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ACTA ORTOPÉDICA BRASILEIRA

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(Reviewed April 2022)

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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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ACKNOWLEDGEMENTS

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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.

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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

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Original Article

HAND SURGERY AND MICROSURGERY

DISTAL NEUROTIZATION OF THE ANTERIOR INTEROSSEOUS NERVE TO RECOVER HAND GRASPING
NEUROTIZAÇÃO DISTAL DO NERVO INTERÓSSEO ANTERIOR PARA RECUPERAÇÃO DA PREENSÃO DA MÃO
Álvaro Baik Cho, Carlos Henrique Vieira Ferreira, Renan Martins Fontana, Gary Alan Ângulo Montano, Leandro Yoshinobu Kiyohara, Luiz Sorrenti
DOI: http://dx.doi.org/10.1590/1413-785220233101e257852

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ORIGINAL ARTICLE

HAND SURGERY AND MICROSURGERY

DISTAL NEUROTIZATION OF THE ANTERIOR INTEROSSEOUS NERVE TO RECOVER HAND GRASPING

NEUROTIZAÇÃO DISTAL DO NERVO INTERÓSSEO ANTERIOR PARA RECUPERAÇÃO DA PREENSÃO DA MÃO

Álvaro Baik Cho[1,2], Carlos Henrique Vieira Ferreira[1], Renan Martins Fontana[1], Gary Alan Ângulo Montano[1], Leandro Yoshinobu Kiyohara[1,2], Luiz Sorrenti[1,2]

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ABSTRACT

Lower trunk lesions are uncommon, representing about 3 to 5% of brachial plexus lesions in adults. One of the functions lost by patients who suffer this type of injury is the flexion of the fingers, with important harming of palmar grip. This series of cases proposes the transfer of a branch of the radial nerve to the anterior interosseous nerve (AIN), presenting a new alternative for the treatment of these lesions with highly satisfactory results. Objective: To demonstrate our strategy, technique, and results in the reinnervation of the AIN in lesions isolated from the lower trunk of the brachial plexus in four cases of high lesion of the median nerve. Method: Prospective cohort study in which four patients underwent neurotizations. The treatment was directed to the recovery of the fingers' flexors of the hand and the grip. Results: All patients presented reinnervation of the flexor pollicis longus (FPL) and deep flexors of the 2nd, 3rd, and 4th fingers. The deep flexor of the 5th finger also showed reinnervation but with reduced strength (M3/4) comparing to the others (M4+). Conclusion: Despite the limited number of cases in this and other studies, the results are uniformly good, allowing to consider this treatment predictable. ***Level of Evidence IV, Case Series.***

Keywords: Nerve Transfer. Microsurgery. Nerve Lesion.

RESUMO

As lesões do tronco inferior são incomuns, representando cerca de 3 a 5% das lesões do plexo braquial em adultos. Uma das funções perdidas pelos pacientes que sofrem esse tipo de lesão é a flexão dos dedos, com comprometimento importante da preensão palmar. Esta série de casos propõe a transferência de um ramo do nervo radial para o nervo interósseo anterior (NIA), apresentando uma nova alternativa para o tratamento dessas lesões com resultados altamente satisfatórios. Objetivo: Demonstrar nossa estratégia, técnica e resultados na reinervação do NIA em lesões isoladas do tronco inferior do plexo braquial em quatro casos de lesão alta do nervo mediano. Método: Estudo de coorte prospectivo no qual quatro pacientes foram submetidos a neurotizações. O tratamento foi direcionado para a recuperação dos flexores dos dedos da mão e da preensão. Resultados: Todos os pacientes apresentaram reinervação do flexor pollicis longus (FPL) e dos flexores profundos do 2º, 3º e 4º dedo. O flexor profundo do 5º dedo também apresentou reinervação, porém com força reduzida (M3/4) em relação aos demais (M4+). Conclusão: Apesar do número de casos limitados neste e em outros estudos, os resultados se mostram uniformemente bons, o que permite considerar esse tratamento previsível. ***Nível de Evidência IV, Série de Casos.***

Descritores: *Transferência de Nervo. Microcirurgia. Lesão do Nervo.*

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INTRODUCTION

Brachial plexus injuries mainly affect patients with polytrauma in high-energy accidents. In recent decades, with distal nerve transfers, including the procedure of transfer from the ulnar motor branch to the median nerve, popularly known as Oberlin,[1] significant advances have been made in surgical options for the treatment of peripheral nerve lesions. However, most of the studies reported so far focused on upper trunk lesions.

The lower trunk lesion, known as Dejeri-klumpk, is uncommon, representing about 3-5% of brachial plexus lesions in adults.[2] One of the functions lost in this specific group of patients is the flexion of the fingers, with important harming of the palmar grip, setting a great challenge for the surgeon. The literature has few reports for the treatment of lower trunk lesions. This study aims to demonstrate our strategy, technique, and results in the reinnervation of AIN in isolated lesions of the lower trunk of the brachial plexus in two cases and in two cases of high lesion of the median nerve.

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

The study was conducted at Hospital Estadual Mário Covas, Faculdade de Medicina do ABC.
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Objectives

Primary: to demonstrate our strategy, technique, and results in the reinnervation of the AIN in two cases of isolated lesions of the lower trunk of the brachