35**		**101**	**26.65**		
	Mean	Median	SD	Mean	Median	SD	
Preoperative	0.76	0.12	2.70	4.92	3.45	4.55	< 0.001
Hospital stay	4.97	2.5	6.14	12.7	9.31	10.5	< 0.001

Group 1: patients treated before the COVID-19 pandemic; Group 2: patients treated during the pandemic; Mann-Whitney test; N: sample number; SD: standard deviation; $p < 0.05$: statistical significance.

Table 5. Causes of mortality and increased length of stay of patients undergoing surgical treatment for femoral fractures before and during the COVID-19 pandemic.

	Group 1		Group 2	
	N	%		N
Causes of death	**278**	**73.35**		**101**
CRP secondary to hydroelectrolytic disorder	2	17.60	3	12.00
CRP of undetermined cause	2	17.60	8	36.00
CRP secondary to upper gastrointestinal bleeding	0	0.00	2	8.00
Urinary focal sepsis	2	17.60	0	0.00
Pulmonary focal sepsis	1	14.70	6	24.00
Sepsis; focus, indeterminate	0	0.00	3	12.00
IRA secondary to COVID	0	0.00	2	8.00
Other causes*	3	32.00	0	0.00
Causes of the increase in hospitalization time				
Waiting until clinical stabilization	194	70.00	32	32.10
Waiting for cardiologist evaluation	55	20.00	47	46.40
Delay for material arrival	0	0.00	14	14.20
Lack of ICU	2	0.90	4	3.60
Waiting for exam	0	0.00	3	3.50
Other causes#	27	10.00	0	0.00

CRP: cardiorespiratory arrest; Other causes*: acute respiratory failure (IRA), pulmonary thromboembolism, cerebrovascular accident, unspecified sepsis, arrhythmia, atrial fibrillation, bronchoaspiration and CRP secondary to anesthetic induction; Other causes#: obtaining social discharge, delay to vacancy in the CC, delay to clinical examination.

Table 6. Mortality of patients undergoing surgical treatment for femoral fractures according to the Polymerase Chain Reaction test for COVID-19.

	COVID-19 CRP						
	Negative		Positive		Total		
	N	%	N	%	N	%	p
Death							1.000
No	60	80.00	3	75.00	63	79.75	
Yes	15	20.00	1	25.00	16	20.25	
Total	75	100.00	4	100.00	79	100.00	

X2: chi-square test; N: sample size; PCR: Polymerase Chain Reaction; $p < 0.05$ statistical significance.

DISCUSSION

In this retrospective observational study, we investigated the clinical outcome of femoral fracture patients who were admitted and surgically treated in a quaternary hospital in the city of São Paulo, Brazil, before and during the COVID-19 pandemic, in a vulnerable population over 60 years of age. We observed that during the pandemic, patients with proximal fracture of the femur presented higher mortality and length of hospital stay.

This study included 379 patients, who were treated before and during the pandemic. The sample was characterized by a higher proportion of female patients aged between 80 and 89 years. These results are consistent with the epidemiology of femoral fractures at the international and national levels, which report greater involvement of female patients,[1,5,11,12] over 80 years of age[1,5,7,11,12] suggesting that the results found can be applied in the epidemiological context of femoral fractures.

Regarding mortality, higher rates were observed in patients treated during the pandemic considering all patients and stratification according to sex. A study conducted in the United Kingdom compared the mortality associated with fractures of the proximal femur in patients treated in the month before the pandemic in relation to those treated one month during the pandemic. Similar to our results, the data presented showed an increase in mortality during the pandemic (22.0%) compared to the previous month (6.2%), which suggests a possible relationship of COVID-19 with mortality in this population.[7]

Several studies have shown that the risk of mortality from COVID-19 increases with age.[7,13] Here we verified the increase in the number of deaths during the pandemic in all analyzed ranges similar to studies carried out in Italy,[1] England[7] and Spain.[14] This fact can be justified by the selection of patients over 60 years of age, who are considered to be at higher risk for the occurrence of COVID-19, which reflects in high mortality. However, recent studies[15,16] reported a decrease in fracture cases at the beginning of the pandemic period, suggesting that there was reduced demand for health services due to fear of contamination and the possibility of late sequelae of COVID-19 infection.

In addition to the increase in the number of deaths, high rates of complications during hospitalization have been associated with COVID-19,[12,15] here we observed that the most frequent causes of death were CRP of undetermined and secondary origin, hydroelectrolytic disorder and sepsis. Similar to our findings, studies have also related the occurrence of hospital complications, such as sepsis and electrolyte imbalance in patients with femoral fractures treated during the pandemic.[1,12]

A possible justification for the increase in cases with unfavorable outcome and length of hospitalization in our reference center is based on the change in the care line of the institution that modified the flow of care and overloaded the care team,[16] a reality also experienced in other health centers.[14,15] Literature on the topic shows that the ideal time for surgical treatment of proximal femoral fractures should occur within 48 hours after the fracture episode,[17,18] to reduce the length of hospital stay and mortality.[19] Nevertheless, in this study we observed that the changes in orthopedic care imposed by the pandemic impacted the preoperative increase and hospital stay, similar to what was reported by Segarra et al.[20]

The pandemic period imposes several adaptations in hospital centers to improve the management of fractured patients during the pandemic that may have impacted the increase in hospitalization time, such as a reduction in the number of elective orthopedic surgeries, improvement in the perioperative management of older patients, deliberation of the appropriate time of surgery according to the risk and severity of COVID-19 and underlying medical condition, and use of universal pandemic containment precautions.[16,20]

Regarding the reasons found for the delay in care, we found that during the pandemic, the main reasons for delay were: waiting for evaluation by a cardiologist, waiting for clinical stabilization and delay in the arrival of material. Similar findings were reported in hospitals that underwent redistribution of the surgical team.[14,15]

In this study, we observed that the pandemic increased mortality regardless of whether the patient was infected with the virus at admission, since only 20.25% of patients were COVID-19 positive, with no differences in mortality, suggesting that other conditions of the pandemic may have interfered with the clinical outcome. However, unlike our findings, the study by Mamarelis et al.[7] and Biarnés-Suñé et al.[11] found increased mortality in patients who tested COVID-19 positive.

Among the main findings of this study, we reinforce that mortality and length of stay in older patients with femoral fracture increased significantly in the pandemic period, findings consistent with those found by Biarnés-Suñé et al.[11] and Egol et al.[12] in more developed countries. Among the strengths of this study, we highlight the sample size, surgical care performed by an experienced team and evaluation of patients undergoing surgical treatment, characteristics little observed in previous studies. However, we highlight some limitations of the study, such as a retrospective data analysis model and the limited capacity of diagnostic tests during the first period of the pandemic, which limited patient testing.

Due to the pandemic, the world has faced difficulties with great social and economic impact, especially in poor and emerging countries that are affected by the lack of resources to meet the growth of demand from COVID-19. Increased demand for intensive care units, wards and resources such as respirators and medicines, has affected the care of other common causes of hospitalization such as fractures of the proximal femur in the older adults, which reinforces the need for greater attention to adopt measures to reduce complications and mortality.

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TOTAL HIP ARTHROPLASTY IN THE PUBLIC HEALTH SYSTEM OF SÃO PAULO: COMPARING TYPES OF FIXATION

ARTROPLASTIA TOTAL DE QUADRIL NO SISTEMA PÚBLICO DE SÃO PAULO: COMPARANDO OS TIPOS DE FIXAÇÃO

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ABSTRACT

Brazil lacks registries on the prevalence of primary total hip arthroplasty (THA) fixation methods. Objective: (i) to describe the demographic profile of patients who underwent THA in the public health system of the municipality of São Paulo during the last 12 years and (ii) to compare fixation methods regarding costs, hospital stay length, and death rates. Methods: This is an ecological study conducted with data available on TabNet, a platform belonging to DATASUS. Public data (from the government health system) on THA procedures performed in São Paulo from 2008 to 2019 were extracted. Gender, age, city region, THA fixation method, number of surgeries, costs, hospital stay length, and death rates were analyzed. Results: We analyzed 7,673 THA, of which 6220 (81%) were performed via cementless/hybrid fixation and 1453 (19%), via the cemented technique. Cementless/hybrid fixation had a higher cost (US$ 495.27) than the cemented one ($p < 0.001$). Nevertheless, hospital stay length was 0.87 days longer for cemented fixation than the cementless/hybrid one. We found no significant difference in death rates between THA fixation methods. Conclusion: THA cementless/hybrid fixation is prevalent in the municipality of São Paulo, which had higher total costs and shorter hospitalizations than cemented fixation. We found no difference between THA fixation methods and death rates. ***Level of Evidence IV, Case Series.***

Keywords: Hip. Arthroplasty, Replacement, Hip. Public Health. Prosthesis Retention

RESUMO

No Brasil, não há registros da prevalência do tipo de fixação da artroplastia total de quadril (ATQ). Objetivo: (i) Descrever perfil demográfico de pacientes submetidos à ATQ no Sistema Único de Saúde de São Paulo durante os últimos doze anos; e (ii) comparar as técnicas de fixação de ATQ quanto aos custos, tempo de internação (TI) e taxa de óbito. Métodos: Estudo ecológico, com dados disponíveis na TabNet do DATASUS. Dados públicos de procedimentos de ATQ eletivos realizados em São Paulo de 2008 a 2019 foram extraídos. Foram analisados: sexo, idade, região municipal, método de fixação em ATQ, número de cirurgias, custo, tempo de internação e óbitos. Resultados: Foram analisadas 7.673 ATQs, sendo 6.220 (81%) não-cimentada/híbridas e 1.453 (19%) cimentadas. A fixação não-cimentada/híbrida teve custo maior em US$ 495,27 do que a cimentada ($p < 0,001$). Entretanto, TI foi 0,87 dia mais longo na fixação cimentada. Não houve diferença significativa nas taxas de óbito entre os métodos de fixação. Conclusão: A fixação não-cimentada/híbrida na ATQ é prevalente em São Paulo, e apresentou maior custo total, porém menor tempo de internação do que a fixação cimentada. Não houve diferença entre o método de fixação em ATQ e a taxa de óbito. ***Nível de Evidência IV, Série de Casos.***

Descritores: *Quadril. Artroplastia de Quadril. Saúde Pública. Retenção da Prótese.*

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INTRODUCTION

Total hip arthroplasty (THA) is considered the surgery of the 20th century since it greatly alleviates pain and improves function, quality of life, and risk-to-benefit ratio in patients who underwent this procedure.[1,2] However, the literature still lacks a consensus on the most efficient technique to fixate bone implants,[3,4] which may be cemented or non-cemented (or hybrid, i.e., one of its components is non-cemented).[5] Whereas cemented prostheses achieve their stability via bone-cement mechanical blocks after polymethylmethacrylate polymerization, non-cemented ones do so by intraoperative press-fit and postoperative bone ingrowth, characterizing biological fixation.[6] THA fixation techniques must meet two main conditions: patients' health and economic viability.[7] The literature evaluates patients' health not only by the obtained clinical results but also by implant survival time and revision rate. Abdulkarim et al.,[3] in a systematic review and meta-analysis of randomized clinical trials of cemented and non-cemented THAs found no difference in implant survival and revision rate between fixation techniques.

All authors declare no potential conflict of interest related to this article.

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On the other hand, Zhang, Yan, and Zhang,[8] after evaluating national arthroplasty records from Sweden, Norway, England-Wales, Australia, and New Zealand and reviewing randomized clinical trials and meta-analyses, concluded that cemented THAs show better long-term survival than non-cemented ones. Moreover, when stratified by age, they found that non-cemented THAs show higher survival rates in younger patients, whereas cemented ones, in older ones.[8] Another study, analyzing nationwide THA records in developed countries, concluded that patients over 75 years of age have a lower risk of revision if they receive cemented THAs.[9]

Regarding its economic viability, some studies have observed that non-cemented prostheses have a higher cost than cemented or hybrid ones.[10,11] However, other studies consider the opposite since non-cemented prostheses require shorter surgeries and dispense with the auxiliary products necessary for cementation.[12-14]

Brazil has neither national records on these procedures nor information on the prevalence of THA fixation type and its related costs. Considering the clinical and economic relevance of THA, it is essential to identify and evaluate how prevalent is the use of these fixation techniques and its costs to the public health system of the municipality of São Paulo, which is the most populous in Brazil[15] and represents an important influence on the national public health system. This study aims (i) to describe, via DATASUS data, the demographic profile of patients subjected to primary and elective THA in public hospitals in the municipality of São Paulo between 2008 and 2019 and (ii) to compare procedure costs, hospitalization length, and death rates in patients subjected to cemented or non-cemented/hybrid THAs, according to their demographic profile.

METHODS

Data related to primary and elective THA procedures, performed in public hospitals in the municipality of São Paulo between 2008 and 2019, were analyzed in this retrospective ecological study. Data were collected from a public platform (TabNet)[16] available online which belongs to DATASUS, providing open data on surgical procedures performed in the public health system of the municipality. Patients subjected to primary and elective cemented (code: 04.08.04.008-4) or non-cemented/hybrid (code: 04.08.04.009-2) THAs and with a preoperative diagnosis of coxarthrosis (ICD: M16), osteonecrosis (ICD: M87) or seropositive rheumatoid arthritis (ICD: M05) were assessed.

DATASUS data enabled the collection and analysis of the total number of cemented and non-cemented/hybrid THAs per year. For each type of fixation, patients' demographic profile was evaluated by gender, age group, and region of the municipality of São Paulo (center, east, north, west, southeast, and south). Moreover, total and intensive care unit (ICU) costs, length of stay, ICU stay, and death rates were evaluated. Total cost is the amount hospitals receive for hospitalizations, materials, and procedures per patient subjected to THA.

Total and ICU costs for THA procedures were converted to US dollars (US$) by its average annual value (Table 1).

Before it began, this study was approved by the Institutional Ethics Committee (26628219.0.0000.0071).

Statistical analysis

The demographic profile of the population subjected to THA was descriptively analyzed. Associations among THA type (cemented and non-cemented/hybrid), gender, age group, and region of the municipality were evaluated by the Chi-square test.

To evaluate total cost and hospitalization length per THA type, their averages a patient per year were considered, respectively. Regarding ICU cost and stay per THA type, its mean was estimated based on the number of patients subjected to each THA type per year since the number of patients who were admitted to ICUs was unavailable.

To compare THA types, total and ICU costs, and hospitalization and ICU stay length, generalized estimation equation models[17] were adjusted via gamma distribution and logarithmic connection functions, considering the correlation between the measurements obtained in the same year for both THA types. As for deaths, due to their absence for some demographic variables, Gamma and Poisson (Tweedie) distributions were used.[18] Analyses were performed on SPSS,[19] considering a 5% significance level.

Table 1. Average annual exchange rate between real (R$) and US dollar (US$) in 2008 and 2019.

Year	Exchange (R$ per US$)
2008	1.8346
2009	1.9976
2010	1.7603
2011	1.6750
2012	1.9546
2013	2.1576
2014	2.3534
2015	3.3315
2016	3.4901
2017	3.1920
2018	3.6542
2019	3.9451

Source: http://www.ipeadata.gov.br/ExibeSerie.aspx?serid=31924.

RESULTS

Public hospitals in the municipality of São Paulo performed 7,673 THAs between 2008 and 2019, of which 1,453 (19%) employed cemented fixation and 6,220 (81%), non-cemented/hybrid one (Figure 1). We found a 65% increase in the number of non-cemented/hybrid THAs and no change in the number of cemented THAs between 2008 and 2013.

We found a significant association between THA fixation type with age group ($p = 0.004$) and São Paulo region ($p < 0.001$) (Table 2). Despite the similar proportion of patients in each age group who underwent both fixation types, we observed that the proportion of cemented THAs is higher (31.3%) than

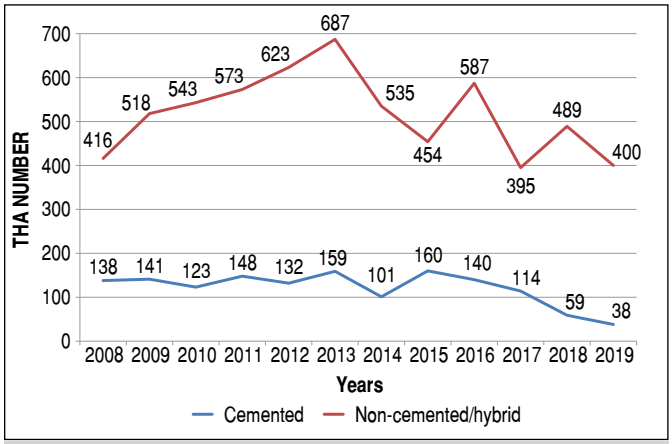

Figure 1. Total number of cemented and non-cemented/hybrid THAs performed per year in public hospitals in the municipality of São Paulo between 2008 and 2019.

THA: total hip arthroplasty.

non-cemented/hybrid ones (26.8%) for patients between 55 and 64 years of age, whereas for those under 55 and those between 65 and 74 years of age, the proportion of non-cemented/hybrid THAs is higher (34.4% and 26.3%, respectively) than of cemented ones (31.7% and 24.3%, respectively). Regarding São Paulo regions, we found a higher proportion of patients subjected to cemented THAs in central (31%), northern (22%), and southern (13%) São Paulo and a predominance of patients subjected to non-cemented/hybrid THAs in its southeastern (49%) and western (30%) regions.

Total cost, assessed by mean total cost per patient, showed that non-cemented/hybrid THA costed US$ 495.27 more than cemented ones ($p < 0.001$) (Table 3). When we compared total costs between THA types regarding gender, age group, and São Paulo region, we found an association between THA cost and all three variables, with an even higher cost for non-cemented/hybrid THAs.

ICU cost, estimated by its average per patient subjected to THA failed to show significant differences between fixation types (Table 4). Comparing ICU costs per THA types and gender, age group, and São Paulo region showed no significant differences, except for region, in which eastern São Paulo showed the highest ICU cost for cemented THA ($p = 0.011$).

Table 2. Demographic profile of patients subjected to total hip arthroplasty in public hospitals in the municipality of São Paulo between 2008 and 2019.

	Total (n = 7,673)	Cemented THA (n = 1,453)	Non-cemented/ hybrid THA (n = 6,220)	p-value#
Gender				0.467
Female	3,937 (51.3%)	758 (52.2%)	3,179 (51.1%)	
Male	3,736 (48.7%)	695 (47.8%)	3,041 (48.9%)	
Age Group				0.004
< 55 years	2,597 (33.8%)	460 (31.7%)	2,137 (34.4%)	
55-64 years	2,119 (27.6%)	455 (31.3%)	1,664 (26.8%)	
65-74 years	1,988 (25.9%)	353 (24.3%)	1,635 (26.3%)	
≥ 75 years	969 (12.6%)	185 (12.7%)	784 (12.6%)	
São Paulo Region				< 0.001
Center	801 (10.4%)	449 (30.9%)	352 (5.7%)	
East	536 (7.0%)	38 (2.6%)	498 (8.0%)	
North	537 (7.0%)	324 (22.3%)	213 (3.4%)	
West	1,903 (24.8%)	34 (2.3%)	1,869 (30.0%)	
Southeast	3,441 (44.8%)	419 (28.8%)	3,022 (48.6%)	
South	455 (5.9%)	189 (13.0%)	266 (4.3%)	

#: Chi-square test; THA: total hip arthroplasty.

Table 3. Average total cost per patient due to types of total hip arthroplasty performed in public hospitals in the municipality of São Paulo between 2008 and 2019, according to gender, age group, and municipality region.

	Cemented THA [US$]*	Non-cemented/hybrid THA [US$]*	Difference between non-cemented/hybrid –– cemented [US$]*	p-value
Average total cost	1,345.15 1,206.97 (1,499.14)	1,840.42 1,639.94 (2,065.41)	495.27 406.91 (583.64)	< 0.001
Gender				
Female	1,382.71 1,247.45 (1,532.63)	1,864.69 1,662.28 (2,091.76)	481.99 399.55 (564.42)	< 0.001
Male	1,312.21 1,170.94 (1,470.52)	1,814.46 1,615.35 (2,038.11)	502.25 394.11 (610.38)	< 0.001
p-value	0.024	< 0.001		
Age group				
< 55 years	1,253.35 1,127.50 (1,393.26)	1,774.14 1,585.77 (1,984.87)	520.78 433.21 (608.36)	< 0.001
55-64 years	1,338.85 1,195.98 (1,498.79)	1,844.79 1,635.54 (2,080.81)	505.94 398.87 (613.01)	< 0.001
65-74 years	1,413.86 1,260.09 (1,586.40)	1,894.00 1,680.20 (2,135.01)	480.14 365.35 (594.94)	< 0.001
≥ 75 years	1,457.12 1,295.27 (1,639.19)	1,912.45 1,713.13 (2,134.97)	455.34 378.32 (532.35)	< 0.001
p-value	< 0.001	< 0.001		
Region				
Center	1,487.71 1,208.94 (1,830.76)	1,763.87 1,428.20 (2,178.43)	276.16 206.92 (345.39)	< 0.001
East	1,159.54 989.72 (1,358.50)	1,774.99 1,462.62 (2,154.06)	615.45 (391.48; 839.41)	< 0.001
North	994.88 (842.97; 1,174.18)	1,123.85 (1,076.57; 1,173.21)	128.97 (−43.81; 301.75)	0.143
West	1,508.22 (1,115.64; 2,038.93)	1,910.42 (1,652.17; 2,209.03)	402.20 (20.37; 784.03)	0.039
Southeast	1,318.15 (1,213.23; 1,432.15)	1,873.19 (1,547.26; 2,267.77)	555.03 (231.11; 878.96)	< 0.001
South	1,412.99 (1,182.93; 1,687.79)	1,707.27 (1,438.70; 2,025.96)	294.27 (125.50; 463.05)	< 0.001
p-value	< 0.001	< 0.001		

Results expressed by mean values (95 CI%); *values in US dollars [US$]; p-values corrected by the sequential Bonferroni method. THA: total hip arthroplasty.

Regardless of THA type, we found that both total and ICU costs were significantly higher for women, gradually increasing as age did (Tables 3 and 4). We also observed a significant variability in costs among municipality regions.

Hospitalization length, assessed by the mean hospital stay per patient, was 0.87 days longer for cemented THAs than for non-cemented/ hybrid ones ($p < 0.001$) (Table 5). Comparing hospitalization length for THA types and gender, age group, and São Paulo region showed that cemented THAs had longer hospitalizations for all genders ($p = 0.001$ and $p < 0.001$); those aged < 55 ($p < 0.001$), 55 to 64 ($p = 0.002$), and 65 to 74 years ($p < 0.014$); and in Western ($p = 0.002$) and Southeastern São Paulo ($p < 0.001$). Moreover, for THA type, comparing hospitalization length between age groups showed a gradual increase concomitant with patients' age only for non-cemented/ hybrid THAs ($p < 0.001$). Comparing hospitalization length between regions, we observed significant differences between THA types.

Table 4. Estimated average ICU cost per patient and type of total hip arthroplasty performed in public hospitals in the municipality of São Paulo between 2008 and 2019, according to gender, age group, and municipality region.

	Cemented THA [US$]*	Non-cemented/Hybrid THA [US$]*	Difference between non-cemented/hybrid – cemented [US$]*	p-value
Average ICU cost	90.73 [64.70; 127.24]	82.35 [68.30; 99.30]	−8.38 (−47.80-31.04)	0.677
Sex				
Female	108.64 [82.80; 142.43]	88.84 [73.56; 107.26]	−19.79 (−58.21-18.62)	0.313
Male	75.14 [44.54; 126.30]	75.24 [61.68; 91.73]	0.10 (−46.86-47.05)	0.997
p-value	0.034	< 0.001		
Age group				
< 55 years	60.28 [32.23; 111.99]	38.42 [30.94; 47.64]	−21.86 (−63.22-19.50)	0.300
55–64 years	89.32 [55.87; 142.47]	77.20 [62.12; 95.87]	−12.13 (−63.86-39.60)	0.646
65–74 years	106.13 [76.67; 146.77]	105.75 (85.45; 130.83)	−0.38 (−51.82; 51.07)	0.989
≥ 75 years	159.79 [115.07; 221.75]	162.93 [139.02; 190.94]	3.14 (−51.65; 57.92)	0.911
p-value	< 0.001	< 0.001		
Region				
Center	52.85 [28.51; 97.27]	33.11 [25.27; 43.30]	−19.74 (−51.71; 12.23)	0.226
East	249.77 [132.65; 469.51]	37.20 [22.54; 61.00]	−212.56 (−376.00; −49.12)	0.011
North	48.37 [35.77; 65.30]	27.67 [12.27; 60.94]	−20.71 (−55.15; 13.73)	0.239
West	298.28 [125.50; 707.02]	71.34 [61.76; 82.39]	−226.93 (−476.12; 22.25)	0.074
Southeast	119.89 [62.67; 228.53]	108.45 [68.06; 172.45]	−11.45 (−127.28; 104.38)	0.846
South	97.12 [70.63; 133.40]	100.65 [45.19; 222.73]	3.54 (−104.79; 111.86)	0.949
p-value	< 0.001	< 0.001		

Results expressed by mean values (95 CI%); *values in US dollars [US$]; p-values corrected by the sequential Bonferroni method. THA: total hip arthroplasty.

Table 5. Average hospitalization length per patient for types of total hip arthroplasty performed in public hospitals in the municipality of São Paulo between 2008 and 2019, according to gender, age group, and municipality region.

	Cemented THA*	Non-cemented/hybrid THA*	Difference between non-cemented/hybrid – cemented*	p-value
Average hospitalization	5.42 [5.09; 5.77]	4.55 [4.33; 4.79]	−0.87 (−1.27; −0.46)	< 0.001
Sex				
Female	5.77 [5.17; 6.45]	4.60 [4.38; 4.84]	−1.17 (−1.86; −0.48)	0.001
Male	5.12 [4.76; 5.50]	4.50 [4.25; 4.77]	−0.61 (−0.97; −0.26)	< 0.001
p-value	0.087	0.199		
Age group				
< 55 years	5.58 [5.04; 6.19]	4.33 [4.07; 4.62]	−1.25 (−1.93; −0.57)	< 0.001
55-64 years	5.30 [4.75; 5.91]	4.37 [4.15; 4.60]	−0.93 (−1.52; −0.33)	0.002
65-74 years	5.08 [4.70; 5.48]	4.58 [4.35; 4.82]	−0.49 (−0.89; −0.10)	0.014
≥ 75 years	6.01 [5.43; 6.65]	5.39 [5.05; 5.75]	−0.62 (−1.26; 0.02)	0.059
p-value	0.082	< 0.001		
Region				
Center	6.37 [5.31; 7.65]	5.22 [4.64; 5.87]	−1.15 (−2.49; 0.18)	0.090
East	6.21 [4.35; 8.87]	5.72 [4.46; 7.34]	−0.49 (−1.40; 0.42)	0.288
North	6.45 [5.59; 7.45]	6.06 [5.13; 7.15]	−0.40 (−1.18; 0.38)	0.318
West	7.06 [5.73; 8.70]	4.47 [4.02; 4.96]	−2.59 (−4.23; −0.96)	0.002
Southeast	4.76 [4.60; 4.93]	4.21 [4.08; 4.34]	−0.55 (−0.66; −0.45)	< 0.001
South	4.70 [3.47; 6.39]	5.00 [4.08; 6.13]	0.30 (−2.05; 2.65)	0.805
p-value	< 0.001	< 0.001		

Results expressed by mean values (95 CI%); *values in number of days; p-values corrected by the sequential Bonferroni method. THA: total hip arthroplasty.

ICU stay length, estimated by mean ICU stay per patient subjected to THA, was 0.36 days longer for non-cemented/hybrid THAs than for cemented ones (p = 0.013) (Table 6). Comparing ICU stay length per THA types with gender, age group, and São Paulo region showed that non-cemented/hybrid THAs had longer ICU stays for all genders (p = 0.020 and p = 0.033) and those aged 55 to 64 years (p = 0.044), 65 to 74 years (p = 0.002), and ≥ 75 years (p = 0.004), whereas cemented THA showed longer ICU stays only in Eastern São Paulo (p = 0.004). We also found that THA types showed significant differences in ICU stay length among gender, age groups, and regions.

Death rates, assessed by the total number of deaths per patient subjected to THA failed to show a significant difference between THA types (Table 7). Comparing death rates and THA types with gender showed no significant differences. We were unable to adjust a comparison model for age group and São Paulo region due to the absence of deaths for some of these demographic variables.

Table 6. Estimated average length of ICU stay per patient for types of total hip arthroplasty performed in public hospitals in the municipality of São Paulo between 2008 and 2019, according to gender, age group, and municipality region.

	Cemented THA*	Non-cemented/hybrid THA*	Difference between non-cemented/hybrid – cemented*	p-value
Average ICU stay	0.61 [0.42; 0.88]	0.97 [0.82; 1.14]	0.36 [0.08; 0.65]	0.013
Sex				
Female	0.73 [0.52; 0.97]	1.06 [0.90; 1.24]	0.34 [0.05; 0.62]	0.020
Male	0.50 [0.25; 0.81]	0.87 [0.72; 1.04]	0.37 [0.03; 0.71]	0.033
p-value	0.048	< 0.001		
Age group				
< 55 years	0.41 [0.18; 0.69]	0.43 [0.36; 0.51]	0.02 (−0.25; 0.28)	0.907
55-64 years	0.60 [0.32; 0.94]	0.99 [0.84; 1.15]	0.39 [0.01; 0.77]	0.044
65-74 years	0.72 [0.47; 1.00]	1.29 [1.10; 1.50]	0.58 [0.21; 0.95]	0.002
≥ 75 years	1.02 [0.75; 1.33]	1.65 [1.39; 1.93]	0.63 [0.20; 1.06]	0.004
p-value	< 0.001	< 0.001		
Region				
Center	0.40 [0.22; 0.61]	0.23 [0.15; 0.32]	−0.17 (−0.35; 0.02)	0.078
East	1.25 [0.69; 2.00]	0.22 [0.08; 0.37]	−1.03 (−1.73; −0.34)	0.004
North	0.32 [0.28; 0.37]	0.18 [0.03; 0.35]	−0.15 (−0.35; 0.06)	0.161
West	1.78 [0.43; 4.39]	0.42 [0.29; 0.57]	−1.36 (−3.09; 0.38)	0.126
Southeast	0.76 [0.25; 1.46]	1.60 [1.21; 2.06]	0.84 (−0.03; 1.72)	0.059
South	0.55 [0.29; 0.85]	0.62 [0.15; 1.28]	0.08 (−0.62; 0.77)	0.832
p-value	0.048	< 0.001		

Results expressed by mean values (95 CI%); *values in number of days; p-values corrected by the sequential Bonferroni method. THA: total hip arthroplasty.

Table 7. Death rates by type of total hip arthroplasty performed in public hospitals in the municipality of São Paulo between 2008 and 2019, according to gender, age group, and municipality region.

	Cemented THA	Non-cemented/hybrid THA	Difference between non-cemented/hybrid – cemented	p-value
Death rate	0.26 [0.09; 0.76]	0.50 [0.34; 0.73]	0.24% (−0.08%; 0.56%)	0.142
Gender				
Female*	0.36% [0.13%; 0.96%]	0.57% [0.32%; 1.05%]	0.22% (−0.22%; 0.66%)	0.333
Male*	0.15% [0.02%; 1.01%]	0.40% [0.25%; 0.63%]	0.24% (−0.15%; 0.64%)	0.225
p-value	0.048	< 0.001		
Age group				
< 55 years	0.00%	0.09%		N/A
55-64 years	0.00%	0.30%		N/A
65-74 years	0.28%	0.37%		N/A
≥ 75 years	1.62%	2.30%		N/A
p-value	N/A	N/A		
Region				
Center	0.67%	0.28%		N/A
East	0.00%	0.40%		N/A
North	0.00%	0.94%		N/A
West	0.00%	0.70%		N/A
Southeast	0.24%	0.33%		N/A
South	0.00%	1.13%		N/A
p-value	N/A	N/A		

Results expressed by estimated mean values (95 CI%); p-values corrected by the sequential Bonferroni method. THA: total hip arthroplasty; N/A: not applicable.

DISCUSSION

The Department of Informatics of the Unified Health System (DATASUS) is an online, free-access electronic platform that stores and organizes information from the Unified Health System (SUS) in Brazil. This enables us to assess epidemiology and health care data, including on surgical procedures.[16] Based on this platform, we evaluated its information on the types of primary and elective THA fixation in public hospitals in São Paulo (the most populous municipality in the country) between 2008 and 2019, totaling 7,673 procedures.

We found a predominance of non-cemented/hybrid THA fixation, with 6,220 (81%) procedures. This technique is also predominant in Canada, Denmark,[20] and USA (99%).[21] However, cemented fixation still prevails in a few countries, such as Sweden (60%).[22] We find a global tendency toward cemented THA in older patients,[20] unlike this study.

Non-cemented/hybrid THA total costs (i.e., the amount hospitals receive for hospitalizations, materials) were US$ 495.27 ($p < 0.001$) higher than cemented ones, as were if assessed by gender and age group. However, DATASUS[16] fails to stratify implant cost, operating room time, and auxiliary material costs, only reporting their total value. This absence precludes a detailed cost analysis, which would enable us to define which are the most relevant in the final cost of the entire process.[23]

THA hospitalization length has substantially decreased in the last two decades due to improved analgesia, anesthesia, surgical technique, preoperative preparation, and early rehabilitation.[24] In the 1980s, mean hospitalization spanned from two to three weeks.[25] Recent studies report recoveries between two and five days.[24,26] This study found that mean hospitalization length for cemented THA (5.42 days) was significantly higher than for non-cemented/hybrid ones (4.55 days) ($p < 0.001$). Oh et al.,[27] described a different result, finding no significant difference between hospitalization time for cemented (4.88 days) and non-cemented THAs (3.76 days).

This study found that mean ICU stays were 0.36 days ($p = 0.013$) higher in patients who underwent non-cemented/hybrid THAs. This increase may be associated with a higher frequency of comorbidities and/or intraoperative complications, which required postoperative intensive care. Studies show a higher frequency of perioperative periprosthetic fractures in non-cemented THAs,[28,29] which could be one of the causes for longer ICU stays.

Increase in age may be associated with longer periods of hospitalization,[30] as found in patients who underwent non-cemented/hybrid THAs ($p < 0.001$). However, we found no such association for cemented THAs, probably due to their decreased number of cases, about five times lower than non-cemented/hybrid THA ones.

Note that, although all age groups had longer hospital stays due to cemented THA, their costs were still lower. Thus, although shorter hospitalizations relate to decreased hospital costs,[24] this seems to be neither the only nor the most important factor affecting costs.

Post-THA mortality rate is low and has decreased over the years,[31,32] around 0.7% for the first 90-postoperative days.[33,34] We found extremely low death rates, with no difference between THA types. However, we found that death rates tended to increase with patients' age, regardless of THA type.

This study has limitations we should mention. First, data capture and quality solely depends on how it is logged and made publicly available on the DATASUS TabNet platform. Second, this database enabled us to only categorize primary THA types into two groups, via codes 04.08.04.008-4 and 04.08.04.009-2 (for cemented and non-cemented/hybrid techniques, respectively). This limits the comparison of data between more groups, such as cemented, non-cemented, hybrid, and reverse hybrid techniques. Another limitation is the absence of clinical outcome and complication records, making it impossible to assess whether fixation types may relate to patients' recovery and quality of life.

Assessing THA fixation, involved cost, and patients' profile enables research to inform the public policies to be adopted for this population. Thus, our results help to describe this procedure for the relevant population by assessing the differences in hospitalization length, costs, and THA fixation types and providing data to managers and healthcare providers aiming toward the best adequacy of public resources.

CONCLUSION

Public hospitals in the municipality of São Paulo performed 7,673 primary and elective THAs between 2008 and 2019, showing a predominance of non-cemented/hybrid fixation (81%). Non-cemented/hybrid THA total costs (the amount hospitals receive for hospitalizations, materials, and produces) was higher than cemented ones. Regardless of fixation type, we found that both total and ICU costs were significantly higher for women and that they gradually increased as age did. Hospital stays were longer for cemented THAs. Death rates showed no significant differences between fixation types.

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EPIDEMIOLOGICAL DISTRIBUTION OF SOFT PART TUMORS IN A TERTIARY HOSPITAL

DISTRIBUIÇÃO EPIDEMIOLÓGICA DE TUMORES DE PARTES MOLES EM UM HOSPITAL TERCIÁRIO

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ABSTRACT

Objective: To evaluate cases of soft tissue tumors at the Orthopedic Oncology service of the PUC-Campinas Hospital and determine the epidemiological profile in the period from February 2012 to November 2019, associating the participation of a non-reference hospital in the approach and treatment of the pathology. Methods: This study evaluated 72 patients aged 18 to 81 years, of both sexes and diagnosed with soft tissue tumor and divided into two groups: (I) primary etiology and (II) metastatic etiology. Results: Of 146 patients admitted, 22 resulted in deaths, with 9 patients from Group I, and 13 from Group II. For all patients with soft tissue tumor, aged between 51 and 58 years, admitted in the period, the probability of survival after 46 months was 71.84%, Group I's was 22.7% and Group II's 91.43%. Conclusion: Despite the scarcity of epidemiological data related to soft tissue tumor, the data appreciated in the hospital's service, not a reference in treating this type of condition, are compatible with the data presented in specialized hospitals in Brazil, thus, in confluence with the literature. ***Level of Evidence III, Comparative, Prognostic and Retrospective Study.***

Keywords: Sarcoma. Soft Tissue Neoplasms. Epidemiology. Neoplasms.

RESUMO

Objetivo: Avaliar casos de tumores de partes moles do Serviço de Oncologia Ortopédica do Hospital PUC-Campinas e determinar o perfil epidemiológico no período de fevereiro de 2012 a novembro de 2019, associando à participação de um hospital que não é referência na abordagem e tratamento da patologia. Métodos: Foi realizada uma análise exploratória de dados com 72 pacientes entre 18 e 81 anos, de ambos os sexos e com diagnóstico de tumor de partes moles. Eles foram avaliados e divididos em dois grupos: (I) de etiologia primária e (II) de etiologia metastática Resultados: Do total de 146 pacientes admitidos, 22 vieram a óbito, sendo 9 pacientes do Grupo I, e 13 do Grupo II. Para todos os pacientes com tumor de partes moles, com idade entre 51 e 58 anos, admitidos no período, a probabilidade de sobrevida após 46 meses foi de 71,84%, enquanto do Grupo I foi de 22,7%, e do Grupo II foi de 91,43%. Conclusão: Apesar da escassez de dados epidemiológicos relacionados ao tumor de partes moles, os dados apreciados no serviço do hospital, que não é referência no tratamento dessa condição, são compatíveis com os dados apresentados em hospitais especializados no Brasil, assim, corroborando a literatura. ***Nível de Evidência III, Estudo Retrospectivo Comparativo Prognóstico.***

Descritores: *Sarcoma. Neoplasias de Tecidos Moles. Epidemiologia. Neoplasias.*

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INTRODUCTION

Cancer is an important public health problem, mainly due to increase in its incidence and its high mortality rate, and treatment is recommended in reference centers specialized in oncology. However, gaps in epidemiological information exist in private and public agencies when it comes to soft tissue sarcoma, both in reference institutions and in non-reference and tertiary hospitals.

Soft tissues are those located between the epidermis and viscera, except for bones, and constitute about 50% of an adult's body weight. Soft tissue sarcomas (STS) are rare malignancies that mimic mesenchymal proliferations and soft tissue components. They account for 1% of all malignant neoplasms in adults and can develop anywhere, although about 40% occur in the lower limbs, especially in the thigh. The main malignant soft tissue tumors are fibrosarcomas and liposarcomas.[1,2]

All authors declare no potential conflict of interest related to this article.

The study was conducted at the Department of Orthopedics and Traumatology of PUC-Campinas Hospital.
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The cause of soft tissue tumors is unknown. However, predisposing genetic factors have already been identified, as well as extrinsic genetic damage (ionizing radiation, exposure to dioxins, chlorophenol and some viruses, such as HIV).[1-3]
Presence of tumor accompanied or not by pain is the main clinical manifestation. Tumor samples can be obtained by percutaneous or incisional biopsy. Diagnoses included histopathology, neoplasm staging and immunohistochemical study.[1-3]
The degree of histological differentiation of the primary tumor, its size and the presence or absence of metastasis are the main prognostic factors related to STS. According to staging, stage I tumors present low histological grade, accounting for about 15% of all sarcomas and usually remain localized. Stage II and III sarcomas are considered high-grade tumors (especially those with evident necrosis) and tend to spread rapidly, although without lymph node involvement, and account for the remaining 85%. Usually of recurrent character. Stage IV is represented by metastatic dissemination.[3-5]
Treatment of extremity sarcomas should be performed in specialized institutions, supported by a multidisciplinary team composed of surgeons, clinical oncologists, radiotherapists, pathologists, radiologists, orthopedists, physical therapists, prosthetics specialists, etc.[4-6]
Distant metastasis is the main cause of death of patients with STS. In patients with high-grade sarcoma, the incidence of distant metastasis is 40% and the relative overall survival rate at 5 years is about 50%.[6,7]
Little is known about the epidemiology of STS in Brazil, reflecting the unusual nature of these lesions. Regarding sex, the man-woman ratio is 1:1. The overall annual incidence varies according to age, being 20.7% in patients under 40 years of age, 27.6% among patients aged 40 to 60 years and 51.7% in patients over 60 years. Regarding race, American statistics show a higher number of cases in Caucasian patients (87%), followed by African Americans (10%) and other races (4%).[8,9]
In Brazil, according to DATASUS data, between 1996 and 2005, standardized mortality rates due to STS increased. At the A. C. Camargo Hospital – São Paulo, between 1953 and 1970, from the total number of patients attended, only 628 (2.0%) were sarcomas. At Araújo Jorge Hospital (HAJ) – Goiânia, between 1996 and 2000, 215 patients diagnosed with STS were admitted, 60.9% of high-grade and 39.1% low-grade. In the Clinics Hospital of Porto Alegre, between October 2006 and 2011, 141 patients were admitted, with a mean age of 52 years and the most frequent location in lower limbs (LL – 40%).[1-3]
Regarding STS in Brazil, we verified the presence of scarce and inconclusive epidemiological data no up-to-date records exist, nor that they incorporate non-reference treatment hospitals into statistics.[1,2,10-19]
The objective of this study is to retrospectively evaluate the cases of soft tissue tumors of the Orthopedic Oncology service of the Hospital and determine the epidemiological profile of soft tissue neoplasms service from February 2012 to November 2019, associating the participation of a non-reference hospital in the approach and treatment of the pathology. The results can contribute to the reliability and dissemination of more targeted epidemiological statistics, fostering the scarce collection of data provided by the scientific community.

METHODS

This cross-sectional, analytical, retrospective and observational study used data from the database of the Orthopedic Outpatient Clinic of the Orthopedic Oncology Group of the PUC-Campinas Hospital. We evaluated 72 patients aged between 18 and 81 years admitted between February 2012 and November 2019, as well as the collection in the total number of patients admitted in the same period with the same pathology.
Cases were divided into two groups: Group I for patients with soft tissue tumor of primary etiology and; Group II for patients with soft tissue tumor of metastatic etiology.
Survival function was calculated using the Kaplan-Meier method. Summary measurements and the construction of tables and graphs were used to analyze exploratory data.
The statistical analysis consisted of a descriptive study, carried out in the statistical software R version 2.4.0.
The research protocol was approved by the Research Ethics Committee with opinion number CAAE 39067920.1.0000.5481.

RESULTS

From February 2012 to November 2019, we had a total of 146 patients admitted to the service with diagnosis (current or prior) of soft tissue tumor, 153 new patients and 13 patients with multiple hospitalizations associated with adjacent or metastatic tumors, corresponding to 8.90% of the total patients.
We used the 153 new patients admitted to the service with diagnosis (current or prior) of soft tissue tumor for analysis, excluding 13 patients who had multiple hospitalizations, and taking note of 3 patients lost during the period, whose information was censored. Admissions of patients categorized as return and/or exams were not counted.
Between February 2012 and November 2019, the mean distribution of admission of new patients was 19.12 people admitted per year, with a maximum of 27 and a minimum of 14. The standard deviation of the sample was 3.98 patients per year.

New patients' distribution of admission

Regarding the biological sex of patients who entered the service during the period studied, 39 (54.16%) were men and 33 (45.83%) women. Self-declared sex data were not obtained.
The ethnic profile consisted of 32 (44.45%) whites, 27 (37.50%) brown patients, 9 (12.50%) blacks and 4 others (5.55%).
Regarding the age of diagnosis, the mean was 53.24 years, and the standard deviation was 13.68 years, with a minimum of 26 years and a maximum of 81 years. The sample mode was unimodal (63 years), with a 52-year median, and 55 years as the distribution amplitude.
Regarding the random sample of 72 medical records analyzed, we had a confidence interval with a 95% confidence level, from 51.33 (lower estimate) to 58, 67 years (higher estimate), indicating that the randomly chosen sample is within the population's parameter.

Distribution of patients in the age group of diagnosis

Regarding the origin of the referral, most came from 62.75% the Brazilian Unified Health System (SUS), and the remaining 37.25% from the private system. The specific referral was mostly by SUS hospitalization (38.57%), followed by health insurance (24.83%), outpatient clinics (24.18%), and private way (12.42%). Regarding the hospitalized patients via insurance, we had a virtually equal distribution between 4 contracted services, being the plan's origin mostly in the city of Campinas-SP (about 60.53%) compared to cities up to 200 Km away from the service (39.47%). The mean length of stay was 15.97 days, and the standard deviation was 3.43 days, as shown in Table 1.

Table 1. Data from the referral source.

Referral Source	Brazilian Unified Health System (SUS)	Private system
Specialized forwarding	Hospitalization | Outpatient clinic	Health plan | Private
Relative frequency (%)	38.57% | 24.18%	24.83% | 12.42%
Total	62.75%	37.25%

<< SUMÁRIO

Regarding the tumor's location, most were located in trunk and extremities (81.24%), 40% of which were located mostly between the femur (right and left) and shoulders. The other most common tumor locations were the humerus, forearm and tibia; however, the medical records could not offer more information about these sites of involvement, thus, it is impossible to associate the location of the tumor in these cases.

Among the patients who presented location of the tumor in the shoulder, we found an association with recurrent dislocations, so it was impossible to correlate a statistical analysis.

Tumor stage classifications were stage I (59.40%), stages II and III (30.80%), and stage IV (9.8%). Data are presented in Table 2.

Regarding the most recurrent soft tissue tumor types, lipoma and osteochondroma of femur diagnoses were the most common. A more detailed analysis was impossible given the lack of archiving of immunohistochemical tests.

Among female patients with a soft tissue tumor diagnosis, we found that 71.02% had ligation or hysterectomy surgeries and/or previous history of breast cancer, and it was impossible to correlate these data with each other and/or with the sample group.

Regarding the treatment techniques used in the service, 63.89% of the patients analyzed presented a complete surgical description in their medical records: 10.40% of these patients performed a diagnostic biopsy and tumor resection concomitantly; 15% of these patients underwent bone and soft tissue resection surgery concomitantly, 29.50% of these patients underwent only soft tissue resection. Of the patients with surgical records analyzed, 9.10% had a diagnosis of adjacent lymph nodes affected by the tumor.

DISCUSSION

From the deaths of the period studied we have: 22 deaths in total, of which 9 were of patients in Group I, with tumor of secondary and metastatic etiology, and 13 of Group II, with tumor of primary etiology, without metastases. Regarding living patients, the results were 4 patients from Group I and 127 in Group II. Therefore, the analysis consisted of 13 patients belonging to Group I and 140 patients belonging to Group II. Patients in Group I were responsible for all re-hospitalizations in the service during the period, as shown in Table 3.

According to the Kaplan-Meier survival analysis method, the probability of surviving 46 months after diagnosis for all patients diagnosed with soft tissue tumor was 0.98, whereas the conditional probability of death was 0.02.

The accumulated survival at 46 months of diagnosis is 0.072, therefore, the probability of a patient with soft tissue tumor being alive after 46 months of diagnosis is approximately 71.85%, as shown in Table 4.

Table 4 shows the calculation of accumulated survival at 46 months, estimating the probability of survival in 5 years of diagnosis. From the 153 new hospitalized patients, 23 died and 3 were censored (interventions or loss of follow-up).

The probability of survival 46 months after diagnosis of patients in Group I was 0.33, whereas the conditional probability of death was 0.67. For that reason, the accumulated survival at 46 months of diagnosis in Group I is 22.7% (Table 5).

The probability of survival 46 months after the diagnosis of patients in Group II was 0.992, while the conditional probability of death was 0.007. Therefore, the accumulated survival at 46 months of diagnosis in Group II is 91.43% (Table 6).

We can thus infer that, for all patients with soft tissue tumor, of both sexes, and aged between 51 and 58 years, admitted and diagnosed at the hospital service in Campinas, São Paulo, between 2012 and 2019, the probability of survival after 46 months was 71.84%. The probability of survival after 46 months in Group I (patients with metastasis) was 22.7%, compared to Group II's (patients without metastasis) 91.43%.

Table 2. Stages of tumor classification.

Classification	Patients analyzed
Stage I	43 (59.4%)
Stage II and III	22 (30.8%)
Stage IV	7 (9.8%)
Total	72 (100%)

Table 3. Profile of re-hospitalizations of diagnosed patients.

Patient situation	Group I (Secondary etiology, with metastasis)	Group II (Primary etiology, without metastasis)	Total
Deaths	9	13	22
Non-deaths	4	127	131
Total	13	140	153

Table 4. Overall survival rates.

Months after diagnosis (i)	Number of individuals alive at the beginning of the month (li)	Deaths (di)	Censuring (wi)	Conditional probability of death (qi = di/li)	Conditional probability of survival (pi = 1 – qi)	Cumulative probability of survival S(ti)	Survival rate of all studied groups
0	153	1	1	0.0065359	0.9934641	0.9934641	99.4%
1	152	1	1	0.0065789	0.9934211	0.9803055	98.0%
2	151	2	1	0.0132450	0.9867550	0.9673214	96.7%
6	149	2	1	0.0134228	0.9865772	0.9543372	95.4%
12	147	1	0	0.0068027	0.9931973	0.9478451	94.8%
14	146	1	1	0.0068493	0.9931507	0.0941353	94.1%
18	145	1	1	0.0068966	0.9931034	0.0934795	93.5%
20	144	1	0	0.0069444	0.9930556	0.9283039	92.8%
26	143	1	1	0.0069930	0.9930070	0.0921812	92.2%
28	142	1	1	0.0070423	0.9929577	0.0915321	91.5%
34	139	3	1	0.0215827	0.9784173	0.0895565	89.5%
36	137	2	1	0.1666667	0.8333333	0.0746304	74.6%
40	134	2	0	0.0149254	0.9850746	0.0735165	73.5%
44	133	1	1	0.0075188	0.9924812	0.0729638	72.9%
46	131	2	1	0.0152672	0.9847328	0.07184986	71.8%

Table 5. Group I survival rates.

Months after diagnosis (i1)	Number of individuals alive at the beginning of the month (li1)	Deaths (di1)	Censuring (wi1)	Conditional probability of death (qi1 = di1/li1)	Conditional probability of survival (pi1 = 1 – qi1)	Cumulative probability of survival S(ti1)	Group I survival rate
0	13	1	1	0.079	0.921	0.921	92.1%
2	12	1	1	0.083	0.917	0.844	84.4%
12	11	1	0	0.09	0.91	0.768	76.8%
18	10	1	1	0.1	0.9	0.683	68.3%
20	9	1	0	0.111	0.889	0.607	60.7%
34	8	2	1	0.25	0.75	0.455	45.5%
36	6	2	1	0.333	0.667	0.227	27.7%

Table 6. Group II survival rates.

Months after diagnosis (i2)	Number of individuals alive at the beginning of the month (li2)	Deaths (di2)	Censuring (wi2)	Conditional probability of death (qi2 = di2/li2)	Conditional probability of survival (pi2 = 1 – qi2)	Cumulative probability of survival S(ti2)	Group II survival rate
1	140	1	1	0.00714285	0.99285715	0.99285715	99.3%
2	139	1	1	0.00719424	0.99280576	0.985714297	98.6%
6	138	1	1	0.00724376	0.99275624	0.978574019	97.8%
14	137	1	1	0.00729927	0.99264706	0.971378624	97.1%
26	136	1	1	0.00735294	0.9925926	0.964183234	96.4%
28	135	1	1	0.0074074	0.99273134	0.957174914	95.7%
34	134	1	1	0.007426866	0.992573134	0.950066104	95.0%
36	133	1	1	0.007518797	0.992481203	0.942922729	94.3%
40	132	2	0	0.01515152	0.98484848	0.92836037	92.9%
44	130	1	1	0.0076923	0.9923077	0.92149269	92.2%
46	129	2	1	0.00775193	0.99224807	0.91434933	91.5%

CONCLUSION

This study considered a total of 146 patients admitted to the service with soft tissue tumor diagnosis, from February 2012 to November 2019, being 153 new patients and 13 patients with hospitalizations associated with metastatic tumors, also accounting for 3 censored patients.

Admission distributions of new patients in the period was considered constant.

Regarding biological sex, the estimated proportion for the distribution was 1:1, similar to that described in the literature. The ethnic profile presented a predominance of white and brown patients with access to the service.

The mean age patients with STS was 53.24 years, similar to that described in the literature, due to possible late diagnoses.

Referral was mostly via SUS. Private referrals presented an egalitarian distribution of contracted insurance services, mostly in the city.

The mean length of stay in the service, between first hospitalization and surgery, was 15.97 days, a standard followed and guided by the service.

Regarding the tumor's location, most (81.24%) were in the trunk and extremities, of which 40% were located between the femur (right and left) and shoulders. Among the patients who presented the tumor in the shoulder, we found an association with recurrent dislocations, so it was impossible to correlate a statistical analysis.

Regarding tumor classification, most were stage I (59.40%), demonstrating a diagnosis of the onset of a low-grade tumor, being excellent for a rapid approach and improvement of patient survival. We observed a recurrence of diagnoses of femur lipoma and osteochondroma as the more recurrent soft tissue tumor types.

Regarding the treatment techniques applied in the service, most patients analyzed (29.50%) underwent only soft tissue resection, maintaining a cautious margin of resection.

In the table of deaths, we present the results of patients who developed metastases in relation to the occurrence of death, demonstrating that the risk of patients with metastases evolving to death is highly significant in relation to patients who did not develop them. However, the occurrence of metastases is not an isolated prognostic factor, and further studies are needed.

For all patients with soft tissue tumor analyzed, the probability of survival after 46 months was 71.84%.The probability of survival after 46 months of patients with metastasis was 22.7%, compared to 91.43% of those without metastasis. Thus, patients with metastases have a lower estimated survival than patients without metastasis. That said, we found that, despite the scarcity of epidemiological data related to soft tissue tumor, the data evaluated in the non-reference hospital service are compatible with the data found in specialized hospitals in Brazil.

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JUXTACORTICAL OSTEOSARCOMA: CLINICAL EVOLUTION AND DEDIFFERENTIATION RELATED FACTORS

OSTEOSSARCOMA JUSTACORTICAL: EVOLUÇÃO CLÍNICA E FATORES RELACIONADOS À DESDIFERENCIAÇÃO

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ABSTRACT

Objective: Evaluate risk factors related to clinical evolution and dedifferentiation of parosteal (juxtacortical) osteosarcoma to high-grade osteosarcoma. Methods: Retrospective cohort study performed over a period of 25 years, using data from medical records of patients diagnosed with parosteal osteosarcoma. The data were submitted to statistical analysis by Fisher's exact test and Student's t-test. Results: Of the 326 patients treated for osteosarcoma, we identified 17 patients diagnosed with parosteal osteosarcoma. Of these, 4 (23.5%) were not actually diagnosed with parosteal osteosarcoma and 4 did not have the minimum data required for analysis, being excluded from the study. Of the 9 patients studied, we observed that 3 (33.3%) evolved with tumor dedifferentiation to high-grade osteosarcoma. Moreover, 2 (66.7%) had local recurrence and 2 (66.7%) metastases. Conclusion: Age, sex, and the tumor size were not directly related to the dedifferentiation from parosteal osteosarcoma to high-grade osteosarcoma. The most aggressive clinical evolution – presence of local recurrences and metastasis – in parosteal osteosarcoma occurred in tumors with dedifferentiation, however, we cannot associate each other as cause and effect, but as related factors. ***Level of Evidence IV, Case Series.***

Keywords: Bone Neoplasms. Clinical Evolution. Osteosarcoma, Juxtacortical. Recurrence. Risk Factors.

RESUMO

Objetivo: Avaliar fatores de risco relacionados à evolução clínica e à desdiferenciação do osteossarcoma justacortical (parosteal, paraosteal) em osteossarcoma de alto grau. Métodos: Estudo de coorte retrospectiva realizado num período de 25 anos. Foram utilizados dados de prontuários de pacientes com diagnóstico de osteossarcoma parosteal que, em seguida, foram submetidos à análise estatística pelo Teste Exato de Fisher e pelo Teste t de Student. Resultados: Foram tratados 326 pacientes com diagnóstico de osteossarcoma, dos quais 17 (5,21%) receberam diagnóstico de osteossarcoma parosteal, 4 (1,22%) foram diagnosticados com osteossarcoma convencional e 4 (1,22%) não tinham dados mínimos necessários para análise, sendo excluídos do estudo. Dos 9 (2,76%) pacientes estudados, 3 (0,92%) evoluíram com desdiferenciação do tumor para osteossarcoma de alto grau. Dois (0,84%) pacientes apresentaram recidiva local e 2 (0,84%%) apresentaram metástases. Conclusão: Os fatores idade, sexo e volume do tumor não estão diretamente relacionados com a desdiferenciação do osteossarcoma parosteal para osteossarcoma de alto grau. Apesar de a evolução clínica mais agressiva – presença de recidivas locais e metástase – no osteossarcoma parosteal ter ocorrido nos tumores com desdiferenciação, não é possível estabelecer uma relação de causa e efeito, apenas considerá-las como fatores relacionados. ***Nível de Evidência IV, Série de Casos.***

Descritores: *Neoplasias Ósseas. Evolução Clínica. Osteossarcoma Justacortical. Recidiva. Fatores de Risco.*

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INTRODUCTION

Osteosarcoma is the most common primary bone tumor, excluding hematopoietic intraosseous tumors. In its conventional form, it is a malignant tumor of high grade that produces an immature bone matrix called the osteoid. Generally, this lesion attacks the bone marrow region.[1,2]

Tumors originated from the bone surface are 20 times less frequent and, for the most part, are of low grade. According to the World Health Organization, surface variants are parosteal steosarcoma (parosteal or juxtacortical), periosteal osteosarcoma, and high-grade surface osteosarcoma.[2] They correspond to 5%, 1.5%, and 0.5% of all cases of osteosarcomas.[2,3]

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The study was conducted at Institute of Pediatric Oncology and Department of Orthopedics and Traumatology of Paulista School of Medicine of Universidade Federal de São Paulo.
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Parosteal osteosarcoma was first described by Geschickter and Copeland in 1951 as "osteoma parosteal."[2,4] This is a low-grade malignant tumor that is located in the metaphysis of long bones, with the distal femur (popliteal region) being the most frequent site.[2,5] Its incidence is higher in females, affecting mostly young adults between 20 and 40 years of age.[2,3,5-7]

This tumor has a slow growth and may transform into a tumor with a high degree of malignancy, the dedifferentiation.[6] However, systemic metastases are rare.[6-8]

Multiple treatment options for parosteal osteosarcoma are described, but most services opt for surgical resection of the tumor with wide margins and reconstruction with bone graft or endoprosthesis without neoadjuvant or adjuvant treatment.[5-9]

Surgery performed with satisfactory margins seems to be the most important prognostic factor, since inadequate margins have been reported in association with local recurrence, dedifferentiation, and metastases, therefore, they have appeared as a negative predictor for a disease-free survival.[5,10-13]

Dedifferentiation is reported among 8-45% of cases. It may occur as a primary event for a high-grade sarcoma (malignant fibrous histiocytoma or conventional osteosarcoma) being juxtaposed to the low-grade or secondary fibrous component after multiple recurrences of an originally low-grade tumor.[2,7,10] In this process there is an increase in the metastatic rate compared to conventional parosteal osteosarcoma.[5,10-14]

Our study aims to evaluate the clinical evolution of patients diagnosed with parosteal/juxtacortical osteosarcoma and to identify probable factors related to the dedifferentiation of parosteal osteosarcoma into high-grade osteosarcoma.

METHODS

A retrospective cohort study was conducted at the Institute of Pediatric Oncology–GRAACC/UNIFESP to evaluate patients with parosteal osteosarcoma that evolved into tumor dedifferentiation to high-grade osteosarcoma. The STROBE guideline was followed for retrospective studies, Figure 1 shows the stratification of the sample.[15]

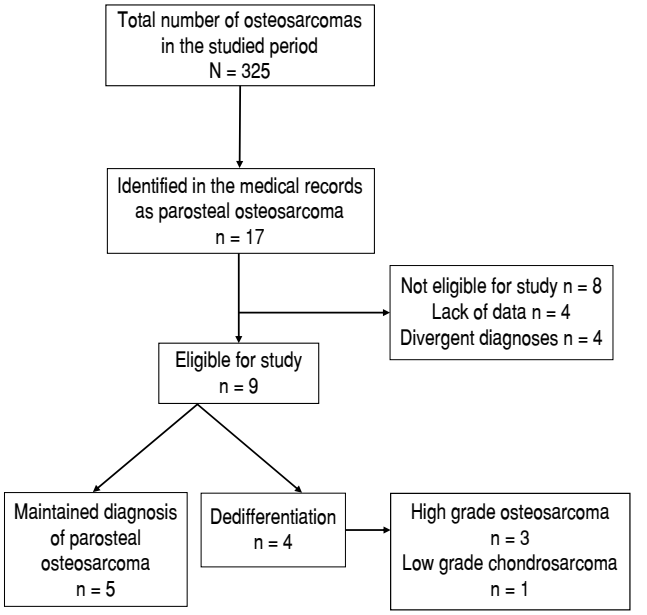

Figure 1. Sample stratification

From 01/01/1993 to 31/12/2018, 17 patients diagnosed with parosteal osteosarcoma were treated in our service, which corresponded to 5.2% of the cases of osteosarcoma (326 patients). We performed a retrospective analysis of the medical records and anatomopathological reports of these patients. Of the 17 patients evaluated, 4 (23.5%) did not have a confirmed diagnosis of parosteal osteosarcoma by the anatomopathological study of the surgical specimen. Four (23.5%) patients did not present, in their medical records, the minimum data necessary for analysis. Thus, the data from nine patients were evaluated, which corresponds to our sample.

The final diagnosis of the bone tumors was considered, based on the triad of the clinical status, imaging scans, and histopathological report.[2,6,7,16] According to the institution's routine, all cases are discussed preoperatively in a joint weekly scientific meeting between the orthopedics, oncology, radiology, and anatomopathology teams, in which the diagnosis and individual conduct of each patient are defined.

The anatomopathological analysis of all patients was performed by the same pathologist. All tests were analyzed macroscopically and microscopically, using hematoxylin-eosin staining and immunohistochemical analysis when indicated.

All patients were diagnosed with parosteal osteosarcoma after analysis of clinical data, imaging, and discussion of the biopsy result, being treated surgically for the purpose of complete tumor resection. Table 1 shows the patients' initial diagnoses, epidemiological data, and final diagnoses of patients.

A retrospective cohort study was conducted with patients in our sample to evaluate which risk factors may be related to the evolution of dedifferentiation from osteosarcoma parosteal to high-grade osteosarcoma. Factors associated with the patients' age at diagnosis, the presence of recurrences, and tumor size were evaluated. We used Fisher's exact test to describe the associations between categorical variables and the Student's t-test to compare the means of the groups of the continuous variables. The null hypothesis (H0) adopted was that there was no difference between the means of the groups, with a significance index of 5% ($p = 0.05$).

Table 1. Epidemiological data of patients with Parosteal Osteosarcoma.

Order	Age	Sex	Initial diagnosis	Dedifferentiation	Resection size	Amputation
1	48	F	Parosteal osteosarcoma	-	NA*	Yes
2	38	F	Parosteal osteosarcoma	-	160 mm	No
3	34	M	Parosteal osteosarcoma	High-grade osteosarcoma (n = 3)	160 mm	No
4	34	F	Parosteal osteosarcoma	Transformation to low-grade chondrosarcoma	340 mm	Yes
5	25	M	Parosteal osteosarcoma	-	200 mm	No
6	38	F	Parosteal osteosarcoma	High-grade osteosarcoma (n = 3)	200 mm	No
7	41	F	Parosteal osteosarcoma	-	215 mm	Yes
8	35	M	Parosteal osteosarcoma	High-grade osteosarcoma (n = 3)	200 mm	No
9	21	F	Parosteal osteosarcoma	-	230 mm	No

* Patient undergoing intralesional resection in the first procedure.

Of the total of 9 patients, 3 (33.3%) were male and 6 (66.6%) were females. The mean age of the patients was 34 years (21 to 48 years). The distal femur was the segment most affected, present in 8 (88.8%) patients; and the proximal humerus was affected in one (11.1%) patient. The research was approved by the Ethics Committee of the Institution and is registered in Plataforma Brasil under the number CAAE 28364920.9.0000.5505; opinion 3,854,662.

RESULTS

Of the 9 patients studied, we observed that 4 (44.4%) evolved due to tumor transformation. Of these, one (11.11%) patient presented transformation to low-grade chondrosarcoma and three (33.33%) presented dedifferentiation to high-grade osteosarcoma.

Of the patients in which we observed alterations in the grade of the tumor, one presented alteration of the lesion and signs of dedifferentiation while waiting for surgery. During this period, a new biopsy was submitted, which showed a change to the grade of the tumor. The patient underwent tumor resection and reconstruction with an unconventional endoprosthesis. The other two patients with dedifferentiation to high-grade osteosarcoma were submitted to systemic oncological treatment and tumor resection, according to the Brazilian Osteosarcoma Protocol. Figures 2 and 3 show imaging scans and pathological report of patient number 9 with parosteal osteosarcoma.

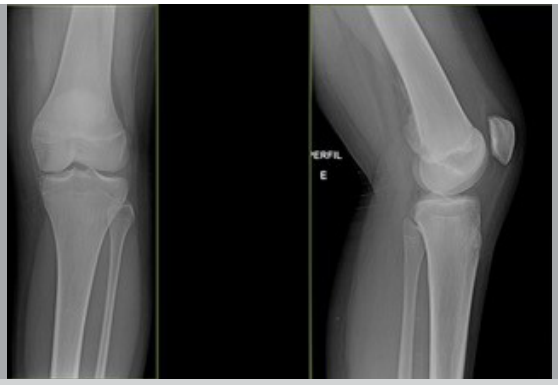

Figure 2. Radiographic examination demonstrating bone lesion in the distal femur (diagnosis of parosteal osteosarcoma).

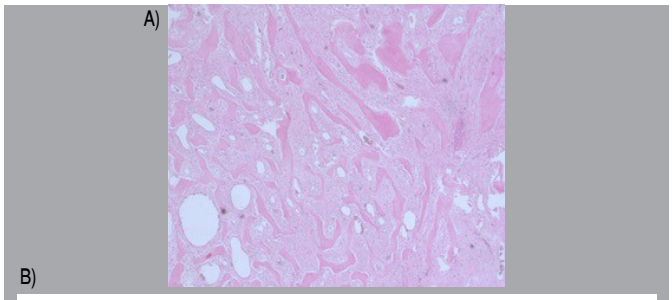

Figure 3. Photomicrographic image of anatomopathological study slide showing parosteal osteosarcoma (A), associated with the explanatory report of the slide (B).

Five among the nine patients presented local recurrence of the lesion, and three patients presented dedifferentiation (two for high-grade osteosarcoma and one for low-grade chondrosarcoma) and two patients maintained the diagnosis of parosteal osteosarcoma. Four (44.5%) patients had pulmonary metastases during treatment, two patients did not present dedifferentiation, and two presented dedifferentiated. All patients underwent surgical resection of the pulmonary nodules. A fifth patient presented pulmonary nodules that were not confirmed as tumors after resection (granulomas).

One (11.1%) among the nine patients underwent intralesional surgery (curettage of lesion) after inconclusive biopsy. In the report of the anatomopathological piece, the diagnosis of parosteal osteosarcoma was evidenced, and the patient presented early recurrence in the popliteal region. A revision of the surgery was performed for resection with wide margin and reconstruction with unconventional endoprosthesis.

Three (33.3%) among the nine patients underwent limb amputation during treatment. Among them, two (22.2%) patients, after multiple approaches, evolved with periprosthesis infection and did not progress satisfactorily after a two-stage revision. The third patient underwent limb amputation after intraoperative complication due to neurovascular injury. A fourth patient presented major recurrence and ulceration in the popliteal fossa region. Amputation was indicated, but the patient did not accept treatment and, after a few months, they became deceased. Table 2 shows the surgical evolution and complications of patients.

Table 2. Surgical evolution and complications of patients.

N°	TOPOGRAPHY	FIRST SURGERY PERFORMED	MARGINS	ORTHOPEDICS COMPLICATIONS
1	Distal femur	Intralesional curettage	Contaminated	Local recurrence, infection, implant loosening, eventual amputation
2	Distal femur	Resection + unconventional endoprosthesis	Negative	-
3	Distal femur	Resection + unconventional endoprosthesis	Negative	Local recurrence, multiple surgeries
4	Distal femur	Resection + filling with cement	Positive	Local recurrence, infection + femoral vein ligation (chronic lymphedema), amputation
5	Distal femur	Resection + unconventional endoprosthesis	Positive	-
6	Proximal humerus	Resection + unconventional endoprosthesis	Positive	-
7	Distal femur	Resection + unconventional endoprosthesis	Positive	Local recurrence, popliteal artery injury (saphenous graft) and claw toes (fibular nerve injury)
8	Distal femur	Resection + unconventional endoprosthesis	Negative	Local recurrence, early release of the implant, internal hemipelvectomy of zone II
9	Distal femur	Resection + reconstruction with plate and cement	Positive	Two revisions due to implant failure

Regarding oncological status, in addition to the patient who deceased due to the disease, one patient with dedifferentiation is undergoing oncological treatment due to systemic recurrence. The other patients are, currently, without evidence of active disease.

Table 3 shows the analysis of the risk factors evaluated for tumor dedifferentiation (parosteal osteosarcoma and dedifferentiated high-grade osteosarcoma).

We observed that none of the factors studied showed a statistically significant association with the dedifferentiation into high-grade osteosarcoma. Figure 4 shows a photomicrographic slide of a patient with parosteal osteosarcoma, and Figure 5 shows the photomicrographic slide of the same patient after dedifferentiation to high-grade sarcoma.

Table 3. Evaluation of risk factors for dedifferentiation into high-grade osteosarcoma.

	PAROSTEAL OSTEOSARCOMA		DEDIFFERENTIATION INTO HIGH-GRADE OSTEOSARCOMA		
AGE	34.5 years (n = 6)		35.6 years (n = 3)		*p = 0.090 (t)*
SEX					
F	5	83.3%	1	33.3%	*p = 0.226*
M	1	16.7%	2	66.7%	
PRESENCE OF RECURRENCES					
No	3	50.0%	1	33.3%	*P = 1.00 (F)*
Yes	3	50.0%	2	66.7%	
MARGINS					
NEGATIVE	1	16.7%	2	66.7%	*p = 0.226 (F)*
POSITIVE	5	83.3%	1	33.3%	
PULMONARY METASTASES					
No	4	66.6%	1	33.3%	p = 0.524 (F)
Yes	2	33.3%	2	66.7%	
TUMOR SIZE					
Mean	229.0 mm (n = 5)		186.6 mm (n = 3)		*p = 0.356 (t)*

(F): analysis by Fisher's exact test; (t): analysis by Student's t-test.

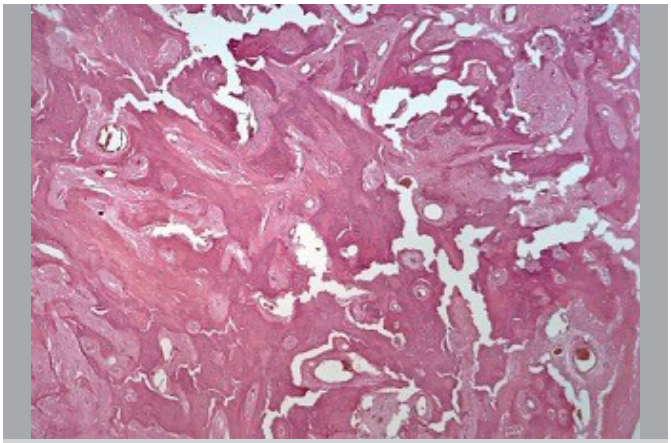

Figure 4. Photomicrographic slide of a patient with parosteal osteosarcoma.

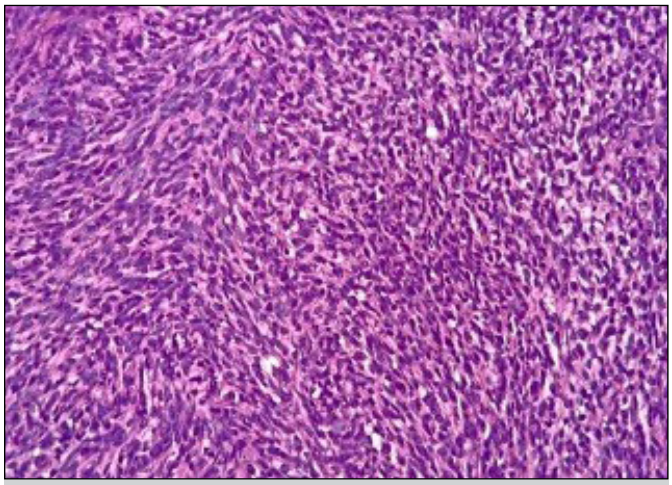

Figure 5. Photomicrographic slide of the same patient after dedifferentiation for high-grade sarcoma.

DISCUSSION

Juxtacortical/parosteal osteosarcoma is an extremely rare pathology. In all publications, we found case series with few patients. Our sample is small, but we were able to carefully study each patient. We found 3 (33.33%) patients with tumor dedifferentiation, a higher number than that found in the Rizzoli Institute[5,12] (24.1% and 24.6%) and in the Mayo Clinic[13] (16%), but lower than the numbers of M.D. Anderson[10] (43%). The lack of follow-up of patients may be a factor of confusion in this data. Many patients come from other regions for diagnosis or even for opinions on treatment and are registered in the medical records, but do not perform the follow-up in our service. Unlike our numbers, the Rizzoli Institute counts these data in the denominator of incidence rate.[5,12]

The mean age of patients who presented dedifferentiation in the literature is slightly higher than that with parosteals osteosarcomas (35.6 years versus 34.5 years, $p = 0.090$). Bertoni et al.[12] identified a mean age of 36 years for patients with dedifferentiation. In another series of the same service, the authors found the mean age of 31 years for cases of parosteal osteosarcoma.[5] Sheth et al.[10] showed a mean lower age in dedifferentiated patients compared to non-dedifferentiated patients (31 years versus 34 years). With the current data, age does not seem to be an important diagnostic factor to differentiate these tumors.[5,12]

According to the observations in recent studies, the female sex and the distal region of the femur (popliteal region) are the most recurrent epidemiological characteristics in parosteal osteosarcoma. Such data are also found in cases that dedifferentiate, a fact that was confirmed in our work.[2,7,9,12,16]

Since it is a low-grade tumor, the treatment focuses on obtaining wide margins and preserving the limb.[7,9,12-14] The most used reconstruction methods are unconventional endoprosthesis and plate and cement reconstruction.[2,4,5,7-11] Amputation is reserved only for cases in which negative margins cannot be achieved or due to complications of relapses.[11,13,16] In our sample, of the 9 patients studied, 33.3% of the patients underwent amputation. All patients showed local tumor recurrence.

A positive surgical margin is considered the main negative prognostic factor for recurrence. Several studies point to the correlation between local recurrence and dedifferentiation[5,9,12-14]. Our results are in line with these data, with 60% of recurrence cases related to contaminated or positive surgical margins.

We did not identify a direct correlation between positive margin and dedifferentiation. In literature, Sheth et al.[10] presents a large

series of cases with dedifferentiation and also does not relate the alteration of the tumor degree with the oncological margin of surgery. On the other hand, the follow-up time can mask the data of dedifferentiation. While some sample series reach up to 100 years;[12,13] in our series, the longest follow-up is of 25 years. Some patients may still differentiate during evolution. Another factor may be the bias of our service receiving only the more severe cases. Some less complex cases end up not being operated on our service and we lose the follow-up.[17]

A third factor is that most of the margins we have are narrow, which we consider positive and not correct from an oncological point of view. However, in the case of a low-grade tumor, a narrow margin may be sufficient, in many cases, for complete resection of the lesion. This, associated with the fewer cases, may not have expressed the real significance of this factor. The margin alone is unlikely to be able to answer this question. There seems to be a biological factor, probably gene expression, that favors one or the other behavior.[17]

Metastasis, regional or distant, is a factor suggestive of dedifferentiation,[5,10,14] since low-grade tumors generally have a low potential for metastatic dissemination. In patients with dedifferentiation, we found pulmonary metastases in 66% of patients, while in those without dedifferentiation this rate is 33%. Although high, these values corroborate with Sheth et al.[10] and Bertoni et al.[12] who consider that metastases are more frequent in dedifferentiated tumors.

Tumor size also does not seem to be a factor related to dedifferentiation. In our series we found that dedifferentiated tumors were smaller than non-dedifferentiated tumors (186 mm versus 229 mm). On the other hand, Lin et al.[18] identified larger sizes in dedifferentiated tumors, but with lower means than those found. Ruengwanichayakun et al.[5] and Okada et al.[13] found a mean size smaller than 100 mm (76 mm and 90 mm) for parosteal osteosarcomas, unrelated to survival.

Probably, the diagnosis of dedifferentiated tumors, since they are more symptomatic, occurs in a period of time prior to that of conventional parosteal osteosarcomas. This may explain the size difference we found. On the other hand, the difficulty of access to specialized health services can be represented by the difference in magnitude of tumor size when compared to those found in the literature.

The main limitation of this study is the sample size, due to the low prevalence of parosteal osteosarcoma. Thus, the statistical studies carried out are intended to support the findings and to enable a comparison between the numbers found, without intending to supply a definitive answer and exhaust the theme. Factors intrinsic to the tumor, regarding gene expression,[17] may better explain why some patients have dedifferentiation and others do not. This approach should also be considered for future analyses on the subject.

CONCLUSION

Parosteal osteosarcoma, when it does not dedifferentiate to a high degree, presents less aggressive clinical evolution. The ones that dedifferentiated into high-grade tumors have a natural history equivalent to conventional osteosarcoma.

We identified that the age and size of the tumor are not directly related to dedifferentiation. On the other hand, dedifferentiated tumors are related to a rate of local recurrence and higher metastasis than parosteal osteosarcomas. The theme requires studies with bigger sample and other factors related to tumor biology to more accurately identify risk factors associated with dedifferentiation and poor evolution of parosteal osteosarcoma.

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ORIGINAL ARTICLE
ORTHOPEDICS AND TRAUMATOLOGY

THE IMPACT OF MOTORCYCLE ACCIDENTS IN A REFERENCE HOSPITAL DURING THE COVID-19 PANDEMIC

IMPACTO NOS ACIDENTES MOTOCICLÍSTICOS EM UM HOSPITAL REFERÊNCIA DURANTE A PANDEMIA DE COVID-19

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ABSTRACT

Objective: This study aimed to analyze the relationship between the number of motorcycle accidents attended at a reference Hospital for trauma in Campinas, state of São Paulo, and the pandemic by COVID-19 during the year 2020. Methods: This is a cross-sectional, descriptive retrospective study carried out at Hospital PUC- Campinas, through the analysis of medical records of patients, victims of motorcycle trauma undergoing orthopedic surgical management in 2020. The phases of the pandemic and the isolation rates according to the São Paulo Plan were studied. Chi-Square tests, and the Least Squares method were applied for statistical calculations. Results: 155 medical records were analyzed, of which 91.61% of the patients were male. Of those admitted, 94.84% suffered fractures and 51.61%, polyfractures. There was a correlation between the average isolation rates and the number of accidents. In the 14-day period, as the average isolation rate increased by 10%, there was an increase of approximately 3 accidents in that period. In the 7-day analysis, 1.7 more traumas were observed for every 10% increase in the average isolation. Conclusion: The results suggest that by increasing the average isolation rate, the number of traumas per motorcycle treated at the institution increased. ***Level of Evidence III, Comparative Retrospective Study.***

Keywords: Accidents, Traffic. COVID-19. Pandemics. Social Isolation.

RESUMO

Objetivos: Analisar se houve relação do número de acidentes motociclísticos atendidos em um hospital referência para o tratamento de trauma em Campinas com a pandemia pela COVID-19 durante o ano de 2020. Métodos: Estudo transversal, retrospectivo descritivo, realizado no Hospital PUC-Campinas, por meio da análise de prontuários de vítimas de trauma por acidente de moto com conduta cirúrgica ortopédica em 2020. Foram estudadas as fases da pandemia e as taxas de isolamento de acordo com o Plano São Paulo (Plano SP). Utilizaram-se análises de p-valor usando testes qui-quadrado e o método de mínimos quadrados para cálculos estatísticos. Resultados: Foram analisados 155 prontuários de pacientes, dos quais 91,61% eram do sexo masculino. Dos internados, 94,84% sofreram fraturas e 51,61%, polifraturas. Houve correlação entre as taxas médias de isolamento com o número de acidentes. No período de 14 dias, à medida em que houve crescimento de 10% na média da taxa de isolamento, observou-se um aumento de aproximadamente três acidentes. Na análise de 7 dias, observou-se 1,7 traumas a mais a cada 10% do aumento da média de isolamento. Conclusão: Os resultados sugerem que, ao aumentar a taxa média de isolamento, houve um aumento do número de traumas por acidente de moto atendidos na instituição. ***Nível de Evidência III, Estudo Retrospectivo Comparativo.***

Descritores: *Acidentes de Trânsito. COVID-19. Pandemias. Isolamento Social.*

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INTRODUCTION

Traffic accidents constitute a public health problem of great importance with repercussions on the population's morbidity and mortality. The accident is understood as an unintentional event, causing physical and/or emotional injuries with great impact on the victim.[1] Statistics from the Mortality Information System (SIM) show that between 2007 and 2011 there were 694,763 deaths from external causes in Brazil, and 28.7% (199,374) of these were due to traffic accidents.[2] Motorcycle accidents represent the largest proportion of deaths,[3] which justifies their importance in relation to public policies and awareness campaigns. The young adult is an important victim, a fact that shows not only a social damage,

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The study was conducted at Hospital PUC-Campinas.
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but also the increased demand for health services and losses in the economically active population.[4]

In addition to the problems about motorcycle accidents, in Brazil, the first case of COVID-19 was confirmed on February 26, 2020. On March 11 of the same year, the World Health Organization upgraded the disease caused by the new coronavirus to a pandemic status.[5] This fact characterized an atypical year in the face of a rapidly spreading virus, affecting the social, economic and public health spheres. Faced with the collapse of the health system, interventions were necessary in an attempt to contain the spread of the virus, such as social isolation.[6] The Government of the state of São Paulo, through the so-called São Paulo Plan, established criteria for cities to regulate the operation of certain sectors. These criteria were grouped and classified into five phases: Phase 1 (red), Phase 2 (orange), Phase 3 (yellow), Phase 4 (green) and Phase 5 (blue), respectively from the highest to the lowest level of restrictions.[7]

Among the social and economic repercussions, the pandemic scenario caused companies – which worked during some periods with the doors closed – to seek new alternatives, such as the implementation or intensification of delivery services through digital platforms, since the possibility of shopping without leaving home became imperative for the entire population.[8]

In addition, many workers who lost their jobs before or during the health crisis, as a complement or as a main source of income, sought on these platforms the possibility of working as motorcycle or bicycle delivery.[9] For this portion of the population, motorcycle accidents mean interruptions in productive activities, temporarily or permanently.[10] For the health system, accidents represent the consumption of infrastructure and economic resources, which are extremely compromised during the pandemic crisis.

Considering the relevance of the morbidity and mortality of motorcycle accidents and the atypical year of 2020 characterized by the coronavirus pandemic, as well as its repercussions, the objective of this study was to analyze the profile of the patient victim of a motorcycle accident, as well as the relationships between the number of accident patients treated at the PUC-Campinas Hospital – which became a reference for trauma in the city during the pandemic – with the phases of the São Paulo Plan classification and the average isolation rates in Campinas.

METHODS

This is a cross-sectional, retrospective and descriptive study, carried out at the Hospital of PUC-Campinas, filed by the Research Ethics Committee with registration in the Plataforma Brasil under number 88812818.3.0000.5481. An analysis of the medical records of 155 patients seen during the year 2020 from January to December was carried out through records in the Orthopedics and Traumatology service. All participants signed the informed consent form (ICF).

Campinas is the city in which the institution where the research was conducted is located. The fleet of motor vehicles in the city in 2020 was 922,266, with a motorization index of 76 vehicles for every 100 inhabitants.[11]

The study population consisted of all patients who suffered motorcycle accidents (driver or rump) who underwent orthopedic surgical management. In the analyses, motorcycle accident patients who did not undergo orthopedic surgeries and roadkill victims were excluded. Age, sex, occupation, period of the day, day of the week, associated injuries and deaths were evaluated.

The data related to the Classification Phases, which are a parameter for the city of Campinas, were taken from the São Paulo Plan (https://www.saopaulo.sp.gov.br/planosp/). In the case of the weekly, biweekly or monthly analysis, the largest number of days framed in the phase (Phase 1, Phase 2, Phase 3, Phase 4 and Phase 5) in which the selected period was located. The Phases are a classification system that takes into account the criteria of Health System Capacity and Pandemic Evolution. The indicators that help in these criteria are: occupancy rate of ICU COVID beds, ICU COVID beds per 100,000 inhabitants, variation of new cases, variation of hospitalizations and variation of deaths.[7]

Isolation rate data were collected from the São Paulo Plan website and these are estimated by SIMI-SP (São Paulo Intelligent Monitoring System) through an agreement with telephone operators, ABR (Brazilian Association of Telecommunications Resources) and IPT (Institute of Technological Research), so that the State can consult anonymously collected information on displacements in the mapped municipalities.[7]

Epidemiological data were statistically analyzed with the aid of the Chi-square test used to estimate the p-value. Small p-values were considered in order to consolidate statistically significant observations. The average of the isolation rates of each selected period was calculated, in order to seek correlation between this variable and the number of accidents when measured at intervals of 7 and 14 days, investigated using linear adjustments through the Least Squares Method. This method uses the inverse of the uncertainties of the means as the weight of the data in determining the correlation.

RESULTS

Among the 155 patients analyzed, 142 were male (91.61%) and 13 were female (8.39%). The most significant age group was 18 to 29 years (54%), with a mean age of 31.21 years (16 to 67 years). In 51.61% of the hospitalized patients, the patients suffered polyfractures and in 37.42% of the general cases they were exposed fractures. The lower limbs were the most affected site, representing 75.48% of the fractures. The injuries occurred mainly in the bones of the tibia, fibula and femur, respectively, representing 28.6%, 19.7% and 13.4% of the total fractures. The period with the highest number of cases was the night (36%), followed by the afternoon (28%), the morning (23%) and the morning (13%), with $p < 0.001$. There was no death among hospitalized patients (Table 1).

In this study, there was a trend in the occurrence of accidents on weekends, since the days with the most significant numbers were Sunday (23.23%), Saturday (17.42%) and Friday (16.13%), with $p < 0.001$ (Table 1).

Table 1. Profile of patients victims of motorcycle accidents treated at Hospital PUC-Campinas in 2020.

	2020	p-value
Total accidents	155	
Sex		< 0.001
Male	91.61%	
Female	8.39%	
Age		< 0.001
Average age	31.21	
Most prevalent age group	18 to 29 years (54%)	
Age Range	16 to 67 years	
Fractures		
Occurrence of fracture	94.84%	> 0.05
Occurrence of polyfracture	51.61%	< 0.001
Occurrence of exposed fracture	37.42%	< 0.001
Most affected place	Lower limbs (75.48%)	p = 0.05
Days of highest occurrence	Sunday (23.23%), Saturday (17.42%) and Friday (16.13%)	< 0.001
Period of highest occurrence	Night (36.13%)	< 0.001
Fatalities	0%	< 0.05

Data on the victims' profession were collected, and in 76 of the cases, they were not informed. The most reported profession was that of motorcyclist in 19 patients (12%), followed by the autonomous profession in 5 of the patients (3%).
Data were collected from fifteen General Balance Sheets of the São Paulo Plan, as of May 2020. With these data, a comparison was made with the Phase in which Campinas passed mostly during the month with the number of accidents attended by the institution (Figure 1).

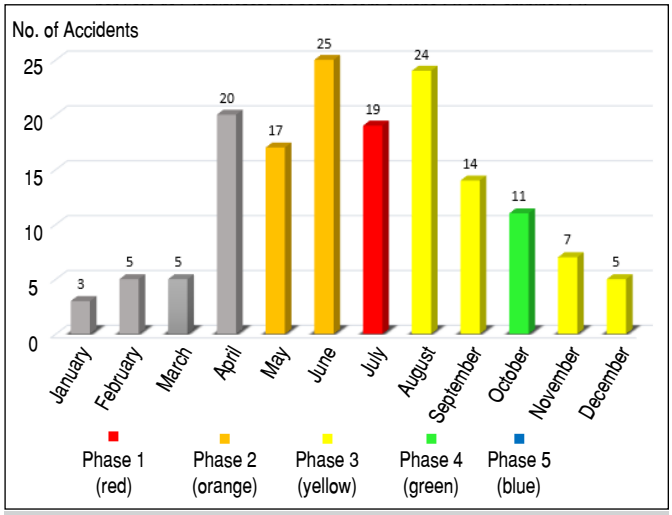

Figure 1. Number of accidents attended by the PUC-Campinas Hospital by Classification Phase according to the São Paulo Plan in Campinas-SP.

The relationship with the yellow phase of August and September was tested with the yellow phase of November and December and they are incompatible ($p < 0.001$), that is, these phases are different in terms of the behavior of the number of accidents. Moreover, there is a difference in the behavior of the initial months of the SP Plan from May to September compared to October to December regarding the number of victims, with $p < 0.005$.
Regarding the isolation rates, Figure 2 shows the two variables (average of the monthly isolation rate and the number of accidents). However, to investigate the correlation between these data, Figure 3 and Figure 4 were constructed using linear adjustments from the Least Squares method, which uses the inverse of the uncertainties of the data to estimate the weight of each data for the adjustment. Each blue point represents sets of 14 or 7 days and the uncertainties are represented by the perpendicular lines that cross the points.

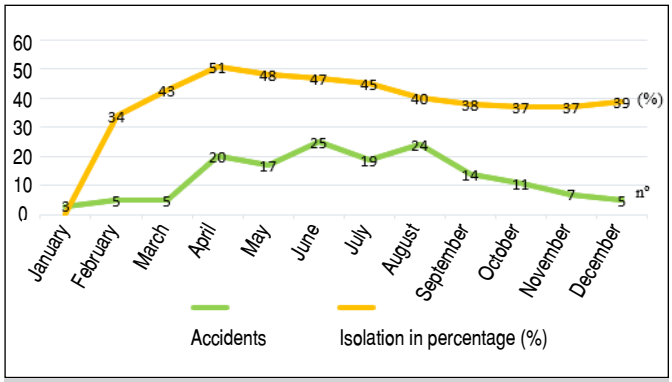

Figure 2. Comparison between the number of motorcycle accidents attended by the PUC-Campinas Hospital and the average percentage of isolation in Campinas-SP.

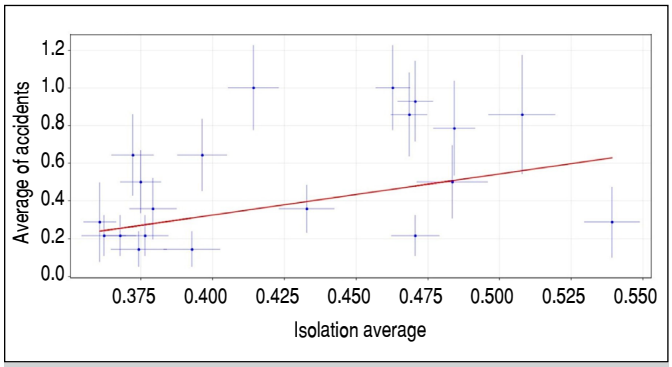

Figure 3. Relationship between average isolation and motorcycle accidents every 14 days.

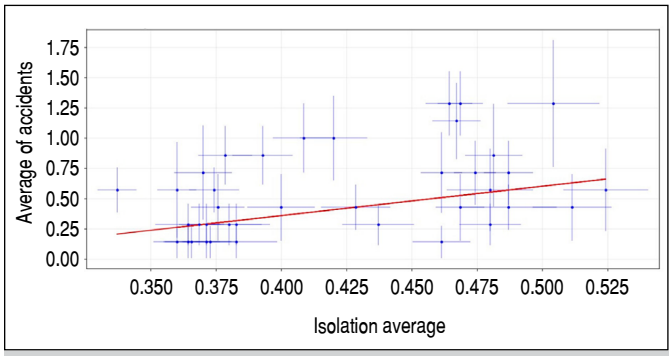

Figure 4. Relationship between average isolation and motorcycle accidents every 7 days.

For the 14-day graph (Figure 3), the correlation was 2.2 with uncertainty of 0.7 (that is, it is statistically significant), which translates that as an increase of 0.1 (10%) in the average isolation rate is observed, the expectation of the average of motorcycle accidents increases by 0.22, which implies a result of approximately 3 more accidents in this period.
Similarly, in Figure 4, every 7 days a ratio of 2.4 (7) was observed, which is also statistically significant, pointing to an increase in the expectation of 0.24 accidents per 10%, which suggests 1.7 more accidents in a period of 7 days.

DISCUSSION

The current situation of the impact of motorcycle accidents has been widely discussed, as it entails social, psychological, economic, social security and environmental consequences, in addition to the demand for health resources.[12] This problem gains greater significance when inserted in the context of the pandemic, in view of the overload of the health system and consequent scarcity of resources, from the attention of institutions in raising awareness of sanitary measures, to infra-structural and economic resources.
The profile of the victim of motorcycle accidents in the present study is in agreement with the medical literature. The victim is predominantly male with a more prevalent age range of 18 to 29 years.[13] In our study, there was a predominance of lesions in the lower limbs, especially in the bones of the tibia, fibula and femur, the results of which are consistent with the profile found in the literature.[13] Lower limb injuries are one of the major causes of prolonged hospital stay, according to a study by Craig, Sleet and Wood.[14]
The number of patients victims of motorcycle accident trauma attended by the PUC-Campinas Hospital during 2020 was 155. This number increased ($p < 0.05$), compared to other studies

carried out in 2010 and 2017 at the same institution, in which 114 and 105, respectively, were the numbers of patients treated who suffered traffic accidents due to motorcycles.[15]

Among the relevant factors that may contribute to the increase in this number, we highlight the relocation, from April 2020, of the municipality's health system by the Sectorial Coordination of Access Regulation of the Department of Audit and Regulation of the Unified Health System, in view of the need for reorganization due to the pandemic, in which the Hospital of PUC-Campinas was chosen as the reference institution for the care of traumas and other non- COVID pathologies in the city of Campinas.[16]

The growth in the number of motorcycle fleets was from 100,324 motorcycles in 2010 to 136,714 units in 2020.[11] However, the growth in the number of motor vehicles in 2020 considering all categories was only 0.6% compared to the previous year. This growth is the lowest in the last 10 years, with an average fleet growth rate of 2.9%.[11]

In addition, it is worth mentioning that during 2020, in view of the community spread of COVID-19, intervention measures to contain the transmission of the virus were widely disseminated in the countries.[17] Faced with this, the government of the state of São Paulo initiated the introduction of social isolation measures on March 16. In the same month, there was another decree with stricter measures, allowing only essential services to operate. As of May 31, the state government implemented a five-phase plan to gradually relax distancing policies.[7]

The need for social isolation is directly linked to the delivery services of establishments considered essential.[8] The crisis caused an increase in the delivery of food, medicines and other products. One of the main delivery service platforms said 100,000 new restaurants were registered during the pandemic, an increase from 30 million orders in 2019 to 48 million orders in 2020.[18]

Given this scenario, the present study sought a relationship between the number of accidents attended by the institution and the Average Isolation Rates during the coronavirus pandemic.

It was observed that there was a relationship between the increase in the average isolation rate index and the number of motorcycle traumas treated at the institution, presenting an increase in the expectation of the number of accidents of approximately 3 more traumas in the period of 14 days, every 10% of the increase in the isolation rate. And for the 7-day period, the 10% increase in the isolation rate represented approximately 1.7 more accidents. This correlation may be linked to the increase in orders for essential items via delivery, since these deliveries are mostly made by motorcycles or bicycles.

The occurrences of motorcycle accidents were mainly on weekends, Sundays and Saturdays, with 20.8% and 23.23% respectively, followed by Friday (16.13%). There was also a centralization of cases in the night (36.13%) and afternoon (28.39%). This pattern corroborates the results of a search made for a delivery app, which shows the concentration of orders on Friday, Saturday and Sunday and, mainly, during dinner (6 pm to midnight) and lunch (11 am to 2 pm).[19]

The increase in demand caused a 32% growth in motorcycle and bicycle deliveries in the city of Campinas during 2020, whose number went from 5,000 to 6,600, according to the Associação de Motoboys de Aplicativos de Campinas.[20] In the data collection of the present study, the profession that most appeared was that of motorcyclist in 19 patients (12%) even though in 76 of them, no profession was described in the medical record.

During this scenario, the impositions brought greater visibility to these workers, especially those who deliver via app or outsourced delivery. This is because the individual insertion of the worker in the labor market has become an emergency income opportunity in a scenario where many people are unemployed or have lost their jobs.[9]

It is important to discuss that motorcyclists are the ones who die the most in work-related accidents, according to a survey by the Brazilian Ministry of Health and the Information Systems for Aggravation and Notifications (Sinan). The results showed that there were 15,511 fatal work accidents recorded between 2011 and 2020, and motorcyclists represent the largest portion of occurrences (21.2%).[21]

The present study has limitations regarding the methodology, as it is an analysis of data and medical files in which it was not possible to confirm the information filled and not filled in the patients' medical records.

CONCLUSION

This study showed results that suggest that there is a relationship between the pandemic and the number of motorcycle accidents, pointing out that by increasing the average isolation rate, the number of traumas per motorcycle attended at the institution increased. These findings can be a source for the development of new studies and even the implementation of public policies on the health of motorcyclists, considering the reduction of traffic accidents and minimization of the burden of the health system and negative outcomes.

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STERNUM TOMOGRAPHIC EVALUATION IN PECTUS PATIENTS: ANALYSIS OF SAGITAL PARAMETERS

AVALIAÇÃO TOMOGRÁFICA DE PACIENTES COM PECTUS: NOVOS ÍNDICES E ÂNGULOS SAGITAIS

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ABSTRACT

Objective: To evaluate the sagittal tomographic reformatting of the sternum using unpublished radiographic parameters (indexes and angles), comparing them between the different types of pectus, and controls. Methods: 44 patients with pectus deformities and controls underwent chest CT for analysis. The types of pectus were classified into: inferior *pectus carinatum* (IPC), superior (SPC) and lateral (LPC), and broad (BPE) and localized *pectus excavatum* (LPE). The following tomographic parameters were created and measured: (1) spine-manubrium-sternum index (SMS); (2) column-sternum index (CSI); (3) manubrium-sternal angle (MSA); (4) inferior manubrium angle (IMA); and (5) inferior sternum angle (ISA). Statistical analysis was performed between the pectus and control groups, and between the different types of pectus. Results: There was a significant difference between: a) *pectus excavatum* and *pectus carinatum* when analyzing the SMS, CSI, MSA and ISA indexes. b) LPE and control group for SMS and ISA. c) LPC and LPE, and LPC and BPE for SMS; d) BPE and LPC for CSI; e) IPC and LPE, and IPC and BPE for ISA; f) SPC and LPE, and SPC and BPE for IMA. Conclusion: The radiographic indexes and angles created provided differentiation parameters between patients with different types of pectus, and between these and controls. ***Level of Evidence II, Prognostic Studies.***

Keywords: *Pectus Carinatum*. Funnel Chest. Costal Cartilage. Sternum. Thoracic Wall. Tomography, X-Ray Computed.

RESUMO

Objetivos: Avaliar a reformatação tomográfica sagital do esterno por meio de parâmetros radiográficos inéditos (índices e ângulos), comparando-os entre os diferentes tipos de pectus e controles. Métodos: 44 pacientes com deformidades pectus e controles foram submetidos à TC do tórax para análise. Os tipos de pectus foram classificados em: pectus carinatum inferior (PCI), superior (PCS) e lateral (PCL), e pectus excavatum amplo (PEA) e localizado (PEL). Foram criados e mensurados os seguintes parâmetros tomográficos: (1) índice coluna-manúbrio-esterno (CME); (2) índice coluna-esterno (CE); (3) ângulo manúbrio-esternal (AME); (4) ângulo inferior do manúbrio (AIM); e (5) ângulo inferior do esterno (AIE). Foi realizada análise estatística entre os grupos pectus e controle, e entre os diferentes tipos de pectus. Resultados: Houve diferença significativa entre: a) pectus excavatum e pectus carinatum quando analisados os índices CME, CE, AIM e AIE; b) PEL e grupo controle para CME e AIE; c) PCL e PEL, e PCL e PEA para o CME; d) PEA e PCL para CE; e) PCI e PEL, e PCI e PEA para AIE; f) PCS e PEL, e PCS e PEA para AIM. Conclusões: Os índices e ângulos radiográficos criados forneceram parâmetros de diferenciação entre pacientes com diferentes tipos de pectus, e entre estes e controles. ***Nível de Evidência II, Estudos Prognósticos.***

Descritores: *Pectus Carinatum. Tórax em Funil. Cartilagem Costal. Esterno. Parede Torácica. Tomografia Computadorizada por Raios X.*

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INTRODUCTION

The anterior wall of the chest is well studied in images obtained from the coronal and axial planes,[1,2] and the Haller index is the best known method to evaluate the severity of *pectus excavatum* (PE).[2] Additionally, the axial tomographic slice is useful for the diagnosis of defects of the inferior third of the sternum, as occurs in the presence of sternal foramen[3] and sternal midline defects.[4] Few authors have analyzed the sternal region in cases of anterior deformity of the thorax through imaging exams in the sagittal plane, and little is known about its usefulness in classifying and

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The study was conducted at Centro Clínico Orthopectus.
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evaluating its severity, and differentiating *pectus* from normal individuals. Welch,[5] in 1958, created a severity grading index for PE and differentiation from the normal ones, calculating the quotient between the sagittal diameter of the anterior portion of the vertebral body (level of the 9th thoracic vertebra) to the posterior plate of the sternum at the point of greatest deformity, and the sagittal diameter started at the end of the spine process of the third thoracic vertebra going to the anterior plate of the sternum. Derveaux et al.,[6] using plain chest radiographs evaluated according to the profile incidence in patients with PE and controls, developed an index that was proposed between the ratio of the sagittal diameter of the anterior portion of the vertebral body to the sternal manubrium region, and the sagittal diameter of the anterior portion of the vertebral body to the posterior plate in the distal third of the sternum, and showed that corrective surgery could improve this index. Haje et al.[7] concluded that some patterns of sternal curvature in the sagittal plane are more frequent in some types of *pectus* and controls, and developed indices that reflect the relative length of the various segments of the sternum.[8] From this analysis, the authors concluded that changes in sternal development, with early fusion of sternal growth plates, seem to have an influence on the etiology of the superior *Pectus Carinatum* (PC) and a lesser influence on other types of *pectus*.[8]

The complete interpretation of tomographic sections in sagittal reformatting of the sternal manubrium region of patients with *pectus* and normal individuals may require multiple parameter analysis. Some doubts may arise, such as: 1) what should be the position of the sternum and its inclination in relation to the spine?; and 2) are there varied angles of the manubrium, sternum, and between the manubrial and sternal regions?

The objective of this study was to evaluate the sagittal tomographic reformatting of the sternal region, creating imaging parameters with objective measurement that can characterize the different types of *pectus* and differentiate them from controls.

METHODS

A retrospective analysis of the medical records of 5,750 individuals with deformity in the anterior contour of the thorax (*pectus*) treated at our non-surgical *pectus* treatment center was performed from February 2004 to September 2014. From this sample, 181 patients with *pectus* who had undergone chest computed tomography were selected whose sternum and costal cartilages were to be studied.

For the analysis of tomographic parameters, 44 patients were selected who had images as digitized media due to the need to use software (Osirix) for reconstruction and analysis. The exclusion criteria were: inadequate images (123 cases), previous surgery for resection of costal cartilage (three cases), iatrogenic *pectus* (one patient) and those with deformities associated with scoliosis greater than 10° (10 cases). See Figure 1.

The clinical diagnosis was defined by two evaluators who classified *pectus* according to the predominant type: *pectus carinatum* inferior (IPC), lateral (LPC) and superior (SPC), and localized (LPE) and broad *pectus excavatum* (BPE).[9-11]

Individuals with *pectus* and the control group (without *pectus*) were subdivided for analysis as shown in Table 1. The patients in the control group underwent chest CT for other reasons and were not known to have *pectus* or spinal deformities, being randomly selected from the imaging database of the radiology clinics involved in this study.

The *pectus* groups were composed of 44 patients (29 males and 15 females), 25 patients with PC (mean age = 14.3 years; SD = 8.86) and 19 with PE (mean age = 16.5; SD = 11.5). The control group consisted of 27 patients (14 males and 13 females), with a mean age of 17.4 years (SD = 15.9, SD = 9.5).

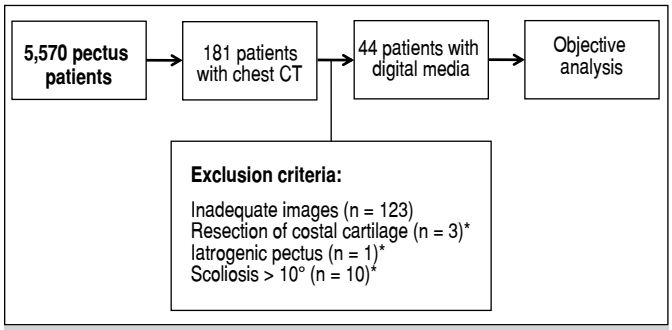


Figure 1. Method for selecting the patient sample.

Images were selected in the Digital Imaging and Communications in Medicine (DICOM®) format, with reconstruction and analysis made via OsiriX v. 5.8.2 32-Bit (Geneva, Switzerland). The images in the sagittal plane were standardized using the 3D evaluation software MIP to amplify the slices, since the sternum of these patients may present significant variations in the coronal and sagittal planes. For analysis, slices made as close as possible to the median plane of the sternum were considered.

The parameters illustrated in Figure 2 were used for the analysis of the *pectus* and control groups.

Statistical analysis

For statistical analysis, we performed the comparison: 1) between the group of patients with PE and CP; 2) between each type of *pectus* and the control group; and 3) between the different types of *pectus*. In the statistical analysis, the software package SPSS version 15.0 was used. To compare the tomographic parameters between all groups we used Pearson's chi-square test (cross-tabulation). One-way analysis of variance (ANOVA) was used for independent groups for the difference between the means of the radiographic parameters studied between the groups. A p-value less than or equal to 0.05 was considered statistically significant.

An informed consent form previously approved by the Ethics and Research Committee of our institutions (42165414.5.0000.5553) was signed by the patient or their legal guardian.

RESULTS

Table 2 shows the results of tomographic parameters found in pectus patients and controls.

The following statistically significant results were found:

1. Comparison between the group of patients with PC, PE and controls:
- SMS: it was higher in the controls compared to the PE (mean 1.94 > 1.67, p = 0.00), and higher in PC individuals compared to the PE (mean 2.05 > 1.67, p = 0.006). Of the controls, 18 (66.7%) patients had SMS > 1.88. The SMS index above 1.88 significantly decreases the chance of the patient having PE (p = 0.00). Of the total number of patients with *pectus* (n = 44), among those who have a SMS index above 1.88 (n = 19), only 4.5% (n = 2) have PE, and no values greater than 2.26 were found for those with PE;

Table 1. Subdivision into groups of patients with *pectus* and control group for analysis.

	***Pectus* groups (n = 44)**					**Control group**
	pectus carinatum (n = 25)			*pectus excavatum* (n = 19)		
Objective analysis	IPC (n = 11)	LPC (n = 4)	SPC (n = 10)	LPE (n = 15)	BPE (n = 4)	Control (n = 27)

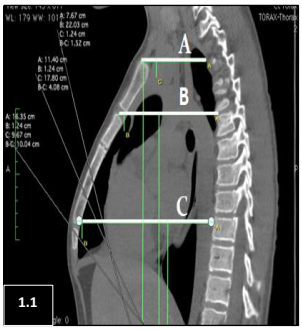
IPC: inferior *pectus carinatum*; LPC: lateral *pectus carinatum*; SPC: superior *pectus carinatum*; LPE: localized *pectus excavatum*; BPE: broad *pectus excavatum*.

→ Spine-manubrium-sternum index (SMS)

→ C/A: division of the distance between the antero-inferior end of the sternum and the thoracic vertebra of the same level (C) by the distance between the anterosuperior end of the manubrium and the thoracic vertebra of the same level (A).

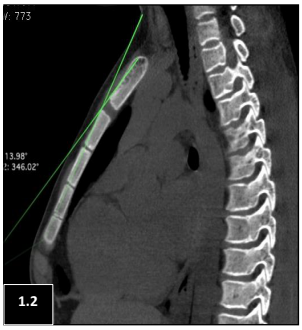
→ Spine-sternum index (CSI)

→ C/B: division of the distance between the anteroinferior end of the sternum and the thoracic vertebra of the same level (C) by the distance between the anterosuperior end of the sternum and the thoracic vertebra of the same level (B).



→Sternal Manubrium Angle (MSA)

→ formed between the lines passing through the anterior ends of the manubrium and the body of the sternum. In the case of curved sterna, the line starts at the sternal proximal pole in the anterior region of the sternal plate and ends at its distal end, in the anterior region of the sternal plate.



→ Inferior Manubrium Angle (IMA)

→ angle between the line drawn between the inferior pole of the manubrial body with the corresponding thoracic vertebra and the line drawn by the anterior axis of the manubrium.

→ Inferior Sternum Angle (ISA)

→ angle between the line drawn between the inferior pole of the sternal body with the corresponding thoracic vertebra and the line drawn by the anterior sternal axis on the profile.

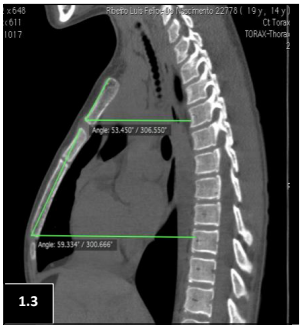


Figure 2. Indices and angles used in the objective analysis.

Table 2. Results of tomographic parameters found in those with *pectus* and in the control group.

		TOMOGRAPHIC PARAMETERS (mean; SD; min-max)				
		SMS	CSI	IMA*	ISA*	MSA*
PECTUS	***PECTUS CARINATUM***	2.05; 0.37; 1.39-3.02	1.27; 0.15; 1.01-1.56	58.02; 8.77; 38.63-74.22	73.96; 9.53; 59.33-90.27	18.93; 6.96; 7.6-30.50
	IPC	2.06; 0.32; 1.59-2.60	1.29; 0.15; 1.1-1.53	59.26; 8.81; 43.61-71.62	72.5; 10.78; 59.33-87.48	16.77; 7.6; 3.29-34.28
	LPC	2.35; 0.58; 1.65-3.02	1.36; 0.17; 1.17-1.56	62.72; 10.48; 50.06-74.22	71.72; 8.85; 60.50-81.98	15.21; 5.48; 7.97-19.93
	SPC	1.93; 0.31; 1.39-2.43	1.21; 0.14; 1.01-1.44	54.78, 7.69; 38.63-66.05	76.46; 8.66; 59.83-90.27	22.8; 5.13; 16.30-30.50
	PECTUS EXCAVATUM	1.67; 0.21; 1.33-2.26	1.13; 0.18; 0.84-1.76	67.10; 5.73, 55.33-81.31	84.58; 7.94, 75.92-102.5	19.46; 5.94; 11.81-31.44
	LPE	1.68; 0.22; 1.33-2.26	1.16; 0.19; 0.94-1.76	66.42; 4.94; 55.33-76.67	84.05; 6.56; 76.0-97.62	19.34; 5.3; 11.81-30.81
	BPE	1.59; 0.15; 1.37-1.70	1.05; 0.15; 0.84-1.17	70.17; 7.68; 64.02-81.31	87.71; 12.1; 75.92-102.5	20.78; 8.6; 13.17-31.44
CONTROL		1.94; 0.23; 1.51-2.36	1.24; 0.11; 1.01-1.43	60.10; 7.06; 40-72.18	76.61; 5.75; 62.63-87.58	18.66; 4.94; 10.3-24.5

*units in degrees. SMS: spine-manubrium-sternum index; CSI: column-sternum index; IMA: inferior manubrium angle; ISA: inferior sternum angle; MSA: manubrium-sternal angle; IPC: inferior *pectus carinatum*; LPC: lateral *pectus carinatum*; SPC: superior *pectus carinatum*; LPE: localized *pectus excavatum*; BPE: broad *pectus excavatum*.

- CSI: was higher in PC compared to PE (mean 1.27 > 1.13; p = 0.01). Only one patient (5.2%) of the 19 who have PE has CSI > 1.3. Of the patients with PC, 16% (n = 4) had a CSI index < 1.12 and, of those with PE, 47.7% (n = 9), whereas values lower than 1.01 were seen only in those with PE;
- IMA: there was a difference in the comparison between the PE and PC, and between PE and control, with no significant difference between PC and control. Of the patients with an aim angle below 61.47°, only 5.5% (n = 1) had PE;
- ISA: there was a difference between PE and PC, and between PE and control (p = 0.00), but no significant difference (although there is a trend) between control and PC, with higher values for patients with PE. No PE has EIE < 75.9°, which occurred in controls and in PC individuals;
- MSA: there was no significant difference between those with PE, PC and control.

Examples of the radiographic parameters evaluated in case of PE and PC are illustrated in Figure 3.

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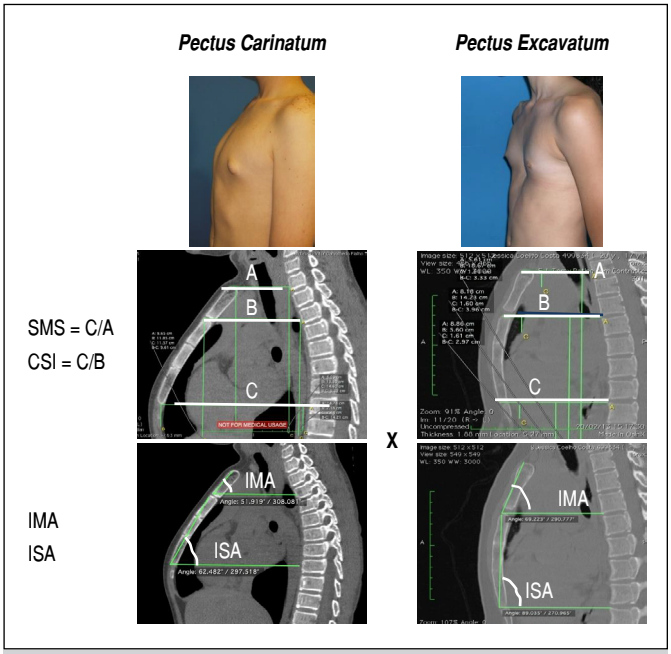

Figure 3. The mean values of the spine-manubrium-sternum index and the spine-sternum index were significantly higher in patients with *pectus carinatum* than in those with *pectus excavatum*, showing in the latter a greater approximation of the spine's inferior portion of the sternum in relation to the proximal pole of the sternum and manubrium. The mean inferior angles of the manubrium and inferior sternum were significantly higher in those with *pectus excavatum* compared to those with *pectus carinatum*, denoting a more verticalized manubrium and sternum or with an inferior extremity more tilted to the posterior in the former, respectively.

2. Comparison between the different subtypes of *pectus*, and between these and control, with statistical significance being observed in the following comparisons:

- SMS: LPE and control (p = 0.05); between LPE and IPC (p = 0.00); LPC and LPE (p = 0.00); LPC and BPE (p = 0.00); e) still with a tendency to significance between BPE and IPC. See example in Figure 4.
- CSI: between BPE and LPC (p = 0.00).
- IMA: between PC and LPE cases (p = 0.003), and between SPC and BPE (p = 0.008). In the SPC individuals, there is a smaller IMA angle compared to PE cases. See Figure 5.
- ISA: between the control group and LPE (p = 0.04); SPC and LPE; IPC and LPE (p = 0.00); IPC and BPE (p = 0.01). See example in Figure 4.
- MSA: No significant difference between groups, but with a tendency for SPC (mean = 22.8) to present higher values and IPC (mean = 16.77) to present lower values.

DISCUSSION

The present study contributed by adding some radiographic parameters that can be added in imaging reports that study the chest of patients with and without *pectus*, helping to understand the positioning of the manubrial and sternal bones in the sagittal plane, in addition to the relationship of these bones with the spine. The analysis of the SMS suggests that the PE presents the inferior end of the sternum relatively closer to the spine than controls and PC cases, while in patients with PC the inferior end of the sternum is no further away from the spine compared to control. Derveaux et al.[6] created an index similar to SMS, but it differs because it was performed using radiographs, making

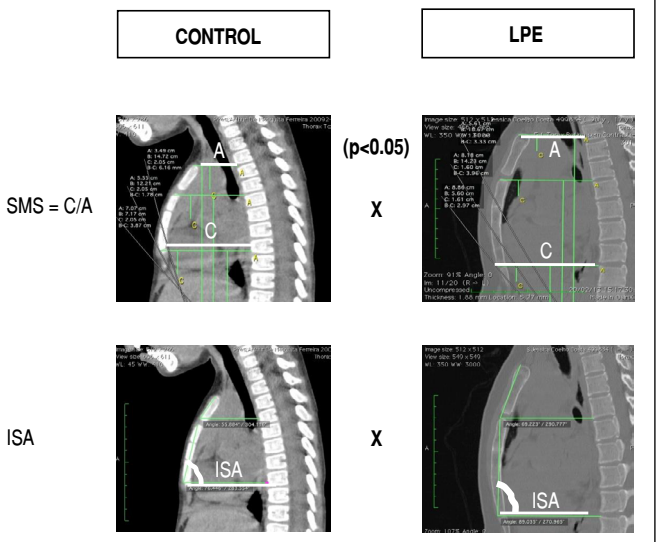

Figure 4. Illustration of measurement of indexes and angles performed. For the analysis of each radiographic parameter separately, between *pectus* groups and controls, there was a significant difference in the spine-manubrium-sternum index and in the inferior angle of the sternum (localized *pectus excavatum* × control). The mean values of the spine-manubrium-sternum index were significantly higher in the controls than in the individuals with *pectus excavatum*, showing that in the latter a greater approximation of the spine's inferior portion of the sternum in relation to the proximal pole of the manubrium. The mean inferior angles of the sternum were significantly higher in those with *pectus excavatum* compared to the controls, denoting a more vertical sternum or with its inferior portion more tilted towards the posterior in the former.

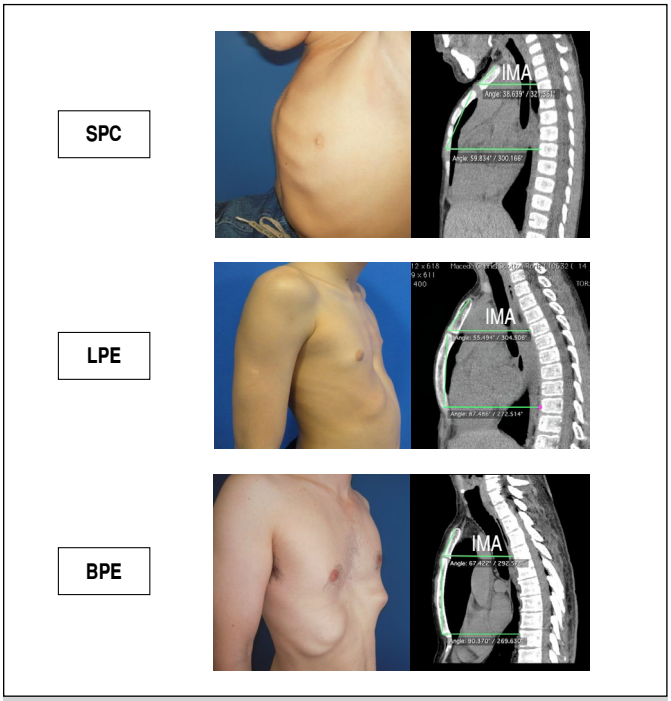

Figure 5. Illustration of measurement of indexes and angles performed. The mean values of the inferior angle of the manubrium were significantly inferior in the cases of *pectus carinatum* superior compared to the cases of *pectus excavatum*, with the latter showing a more verticalized manubrium compared to the former.

the measurement method more inaccurate than in CT, besides the possibility of magnification and positioning errors (mainly sternal rotation or chest rotation of the patient), and not having used measurement software, which achieves more precision and allows to better determine the median region of the sternum in relation to radiography. In addition, Derveaux et al.[6] traced the inferior line of their parallel index in relation to the vertebral body directed to the xiphoid, making it inclined in relation to the upper line of this index. In the SMS, the lower line was drawn towards the thoracic vertebra of the same level. Therefore, comparing the SMS with the configuration index created by Derveaux et al.[6] is not ideal, although it is also able to demonstrate greater or lesser distance from the lower extremity of the sternum relative to the spine and has also found a difference between the control group and PE, and between PC and PE, but also found a significant difference between PC and controls, differing in this aspect of our study.

This deviation from the longitudinal axis of the sternum to the posterior axis in patients with *PE*, demonstrated by the SMS and CSI, may be related to the etiopathogenesis of the deformity. Francis et al.[12] argues that the sternum is the key factor causing *pectus*, with its distal extremity being more depressed in the case of PE, and the opposite in the case of PC. Our previous study of the analysis of sternal curvature patterns concluded that this does not always occur, and there are cases of PE in which the lower extremity of the sternum has an anterior tilt.[7]

We found that if the SMS $>$ 1.88 and/or CSI $>$ 1.3 and/or IMA $<$ 61.37° and/or ISA $<$ 76°, there is a low probability of the patient under analysis having PE, but there are no cutoff values that allow to differentiate if the patient has PC or are controls. The CSI index was higher than 1.3 in only one patient with PE, and the SMS was significantly lower in the LPE than in the control group.

The ISA angle was significantly higher in the LPE compared to the controls and to the IPC group. The IMA and ISA indexes showed that in the comparison between the SPC and PE cases, there is a smaller angle IMA and ISA of the SPC compared to the cases of PE, suggesting a more vertical manubrium or with greater aim in the latter compared to the former, making this angle a possible tool in the imaging differentiation of these deformities. The IMA angle was significantly greater in patients with PE compared to controls and CP.

The fact that MSA did not show a significant difference between the subtypes of *pectus* suggests that the etiopathogenesis of deformity is not related to this angulation. Perhaps future studies evaluating this angle in cases of more severe SPC than the present study will reach a more significant conclusion regarding this angulation. Joshua et al.[13] analyzed an angle called sternal manubrium, but it was measured with a different methodology, representing the angle between the manubrium and the proximal third of the sternum in normal individuals and found no difference between the individuals pre- and post-puberty.

In the present study, *pectus* patients without scanned tomographic images were excluded, which left the number of patients analyzed with fewer cases than ideal for some analyses, especially for the group of patients with BPE and LPC. One bias is that the parameters analyzed are subject to variations in interpretation and measurement, respectively, intra- and inter-examiners, requiring further studies to verify the reliability of the method utilized.

Although we used a control group, another possible bias of the present study is that we do not know if the CT parameters studied may vary with age and gender in normal and control subjects. Derveaux et al.[6] found variations in the index according to age. Before analysis, it was important to find the median line of the sternum, which is not necessarily the median line of the body. We also know that when we observe the sternum in the coronal plane, it can be inclined or oblique in the body, making it difficult to trace the median line.

We also know that the same clinical types of *pectus* are not necessarily the same, suggesting that there is a need to further improve clinical classifications. Haje, Haje and Silva Neto[11] recently subdivided the LPE and SPC classifications. The better definition of these clinical subtypes may help in the creation of tomographic parameters to differentiate them.

The Haller index is used before and after the correction surgery of the PE,[2] and it is possible to use it for the radiological parameters created, especially the CSI, SMS and ISA, because they reflect the degree of positioning of the portion of the lower extremity of the sternum, but more studies will be necessary to validate this hypothesis. During Nuss surgery to correct the PE, the body and the lower extremity of the sternum are elevated by the respective nails, and undercorrections or hypercorrections are not uncommon.[14] Derveaux et al.[6] found an improvement in their index after corrective surgeries for *pectus*.

Some of the radiographic parameters created in the present study may suggest whether the patient has PC or PE, and may be analyzed in conjunction with other parameters to be analyzed in coronal and axial reformatting, requiring a correlation between all these variables in future studies.

The main author has extensive experience in the treatment of *pectus* with the use of orthoses and exercises. Initially, in some situations, a CT scan focusing on the anterior aspect of the chest in order to better understand these deformities[1] before treatment, but this examination has been less and less performed because the tomographic patterns in the different types of deformity seemed to be repeated, and the clinical types and the examination did not modify the treatment, in addition to the concern with radiation. Eventually, we indicated CT to evaluate the prognosis of spontaneous worsening, especially in mild SPC during childhood (evaluating whether there is early fusion of the manubrium-sternal region or sternal shortening),[1,8,11] and in some cases of LPC, when there is an asymmetry of the pectoral region, serving to evaluate the degree of participation of bone deformity and soft tissues in the genesis of asymmetry.[11]

CONCLUSIONS

The radiographic indices and angles created (except for the angle between the manubrium and the sternum) provided differentiation parameters between patients with different types of *pectus*, and between these and controls.

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OSTEOTOMY AT THE BASE OF FEMORAL NECK AND OSTEOPLASTY FOR THE TREAMENT OF SCFE

OSTEOTOMIA NA BASE DO COLO FEMORAL E OSTEOPLASTIA PARA O TRATAMENTO DA EPIFISIOLISTESE

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ABSTRACT

Objective: To compare the clinical outcomes between patients with moderate and severe slipped capital femoral epiphysis (SCFE) treated with osteotomy at the base of neck and osteoplasty and with healthy individuals. Methods: Comparative cohort with 12 patients (14 hips) with moderate and severe SCFE who underwent osteotomy at the base of neck and osteoplasty between 2007 and 2014. The mean age at surgery was 13.3 ± 2.5 years and the mean follow-up was 3.8 ± 2.2 years. We assessed the level of hip pain by the visual analog scale (VAS) and anterior impingement test (AIT); the level of function using the Harris Hip Score (HHS) and 12-Item Short Form Health Survey (SF-12), the range of motion (ROM) by goniometry and Drehmann sign, and the hip muscular strength by isokinetic and Trendelenburg sign. Results: The level of pain was slightly higher in the SCFE cohort compared with healthy hips (VAS, 0.8 ± 1.4 vs 0 ± 0, 0.007; AIT, 14% vs 0%, p = 0.06; respectively). No differences were observed between the SCFE and control cohort for the functional scores (HHS, 94 ± 7 vs 100 ± 1, p = 0.135); except for ROM, with increased internal rotation (37.3° ± 9.4° vs 28.7° ± 8.2°, p < 0.001), and strength, with decreased abduction torque (75.5 ± 36.9 Nm/Kg vs 88.5 ± 27.6 Nm/Kg, p = 0.045) in the SCFE cohort. Conclusion: The osteotomy at the base of neck and the osteoplasty restored the hip motion and muscle strength, except for the abductor strength, to near normal levels, representing a viable option for the treatment of moderate and severe SCFE. ***Level of Evidence III, Ambidirectional Cohort Study.***

Keywords: Slipped Capital Femoral Epiphyses. Femoroacetabular Impingement. Osteotomy. Hip Joint. Muscle Strength Dynamometer. Joint Deformities, Acquired.

RESUMO

*Objetivo: Comparar resultados clínicos de pacientes com escorregamento epifisário proximal do fêmur (EEPF) moderado e grave tratados com osteotomia basocervical e cervicoplastia com indivíduos saudáveis. Métodos: Coorte comparativa com 12 voluntários saudáveis e 12 pacientes (14 quadris) com EEPF moderado e grave submetidos à osteotomia basocervical e cervicoplastia entre 2007 e 2014. A média de idade na cirurgia foi de 13,3 ± 2,5 anos e o seguimento médio de 3,8 ± 2,2 anos. Avaliou-se nível de dor no quadril utilizando a escala visual analógica (EVA) e o teste de impacto anterior (TIA); nível de função usando o Harris Hip Score (HHS) e o 12-Item Short Form Health Survey (SF-12); amplitude de movimento (ADM) com goniometria e sinal de Drehmann; e força muscular do quadril com dinamômetro isocinético e sinal de Trendelenburg. Resultados: O nível de dor foi ligeiramente maior na coorte de EEPF comparado a quadris saudáveis (EVA, 0,8 ± 1,4 vs 0 ± 0, 0,007; TIA, 14% vs 0%, p = 0,06; respectivamente). Não foram observadas diferenças entre os grupos EEPF e controle para os escores funcionais (HHS, 94 ± 7 vs 100 ± 1, p = 0,135), exceto para ADM, com aumento da rotação interna (37,3° ± 9,4° vs 28,7° ± 8,2°, p < 0,001), e força, com diminuição do torque de abdução (75,5 ± 36,9 Nm/Kg vs 88,5 ± 27,6 Nm/Kg, p = 0,045), para o grupo EEPF. Conclusão: A osteotomia basocervical e a cervicoplastia restauraram o movimento do quadril e a força muscular, com exceção da força abdutora, a níveis próximos do normal, representando uma opção viável para o tratamento de EEPF moderado e grave. **Nível de Evidência III, Estudo de Coorte Ambidirecional.***

Descritores: *Escorregamento das Epífises Proximais do Fêmur. Impacto Femoroacetabular. Osteotomia. Articulação do Quadril. Dinamômetro de Força Muscular. Deformidades Articulares Adquiridas.*

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INTRODUCTION

Slipped capital femoral epiphysis (SCFE) is a common hip disorder that affects adolescents, and whose long-term outcomes are associated with pain,[1,2] limited motion[3-5] and weakness.[6-8] In moderate and severe SCFE, residual deformities may predispose femoroacetabular impingement, cartilage damage and

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The study was conducted at Hospital das Clínicas of Ribeirão Preto Medical School, Universidade de São Paulo.
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osteoarthritis.[9,10] The deformity correction may involve compensating osteotomies at the trochanteric region,[11,12] at the base of femoral neck,[13] with or without osteoplasty,[8,14-16] and the capital realignment performed at the growth plate level.[17]

The capital realignment represented by the modified Dunn procedure is able to restore the proximal femur anatomy; however, the rate of avascular necrosis (AVN) is controversial, varying from 14% to 50% in unstable SCFE.[10,18-21] A low rate of AVN has been reported following compensating femur osteotomies for moderate and severe stable SCFE.[8,13,16,19,22] Recently, the association of osteotomy at the base of the femoral neck and osteoplasty has been shown to partially restore the function of abduction in SCFE.[8] However, limited evidence estimates the level of functional restoration following the compensating osteotomy at the base of the femoral neck with osteoplasty.[8] Our study evaluated clinical outcomes of osteotomy at the base of femoral neck and osteoplasty for the treatment of moderate and severe SCFE by assessing the level of hip pain, clinical scores, range of motion and muscle strength after a minimum follow-up of two years. Later, we compared the results with those from healthy individuals.

METHODS

This is a prospective study approved by the Institutional Review Board (HCRP 942.952 and 2.357.360). All subjects and their parents signed the informed consent form for this research. Between 2007 and 2014, 45 patients were diagnosed with moderate and severe SCFE. Four patients were lost to follow-up, 13 patients underwent the modified Dunn procedure, and 16 were not included because they had not undergone dynamometry. We enrolled 12 patients (14 hips) who underwent osteotomy at the base of the femoral neck associated with neck osteoplasty with a mean ± standard deviation (SD) age at surgery of 13.2 years (range, 7.4 to 17.6 years), and a mean ± SD follow-up of 3.8 ± 2.1 years (range, 2.0 to 9.9 years). The osteotomy at the base of femoral neck and osteoplasty was performed according to a previously described surgical technique (Figure 1).[8] No patients evolved to AVN. Twelve healthy volunteers without a clinical history of hip disease were invited to compose the control cohort (Table 1).

For unilateral SCFE, a restricted non-weight bearing protocol with crutches was recommended during the first six weeks, followed by protected partial weight bearing for another four weeks. On the first postoperative day, patients underwent passive mobilization and isometric strengthening exercises. Active hip motion started at three to four weeks after surgery. Following the osteotomy healing, patients were encouraged to walk and perform the muscle strengthening exercises.[8]

We assessed the demographic data composed of age, sex, and SCFE characteristics, including acuity, severity and stability, length of postoperative follow-up, and body mass index (BMI) (Table 1). One pediatric orthopedic surgeon (with 12 years of experience) assessed the pre- and postoperative Southwick angles.[11]

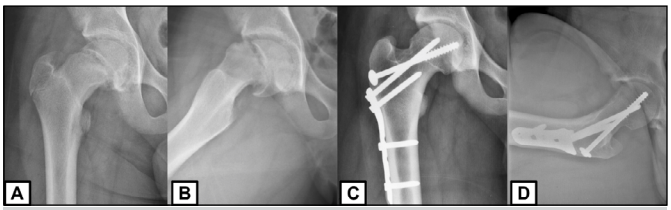

Figure 1. Anteroposterior and lateral radiographic images of a patient before (A and B) and two years after (C and D) osteotomy at the base of neck and osteoplasty.

Table 1. Demographic and radiographic data from a cohort of patients with slipped capital femoral epiphysis and from a healthy cohort. Values refer to mean ± standard deviation (range), median and interquartile range (P25th-P75th) or frequency and percentages of hips.

	Osteotomy at the base of femoral neck and osteoplasty (14 hips)	Control (24 hips)	Adjusted p value
Age at surgery (years)	13 ± 3 (7-18)		
Age at evaluation (years)	17 ± 2 (13-21)	17 ± 2 (13-20)	p = 1.00
Sex (boys:girls)	10:4 (71%:29%)	12:12 (50%:50%)	p = 0.21
Body mass index, (kg/m^2)	28 ± 6 (20-38)	22 ± 5 (16-34)	
Percentile by age of body mass index			p < 0.001
Normal weight (≤ 85th)	6 (43%)	22 (92%)	
Overweight (85th to 95th)	3 (21%)	0	
Obese (≥ 95th)	5 (36%)	2 (8%)	
Follow-up (years)	3.8 ± 2.1 (2.0-9.9)		
Acuity			
Acute (< 3 weeks)	0		
Chronic (> 3 weeks)	10 (71%)		
Acute on chronic (> 3 weeks with acute pain exacerbation)	4 (29%)		
Severity			
Mild (Southwick angle ≤ 30º)	0		
Moderate (Southwick angle > 30º and < 60º)	6 (43%)		
Severe (Southwick angle ≥ 60º)	8 (57%)		
Stability			
Stable (able to walk)	10 (71%)		
Unstable (not able to walk, even with crutches)	4 (29%)		
Preoperative Southwick angle (º)	63 ± 19 (34-100)		
Postoperative Southwick angle (º)	18 ± 12 (2-41)		

The mean ± SD age of the SCFE cohort at the final evaluation was 17.0 years ± 2.2 (range, 12.8 to 20.7 years). Clinical outcomes were estimated using the visual analog scale of pain, anterior impingement test, Harris Hip Score (HHS)[23] and 12-Item Short Form Health Survey (SF-12).[24] The hip motion was evaluated using goniometry[25] and the Drehmann sign. The patient was positioned supine to measure the range of flexion, adduction and abduction; in lateral decubitus for extension, and in the sitting position with 90° of hip flexion for rotations. The hip muscle strength was determined using the isokinetic dynamometry of hip[8,26] and Trendelenburg test. One of two trained observers (physical therapists with nine and four years of experience) performed the clinical evaluation at final follow-up. The concentric isokinetic hip strength was assessed

using the dynamometer Biodex Multi-joint System 4 Pro (Biodex Medical Systems, Shirley, NY, USA). Flexion and extension strength was measured in supine position;[26] and adduction and abduction strength, in lateral decubitus.[8] The maximum strength was assessed in five consecutive repetitions with an angular speed of 60°/s.[8]

Statistical analysis

For statistical analysis, a linear regression model with mixed effects was performed. Mean values of peak torque were normalized by body mass, since our cohorts had different mean BMI, and body mass has been shown to influence to muscle strength.[27] Variations of baseline demographic parameters were controlled within the statistical model using adjustments for the presence or absence of SCFE bilaterality and sex. Post hoc analysis included the Tuckey correction to adjust for multiple testing. SAS Statistical Software (version 9.3; SAS Institute, Inc. Cary. North Carolina) and R Core Team (2016, Foundation for Statistical Computing, Vienna, Austria) were used, and p-values < 0.05 were considered significant.

RESULTS

At final follow-up, the level of pain following osteotomy at the base of neck and osteoplasty was slightly higher compared with normal hips (0.8 ± 1.4 vs 0 ± 0, $p = 0.007$). Ten of 14 hips (71%) were free of pain (VAS = 0) following the base of neck osteotomy. With the numbers available, the base of neck osteotomy showed no difference in prevalence of positive anterior impingement test (14% vs 0%, $p = 0.06$) and HHS (93.5 ± 7.3 vs 99.8 ± 0.6, $p = 0.135$) compared with healthy hips. Twelve (86%) of 14 hips submitted to osteotomy at the base of neck and osteoplasty had good or excellent HHS outcomes (> 80). Base of neck osteotomy and healthy individual cohorts showed similar SF-12 physical (53 ± 4 vs. 57 ± 2, $p = 0.325$) and mental scores (57 ± 4 vs. 54 ± 6, $p = 0.533$) (Table 2).

The range of motion was similar between the base of neck osteotomy and normal hips, except for increased internal rotation in the SCFE cohort ($37^{o} \pm 9^{o}$ in osteotomy at base of neck vs. $29^{o} \pm 8^{o}$ in normal hips, $p < 0.001$). The Drehmann sign was absent in all hips treated with base of neck osteotomy and in normal hips from control cohort (Table 2).

Following the compensating osteotomy at the base of neck and osteoplasty, the muscular strength was similar to normal hips for flexion, extension and adduction. However, we observed a reduction in the abduction torque in the SCFE cohort compared with normal hips (76 ± 37 Nm.kg in base of neck osteotomy vs. 89 ± 28 Nm.kg in normal hips; $p = 0.045$). A low proportion of Trendelenburg sign was observed in the SCFE cohort (7% in base of neck osteotomy vs 0% in controls, $p = 0.194$) (Table 2).

Table 2. Functional and clinical evaluation of individuals who underwent base of neck osteotomy and osteoplasty and control individuals. Values refer to mean ± standard deviation (range) or frequency and percentages of hips.

	Osteotomy at the base of femoral neck and osteoplasty (14 hips)	Control (24 hips)	95%CI; p-value
Pain and clinical scores			
VAS	0.8 ± 1.4	0.0 ± 0.0	−1.4 to −0.2; 0.01
Anterior impingement test	2 (14%)	0	0.0 to 0.3; 0.06
HHS	93.5 ± 7.3	99.8 ± 0.6	−13.0 to 1.8; 0.14
SF-12 PCS	53.1 ± 4.3	56.6 ± 2.0	−7.2 to 2.5; 0.33
SF-12 MCS	57.0 ± 3.7	54.4 ± 5.6	−4.7 to 9.0; 0.53
Range of motion (°)			
flexion	106.1 ± 7.2	111.1 ± 4.2	−7.5 to 1.7; 0.22
extension	15.1 ± 7.1	14.2 ± 2.3	−2.0 to 5.1; 0.38
adduction	26.4 ± 7.1	23.4 ± 2.7	0.6 to 8.2; 0.03
abduction	32.0 ± 4.6	32.3 ± 5.2	−4.5 to 4.1; 0.94
internal rotation	37.3 ± 9.4	28.7 ± 8.2	5.3 to 17.8; < 0.001
external rotation	36.7 ± 9.3	35.5 ± 5.5	−4.8 to 6.8; 0.73
Drehmann sign	0	0	−0.2 to 0.2; 1.0
Mean of torque peak (Nm/kg)			
abduction	75.5 ± 36.9	88.5 ± 27.6	−36.2 to −0.4; 0.045
adduction	125.2 ± 53.5	130.6 ± 29.6	−13.9 to 36.2; 0.38
flexion	130.5 ± 55.8	140.4 ± 41.8	−44.8 to 6.5; 0.14
extension	162.1 ± 69.8	179.6 ± 55.9	−15.6 to 61.9; 0.24
Trendelenburg test	1 (7%)	0	−0.0 to 0.2; 0.19

DISCUSSION

The treatment of moderate and severe slip deformities is controversial, and the literature evaluating clinical outcomes of compensating osteotomy at the base of the femoral neck and osteoplasty is scarce.[8] In our study, we evaluated the clinical outcomes of the osteotomy at the base of the femoral neck in association with neck osteoplasty for the treatment of moderate and severe SCFE at a minimum follow-up of two years. The level of pain, clinical scores, range of motion and muscle strength were compared with the outcomes obtained from normal hips. We found that the osteotomy at the base of femoral neck and osteoplasty was associated with most of the clinical parameters of this study comparable to the level of healthy individuals, except for abduction strength.

Patients with moderate and severe SCFE may experience significant pain preceding the progression of osteoarthritis, as a consequence of intra-articular disease such as proximal femur deformity, femoroacetabular impingement and labral damage.[16] Treatment for femoroacetabular impingement with osteoplasty, associated or not with surgical hip dislocation and femoral osteotomy has been suggested to decrease pain in SCFE.[8,14,15] In our study, 71% of hips were free of pain at short to midterm. Furthermore, no pain was trigged by the anterior impingement test in 86% of hips following the base of femoral neck osteotomy and osteoplasty. We believe that the compensating realignment provided by the osteotomy, enhanced by the benefits of the osteoplasty in mitigating femoroacetabular impingement conflicts, reduces the intra-articular disease and the level of pain. Theoretically, the anatomical realignment by the modified Dunn procedure would minimize the presence of residual femoroacetabular impingement signs. However, Ziebarth et al.[28] reported negative anterior impingement test in 61% of hips with mild to severe slip following modified Dunn procedure and minimum of

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10 years of follow-up. This finding could be explained by a potential femoral neck thickening following the anatomical realignment.[28] In our study, the association of osteoplasty was possibly the main factor for the low prevalence of impingement sign.

We observed no differences in the HHS and SF-12 outcomes between osteotomy at the base of femoral neck and osteoplasty and control individuals. Good and excellent outcomes (HHS > 80) were observed in 86% of hips following base of neck osteotomy. Previously, Kramer, Craig, and Noel[13] reported poor results with definitive limping, limited range of motion and painful gait in 16% (9/55) of patients after the compensating osteotomy. Extracapsular base of neck osteotomy has been associated with 86% of satisfactory results, according to a modified Southwick criteria.[22] It has been suggested that osteoplasty in association with compensating Imhäuser osteotomy improves clinical outcomes,[19,29] showing greater Non-Arthritic Hip Scores in comparison with hips without osteoplasty.[15]

Range of motion was mostly restored to near normal levels following the osteotomy at the base of the neck with osteoplasty, except for increased internal rotation. Possibly, the anterosuperior bone wedge subtraction and improvement in articular clearance by osteoplasty may explain the increase in internal rotation.[30] Although the osteoplasty provides increased range of motion, this procedure may lead to increased risk of neck fracture,[31] which, in association with the risk of slip progression, lead us to insert a cannulated screw from the lateral cortex into the epiphysis. The screw was important to provide immediate *in situ* fixation of the epiphysis with further epiphysiodesis, and potentially protect the neck from fractures at the short-term postoperative period.

The increasing deformity assessed by the slip angle is correlated with decreasing muscle strength of hips with SCFE undergoing *in situ* epiphysiodesis.[6] Theoretically, the deformity correction of moderate and severe SCFE would be able to improve the hip biomechanics. Following the compensating correction with the base of neck osteotomy and osteoplasty, we did not observe weakness in flexion, extension and adduction. However, the abduction strength has not been completely restored. Angelico et al. suggested that the abduction strength was restored to the level of mild slips, but not to normal levels.[8] Femoral neck shortening following the osteotomy could reduce the abductor arm,[7,13] and the direct lateral approach may disturb the abductor muscles.[8] On the contrary, the improvement in the anatomical positioning of the greater trochanter in the transverse plane following the base of neck osteotomy may have positive biomechanical effects.[7] The Trendelenburg test was negative in 93% of our patients, which is in agreement with previous studies reporting negative Trendelenburg test in 80% and 87% of patients after base of neck osteotomy.[13,22] Further investigation is suggested to determine whether the torque is correlated with characteristics of the radiographic anatomy, such as the neck length or trochanteric height.

Our study has several limitations. First, we acknowledge that there are demographic differences related to sex and obesity rate in our cohorts. Second, although less than 15% of patients were lost to follow-up, we could not enroll more patients for dynamometry. As a consequence, the sample size of each cohort is small. Third, there is no comparison with SCFE treated with other surgical techniques, since our patients treated with the modified Dunn procedure presented unstable severe slips, making the comparison unbalanced due to a greater prevalence of avascular necrosis. Fourth, the minimum follow-up of two years is not enough to evaluate hip survival, osteoarthritis, and osteonecrosis. The osteonecrosis rate for stable SCFE has been reported to be as low as 0%,[32-35] and the overall incidence of chondrolysis is estimated at 7%.[36] In our series, we did not observe osteonecrosis nor chondrolysis in hips undergoing osteotomy at the base of neck and osteoplasty. Finally, there is a potential for measurement bias on the hip motion, which is relatively challenging for obese patients.

CONCLUSION

In conclusion, our results showed that the treatment of moderate and severe SCFE with the osteotomy at the base of femoral neck in association with neck osteoplasty restored the hip motion and muscle strength to normal levels, except for abductor strength. Functional scores showed that the osteotomy at the base of femoral neck and osteoplasty may provide good or excellent outcomes in more than 80% of moderate and severe SCFE in the short-term and a potentially low risk of avascular necrosis.

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ANTEGRADE NAILING VERSUS LOCKING PLATE OF 2-AND 3-PART PROXIMAL HUMERUS FRACTURES

HASTE INTRAMEDULAR *VERSUS* PLACA BLOQUEADA NO TRATAMENTO DA FRATURA DO ÚMERO PROXIMAL EM DUAS E TRÊS PARTES

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ABSTRACT

Objective: To evaluate and compare the proportions of complications and radiographic findings of osteosynthesis of 2- and 3-part proximal humerus fractures with two methods of treatment: third-generation antegrade nailing and locking plate. Methods: 46 patients with a mean age of 58.9 ± 16.6 years between January 2020 and January 2021 were evaluated. In sixteen cases (34.8%), antegrade nailing was used, and in thirty cases (65, 2%), a locking proximal humerus plate. The method used included the rate of complications with a minimum follow-up of 6 months after surgery and radiographic evaluation. Results: There was no difference between the groups regarding the proportion of complications (nail group 18.8%, plate group 13.3%; p = 0.681). The nail group had less residual varus loss (cervicodiaphyseal angle nail group with 132.1º ± 2.3º, plate group 123.8º ± 10.1º; p < 0.001). In the plate group, women had the lowest value (1.43 ± 0.22) of the deltoid tuberosity index (DTI) compared to men (1.58 ± 0.11) (p = 0.022). Conclusion: Osteosynthesis, with a locking plate and antegrade nailing, did not show differences in the proportion of complications. The nail group had less change in the postoperative cervicodiaphyseal angle, however, there were two serious complications with screw cut-out and varus deviation, requiring surgical reapproach. ***Level of Evidence II, Retrospective Observational Study.***

Keywords: Postoperative Complications. Fracture Fixation, Intramedullary. Fracture Fixation. Humeral Head.

RESUMO

Objetivo: Avaliar retrospectivamente e comparar proporções de complicações e achados radiográficos da osteossíntese da fratura do úmero proximal em duas e três partes com dois métodos de tratamento: haste intramedular bloqueada de terceira geração e placa bloqueada. Métodos: Foram avaliados 46 pacientes com idade média de 58,9 ± 16,6 entre janeiro de 2020 a janeiro de 2021. Em 16 casos (34,8%), utilizou-se a haste intramedular e, em 30 casos (65,2%), a placa bloqueada de úmero proximal. A avaliação incluiu a taxa de complicações com seguimento mínimo de seis meses de pós-operatório e avaliação radiográfica. Resultados: Não houve diferença significativa entre os grupos quanto à proporção de complicações (grupo haste: 18,8%; grupo placa: 13,3%; p = 0,681). O grupo haste apresentou menor perda residual em varo (ângulo cervicodiafisário: grupo haste com 132,1º ± 2,3º; grupo placa com 123,8º ± 10,1º; p < 0,001). No grupo placa, as mulheres apresentaram menor índice de tuberosidade-deltoide (DTI) (1,43 ± 0,22) em relação aos homens (1,58 ± 0,11) (p = 0,022). Conclusão: No seguimento de curto prazo, a osteossíntese, com placa bloqueada ou haste intramedular, não apresentou diferenças nas proporções de complicações. O grupo haste apresentou menor alteração do ângulo cervicodiafisário no pós-operatório; entretanto, ocorreram duas complicações graves com cut out e desvio em varo com necessidade de reabordagem cirúrgica no grupo haste. ***Nível de Evidência II, Estudo Retrospectivo Observacional.***

Descritores: *Complicações Pós-Operatórias. Fixação Intramedular de Fraturas. Fixação de Fratura. Cabeça do Úmero.*

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INTRODUCTION

Proximal humerus fracture is the third most common fracture in patients over 65 years, after hip and wrist fractures.[1] In the last 40 years, there has been an increase in its incidence, and currently it corresponds to 6% of all fractures in adults.[2] The incidence of this fracture increases about 15% per year, making it a public health concern, as does femoral neck fracture in older adults.[3]

The most common trauma mechanism is falling from standing height with support on the outstretched hand. It is more common in older women due to the higher incidence of osteoporosis in this population group. Approximately 85% of cases can be treated nonoperatively.[4] For surgical cases, there are several fixation techniques, such as Kirschner wires, antegrade nailing and internal fixation with open reduction using plates for the proximal third of the humerus.

The treatment of displaced fractures, in two and three parts, remains controversial. The most frequently used treatment options are the locking plate and the antegrade nailing.[5] Complications associated with locking plates include necrosis of the humeral head (35%), screw cut-out (57%) and pseudarthrosis (13%).[6] Osteosynthesis, with antegrade nailing, emerged as a viable option in the treatment for proximal humerus fractures, with the advantage of lower soft tissue dissection and superiority over plates in biomechanical studies for fractures in two parts of the surgical neck.[7] However, it does not lack complications. The first and second generation of antegrade nailing showed high rates of reoperations and complications, especially iatrogenic rotator cuff injuries, being discouraged by most surgeons.[8] Third generation antegrade nailing was developed to solve these problems, with a short and smaller diameter nail format with an entry point in the muscular portion of the supraspinatus, which would provide a high rate of consolidation, good clinical outcomes and low rate of complications.[9]

Given the above, this study retrospectively analyzed the complication rates of two surgical techniques: antegrade nailing and locking plate of the proximal humerus. The objective is to evaluate the differences in the rate of complications and in the radiographic results with a minimum follow-up of 6 months after the operation.

METHODS

A retrospective, non-randomized study was carried out in adults with 2- and 3-part proximal humerus fractures, according to the Neer classification,[10] subjected to surgical treatment with antegrade nailing or locking plate. In total, 50 patients operated between January 2020 and January 2021 were selected. All patients signed the Informed Consent Form to participate in this study, which was submitted for evaluation and approval by the Committee for Ethics in Research with Human Beings, registered in Plataforma Brasil (CAAE No. 48052621.5.0000.8153).

Inclusion criteria

Inclusion criteria were all adult patients with a closed 2- and 3-part proximal humerus fracture,[10] who underwent surgical treatment with a third-generation antegrade nailing or locking plate and who had a minimum follow-up of 6 months postoperatively.

Exclusion criteria

Those who had a follow-up shorter than the established one, were under 18 years, had a history of previous surgery on the affected shoulder, had insufficient data in their medical records and had refused to participate in the research were excluded.

After applying the inclusion and exclusion criteria, 46 patients were selected. The minimum postoperative follow-up for all patients was 6 months.

Sixteen patients underwent osteosynthesis with third-generation antegrade nailing (Multiloc Humeral Nail®, DePuy Synthes®, Switzerland) and thirty patients were treated with a locking proximal humerus plate (Hexagon®, Hexagon Implants®, Brazil). All patients were operated by the same group of surgeons.

Radiographic evaluation

The radiographic classification used in this study was the one described by Neer,[10] in 1970, which divides the proximal humerus into 4 parts based on the three radiographs in the shoulder trauma series. The Deltoid Tuberosity Index (DTI) is calculated through the radiographic incidence in true AP, in the superior end of the deltoid tuberosity, in which the cortical edges are parallel. The ratio of the outer cortical diameter and the inner cortical diameter defines the DTI value.[11]

The cervicodiaphyseal angle was measured according to the method described by Schnetzke et al.[12] (Figures 1 and 2) to quantify any varus or valgus deviation, based on the head-shaft anatomical value of 135°. Radiography is performed in true AP. For the purpose of this study, the difference between the measured postoperative angle and the anatomical value of 135° was established in all patients (plate and nail group). According to Fleischhacker et al.,[13] varus malpositioning, with a difference greater than 20° (< 115°) are associated with worse functional outcomes and predictor of secondary varus collapse. In addition, surgical revision may be necessary.[13]

The study of Capriccioso, Zuckerman and Egol[14] defined that proximal humerus fractures with varus displacement (< 130°) have a higher risk of postoperative complications than fractures with valgus displacement (> 135°).

Statistical analysis

Central tendency and dispersion values (mean and standard deviation) and amplitude (maximum and minimum values) were described for continuous and interval variables and, in the case of categorical variables, absolute numbers and percentages were described. The findings were stratified by antegrade nailing and plate, and the means were compared using the Student's t-test for independent samples, and the proportions were compared using the chi-squared test or Fisher's exact test (when it involved comparisons with amounts less than 5). The significance level adopted was 5%. Means of age and DTI were compared by sex, further stratified by antegrade nailing and plate. The significance level adopted was also 5%.

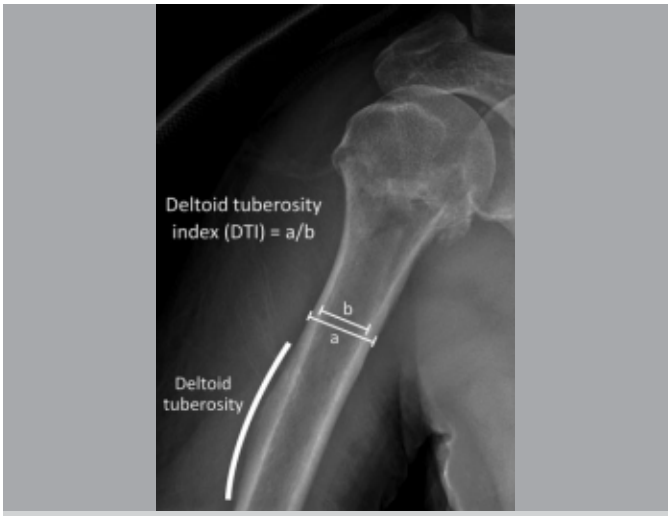

Figure 1. Calculation of the deltoid tuberosity index.

Source: Spross et al.[11]

Figure 2. Measurement of the cervicodiaphyseal angle.

Cervicodiaphyseal angle measurement method as described by Schnetzke et al.[12] As described, line A is drawn from the upper and lower edges of the articular surface. Line B is drawn from the center of the humeral head, being perpendicular to line A. Line C is drawn through the center of the diaphysis. The angle formed between lines B and C is defined as the cervicodiaphyseal angle.

Source: Schnetzke et al.[12]

RESULTS

Between January 2020 and January 2021, 50 patients underwent surgical treatment for 2- and 3-part proximal humerus fractures. Of these, four patients were excluded from the study due to insufficient documentation in medical records.

Thus, 46 patients were included in the study. Most were women (n = 26; 56.5%), with a mean age of 58.9 ± 16.6 years (21-88 years) (Table 1). Regarding the fractured side, there was a significantly higher proportion of fractures on the left side (n = 27;), with significant difference ($p < 0.05$).

There was a significant difference in relation to the postoperative cervicodiaphyseal angle, which was closer to that considered anatomical (132° × 123.5°, $p < 0.001$) in the nail group.

Regarding the deltoid tuberosity index (DTI), a significant difference was found between men and women in the plate group (1.43 × 1.58).

The decision on the number of proximal screws used in the nail and locking plate groups is based on bone quality and fracture morphology.[15] There was a significant difference regarding the number of proximal screws used between the groups, both mean (3.4 × 5.47, $p < 0.001$) and proportion by numbers.

Consolidation occurred in all patients 6 months after the operation, except for two patients who evolved with cut out and secondary varus loss in the nail group.

There was no significant difference between the need for surgical reapproach and complication rates and between the nail and plate groups (18.8% × 13.3%). The main complication in the plate group was loss of reduction with varus deviation. One patient in the plate group presented advanced and symptomatic osteonecrosis of the humeral head, undergoing reverse arthroplasty.

In the nail group, there was one case of deep infection, with a consolidated fracture, and the osteosynthesis material was removed. In two cases in the nail group, there was screw cut-out with secondary varus deviation, requiring surgical revision. One patient underwent revision for a locking proximal humerus plate (Philos®, DePuy Synthes®, Switzerland). Another 55-year-old patient, diagnosed with severe depressive disorder and with previous self-extermination attempts, was chosen to undergo Jones resection arthroplasty.

Table 1. Findings related to the operated patients (stratification by antegrade nailing and plate).

Variables analyzed	Categories or statistics	Antegrade Nailing	Plate	Total	p value
Sex (n; %)	Female	12 (75.0)	14 (46.7)	26 (56.5)	0.117
	Male	4 (25.0)	16 (53.3)	20 (43.5)	
Age (in years)	Mean (SD)	64.1 (11.6)	56.2 (18.3)	58.9 (16.6)	0.128
	Minimum; maximum	46-87	21-88	21-88	---
Neer classification (n; %)	2 parts	6 (37.5)	20 (66.7)	26 (56.5)	0.057
	3 parts	10 (62.5)	10 (33.3)	20 (43.5)	---
cervicodiaphyseal angle (in degrees)	Mean (SD)	132.1 (2.3)	123.8 (10.1)	126.7 (9.1)	< 0.001***
	Minimum; Maximum	128-136	90-136	90-136	---
Deltoid tuberosity index (DTI)	Mean (SD)	1.45 (0.12)	1.51 (0.18)	1.49 (0.16)	0.204
	Minimum; Maximum	1.25-1.62	1.00-1.79	1.00-1.79	---
Number of Screws	Mean (SD)	3.4 (0.5)	5.7 (0.5)	4.9 (1.2)	< 0.001***
	Minimum; Maximum	3; 4	5; 7	3; 7	---
Number of Screws (n; %)	3	9 (56.3)	0 (0.0)	9 (19.6)	< 0.001***
	4	7 (43.7)	0 (0.0)	7 (15.2)	
	5	0 (0.0)	10 (33.3)	10 (21.7)	
	6	0 (0.0)	19 (63.3)	19 (41.3)	
	7	0 (0.0)	1 (3.4)	1 (2.2)	
Side (n; %)	Right	10 (62.5)	9 (30.0)	19 (41.3)	0.033*
	Left	6 (37.5)	21 (70.0)	27 (58.7)	
Complications (n; %)	No	13 (81.3)	26 (86.7)	39 (84.8)	0.681
	Yes	3 (18.8)	4 (13.3)	7 (15.2)	
Surgical reapproach (n; %)	No	13 (81.3)	28 (93.3)	41 (89.1)	0.325
	Yes	3 (18.8)	2 (6.7)	7 (15.2)	

SD: standard deviation; *** $p < 0.001$; * $p < 0.05$.

Table 2. Findings related to age and deltoid tuberosity index, stratified by nailing and locking plate.

	Age (in years) Mean (SD)		Deltoid tuberosity index (DTI) Mean (SD)	
	Female	Male	Female	Male
Nail	63.7 (10.0)	65.3 (17.5)	1.46 (0.11)	1.42 (0.11)
	p = 0.822		p = 0.570	
Plate	61.9 (19.7)	51.2 (16.0)	1.43 (0.22)	1.58 (0.11)
	p = 0.111		p = 0.022*	

SD: standard deviation; * $p < 0.05$.

DISCUSSION

Although the literature shows several treatment options for 2- and 3-part proximal humerus fractures, there is no well-defined gold standard.[16] Thus, the objective of this study was to identify differences between antegrade nailing and locking plate in terms of radiographic alterations and rate of complications.

Many authors have reported several complications with the use of an antegrade nailing, such as rotator cuff injury, proximal nail protrusion, causing subacromial impingement, secondary fracture deviation and joint protrusion of locking screws.[17]

The study described by Boileau et al.[18] defined the conditions necessary to prevent these possible complications, such as the use of a straight antegrade nailing with a smaller diameter (7-8 mm), with insertion in the musculotendinous region with an entry point at the top of the humeral head approximately 10 mm

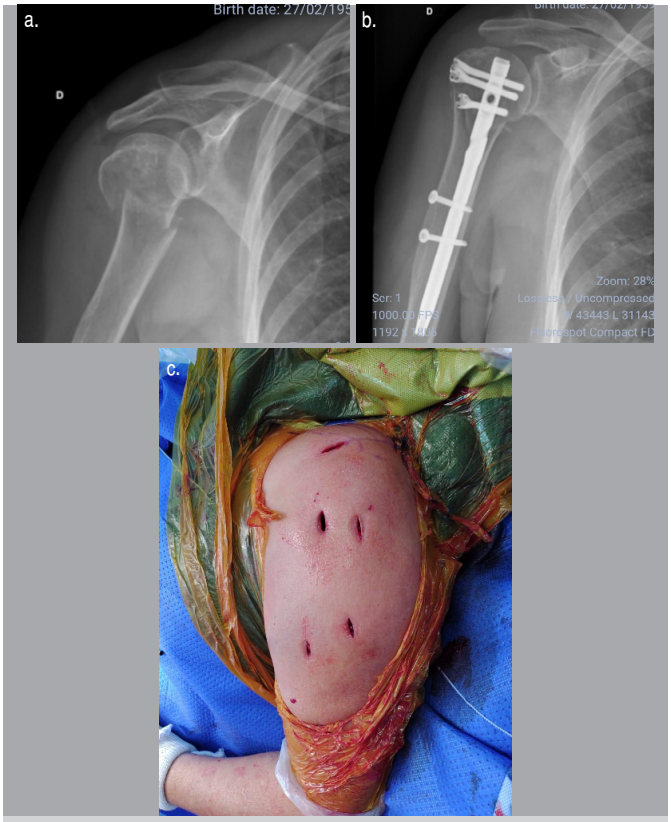

Figure 3. a. Fracture in two parts of the surgical neck; b. Postoperative radiography; c. Intraoperative appearance.

posterior and medial to the bicipital sulcus and aligned to the long axis of the diaphysis.

Several authors have addressed the comparison between treatment options in proximal humerus fractures. Shi et al.[19] performed a systematic review comparing surgical plate treatment *versus* antegrade nailing and concluded that osteosynthesis with a nail reduced the number of complications, surgical time, blood loss and postoperative osteonecrosis rate. Li et al.,[20] in their systematic review, concluded that antegrade nailing is superior to the plate in terms of surgical time and consolidation; however, there was no significant difference regarding the incidence of complications and functional outcomes.

Zhu et al.[21] performed a randomized study comparing patients treated with locking plate and antegrade nailing. They reported a higher rate of complications in the plate group (31% *versus* 4%), the main complication being screw cut-out. Plath et al.,[22] in a prospective study, found no significant differences between the plate groups *versus* antegrade nailing on functional outcomes and complication rates. Gracitelli,[23] in 2015, in a prospective clinical study, found no clinical differences between nailing and locking plate.

Biomechanical studies comparing antegrade nailing and locking plate present controversial results. Some studies show greater rigidity for the antegrade nailing for axial loading and cantilever effect in flexion, extension, varus and valgus, but its disadvantages would be, mainly, the rotator cuff injury and the difficulty to reduce the fracture.[24] Other studies showed that the locking plate was superior in terms of torsional strength and cyclic loading in varus.[25]

The most recent studies show that both the antegrade nailing and the locking plate are viable options for the treatment of proximal humerus fractures, presenting good functional results with high consolidation rates.[26,27]

The DTI value was lower in women in the plate group, which is related to poorer bone quality and predisposition to fractures. The study of Kim et al.,[28] in 2020, showed a strong correlation between the deltoid tuberosity index (DTI) and the T score value in bone densitometry. Values < 1.4 correlate with low bone mineral density in patients with proximal humerus fracture, and female sex and advanced age were considered independent risk factors for severe proximal humerus fracture.

We are aware of the limitations of the study: the retrospective design, no randomization and no control group, which allows for bias. Finally, as a clinical outcome assessment was not performed, we could not define which of the methods presents the best result and could not extrapolate the results to clinical practice. However, we present the complications and radiographic findings of our study and encourage further investigation.

In this study, which presented homogeneous samples in both groups, no significant difference was found regarding the rate of complications and surgical reapproach. However, the nail group had two serious complications (screw cut-out with secondary varus deviation) requiring surgical reapproach.

CONCLUSION

Regarding the number of complications in 2- and 3-part proximal humerus fractures, there was no significant difference in the treatment between plate and antegrade nailing. The nail group showed less residual varus loss in the postoperative period, however, there were two serious complications with screw cut-out in that group. Despite the short follow-up, this study is in agreement with current results published in the medical literature. New studies, with a larger sample, randomization and longer follow-up time are needed to define the best treatment option for 2- and 3-part proximal humerus fractures.

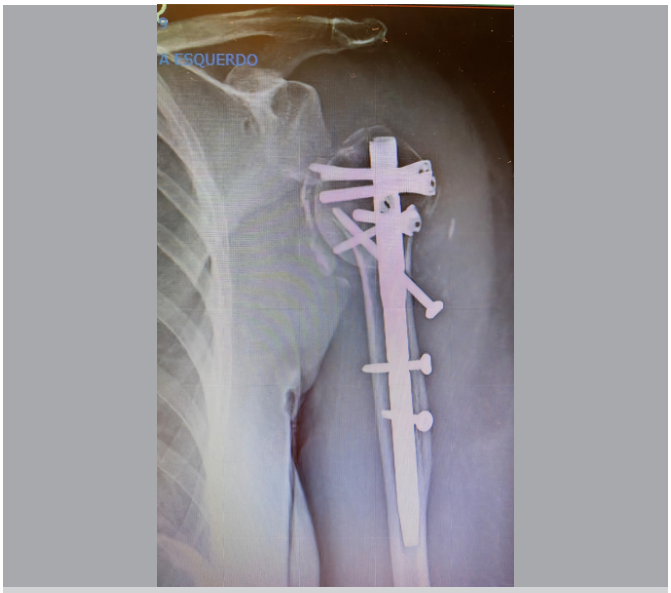

Figure 4. Cut-out with loss of varus reduction with intramedullary nail.

AUTHORS' CONTRIBUTIONS: Each author contributed individually and significantly to the development of this article. GRG: data analysis, interpretation and writing; LSB: surgeries and data analysis and interpretation; RAM, JIAN: surgeries and data analysis; DCT: revision and intelectual concept of the article; CJM: data analysis and interpretation.

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MORTALITY AFTER SURGICAL TREATMENT OF PROXIMAL HUMERUS FRACTURES IN OLDER PATIENTS

MORTALIDADE APÓS TRATAMENTO CIRÚRGICO DAS FRATURAS PROXIMAIS DO ÚMERO EM PACIENTES IDOSOS

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ABSTRACT

Mortality of patients after osteosynthesis of proximal humeral fractures (PHF) has been poorly studied in contrast to fractures of the proximal femur. Objective: To evaluate the mortality of older patients with PHF undergoing surgical treatment. Methods: Retrospective study of patients undergoing surgical treatment PHF between 2009-2019. Demographic data, Neer classification, and mortality of this cohort of patients were evaluated. Non-categorical variables were tested using the Kolmogorov-Smirnov test. The unpaired t-test (parametric variables) was used. Categorical variables were tested by Fisher's exact test. A Kaplan-Meier mortality curve was constructed. Results: 59 patients were evaluated. There was a predominance of females in the sixth decade of life. The most prevalent fractures were Neer's type III. The highest mortality occurred in the first 4 years after surgery (4.1 + 3.2 years). The only comorbidity capable of changing the survival curve was DM ($p = 0.03$) Conclusion: Overall mortality was 11.3%. The highest mortality occurred in the first 4 years of follow-up. Diabetic patients evolve with earlier mortality and have 7 times more chance of death. ***Level of Evidence III, Retrospective Study.***

Keywords: Humeral Fractures. Mortality. General Surgery.

RESUMO

A mortalidade de pacientes após osteossíntese de fratura de úmero proximal (FUP) é pouco estudada em comparação com as fraturas do fêmur proximal. Objetivo: Avaliar a mortalidade de pacientes idosos com FUP submetidos a tratamento cirúrgico. Métodos: Estudo retrospectivo de pacientes submetidos ao tratamento cirúrgico FUP entre 2009 e 2019. Foram avaliados dados demográficos, classificação de Neer e a mortalidade dessa coorte de pacientes. As variáveis não categóricas foram testadas pelo teste de Kolmogorov-Smirnov. Utilizou-se o teste t não pareado para variáveis paramétricas. As variáveis categóricas foram testadas pelo teste exato de Fisher. Construiu-se a curva de mortalidade pelo método de Kaplan-Meier. Resultados: Foram avaliados 59 pacientes, havendo predomínio do sexo feminino na faixa dos 60 anos. As fraturas mais prevalentes foram as do tipo III de Neer. A maior mortalidade ocorreu nos quatro primeiros anos pós-operatórios (4,1 + 3,2 anos). A única comorbidade capaz de mudar a curva de sobrevida foi o diabetes mellitus ($p = 0,03$). Conclusão: A mortalidade geral foi de 11,3%. A maior mortalidade ocorreu nos primeiros quatro anos de seguimento. Pacientes diabéticos evoluem com mortalidade mais precoce e possuem sete vezes mais chance de óbito. ***Nível de Evidência III, Estudo Retrospectivo.***

Descritores*: Fraturas do Úmero. Mortalidade. Cirurgia Geral.*

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INTRODUCTION

The proximal humerus fractures (PHF) represent between 1% and 7.8% of all fractures and constitute the third most common among older adults, being less prevalent only when compared to fractures of the proximal femur and distal radius.[1] After 50 years of age, the incidence of PHF increases before reaching a peak between 80 and 89 years.[1] Due to the growth of the older population, the number of fractures between 2008 and 2030 is expected to increase by 50%. Thus, most fractures affect older females and result from low-energy trauma, such as falling from one's own height.[1,2]

The epidemiological context of PHF shows that patients suffering from this injury are also affected by other comorbidities such as osteoporosis, gait and/or neurological disorders, diabetes, hypertension, cardiac dysfunctions.[2]

Osteoporosis fractures can lead to a worsening in quality of life and may increase mortality in older adults.[3] Most studies are focused on the analysis of mortality after fracture of the proximal femur[4] and demonstrate high mortality mainly between the first and second year after the surgical procedure.[5]

All authors declare no potential conflict of interest related to this article.

The study was conducted at Hospital Estadual Sumaré, Unicamp.
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Theoretically, the PHF has a smaller influence on ambulation and, therefore, a smaller influence on mortality when compared to fractures of the proximal femur. However, some studies have shown that mortality is also high in this cohort of patients.[4,6]
There are no Brazilian studies evaluating the mortality of older patients with PHF after surgical treatment.
The aim of this study was to evaluate the mortality of older patients with PHF fractures undergoing surgical treatment.

METHODS

We conducted a retrospective study with analysis of medical records of patients undergoing surgical treatment of proximal humeral fractures in the period between 2009-2019 in a reference hospital. Demographic data such as gender age, comorbidities and Neer classification of the fracture were evaluated. The Neer classification was defined and recorded in the medical records by the surgeon who performed the surgical procedure.
The death record followed the following search strategy in a sequential manner: Survey of the patient's medical record with verification of whether there is an indication of death; Telephone contacts with patients and/or family members, with the sole purpose of confirming or excluding death of the patient.
The inclusion criteria were: patients undergoing surgical treatment of PHF aged 60 years or older; medical records containing all demographic and radiological data.
Exclusion criteria were: cases without information about death and patients with 2 or more associated fractures. Non-categorical variables were tested using the Kolmogorov-Smirnov test to define the normality of the sample. In the study of these variables, unpaired t-test (parametric variables) was used. Categoric variables were analyzed using the Fisher exact test. The Kaplan-Meier mortality curve was constructed. A significance level of $p < 0.05$ was considered. The software SPSS statistics, version 27, was used. The study was submitted to the research ethics committee and was approved under CAEE number 30650120.5.0000.5404.

RESULTS

A total of 131 surgeries were performed in patients with PHF between 2009-2019. In 107 patients, it was possible to know the death record or not. At the end, 59 patients met all the inclusion criteria. There was a predominance of females in the sixth decade of life (Figure 1). The most prevalent fractures were Neer type III. Demographic data are shown in Table 1.
Osteosynthesis with Locking Plate was the treatment of choice in most cases. The surgical techniques used and their frequency are described in Figure 2. A small number of patients were treated[3] with arthroplasty and only one case underwent Jones resection arthroplasty (Figure 2).
Most patients (69.4%) had at least one comorbidity. The maximum number of comorbidities was 7 pathologies. The most prevalent comorbidity was Hypertension followed by Diabetes Mellitus (DM). The frequency of comorbidities is described in Figure 3.
Six patients (11.3%) died during the maximum follow-up period of 11 years. Three patients were female and three were male. One patient died on the first postoperative day due to anesthetic complications. The highest mortality occurred in the first 4 postoperative years (4.1 ± 3.2 years). Mortality was represented by the Kaplan-Meier Curve (Figure 4.)
The three most prevalent comorbidities (DM, hypertension and smoking) were tested for association with higher mortality or not. The presence of DM influenced mortality and increased the chance of death by 7.6 times. Other comorbidities, fracture classification, sex and age did not change mortality Table 2.
The only comorbidity capable of changing the survival curve was DM ($p = 0.03$), which led to earlier mortality (Figure 5).

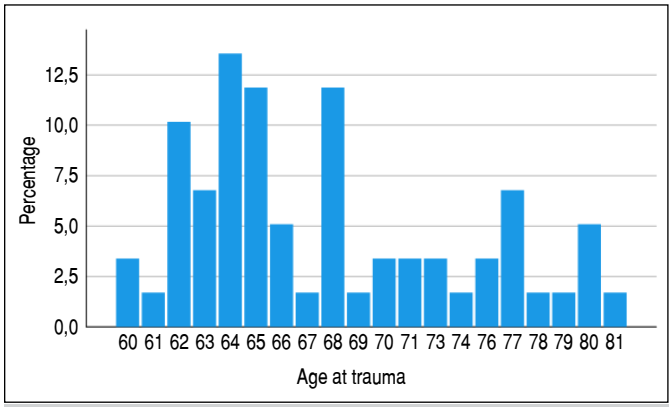

Figure 1. Prevalence × Age of patients.

Table 1. Patient demographics.

Variable	Values
Mean age SD (years)	68.1 5.9
Sex [N (%)]	
Male	22 (37.2)
Female	37 (68.8)
Neer Classification [(N (%)]	
II	20 (34)
III	22 (37)
IV	17 (29)

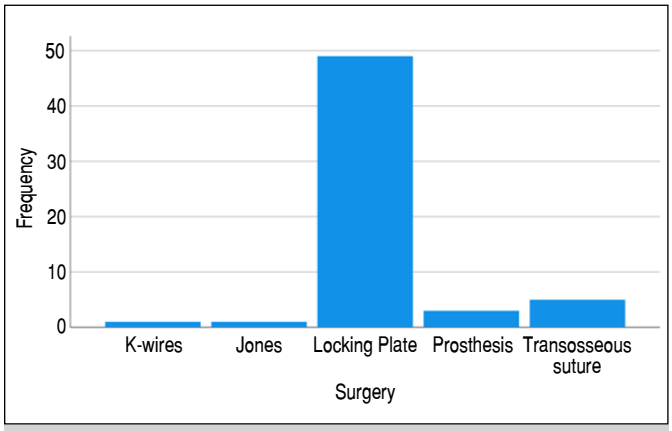

Figure 2. Types of surgery and frequency performed.

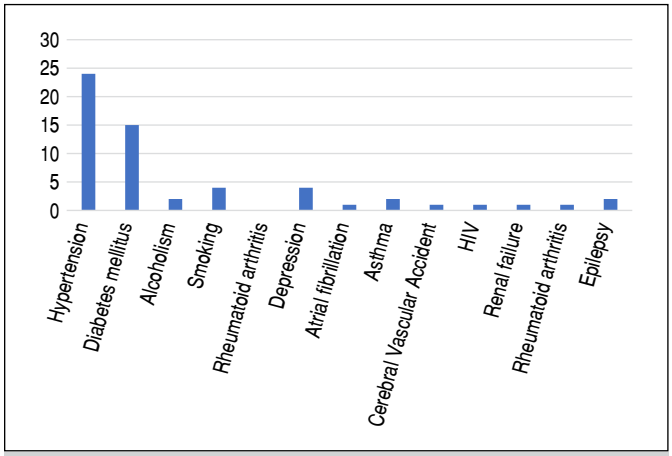

Figure 3. Prevalence by type of comorbidity.

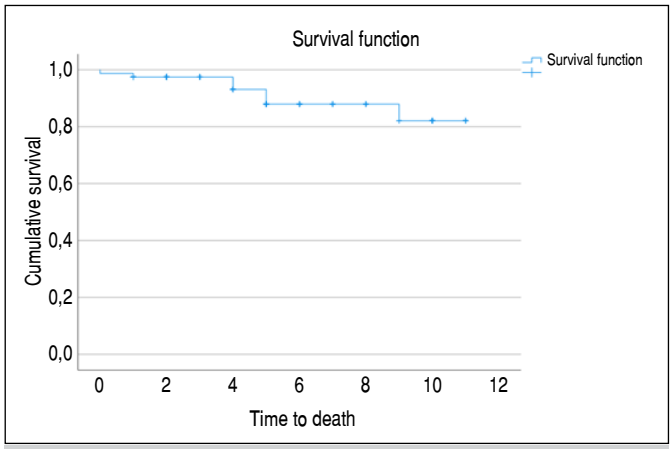

Figure 4. Kaplan-Meier Overall Survival Curve.

Table 2. Number of deaths compared with other clinical and radiological variables.

Variable	Deaths (6)	Alive (53)	p-value	OR*	CI+
Age (Mean + SD)	67.83 ± 8.15	68.21 ± 5.79	0.88[a]	na	na
Comorbidities [N]					
+ Diabetes Mellitus (16)	4	11	0.032[b]	7.63	1.2-47.2
+ Hypertension (24)	3	21	0.67[b]	1.52	0.28-8.27
+ Smoking (4)	1	3	0.35[b]	3.33	0.29-38.3
Neer Classification					
I (20)	1	19			
II (22)	4	18	0.29[b]	na	na
III (17)	1	16			
Sex					
Female (37)	3	34	1.78[b]	0.37	0.32-9.75
Male (22)	3	19			

*OR: odds ratio; + CI: confidence interval; [a] Unpaired t-test; [b] Fisher's exact test; + presence; na: not applicable.

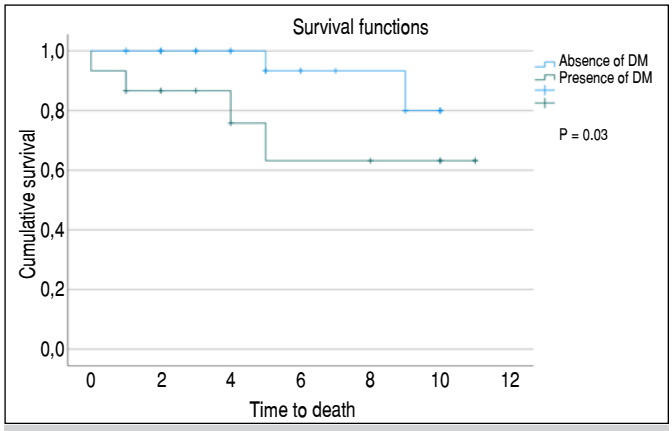

Figure 5. Mortality × presence of diabetes or not.

DISCUSSION

The prevalence of fracture in the older adults, especially in women over 65 years of age, related to frailty increased due to the greater longevity of the population.[2] Proximal humeral fractures follow this same pattern and may have a prevalence ratio up to 2 times higher in females, in agreement with our results.[6,7]

Osteoporosis, hypertension and DM are also prevalent in this cohort of patients. Thus, some authors consider the fractures that occur in this context of multiple comorbidities as another indicator of global fragility in the health of patients. Therefore, fractures such as that of the proximal femur, distal radius and proximal humerus would be indirect indicators of organ failure and greater predisposition to mortality.[8]

The postoperative mortality of patients with proximal femoral fracture is widely studied in the literature in contrast to the mortality of patients undergoing surgical treatment of the proximal extremity of the humerus. Mortality in older patients affected by fractures of the proximal femur is high and can occur in up to 36% of this population in one year of follow-up. However, some studies suggest that PHF may be associated with increased mortality in 1 year after fracture.[9]

We found 11.3% mortality in the study population during the 11 years of evaluation. The highest mortality reported in this study occurred in the first 4 postoperative years (4.1 ± 3.2 years). Somesarlo et al.[9] observed a similar mortality: 3.3% during the first year after fracture of the proximal humerus, 7.7% in three years after trauma and 12% at the end of five years.

Patients who progress to death after the occurrence of proximal humeral fracture have a higher incidence of associated comorbidities.[10] The main comorbidities found in our study were also arterial hypertension and DM, in agreement with the literature.

DM is prevalent in the older population and is associated with higher mortality especially in those who have the disease for 10 years or more.[11] In addition, they increase the risk of falls and consequently the prevalence of fractures.[12] In our study, the presence of DM increased the risk of death by 7 times. A Spanish study found a higher chance of early complications and mortality after surgical treatment of fracture of the proximal humerus associated with DM in agreement with our data.[13]

In our study, demographic variables such as sex and age did not influence mortality. An Australian study differs from our results and showed that men are 5.8 times more likely to die than women.[14]

The fracture pattern determined by the Neer classification was not associated with higher mortality. Possibly because it is a cohort of older patients, Neer IV fractures are more related to the intensity of osteoporosis than to the energy of trauma.

Surgical treatment of proximal humeral fractures with arthroplasty, especially reverse arthroplasty, has been increasingly used.[15] The greater indication of arthroplasties is based on better postoperative shoulder function and lower readmission rate[16] and consequently lower cost to the health system when compared to osteosynthesis.[17] However, in our study, osteosynthesis with the locking plate was the most used method. This discrepancy can be explained by the unavailability of reverse arthroplasty in the Brazilian Unified Health System, which so far makes its practice unfeasible.

The method of treatment (osteosynthesis or arthroplasty) did not influence patient mortality. Boileau in a French review found a mortality of 21% in 5 years after reverse arthroplasty.[18]

The study presents some weaknesses. As this was a retrospective study, it was not possible to establish control of the groups to reduce bias. In addition, social factors such as independence from household activities that are associated with higher mortality were not studied.[19] Finally, the influence of the use of continuous use medications that can alter mortality was not evaluated.[20] However, to the best of our knowledge, this is the first national study that evaluated the mortality of patients undergoing surgical treatment for proximal humeral fractures.

CONCLUSION

The overall mortality of older adults subjected to surgical treatment of proximal humeral fracture was 11.3%

The highest mortality occurred in the first 4 years of follow-up.

Diabetic patients evolve with earlier mortality and are 7 times more likely to die than non-diabetic patients.

<< SUMÁRIO

AUTHORS' CONTRIBUTIONS: Each author contributed individually and significantly to the development of this article. GGM: writing the article, reviewing and performing the surgeries and statistical analysis and in the entire intellectual concept of the article; RVLQS: writing the article and collecting data; FKK, DRZ: writing the article, reviewing and performing the surgeries; MAC: reviewing the article; ME: statistical analysis and reviewing the article.

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THE IMPACT OF COVID-19 ON THE EPIDEMIOLOGICAL PROFILE OF FRACTURES

O IMPACTO DA COVID-19 SOBRE O PERFIL EPIDEMIOLÓGICO DE FRATURAS

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ABSTRACT

Objective: To analyze the epidemiological transition of fractures in patients who were treated in a tertiary hospital which is reference in traumatology during the COVID-19 pandemic to assess the changes in trauma service. Methods: This is a retrospective and descriptive analysis of data on orthopedics lesions treated at Instituto Doutor Jose Frota between December 16, 2019 and June 16, 2020 (three months before and after the first case of COVID-19 in Ceará). Results: In total, we evaluated 913 patients, 28.5% of which were women and 71.5%, men. We found a significative reduction ($p < 0.05$) in the proportion of female patients operated in the analyzed time. We also observed an increase in patients' mean age, 35.4 years before the pandemic, and 38.48 ($p = 0.04$) during the consecutive period. Trauma mechanisms significantly changed ($p < 0.05$), with a proportional increase of high-energy traumas and reduction of instances of falling. We found a 11.9% reduction in orthopedic surgeries, from 655 to 577 at the time after the first case of COVID-19 ($p = 0.071$). Mean hospitalization length ($p < 0.001$) and time until surgeries decreased ($p < 0.001$). Conclusion: We observed the impact of lockdown in this hospital of trauma especially via the decreased number of operated cases and the change in patients' profile and trauma mechanism. ***Level of Evidence III, Retrospective Comparative Study.***

Keywords: COVID-19. Traumatology. Fractures, Bone. Epidemiology.

RESUMO

Objetivo: Analisar a transição do perfil epidemiológico de fraturas de pacientes atendidos em um hospital terciário referência em traumatologia durante a pandemia de COVID-19, a fim de verificar mudanças no atendimento traumatológico. Métodos: Análise retrospectiva e descritiva dos dados de lesões ortopédicas admitidas no Instituto Doutor José Frota entre 16 de dezembro de 2019 e 16 de junho de 2020 (três meses antes e depois do primeiro caso de COVID-19 no Ceará). Resultados: Dos 913 pacientes avaliados, 28,5% eram mulheres e 71,5% homens. Houve redução significativa ($p < 0,05$) nas proporções de mulheres operadas no tempo analisado. Houve aumento na média da idade, sendo 35,40 anos pré-pandemia, e 38,48 ($p = 0,04$) no período seguinte. Os mecanismos de trauma mudaram significativamente ($p < 0,05$), com aumento proporcional de fraturas por alta energia e redução no número daquelas por queda ao solo. A quantidade de cirurgias ortopédicas reduziu em 11,9%, de 655 antes do primeiro caso de COVID-19 para 577 posteriormente ($p = 0,071$). A média do número de dias diminuiu para duração do internamento ($p < 0,001$) e para o tempo até a realização da cirurgia ($p < 0,001$). Conclusão: O impacto do lockdown neste hospital de trauma se deu principalmente pela diminuição na quantidade de casos operados e pela mudança do perfil e mecanismo de trauma dos pacientes. ***Nível de Evidência III, Estudo Retrospectivo Comparativo.***

Descritores: *COVID-19. Traumatologia. Fraturas Ósseas. Epidemiologia.*

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INTRODUCTION

At the end of 2019, a viral outbreak[1] surprised China, putting countries around the world on alert as they observed the pronouncements of the World Health Organization (WHO)[2] and the evolution of circumstances in the Chinese territory. In February 2020, Brazil would register its first official infection case by the new Coronavirus (SARS-CoV-2).[3] In Ceará, the first official notification of infection with COVID-19 occurred on March 16, 2020,[4] increasing to more than 690,000 confirmed cases and 18,000 deaths[5] until the 17th Epidemiological Week (May 1, 2021).

All authors declare no potential conflict of interest related to this article.

The study was conducted at Instituto Doutor José Frota.
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The WHO recommends that countries have a ratio of at least one doctor per 1,000 inhabitants. According to the latest data from its Federal Council of Medicine (CFM),[6] Brazil meets this requirement, with almost 2.2 such professionals per 1,000 Brazilian citizens. However, the particularities of COVID-19, such as its great capacity for dissemination and the poor knowledge of effective treatment, can still raise it to a level which would justify caution, forcing drastic measures from public managers and completely changing the routine of the Brazilian people.

Social distancing, constant hand sanitizing, mandatory mask use, quarantine status, lockdown, and changes in the internal dynamics of health centers are among the guidelines to alleviate the spread of the virus.[7] This change also included orthopedic and trauma services. Some international hospitals, such as those in Italy and Nepal, have decided to suspend all elective or non-emergency procedures (except for cancer patients) since some orthopedic surgeries can lift possibly contaminated aerosols.[8] Additionally, such centers have aimed to make as many ICU beds vacant as possible for COVID-19+ patients, preserve health resources, and avoid possible hospital contamination for other patients.[9,10] Moreover, this conduct enables channeling orthopedic physicians and colleagues from other specialties (including residents) to meet the large number of individuals infected by the new Coronavirus.

Note, however, that social isolation and traffic control can positively and negatively impact Brazilian medical services. On the one hand, secluding people in their homes promotes viral containment and reduces traffic accidents (as a study conducted in New Zealand[11] has shown). On the other hand, it hinders the transit of older individuals or accident victims, especially those in rural areas or who use public transport in cities which reduced their operating fleet.

All these changes modified the profile of patients treated by trauma centers throughout Brazil.[12] Understanding this transition, especially in a constantly changing pandemic, is important to enable the adjustment of care to ensure efficient service with the greatest possible safety for patients and healthcare providers.

Thus, this study aims to analyze how the epidemiological profile of fractures in patients treated in a tertiary hospital (which is a reference in traumatology) changed during the COVID-19 pandemic to offer a panoramic view of what occurred regarding trauma care.

METHODS

This is a retrospective and descriptive analysis of records from patients with orthopedic lesions admitted 90 days before and after the first case of COVID-19 in Ceará State, Brazil, in a local tertiary trauma center.

Data from patients admitted to Instituto Doutor José Frota (IJF), a regional reference trauma center, between December 16, 2019 and June 16, 2020, were analyzed, corresponding to periods between three months before the first COVID-19 case in Ceará and three months afterward.

Patients of all genders with mature or immature skeletons — shown via radiography (i.e., those with closed epiphyseal plates) — who suffered orthopedic lesions and were treated and operated on at IJF from December 16, 2019 to June 16, 2020 were included in this study.

Patients with fractures only on their ribs or face, those who had no orthopedic lesions on admission, who lacked adequate imaging tests, and who showed inadequate medical records were excluded from this study.

Identification data (medical record number, age, gender), affected side, comorbidities, fractured bones, aspects of the trauma mechanism, date of the trauma, performed surgery dates, hospitalization length, time until surgeries, and number of performed surgeries were collected.

Fractures types were systematized into large groups according to the affected body segment: Shoulder (clavicle, proximal humerus, and scapula), diaphyseal humerus fractures, elbow (distal humerus, olecranon, radial head, and elbow fracture-dislocation), forearm (radius and ulna diaphyseal fractures, alone or combined), wrist (distal radius and carpal fracture and fracture-dislocations), hand (phalanges and metacarpal bones), pelvis and acetabulum (pelvic ring and sacrum fracture-dislocations and acetabulum fractures), hip (neck, transtrochanteric, and subtrochanteric proximal femur fractures), femur diaphyseal fractures, knee (distal femur, patella, and tibial plateau), legs (leg bone diaphyseal fractures, alone or combined), ankle, tibial pilon, and foot (tarsal and metatarsal bones and phalanges).

Minimums, maximums, medians, means, and standard deviations were used to describe quantitative variables and patient number and proportion, for qualitative ones. The Z-test was used to compare proportions between two analyzed periods; the Student's t-test, normal distributions; and the Mann-Whitney test, abnormal distributions. The Shapiro-Wilk test was used to assess sample distribution normality. A $p \leq 0.05$ statistical significance was considered.

According to Resolution 466/2012 of the National Health Council, this study was approved by the Research Ethics Committee of the institution via opinion no. 4,140,174.

RESULTS

Of 913 evaluated patients, 260 (28.5%) were women and 653 (71.5%), men (Table 1). We found a significant reduction ($p < 0.05$) in the proportion of female patients operated before and during the first three months of restrictive measures (Table 2).

We found that the mean age of patients evaluated in the period before the pandemic (35.40 years) increased during the evaluated social isolation to 38.48 years ($p = 0.04$) (Table 3)

Hips (13.43%), forearms (12.27%), and elbows (11.11%) were the body segments which showed the highest number of operations in the first studied period. During social isolation, they consisted of legs (16.09%), knees (11.87%), and hips (11.68%).

We found a significant difference ($p < 0.05$) between trauma mechanisms in the evaluated periods, with a proportional increase of fractures caused by car accidents, aggressions, cars running over pedestrians, and gunshot wounds (GW) and a reduced number of fractures resulting from falls to the ground (Table 4).

Table 1. Number and percentage of patients per variable.

Variable	N	%
Gender		
Female	260	28.5
Male	652	71.5
Comorbidities		
No	794	87.8
Yes	103	11.4
Comorbidities*		
SAH	52	5.8
DM	30	3.3
Cadiopathy	9	1
Joint GW		
No	53	71.6
Yes	21	28.4
Articular GW with bone loss		
No	25	86.2
Yes	4	13.8

* Multiple answers; SAH: systemic arterial hypertension; DM: diabetes mellitus, GW: gunshot wound.

Table 2. Number and percentage of patients by variable and period.

Gender	Period	N	%	p*
Female	Before	160	61.5	< 0.001
	After	100	38.5	
Male	Before	337	51.7	0.193
	After	315	48.3	
Comorbidity				
SAH	Before	24	4.8	0.092
	After	28	6.7	
DM	Before	16	3.2	0.434
	After	14	3.4	
Cardiopathy	Before	7	1.4	0.077
	After	2	0.5	
Joint GW				
No	Before	21	39.6	-
	After	32	60.4	
Yes	Before	12	57.1	-
	After	9	42.9	
Articular GW with bone loss				
No	Before	10	40.0	-
	After	15	60	
Yes	Before	2	50.0	-
	After	2	50.0	

* Z-test for difference in proportions; SAH: systemic arterial hypertension; DM: diabetes mellitus; GW: gunshot wound.

Table 3. Descriptive statistics of quantitative variables.

Variables	n	Minimum	Maximum	Median	Mean	SD
Age	912	2	97	32.0	36.80	22.74
Hospitalization length (days)	911	1	155	11.0	17.64	18.29
1st surgery (days)	912	0	83	3.0	6.92	10.00
2nd surgery (days)	231	0	86	13.0	18.35	16.00
3rd surgery (days)	37	4	89	30.0	32.62	20.18
4th surgery (days)	10	5	84	38.5	42.60	24.86
5th surgery (days)	4	15	125	47.5	58.75	47.26
6th surgery (days)	2	44	146	95.0	95.0	72.12
Surgery amount	912	0	6	1.0	1.35	0.65

We found no statistically relevant difference among comorbidities in both evaluated patient groups. Among the comorbidities reported in the first period, 24 patients (4.8%) showed systemic arterial hypertension; 16 (3.2%), diabetes mellitus; and 7 (1.0%), heart disease. Of the patients evaluated in the following three months, 28 (6.7%) reported SAH (p = 0.092); 14 (3.4%), diabetes (p = 0.434); and 2, (0.5%) cardiopathies (p = 0.077). Other pathologies showed very low percentages (< 1%) in both evaluated periods and most patients (87%) showed no comorbidities (Table 2).
The number of orthopedic surgeries performed decreased by 11.9%, from 655, before the first case of COVID-19 in Ceará, to 577 after it (p = 0.071).
We found a significant difference between both analyzed periods regarding hospitalization length (p < 0.001) and time until surgery(ies) (p < 0.001), with a decrease in their mean number of days (Table 5).

Table 4. Number and percentage of patients by trauma mechanism and period.

Trauma mechanism	Period	n	%	p*
Car accident	Before	19	3.8	< 0.001
	After	46	11.1	
Bicycle Accident	Before	9	1.8	0.447
	After	8	1.9	
Motorcycle accident	Before	180	36.1	0.126
	After	135	32.5	
Aggression	Before	4	0.8	0.007
	After	13	3.1	
Pedestrian versus motor vehicle accidents	Before	19	3.8	0.025
	After	28	6.7	
GW	Before	38	7.6	0,038
	After	46	11.1	
Fall to the ground	Before	179	35.9	< 0.001
	After	92	22.2	
Fall from height	Before	34	6.8	0.354
	After	31	7.5	
Other falls	Before	12	2.4	0.220
	After	7	1.7	
Others	Before	4	0.8	0.048
	After	9	2.2	

*Z-test for difference in proportions; GW: gunshot wound.

Table 5. Descriptive statistics and comparison between periods before and after the pandemic.

Period	Period	n	Minimum	Maximum	Median	Mean	SD	p
Age(years)	Before	498	2	96	30.0	35.40	23.97	0.04[a]
	After	414	2	97	36.0	38.48	21.06	
Hospitalization length (days)	Before	498	1	155	15.5	21.55	19.60	< 0.001[a]
	After	413	1	151	8.0	12.93	15.31	
1st surgery (days)	Before	498	0	83	5.0	9.19	11.82	< 0.001[a]
	After	414	0	67	2.0	4.18	6.22	
2nd surgery (days)	Before	126	0	86	17.0	23.05	18.31	< 0.001[a]
	After	105	2	72	10.0	12.71	10.22	
3rd surgery (days)	Before	19	4	89	36.0	39.47	21.82	0.024[b]
	After	18	6	72	26.0	25.39	15.82	
4th surgery (days)	Before	6	5	71	37	41.00	25.08	-
	After	4	17	84	39.5	45.00	28.15	
5th surgery (days)	Before	2	15	56	35.5	35.50	28.99	-
	After	2	39	125	82.0	82.00	60.81	
6th surgery (days)	Before	0	-	-	-	-	-	-
	After	2	44	146	95.0	95.0	72.12	
Surgery amount	Before	498	0	5	1.0	1.32	0.61	0.071
	After	414	1	6	1.0	1.39	0.68	

[a] Student's *t*-test; [b] Mann-Whitney test.

DISCUSSION

The pandemic is still a reality in 2021, despite the development of vaccines against SARS-CoV-2. For example, according to data from its Ministry of Health,[3] the number of daily deaths in Brazil due to the second wave of the COVID-19 pandemic reached 4,249 on April 8, 2021. In the same period, massive vaccination decreased the number of cases in the United States, in contrast to its alarming and uncontrolled spread in India.[13] These data reflect how the

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pandemic affects nations differently, either by more than one wave of contamination, by the varying number of lives lost or by the adopted containment policies.

The trauma hospital which is the focus of this study conducted 11.9% less orthopedic surgeries throughout the analyzed periods, which we expected due to restrictive measures reducing urban mobility and suspending elective surgeries. Other orthopedic and trauma sectors outside Brazil[14,15] saw the same reduction trend. Additionally, orthopedic centers in Southeastern Brazil[12] and trauma hospitals in London[16] also observed a decrease in waiting time for surgeries and hospitalization time, respectively. These aspects align management to reduce risk of exposure to the virus and attempt to allocate as many beds and inputs as possible for patients with COVID-19.

Another parameter we observed was the subtle increase in the mean age of treated patients: 35.4 years in the "pre-COVID" period and 38.5 years in the following one. This trend, which other studies also report,[17] may relate to the imposed restrictive measures probably reducing the participation of young people in motorcycle accidents, whose prevalence is due to greater recklessness and recreational use.

The studied period also shows increased fractures due to high-energy traumas, such as automobile accidents, assaults, cars running over pedestrians, and GW. This trend is unexpected since restrictive measures should reduce circulating vehicles and the number of people on the streets, as other trauma centers[15,17] have reported.

However, some factors may explain this non-reduction of high-energy traumas. The late lockdown officialization in the region of the studied trauma hospital[18] (only in the first week of May, after Decree No. 33,574) may be one such explanation, before which the region only had a few looser isolation measures. Another cause to be considered is that the studied health center treats patients from several nearby regions, who received the announcement of the lockdown at different times – whether, in some municipalities, at the end of May and, in others, only in June.[19] We stress that, in fact, some localities left the lockdown while others were adopting the regime, both assisted by this same reference trauma center, contributing once again to the non-reduction of high-energy traumas.

Additionally, the increase in violence resulting from unemployment[20] (especially from individuals unassisted by the national emergency aid, established on April 2, 2020, by Law No. 13,982,[21] but whose concession had a late onset)[22] and the shutdown of Ceará[23] military police activities for about two weeks in the first quarter, which may have contributed to the greater number of GW we found. According to the Violence Monitor, a tool developed by the Center for the Study of Violence at Universidade de São Paulo in partnership with the Brazilian Public Security Forum and G1, Brazil recorded 5% more murders in 2020 than in 2019 — and the Northeast negatively stood out for its significant 20% occurrence increase.[24]

Although we can satisfactorily observe an epidemiological transition in the profile of treated patients, the short period this study analyzed may be a limiting factor to finding more expressive changes. Thus, analysis of a longer period and mapping the origin of serviced patients could more accurately illustrate the impacts of the lockdown in each region, providing more solid bases for local health managers' future decision-making, favoring a specific alignment of care to ensure a more efficient and safe service for all.

Regarding future perspectives, we must highlight the protagonism of telemedicine. In fact, hospitals have implemented hybrid care into their orthopedic services during the pandemic, involving face-to-face contact with patients and steps performed over the telephone and obtaining good results regarding complaint resolution.[25] As of this study, Brazil is experiencing its second COVID-19 pandemic wave, with restrictive locomotion and commercial activities measures periodically still in vogue. Thus, analyzing the implementation of telemedicine in stages of care at the IJF would prove timely and with advantageous possibilities for patients and healthcare providers.

CONCLUSION

The impact of the lockdown during the first wave of the Coronavirus pandemic in a reference trauma hospital decreased the number of operated cases and changed trauma mechanism patterns and the profile of patients undergoing surgery.

Understanding the transition of patients' profile and trauma treated during the pandemic enabled the planning of strategies and optimized its approach and trauma care during this phase of the pandemic and for the subsequent waves of COVID-19 cases which will overload the health system.

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USE OF THE INTERNET AND SOCIAL NETWORKS IN ORTHOPEDICS AND TRAUMATOLOGY AND PERSPECTIVE OF POST COVID TELEMEDICINE

USO DA INTERNET E REDES SOCIAIS NA ORTOPEDIA E TRAUMATOLOGIA E PERSPECTIVA DA TELEMEDICINA PÓS-COVID

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ABSTRACT

The internet has been changing the doctor-patient relationship in the orthopedic area, especially in recent months, due to the COVID-19 pandemic. Objective: To gather information on the use of social networks regarding orthopedics and traumatology, as well as patient opinions on telemedicine. Methods: Cross-sectional study with 237 patients discharged from the orthopedics outpatient clinic of the Odilon Behrens Metropolitan Hospital, in service exclusively for the SUS, answered a questionnaire containing questions related to the use of the internet, social networks, and telemedicine in the current context. Results: Most participants never or rarely look for information on the internet before or after the medical appointment; but when they do, the search results are rarely enlightening. There was a lower demand for information among men when compared with women. There were no significant differences regarding the age of the participants who agreed that most appointments will be carried out over the internet in the future. Conclusion: The search for medical information on social networks is a global reality, but it still generates disagreements regarding its effectiveness and scope. More studies are needed in different orthopedic services for further analysis on the use of social networks within this field. ***Level of Evidence IV, Case Series.***

Keywords: Orthopedics. Internet. Telemedicine. Trauma. COVID-19. Health.

RESUMO

A internet vem alterando a relação médico-paciente na área ortopédica, principalmente nos últimos meses, em função da pandemia da COVID-19. Objetivo: Reunir informações sobre o uso de redes sociais na ortopedia e traumatologia, assim como opiniões de pacientes sobre telemedicina. Métodos: Estudo do tipo transversal. 237 pacientes egressos do ambulatório de ortopedia do Hospital Odilon Behrens, de uso exclusivo do SUS, responderam a um questionário contendo questões relacionadas ao uso da internet, das redes sociais e da telemedicina no contexto atual. Resultados: A maioria dos participantes nunca ou raramente buscam informações na internet antes ou depois da consulta; mas, quando o fazem, os resultados da pesquisa raramente são esclarecedores. Houve uma menor procura de informações entre os homens quando comparados às mulheres. Não houve diferenças significativas quanto à idade dos participantes que concordaram que grande parte das consultas serão realizadas pela internet no futuro. Conclusão: A busca por informações médicas nas redes sociais é uma realidade mundial, mas ainda gera divergências referentes à sua eficácia e abrangência. São necessários mais estudos em serviços ortopédicos distintos para maior análise sobre o uso das redes sociais nesse segmento. ***Nível de Evidência IV, Série de Casos.***

Descritores: *Ortopedia. Internet. Telemedicina. Trauma. COVID-19. Saúde.*

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INTRODUCTION

The Internet's influence on the doctor-patient relationship has intensified in recent years and months due to the great dissemination of knowledge in the health area through digital means combined with the change in routine care and appointments as a consequence of the current COVID-19 pandemic.

All authors declare no potential conflict of interest related to this article.

The study was conducted at Hospital Metropolitano Odilon Behrens.
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Patients and physicians seek to increase the amount of information in various areas of medicine in the field of diagnosis and treatment of diseases, and one of the most practical and accessible forms to do so is with the use of social networks and the Internet. Regarding the orthopedic and traumatological field, both the Internet access and the use of various search medias have increased considerably in the last two decades within the orthopedic area.[1]

In 2012, 1,828 individuals were interviewed in several states of Brazil; about 90% conducted searches on health issues on various digital information media.[2] Despite this advance, several issues remain; patients do not receive adequate information about their condition, and most websites do not employ any quality criteria for the dissemination of information.[3]

A study conducted in Maryland in the United States, in 2018, showed that, of 213 patients undergoing follow-up at a medical orthopedic sports clinic, 54% used the internet as a way to acquire information about their condition even before consulting with the specialist.[4]

To estimate the real usefulness of the Internet and social networks as a beneficial source of information, especially in a troubled period, such as that experienced by the pandemic of the COVID-19, it is essential to determine the ease of access, reliability of the sources, and quality of the results obtained by patients. The main objective of this study is to gather information about the patient's research method, the sources used, and their opinion on the reliability of the results obtained by these online searches, before and after their medical appointment. Consequently, we aim to stimulate reflection on the use of telemedicine in orthopedics and traumatology.

METHODS

This is a cross-sectional study with the application of a questionnaire (see Annex 1) in the outpatient orthopedics and traumatology service of the Odilon Behrens Metropolitan Hospital in Belo Horizonte, in the State of Minas Gerais, from September 2020 to March 2021. The research was duly submitted to and approved by the Ethics and Research Committee (CAAE: 38877820.0.0000.5129; opinion No.: 4.502.501). The study adopted the following inclusion criteria: Patients who required a scheduled follow-up appointment after receiving care in the SUS emergency room of the Odilon Behrens Metropolitan Hospital and who agreed to and signed the terms of the Informed Consent Form (Annex 1). On the other hand, the exclusion criteria were: Patients under 18 years of age and patients over 80 years of age.

A total of 237 patients answered a questionnaire containing 8 questions related to the availability of internet access and social networks, reliability of the sources and information obtained according to the patient's perspective, and on the use of telemedicine in the current situation.

RESULTS

Descriptive statistics were used to explore and summarize the collected data. The quantitative variables were presented in mean, standard deviation (SD), minimum and maximum. For qualitative variables, absolute and relative frequencies were used. The normality of data was assessed using the Kolmogorov-Smirnov test. The comparison of frequencies between qualitative variables was performed with the Chi-Square test. To compare the ages of the participants according to the answers in each question, the Kruskal-Wallis test was used with Dunn's post-hoc. When the age comparison was performed for the yes or no answer on question 6, the Mann-Whitney test was used. A significance level of 0.05 was adopted. All analyses were performed in the IBM SPSS Statistics 20.0 program.

Characterization of participants

The results of this study are based on the responses of 237 individuals: 130 (55%) women and 105 (44%) men. Only 2 (1%) participants did not report their gender.

Figure 1 shows the age groups of the study participants.

Search for information on the internet

Figure 2 shows the search for information on the Internet, before and after the medical appointment. We observed that most participants never or rarely seek information on the Internet, before or after their medical appointment.

Table 1 shows the relevance of the information obtained on the Internet. Most study participants (48%) say that internet search results are never or rarely enlightening. Similarly, 27% of participants say that internet search results are rarely in accordance with the medical explanation.

Table 2 shows the most used sources for searching information on the Internet. Notably, Google is the most commonly used platform, followed by YouTube. Few participants use Instagram or Facebook to search for information.

Regarding most appointment being conducted over the Internet in the future, 171 (72%) of the participants agree with this statement and 66 (28%) disagree.

Table 3 and Figure 3 show the participants' perception on attending a medical appointment or follow-up by video, via the Internet. We found a very diverse opinion among the participants. However, a small part of the participants points out that attending appointments and follow-ups via the Internet would be their first option.

Analysis by gender

Table 4 and Figures 4 to 8 show a comparison between the opinion of men and women. The two people who did not indicate their gender were excluded from these analyses. We found significant differences between the sexes in relation to the search for information after the appointment, revealing a lower demand for information by men when compared with women ($p < 0.001$). On the other hand, men are more optimistic about most appointment being conducted via the Internet in the future in relation to women ($p < 0.001$).

Analysis of ages

Table 5 and Figures 9 and 10 show a comparison of the participants' ages according to the search for information before or after the appointments. We found that those who never search for information before and after the appointments have a mean age significantly higher than those who rarely, frequently, or always search for information ($p < 0.001$).

Data presented in mean (standard deviation). p-value for the Kruskal-Wallis test. *Statistically significant difference in relation to the age of those who responded rare, frequently, or always ($p < 0.001$).

No significant differences were found between the ages of those who answered yes ($M = 48.1$, $SD = 17.9$) and no ($M = 50.9$, $SD = 17.8$) in relation to most appointments being conducted via the Internet in the future (p-value = 0.194).

Table 6 shows the comparison between the ages of the participants according to whether they feel comfortable or not to attend a medical appointment and follow-up by video via the Internet. We found that the age of those who say they "would never" and "would be my first option" is significantly higher than those who responded "rarely" and "could be useful in many cases" both for appointment and for follow-up ($p < 0.001$).

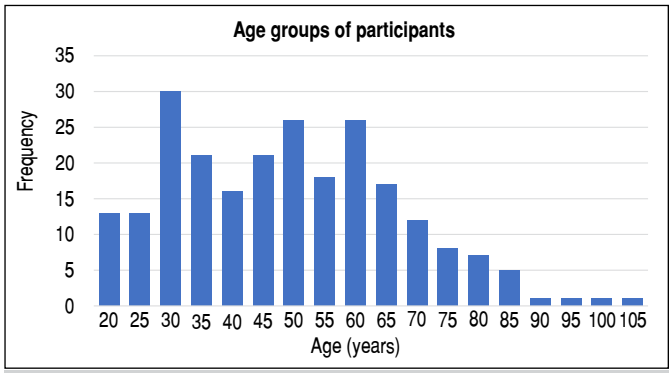

Figure 1. Age of study participants.

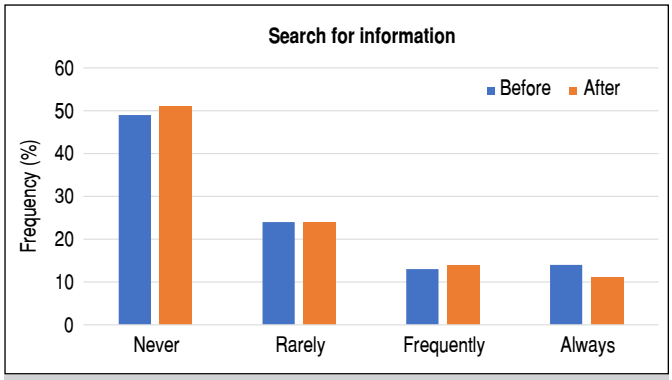

Figure 2. Search for information on the internet before and after the consultation.

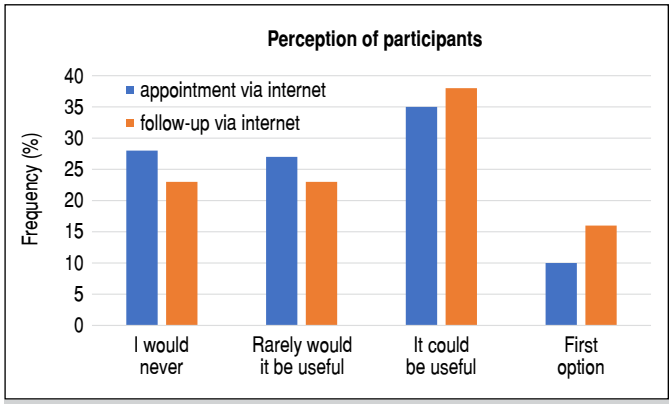

Figure 3. Participants' perception of attending a medical appointment or follow-up via video, over the Internet.

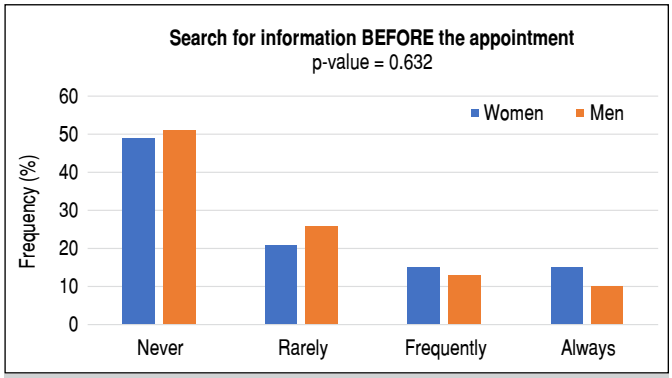

Figure 4. Search for information on the internet before the appointment.

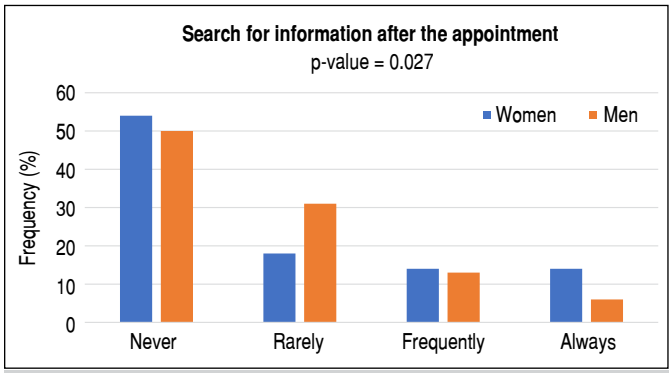

Figure 5. Search for information on the internet after the appointment.

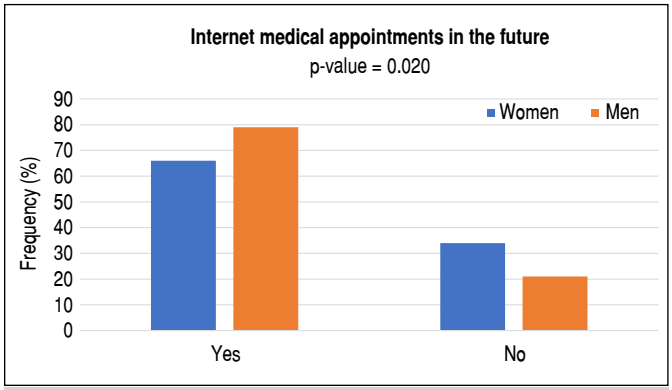

Figure 6. Appointment via the Internet in the future.

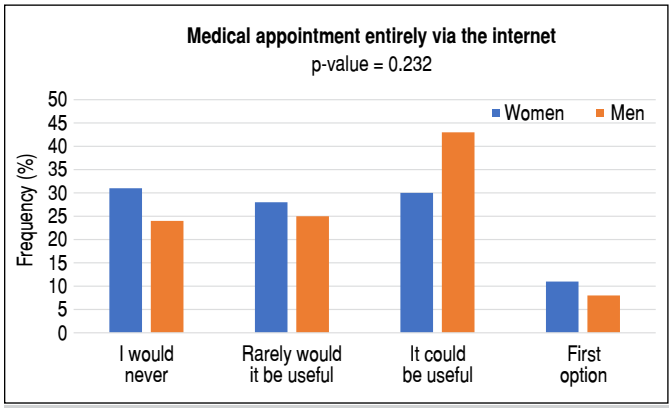

Figure 7. Opinion on conducting medical appointments entirely by video via the Internet.

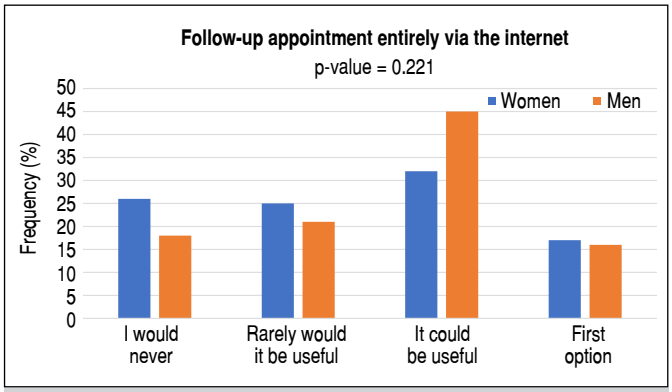

Figure 8. Opinion about performing the follow-up by video via the Internet.

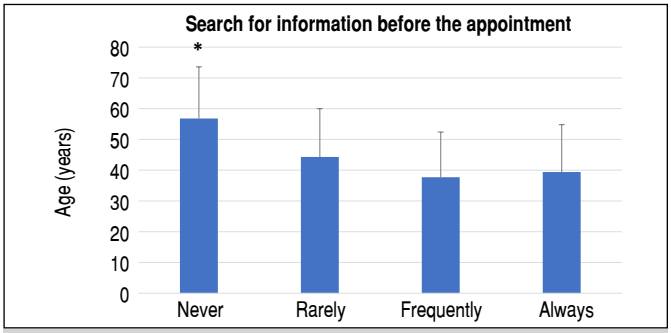

Figure 9. Comparison of the ages of the participants according to the search for information before the appointment.

*Statistically significant difference in relation to the age of those who responded rare, frequently, or always ($p < 0.001$).

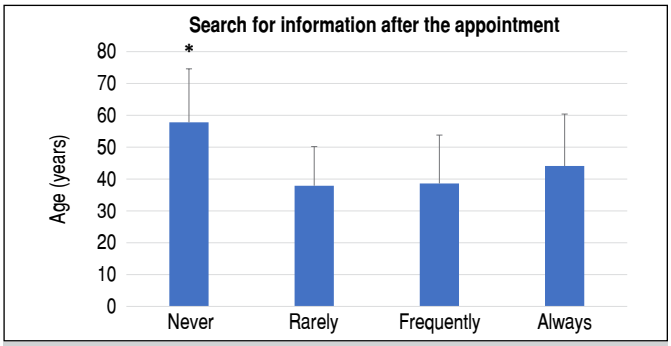

Figure 10. Comparison between the ages of the participants according to the search for information after the appointment.

*Statistically significant difference in relation to the age of those who responded rare, frequently, or always ($p < 0.001$).

Table 1. Relevance of information obtained on the Internet.

Question	Never	Rarely	Frequently	Always	Absent	Total
Enlightening internet search results	29 (12%)	86 (36%)	24 (10%)	5 (2%)	93 (40%)	237 (100%)
Search results according to medical explanation	20 (8%)	64 (27%)	39 (16%)	16 (7%)	98 (42%)	237 (100%)

Table 2. Most commonly used sources for searching for information.

Search source	Almost never	Frequently	Always	Absent	Total
Google	23 (10%)	47 (20%)	74 (31%)	93 (39%)	237 (100%)
YouTube	37 (16%)	38 (16%)	27 (11%)	135 (57%)	237 (100%)
Instagram	66 (28%)	6 (2%)	7 (3%)	158 (67%)	237 (100%)
Facebook	69 (29%)	3 (1%)	5 (2%)	160 (68%)	237 (100%)

Table 3. Participants' perception of performing a medical appointment or follow-up by video, via the Internet.

Question	I would never	Rarely would it be useful	It could be useful in many cases	It would be my first option
Medical appointment conducted entirely by video via the Internet	67 (28%)	63 (27%)	84 (35%)	23 (10%)
Follow-up appointment conducted by video via the Internet	55 (23%)	54 (23%)	89 (38%)	39 (16%)

Table 4. Frequency of characteristics among men and women.

		Women (n = 130)	Men (n = 105)	Chi-squared test
Search for information BEFORE the appointment	Never	64 (49%)	53 (51%)	p-value = 0.632
	Rarely	29 (21%)	27 (26%)	
	Frequently	16 (15%)	14 (13%)	
	Always	21 (15%)	11 (10%)	
Search for information AFTER the appointment	Never	70 (54%)	52 (50%)	p-value = 0.027
	Rarely	23 (18%)	33 (31%)	
	Frequently	18 (14%)	14 (13%)	
	Always	19 (14%)	6 (6%)	
In the future, most of the appointments will be conducted via the Internet	Yes	86 (66%)	83 (79%)	p-value = 0.020
	No	44 (34%)	(21%)	
Medical appointment conducted entirely by video via the Internet	I would never	40 (31%)	25 (24%)	p-value = 0.232
	Rarely would it be useful	37 (28%)	26 (25%)	
	It could be useful in many cases	39 (30%)	45 (43%)	
	It would be my first option	14 (11%)	9 (8%)	
Follow-up appointment conducted by video via the Internet	I would never	34 (26%)	19 (18%)	p-value = 0.221
	Rarely would it be useful	32 (25%)	22 (21%)	
	It could be useful in many cases	42 (32%)	47 (45%)	
	It would be my first option	22 (17%)	17 (16%)	

Table 5. Frequency of patients in age groups.

Question	Never	Rarely	Frequently	Always	p-value
Search for information BEFORE the appointment	56.8 (16.8)*	44.3 (15.7)	37.7 (14.7)	39.4 (15.4)	< 0.001
Search for information AFTER the appointment	57.8 (16.4)*	37.9 (12.3)	38.6 (15.2)	44.1 (16.3)	< 0.001

Table 6. Age of participants in relation to feeling comfortable or not to attend medical appointment and follow-up by video via the Internet.

Question	I would never	Rarely would it be useful	It could be useful in many cases	It would be my first option	p-value
Medical appointment conducted entirely by video via the Internet	55.4 (15.5)#	45.8 (17.9)	44.0 (18.4)	56.1 (15.0)#	< 0.001
Follow-up conducted by video via the Internet	56.1 (16.1)#	45.3 (18.4)	42.6 (15.2)	58.0 (18.5)#	< 0.001

Data presented in mean (standard deviation). p-value for the Kruskal-Wallis test. # Statistically significant difference between the groups of "would rarely be useful" and "could be useful in many cases."

DISCUSSION

The evolution of the media in current times makes the Internet a powerful tool for the dissemination and learning within the field of health. Due to the ease of introducing new content, as well as the unlimited searching possibilities, people search for the meaning of diseases, their treatment, prevention, promotion of well-being, and several other factors that intertwine with the health and disease process.[5,6]

A survey conducted by Google Brazil showed that, of 603 adults, 60% conducted online research, in the last three months, involving information about a specific medical treatment; 52% searched for general information on diseases; 48% searched for symptoms and causes; 40% searched for the use of certain medications; 39% searched on the consequences of treatment; 39% also searched for specialists; and 28% searched for diagnoses of various diseases.[2] Patients who use this powerful tool, however, are exposed to many dubious and possibly erroneous information, since the multitude of data hinders the reliability of the sources accessed, making it necessary to better understand the pattern of searches performed by these users.[2] In the area of Orthopedics and Traumatology, this type of online search is growing more and more, and it has become a relevant issue in the daily life of professionals in this field.[1]

Our study showed that the vast majority, about 75% of our patients, never or rarely seek medical information on the internet, before or after their appointment. This data contradicts Krempec, Hall, and Biermann,[1] who observed that, in 2002, about half (45%) of the patients of a follow-up orthopedic outpatient clinic in Indiana, USA, used the internet to acquire information about their condition. We believe that this difference is due to the social profile inherent to the patients, considering that our questionnaire was applied in an outpatient service form the Unified Health System with trauma profile.

Another point that makes relevant our questioning about the credibility of the information obtained by patients through their search methods was that about half of the patients (48%) who sought information did not consider the results to be enlightening. This suggests that the search method or even much of the information found online on the health-disease process is difficult for our patients to understand or access. The main search sources used were Google and YouTube.

Despite the above, we see that even if most patients do not seek information on the Internet about their conditions, about 72% understand that medical appointments in the future may be conducted via the Internet, with only 28% disagreeing. Most believe that a video appointment via the Internet could be useful in many cases. This demonstrates, despite the difficulty in obtaining data about their diseases, trust and acknowledgement on the importance of the Internet and digital media in the doctor-patient relationship of the future.

With statistically relevance, we observed that there is a lower demand for information by men when compared with women. On the other hand, men are more optimistic about internet appointments in the future.

Regarding age, we found that the older the individual, the less they research on the Internet for information regarding their condition. We believe these finding to be consistent with other social and human aspects, in which younger generations relate and adapt better with technological means of connection, with a tendency to increase, over time, the use of these tools in various areas, including in the medical environment.

CONCLUSION

Online search for medical information on the Internet and social networks is a reality in Brazil and in the world, but it still generates numerous divergences regarding its effectiveness and scope within the population. This study was conducted in a trauma department at a hospital exclusive to the SUS services, which suggests a lower adhesion to the use of social media and the Internet, both before and after medical appointment. Further studies are needed in orthopedic services with different profiles for further analysis of the use of social medias, especially among patients with a non-trauma profile and in hospital of private or insurance-covered services. Telemedicine, in turn, has shown to be a promising strategy for health care, especially for populations in vulnerable conditions, for those who are geographically distant with difficulty in accessing health care, and for circumstances such as in the current COVID-19 pandemic. We emphasize, however, that in-person appointments, as well as orthopedic physical examination, is not only essential for diagnosis and the development of a doctor-patient bond, but also indispensable for the proper practice of medicine, especially in the area of Orthopedics and Traumatology.

AUTHORS' CONTRIBUTIONS: Each author contributed individually and significantly to the development of this article. ARE, FDNN: writing and data analysis; DMN: elaboration of data study and preparation of tables and graphs; TSVB: review of the article and intellectual concept of the article; LFMS, PCLP: application of questionnaires and data analysis.

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(ANNEX 1)
INFORMED CONSENT FORM

We invite you to participate in the survey The Use of the Internet and Social Network in Orthopedics and Teleconsultation, under the responsibility of the researcher Tomás Santos Vasconcelos Barros, who intends the perception of patients in relation to Teleconsultation and information on health in social networks.

Your participation is voluntary and will take place through the completion of a questionnaire.

If after consenting to your participation you would like to withdraw your participation, you have the right and freedom to do so at any stage of the research, either before or after the collection of the data, regardless of the reason and without any detriment to you. You will have no expense and will also receive no remuneration.

If you agree to participate, you will be contributing indirectly to understanding and improving the patient relationship with digital media in society.
If you want to participate, we advise that the questionnaire contains questions regarding your use of the Internet and Social Networks, which we carefully prepared so as not to contain intimate or embarrassing questions.

You can choose to withdraw at any time of completion, without justification. And we guarantee compensation in case of any damage that may occur as a result of the research.
The refusal to participate will not influence the continuity of your treatment.
The results of the research will be analyzed and published, but your identity will not be disclosed, being kept confidential.

For any other information, you may contact the researcher by phone:

- Researcher Responsible: Tomás Santos Vasconcelos Barros
Address: Rua São Paulo, nº 1091 – 908. Bairro Centro - Belo Horizonte - MG Zip Code: 30170-131 – Phone number: 31 (99572-3713)
Email: ortopediahob@gmail.com

-Ethics and Research Committee of The Odilon Behrens Metropolitan Hospital (CEP-HOB)
Address: Rua Formiga 50, Sala 108 Bairro: São Cristóvão - Belo Horizonte - MG
Phone number: (31)3277-6120. Email: cephob@gmail.com

Post-Information Consent.

I,_____, was informed on the intentions of the researcher and why they need my collaboration, and I understood the explanation. Therefore, I agree to participate in the project, knowing that I will not gain anything and that I can leave whenever I want.
This document is issued in two copies that will be both signed and initialed by the participant and the researcher, leaving one copy with each.

_____ Date: ___/ ____/ _____
Participant's signature

_____
Researcher's signature

QUESTIONNAIRE - Use of the Internet and Social Networks in Orthopedics and Teleconsultation

1. How often do you search for health information on the internet BEFORE the medical appointment?
( ) Never
( ) Rarely
( ) Frequently
( ) Always

2. And AFTER the appointment?
( ) Never
( ) Rarely
( ) Frequently
( ) Always

3. Do you consider that the results of your internet search were enlightening?
( ) Quite, I was able to learn a lot about the disease and the treatment
( ) Sufficiently, I understood a little about it
( ) Not at all, I could not find information, or it did not clarify my doubts
( ) It interfered, the research left me with more doubts or fears

4. Were your research results in line with what the doctor explained during the appointment?
( ) Fully in accordance with
( ) Mostly
( ) Only a small part
( ) No, it was completely different.

5. Which of these you use or have used for health information searches:
Almost Never Frequently Always
Google ( ) ( ) ( )
Youtube ( ) ( ) ( )
Instagram ( ) ( ) ( )
Facebook ( ) ( ) ( )

6. Do you believe that in the future most of the medical appointments will be conducted via the Internet?
( ) Yes
( ) No

7. What is your opinion on a medical appointment with an orthopedist being conducted entirely by video via the Internet?
( ) I Would Never
( ) Rarely would it be useful
( ) Could be useful in many cases
( ) It would be my first option

8. What is your opinion on a follow-up medical appointment being conducted via the Internet? *
( ) I Would Never
( ) Rarely would it be useful
( ) Could be useful in many cases
( ) It would be my first option

Age = _____
Gender = _____
Occupation = _____

Review Article
Orthopedics
DOI: http://dx.doi.org/10.1590/1413-785220223005e254358

REVIEW OF ARTICULATED ELBOW ORTHOTICS FOR JOINT STIFFNESS REHABILITATION

REVISÃO DE ÓRTESES ARTICULADAS DE COTOVELO PARA REABILITAÇÃO DE RIGIDEZ ARTICULAR

Alisson Martins Granja Cavalcanti[1], Renato Santos de Oliveira Filho[1], Heitor Carvalho Gomes[1], Amanda Bezerra de Souza Martins[2], Elvio Bueno Garcia[1], Lydia Masako Ferreira[1]

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ABSTRACT

Joint stiffness is the most common complication in elbow injuries, presenting several etiologies and pathophysiological mechanisms that hinder treatment and prognosis. Prevention and treatment of joint contracture depend on the cause of stiffness, and early intervention should modify its outcomes. The methods used may be conservative or surgical, alone or in combination, according to each individual situation. Objective: Review articles on articulated elbow orthosis for joint stiffness rehabilitation. Methods: A literature review was conducted in journals available at the PubMed, Medline and LILACS databases, using the following Health Science Descriptors (DeCS): orthotic devices; braces; elbow; elbow joint; contracture; joint disorders. It sought to retrieve and analyze studies with the highest level of evidence that have already been conducted on articulated elbow orthosis for joint stiffness rehabilitation. Results: After applying the inclusion and exclusion criteria, four articles were included from PubMed and none from Medline or LILACS. Of the four PubMed articles, two were systematic reviews and two were randomized clinical trials. Conclusion: Articulated elbow orthoses can benefit joint stiffness treatment, improving range of motion and pain, showing superior effect compared to non-articulated plaster orthotics. ***Level of Evidence III, Systematic Review of Level III Studies.***

Keywords: Orthopedic Devices. Braces. Elbow. Elbow Joint. Contracture. Articulation Disorders.

RESUMO

A rigidez articular é a principal complicação do cotovelo, afetando o tratamento e o prognóstico. O manejo da contratura articular se baseia na sua etiologia, e a intervenção precoce deve modificar o desfecho dessa complicação. Objetivo: Revisar artigos sobre órtese articulada de cotovelo para reabilitação de rigidez articular. Métodos: Foi realizada uma revisão bibliográfica em periódicos disponíveis do PubMed, Medline e LILACS, utilizando os Descritores em Ciências da Saúde (DeCS): aparelhos ortopédicos; braquetes; cotovelo; articulação do cotovelo; contratura; e transtornos da articulação. A intenção foi estabelecer e conhecer estudos de alto poder de evidência já realizados, que tenham tido como referência a temática de órteses articuladas de cotovelo para reabilitação de rigidez articular. Resultados: Após a aplicação dos critérios de inclusão e exclusão, revisaram-se artigos indexados no PubMed, Medline e LILACS, encontrando-se quatro artigos pelo PubMed e nenhum pelo Medline ou LILACS. Dos quatro artigos, dois eram revisões sistemáticas e dois eram ensaios clínicos randomizados. Conclusão: Órteses articuladas de cotovelo podem ser benéficas no tratamento de rigidez articular, sendo sugerido que melhoram amplitude de movimentos (ADM) e dor, inclusive com efeito superior em relação às órteses não articuladas gessadas. ***Nível de Evidência III, Revisão Sistemática de Estudos de Nível III.***

Descritores: *Aparelhos Ortopédicos. Braquetes. Cotovelo. Articulação do Cotovelo. Contratura. Transtornos da Articulação.*

Citation: Cavalcanti AMG, Oliveira Filho RS, Gomes HC, Martins ABS, Garcia EB, Ferreira LM. Review of articulated elbow orthotics for joint stiffness rehabilitation. Acta Ortop Bras. [online]. 2022;30(5): Page 1 of 4. Available from URL: http://www.scielo.br/aob.

INTRODUCTION

Joint stiffness is a major complication that most commonly affects the elbow, hindering treatment and prognosis. Joint contracture management depends on its etiology, and early intervention should modify its outcome.[1-3]

Intrinsic or extrinsic elbow lesions should be considered (Table 1), which appear frequently combined with factors such as: patient age, inflammatory, infectious or degenerative diseases, hemophilic diseases, trauma, burns, immobilization duration, heterotopic ossification, tumors, neurological and congenital diseases.[1]

All authors declare no potential conflict of interest related to this article.

The study was conducted at Universidade Federal de São Paulo.
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Table 1. Joint stiffness intrinsic and extrinsic components.

Intrinsic components	Extrinsic components
Intraarticular adhesions	Capsular or ligament contracture
Poor joint alignment	Heterotopic ossification
Loss of joint cartilage	Extra-articular vicious consolidation
Combination of the above	Soft tissue contractures by burns

Source: Charalambous and Morrey.[2]

Prevention and treatment of joint contracture depend on the cause of stiffness, and early intervention should improve prognosis. The methods used can be conservative or surgical, alone or in combination.[4]

Postoperative use of articulated orthosis helps with stretching and maintaining soft tissue joint range-of-motion gain (capsular, ligament, tendon and muscle structures) throughout the therapeutic process.[5]

Static or dynamic orthosis (depending on the protocol used) in association with continuous passive motion (CPM), of variable duration, is recommended for the inflammatory phase, which lasts about two weeks and includes the immediate postoperative phase. In the next phase, lasting two to six weeks, when scar tissue maturation occurs, collagen can still be elongated, and any movement lost due to CPM discontinuation can be regained. During remodeling (six weeks to six months), the priority is to achieve active range of motion along the same passive arc. At this stage, muscles and tendons should be at their maximum range of motion, but may lack strength at its extremes, which may regress if not maintained by the orthosis. If the patient fails to strengthen the joint to its maximum flexion and extension, contracture will recur.

The immobilization program should be continued, with gradual removal of the daytime orthosis, but keeping the nighttime orthosis for six months or more. Immobilization will last proportionally to the contracture.

In clinical practice, plasters and non-articulated orthotics are commonly used in the postoperative phase of orthopedic surgeries, for a variable period, to protect the surgical procedure performed. But this immobilization method goes against the principle of early mobility that every joint should have, since absolute rest of the limb is not indicated. Experts are often faced with complex joint lesions and observe the need for additional extrinsic protection after surgical fixation, or even after a lesion that does not require an invasive approach.[6]

Among the orthotics indicated for elbow injury rehabilitation, articulated orthoses are preferred over non-articulated ones, since the former allow joint movement. Articulated orthotics are divided into static and dynamic:

- Static orthoses: allow the maximum tolerated elongation (maximum flexion or maximum extension), in a constant position.[7]
- Dynamic orthoses: are adjustable and scaled securely to avoid pain or instability, allowing constant stretch load.[2]
- Static-progressive orthoses: static orthotics that allows adjustment in joint position in small increments, adding force.[7]

Needing faster and better results, health professionals encourage the use of articulated orthotics as an important instrument to assist in injury rehabilitation, aiming at joint protection and mobility, generating safety for the surgeon and the rehabilitation team, and positive effects for the patient, both in pain control and early member functionality.

Objective

Review articles on articulated joint orthosis for joint stiffness rehabilitation.

METHODS

A literature search, without time and language restrictions, was conducted on the PubMed, MEDLINE and LILACS databases, using the following Health Sciences Descriptors (DeCS): "printing, three-dimensional," "orthotic devices," "braces," "elbow," "elbow joint," "contracture" and "articulation disorders."

Our review sought to retrieve and analyze studies with the highest level of evidence that have already been conducted on elbow joint orthoses for joint stiffness rehabilitation.

Table 2 summarizes the strategy used. We found 299 articles in PubMed, 321 in Medline, and 5 in LILACS.

Table 2. Search strategy.

PubMed	*(Elbow) OR Elbow[MeSH Terms]) AND Capsular Contracture) OR Capsular Contracture[MeSH Terms]) AND Orthoses) OR Orthoses[MeSH Terms]) AND Orthosis) OR Orthosis[MeSH Terms]) AND Brace) OR Brace[MeSH Terms]) AND Orthotic Devices) OR Orthotic Devices[MeSH Terms]) AND Splints) OR Splints[MeSH Terms]) AND Static Splints) OR Static Splints[MeSH Terms]) AND Dynamic Splints) OR Dynamic Splints[MeSH Terms]) AND Elbow Splint) OR Elbow Splint[MeSH Terms]*)
LILACS	(*Orthoses OR Orthosis OR Brace OR Elbow Splint OR Orthotic Devices OR Static Splints OR Dynamic Splints AND Elbow OR Capsular Contracture OR Printing, Three-Dimensional*)

Inclusion criteria

- Clinical trial;
- Randomized clinical trial;
- Systematic review;
- Meta-analysis;
- Human beings;
- Articles published in the last 20 years.

Non-inclusion criteria

- Population under 18 years old;
- Expert opinion;
- Animal research;
- Articles published over 20 years ago

Exclusion criteria

- Studies with children;
- Dental braces;
- Orthotics for lateral epicondylitis;
- Absence of joint stiffness or diseases that do not result in loss of range of motion (ROM);
- Neurological diseases;
- Peripheral nerve diseases;
- Wrist and hand diseases.

RESULTS

After applying the inclusion, non-inclusion and exclusion criteria, we were left with four articles from PubMed and no paper from LILACS. Of the four PubMed articles, two were systematic reviews and two randomized clinical trials.

In a systematic review, Chen et al.[8] evaluated the use of static-progressive orthotics for elbow contracture. The authors searched for articles in English published during January 1, 1997, and January 31, 2017, in the Web of Science, Cochrane Library, PubMed and EBSCOhost databases. Two evaluators assessed the quality of the articles. After summarizing each paper in evidence tables, the authors performed a narrative synthesis. The final sample included ten clinical trials,

of which only two were controlled clinical trials. By way of conclusion, the researchers suggest that these orthotics could improve ROM for patients with elbow contracture. Some studies selected patients shortly after surgical treatment, while others recruited patients who failed standard physiotherapy from 4 to 11 weeks or had elbow contracture between 52 days and 16.7 months. Despite the positive outcomes reported in all papers analyzed, the contribution of static-progressive orthotics to improvement in interventions performed after surgery can be questioned, as it is difficult to exclude the effects of another concomitant treatment. In short, evidence suggests that progressive-static orthotics help in elbow contracture by improving range of motion.

Veltman et al.[9] analyzed eight studies evaluating progressive-static and dynamic splints for non-surgical treatment of post-traumatic elbow stiffness, including one randomized clinical trial and seven retrospective cohort studies. For analysis, patients were divided into two groups: (1) patients treated with progressive-static immobilization and (2) patients treated with dynamic immobilization. The first group included 160 patients (160 elbows) with elbow stiffness described in six studies. Mean range of motion before immobilization for all elbows was 72° (range 54°–89°) with an average of 112° flexion (range 101°–118°) and an average of 39° extension deficit (range 23°–59°). Mean improvement was 36° for an average post-immobilization ROM of 108° (range 100°–112°) with 128° flexion (range 125°–130°) and 22° extension deficit (range 17°–28°). The second group included 72 patients (72 elbows) with elbow stiffness analyzed in three studies. Mean time between trauma and the start of static or dynamic immobilization was 9 months. Mean range of motion before immobilization for all elbows was 63° (range 52°–68°) with an average of 111° flexion (range 100°–124°) and an average of 48° flexion contracture (range 41°–58°). Mean improvement was 37° for an average post-immobilization ROM of 100° (range 92°–105°) with 127° flexion (range 126°–129°) and 28° extension deficit (range 21°–37°). In conclusion, both dynamic and progressive-static splints present good outcomes in elbow stiffness treatment. Choice of one orthotics over the other is up to the surgeon and the patient. According to the authors, treatment with dynamic orthotics or progressive-static immobilization have similar outcomes.

In a randomized clinical trial, Merolla et al.[10] evaluated the efficacy, usability, and tolerability of a dynamic elbow orthosis compared to standard plaster following medial or lateral collateral ligament reconstruction. The study included 26 individuals, 23 with medial collateral ligament (MCL) injury and three with lateral collateral ligament (LCL) injury, randomized into two groups of 13 patients: group A received dynamic orthotics and group B was treated with plaster splint. Outcome measures included visual analog pain scale pain score, arm circumference, grip strength, Oxford Elbow Score (OES), and ROM. Patients were evaluated at the beginning of the study and at 2, 6, 12, and 24 weeks. All patients reported a significant pain reduction at 6, 12, and 24 weeks ($p < 0.05$). Mean circumference was significantly higher in group A at all times (all $p < 0.05$). Mean grip strength was higher in group A at 2 and 6 weeks ($p < 0.05$), whereas the difference found at 12 and 24 weeks was not significant. The OES and passive ROM values of both groups were not significantly different at any time. The authors concluded that both the dynamic orthosis and the plaster splint provided effective and safe elbow immobilization after MCL or LCL reconstruction. Dynamic orthosis provided greater pain reduction, faster recovery of muscle trophism and grip strength, and was better tolerated.

In a prospective randomized clinical trial, Lindenhovius et al.[11] evaluated the difference between immobilization with progressive-static and dynamic elbow splints in flexion-extension and pronation. The study included 66 patients with post-traumatic elbow stiffness: 35 received progressive-static immobilization and 31 dynamic orthosis. Patients answered the Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire at enrollment and at the six- and twelve-month evaluation. Results showed no significant differences in ROM gain over time between the orthotics. Improvement in arch flexion (dynamic versus static) averaged 29° versus 28° at three months ($p = 0.87$), 40° versus 39° at six months ($p = 0.72$) and 47° versus 49° at twelve months after immobilization was started ($p = 0.71$). Mean DASH score (dynamic versus static) was 50 against 45 points at enrollment ($p = 0.52$), 32 against 25 points at six months ($p < 0.05$) and 28 against 26 points at twelve months after enrollment ($p = 0.61$). The authors found no significant differences in motion improvement between the progressive-static and dynamic immobilization protocols. Choice of the immobilization method can be determined by patients and their physicians. Three patients who were prescribed a dynamic splint requested a change to a progressive-static splint due to pain and discomfort.

DISCUSSION

We found little relevant literature on specific therapeutic management for elbow stiffness. Most studies on the topic incur in methodological deficiencies when comparing between types of articulated elbow orthotics. Data often refers to global rehabilitation concepts rather than specific evaluation and treatment. Hence, elbow stiffness after injury is challenging dilemma for surgeons, therapists and patients.[12]

Joint contracture is a common complication after trauma and can lead to surgical treatment in up to 12% of cases. Pain and swelling after trauma or surgery play an essential role in promoting stiffness. Research points to capsular retraction and soft tissue contracture as major contributors of elbow stiffness after bone and ligament restoration and alignment.[12]

Overall, orthotics use have two purposes: protection and recovery of movement. Protective immobilization is fixed and non-articulated, maintained at a 90° comfort position, and initiated after trauma; whereas immobilization for regaining motion is usually articulated, initiated after some tissue healing and subsequent application of a low prolonged stretching load, used to increase ROM.[13]

Dynamic orthotics tend to cause greater soft tissue lesions and inflammation under a constant load on the joint, resulting in low compliance. Progressive-static orthotics can achieve greater stretching via stress relaxation. Progressive-static orthotics have many advantages: force and ROM adjustment to maximum tolerable intensity; tolerable load controlled by patient according to subjective sensation; greater tolerance and compliance; mobility, patient could do active exercises after easily removing the orthotics; effective, efficient, economical, requires less time and money.[12]

Although ROM gain occurs mostly in the first six months of orthotics use, a randomized controlled clinical trial conducted with patients using progressive-static or dynamic orthosis for joint stiffness, observed a group gain in between six and twelve months, showing that persistence and patience during non-surgical treatment are important and necessary.[11]

After conducting a meta-analysis and systematic review of 13 studies on the efficacy of orthotics in treating non-bone mobility restriction of the elbow, a study analyzed progressive-static, dynamic or static devices for treatment of soft tissue injuries after trauma or surgery that caused joint stiffness. Mean duration from incident to the start of treatment with the device was 6.9 ± 5.1 months. ROM improvement was 38.4 ± 8.9 (95% confidence interval, 39.5° to 41.8°). Comparison between dynamic, static or static-progressive orthotics found no significant difference, but the authors recommended using progressive-static orthotics three times for thirty minutes a day in each direction as the first-line treatment for elbow stiffness without evidence of restriction or heterotopic ossification.[14]

Early joint mobility should be prioritized for a satisfactory final clinical outcome. Extrinsic stabilization using orthotics effectively ensures the safety of the procedure performed, providing immobilization and favorable environment to capsule-ligament and bone healing.

This method, such as a cast or plaster splint, provides stability and reduces force transmission at the fracture site or soft tissue injury to allow healing of the bony and ligament structures around the joint, but when used excessively, can cause secondary stiffness and contracture.[13] Besides hindering early gain of motion, it hampers grooming and hygiene, requires changes, interferes in the quality of radiological exams, can have allergic effects, requires time for the procedure, presents constant loosening, can lead to adverse circulatory effects, joint stiffness, loss of muscle mass, skin necrosis, or even compartment syndrome.[12]

The articulated orthosis enables early mobility and protection of the procedure performed, since it blocks varus and valgus movements, enabling healing of acute ligament injuries or reconstruction of chronic injuries, preservation of fractures, chondral procedures, arthroplasties, etc. It provides protection with joint mobility, briefly recovering functionality, reducing pain, providing comfort of use, benefiting limb blood circulation, and avoiding joint stiffness.

CONCLUSION

Joint elbow orthotics may be beneficial for treating joint stiffness, since they improve ROM and pain, including superiority effect on non-articulated gelding orthosis. Progressive and dynamic static orthotics showed similar outcomes, differing only in the greater discomfort when wearing dynamic orthotics.

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BRAZILIAN CONSENSUS STATEMENT ON VISCOSUPPLEMENTATION OF THE HIP (COBRAVI-Q)

CONSENSO BRASILEIRO DE VISCOSSUPLEMENTAÇÃO DO QUADRIL (COBRAVI-Q)

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ABSTRACT

Objective: The Brazilian Consensus on Hip Viscosupplementation aims to generate a referential and consensual source from the theoretical knowledge and clinical experience of specialists in the field. Methods: A multidisciplinary panel was formed with 15 specialists (sports medicine, orthopedists, physiatrists and rheumatologists), based on clinical and academic experience in the use of viscosupplementation of the hip. 12 statements were prepared, discussed and voted. Each panelist gave a value between 0 and 10 on a Likert scale, specifying their level of agreement with the statement. Results: The panel reached a consensus on several aspects of viscosupplementation of the hip, with emphasis on the following statements: best indication is for mild to moderate hip arthrosis; it may be indicated in severe osteoarthritis; results may vary according to the characteristics of the viscosupplement used; Viscosupplementation should not be performed as an isolated procedure, but in conjunction with other rehabilitation and pharmacological measures; best injection technique should be based on anatomical references coupled with imaging guidance; it is a cost-effective procedure. Conclusion: Viscosupplementation is a safe and effective therapy for hip osteoarthritis, even in severe cases. Guided injection is recommended. ***Level of Evidence V, Expert Opinion.***

Keywords: Osteoarthritis. Hip. Viscosupplementation. Injections, Intra-Articular.

RESUMO

Objetivo: O Consenso Brasileiro de Viscossuplementação do Quadril visa gerar uma fonte referencial a partir do conhecimento teórico e da experiência clínica de especialistas da área. Métodos: Um painel multidisciplinar foi formado com quinze especialistas (médicos do esporte, ortopedistas, fisiatras e reumatologistas), com base na experiência clínica e acadêmica no uso da viscossuplementação do quadril. Foram elaboradas, discutidas e votadas doze afirmativas. Cada membro do painel deu um valor entre 0 e 10 numa escala tipo Likert, especificando seu nível de concordância com a afirmação. Resultados: O painel chegou a um consenso sobre diversos aspectos da viscossuplementação do quadril, destacando-se: a melhor indicação é para tratar artrose de quadril leve a moderada; pode ser indicada para casos graves; os resultados podem variar de acordo com o viscossuplemento utilizado; não deve ser realizada como procedimento isolado, mas em conjunto com outras medidas reabilitadoras e farmacológicas; a melhor técnica para infiltração no quadril deve se basear nas referências anatômicas combinadas com guiagem por imagem; a viscossuplementação do quadril é um procedimento custo-efetivo. Conclusão: A viscossuplementação é uma alternativa terapêutica segura e eficaz na osteoartrite do quadril, mesmo em casos graves. Recomenda-se o uso de métodos guiados. ***Nível de Evidência V, Opinião do Especialista.***

Descritores*: Osteoartrite. Quadril. Viscossuplementação. Injeções intra-articulares.*

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INTRODUCTION

Osteoarthritis (OA) of the hip is one of the main causes of pain and disability in the western population.[1] Its incidence increases with age, when there is some stage of the disease in about 25 to 30% of people aged over 45 years, and it can also occur in young adults, especially in high performance athletes, in individuals who perform some labor activities, and after joint fracture.[2-6]

The main goals of OA treatment involve pain relief and improved mobility, with a consequent positive impact on quality of life. The use of oral medications, such as acetaminophen, non-steroidal anti-inflammatory drugs, and opioid analgesics, is recommended.[7] In addition, physical therapy, specific physical activities, and weight control are indicated and, in refractory cases, surgical procedures such as hip arthroplasty.[7-11] However, the use of oral medications has complications[10] as well as arthroplasties.[9]

Thus, other types of treatment have been used for treating OA, aiming at avoiding the side effects of conventional treatments and delaying the evolution of OA.[11-13] The concentration and molecular weight of hyaluronic acid in synovial fluid decreases with age and progression of osteoarthritis.[14] Therefore, among these new alternatives, viscosupplementation (VS) has been studied and used, through the intra-articular injection of hyaluronic acid (HA), which has an important role in joint lubrication and restoration of the rheological properties of the synovial fluid.

The use of VS in the treatment of knee OA is well established.[15] Nonetheless, in the treatment of hip OA, VS has been more recently used, lacking robust studies to adequately support its implementation.[11,16] When verifying the existing literature for use in hip OA, we found numerous gaps regarding the correct indication, as for the association with intra-articular corticosteroids, the existence of differences between the different presentations of HA, the number of infiltrations, and its economic feasibility and real effects, among others. Seeking to contribute to solving these doubts, we decided to reach a consensus, which is the objective of this study.

METHODS

A multidisciplinary panel of physicians with clinical and academic experience in the use of viscosupplementation in hip OA was carried out, with the objective of discussing, in the light of previously surveyed literature, twelve statements that raise the main doubts in the use of this therapy. Two authors searched the PubMed, EMBASE, Google Scholar, and Cochrane databases using the keywords "viscosupplementation," "hyaluronic acid," "hylan," "hyaluronan," "osteoarthritis," and "hip." Articles with levels of evidence I and II were eligible for this study. The selected articles were then sent to the panel members. All of them also received twelve statements (doubts) that would be discussed in a meeting between all panel members. The local research ethics committee did not request for approval, as it is an experts' opinion document.

Subsequently, a face-to-face meeting of the participants was held, in which each member of the panel attributed a value between 0 and 10 on a Likert-type scale, specifying their level of agreement with each statement. On this scale, the value zero meant "strongly disagree," and the value 10 meant "strongly agree." After voting, the values were grouped into three categories, with values between 0 and 3 meaning "disagreement"; values between 4 and 6, "indifference"; and values between 7 and 10, "agreement." Finally, the level of agreement among panelists for each statement was established as "unanimous in favor" when all votes were greater than or equal to 7; "strongly in favor," when only one of the votes was not greater than or equal to 7; "moderately in favor," when only 2 to 4 of the votes were not greater than or equal to 7; "no consensus," when there was no category with at least 4 votes more than another; "moderately against," when only 2 to 4 of the votes were not less than or equal to 3; "strongly against," when only 1 of the votes was not less than or equal to 3; and "unanimous against," when all the votes were less than or equal to 3.

RESULTS

Statement 1: The best indication is for mild to moderate hip OA.
Agreement: Strongly in favor
Mean: 8
Median: 8
Achieved values: 4-10

The experts' panel argued that there are few studies involving severe hip OA, particularly in younger patients. In addition, they emphasized that the expectation in patients with hip OA is to delay surgery. In this regard, what has been observed is that the vast majority of physicians do not pay attention to this possibility, ultimately performing it at a later time. This justifies one of the reasons for the lack of interest in VS, because the symptoms in mild hip OA are minimal.

The literature has a clear indication in favor of the use of VS in cases considered mild to moderate, in which its use allows an important decrease in pain and gain in joint mobility, improving quality of life.[1,17-19] According to Pogliacomi et al.,[2] improvement only occurs in moderate osteoarthritis, with no relevance for mild cases. Conversely, De Lucia et al.[20] reported that improvement equally occurs in all stages of OA.

Statement 2: It may be indicated in cases of severe hip OA.
Agreement: Strongly in favor
Mean: 8.75
Median: 9
Achieved values: 6-10

In cases of severe OA, it was argued that the properties of HA will not be able to reverse the deleterious changes of OA. Its use would be more directed to delay hip arthroplasty, but there is no substantial literature to support this evidence. Thus, the opinion of the experts' panel is that the use in cases of severe OA would be indicated for individuals who do not have the clinical conditions to undergo the surgical procedure or who do not want to do it. This view is supported by De Lucia et al.[20] Conversely, authors such as Henrotin et al.,[11] Piccirilli et al.[17] and Eymard, Chevalier and Conrozier,[19] do not believe in viscosupplementation in severe hip OA.

Statement 3: Previous or concomitant use of intra-articular triamcinolone hexacetonide may potentiate the effect of VS.
Agreement: Moderately in favor
Mean: 8.43
Median: 8.5
Achieved values: 6-10

Experts' opinion is that the combination of triamcinolone hexacetonide with VS provides a faster analgesic effect and maintains the longer lasting effect of VS. Therefore, most prefer to make use of the combination instead of using only hyaluronic acid. This view is supported by Conrozier et al.,[18] who point out that VS takes about four weeks to initiate analgesia, being the most effective corticosteroid in this period, reporting that triamcinolone hexacetonide would be the ideal corticosteroid for stabilizing hyaluronic acid, increasing its viscosity and causing a beneficial interaction. Bannuru et al.[21] reported that HA takes longer to act, but has a much longer effect than corticosteroids. Hence, the concomitant use of both medications would have a synergistic effect.[18,22-24]

It was also discussed that, in cases of acutely swollen joint with joint effusion, the isolated use of corticosteroids would be more indicated to reduce the inflammatory process, after performing

arthrocentesis, preventing important changes in the HA to be infiltrated, the same measure recommended by Maricar et al.[25] and Uthman, Raynauld and Haraoui[26] with VS being used after an interval[18] of 7 to 10 days. In cases in which there was no joint effusion, the use of triamcinolone hexacetonide and VS could be concomitantly performed.

Statement 4: VS results vary according to the molecular characteristics of the viscosupplement used.
Agreement: Unanimous in favor
Mean: 8.75
Median: 9
Achieved values: 7-10

The experts discussed that there are different VS options on the market. They observed that the higher the concentration of the product, the better the clinical result. For De Lucia et al.[20], VS with medium and high molecular weight have the same effect, whereas Tikiz et al.[27] did not observe any difference comparing the VS with high and low molecular weight.

Statement 5: VS should not be performed as an isolated procedure in the treatment of OA, but in association with other rehabilitative and pharmacological measures.
Agreement: Unanimous in favor
Mean: 10
Median: 10
Achieved values: 10

In the experts' opinion, there is a consensus in the literature that VS should be used together with other measures, as the treatment of OA is multimodal, encompassing weight loss, specific physical exercises, physical therapy, palliative drugs, among others.[2,18,28,29]

Statement 6: The number of applications will depend on the clinical conditions of the patient and the viscosupplement used.
Agreement: Unanimous in favor
Mean: 8.81
Median: 9
Achieved values: 7-10

According to the specialists' experience, the number of applications will initially depend on the used VS and the patient's clinical conditions. Mauro et al.,[30] considered three injections with HA as ideal for patients with mild to moderate OA. This same frequency of three vials, with weekly intervals, was adopted by Tikiz et al.[27] and Poubagher, Ozalay and Pourbagher[31]. Qvistgard et al.[32] also used three vials, but at 14-day intervals. Clementi et al.[33] observed that in cases of moderate OA, the improvement in pain and function was the same when using one vial of HA with high molecular weight and two vials of HA with medium molecular weight. For Migliore et al.,[1] it is safer to use VS with indication of a single intra-articular injection than those with indication of more than one to obtain the same beneficial effects, as it reduces risks and facilitates patient's adherence to treatment.

Statement 7: In cases of mild osteoarthritis of the hip, VS has a chondroprotective effect.
Agreement: No consensus
Mean: 5.94
Median: 6.5
Achieved values: 0-10

The discussion among experts addressed the fact that the use of VS as a chondroprotective drug in the case of mild hip OA is on the borderline between clinical conviction and literature data, considering that there are no studies demonstrating such an effect. It has been postulated that there is little clinical experience on the subject, and it is stated that prophylactic VS is not routinely performed on the hip.

Statement 8: The best technique for VS infiltration in the hip should be based on anatomical references coupled with ultrasound guidance.
Agreement: Strongly in favor
Mean: 9.25
Median: 10
Achieved values: 5-10

According to experts, the use of guided joint infiltration depends on several factors, including the physician's experience, the region to be infiltrated, the patient's biotype, the amount of fluid to be infiltrated, and the chosen access route. In the case of hip joint, the presence of the neurovascular bundle and its depth reinforce the use of guided infiltration. In addition to ultrasound, radioscopy and computed tomography were suggested, depending on the local infrastructure as an imaging method for performing the procedure.
When searching in the literature, the need to associate a subsidiary method to guide hip infiltration is unanimous, due to the risk of injury to the neurovascular bundle and technical difficulty in reaching the joint, in which ultrasound is predominant, both for the simplicity of use and for the absence of risks both for physicians and patients.[1,2,18,20,30,33,34]

Statement 9: VS generates cost reduction for the Supplementary Health System, being a cost-effective procedure.
Agreement: Strongly in favor
Mean: 8.5
Median: 10
Achieved values: 2-10

For specialists, this is a difficult topic, given the scarcity of studies on the subject, especially with regard to national literature. Migliore et al.,[35] observed that the use of VS in the Italian health system, in cases of hip OA, reduced the cost of treatment by delaying surgical procedures — such as arthroplasty and its complications —, in addition to reducing the use of oral medications and its side effects and the need for physical therapy. Arnold et al.[36] also observed a cost reduction in the expense of this pathology, when comparing VS in hip OA with arthroplasty; but Pasquale et al.[37] has a contrary view, reporting that arthroplasty would be cheaper than the treatment with viscosupplement.

Statement 10: Viscosupplementation promotes analgesic effect.
Agreement: Unanimous in favor
Mean: 9.25
Median: 9
Achieved values: 8-10

Statement 11: Viscosupplementation promotes anti-inflammatory effect.
Agreement: Strongly in favor
Mean: 8.5
Median: 9
Achieved values: 4-10

We chose to discuss these two statements together, considering the proximity between analgesic and anti-inflammatory effects. Specialists notice a real effect in reducing pain and less need for using anti-inflammatory drugs, which suggests that it also has this effect.
The literature that indicates the use of VS in hip OA is preponderant in reporting pain improvement as one of the main effects of this medication.[1,2,14,20,38,39] As for the anti-inflammatory action, Pogliacomi et al.[2] highlight it for inhibiting the formation and release of prostaglandin, and it is described by Gupta et al.[14] and Piccirilli et al.[17]

Statement 12: VS can promote improved functionality and quality of life in patients with hip OA.
Agreement: Unanimous in favor

Mean: 8.68
Median: 9
Achieved values: 7-10

According to experts, VS has a beneficial effect, but not for all patients. The difficulty in stating a percentage of improvement and its impact on the patient's quality of life was also questioned. When searching in the literature, several studies present, as one of the effects of viscosupplementation on hip OA, the improvement of joint function and pain, with a consequent improvement in the quality of life.[1,2,14,20,38]

DISCUSSION

This consensus is the continuation of the study on the application of viscosupplementation to the treatment of OA in human joints, which began with the knee.[15] Despite the extensive literature on its use and effectiveness in knee OA, the same does not occur in hip OA, as we could verify when surveying the existing literature, in which we identified both recommendations against its use[16,21,39,40] and studies describing good results with the use of VS as a treatment option.[1,2,18,20,21,30,33]
In studies that indicate the use of viscosupplements,[1,2,17-19,21] there is great heterogeneity regarding the type of patient to be treated as well as the different presentations of viscosupplements available on the market. In our view, it is valid to use VS at any stage of OA, as many patients do not have the clinical conditions to undergo surgical procedures or even do not want it, but we have observed that the best results are found for less severe cases.[1,2,17-19]
When using HA, in view of the previous existence of synovitis, we perform arthrocentesis and infiltration with triamcinolone hexacetonide, delaying the infiltration with HA, due to the important changes of this acid by the inflammatory process, as recommended by other authors.[18,25,26] We perform VS only after healing the synovitis, which occurs, on average, 7 to 10 days after infiltration. In the absence of synovitis, we chose to use triamcinolone hexketonide in association for achieving an early analgesic effect, as HA only had the same effect approximately four weeks after its use, which was also observed by Bannuru et al.[21]
Despite being a consensus among us that the characteristics of HA influence the result, no differences were identified in the literature consulted on this topic.[20,27] However, we emphasize that it is easier for the patient to adhere to the treatment when we use a single infiltration, as well as reducing the risks of it, consideirng the technical difficulties involving this joint. This observation is supported by Migliore et al.[1] The literature also shows that the type of hyaluronic acid is directly linked to the number of required injections, but there seems to be no difference in the result.[27,30-33] When using intra-articular HA, we emphasize that, as it is a deep joint and with important technical difficulties, the use of guided infiltration, especially with ultrasound, makes the procedure safer and more effective. Our observation is in line with the literature.[1,2,18,20,30,33,34] It is worth emphasizing that this procedure, from our point of view, is part of a multimodal treatment in which weight loss and specific physical exercises are relevant, as described by other authors.[2,18,28-30] This treatment results in an improvement in quality of life,[2,14,20,35,38] due to the improvement in pain and function, both due to analgesic[1,2,14,20,38,39] and anti-inflammatory effects.[2,14,17]
Another important effect that we observed with the use of HA is the reduction of costs, despite the fact that we do not have relevant studies in our country, with HA being used only for knee OA.[15] In the literature review, Migliore et al.,[35] cited significant cost savings in the Italian health system, but Pasquale et al.[37] observed that total hip arthroplasty would be cheaper than the treatment with viscosupplement.

CONCLUSION

The experts, authors of this study, conclude that the use of HA in the treatment of hip OA is a therapeutic alternative that should be used, even in severe cases, due to its safety, efficacy, improvement of pain and function, improvement of patients' quality of life, regardless of the type of HA used, thus emphasizing that the use of guided methods makes the procedure safer and more effective.

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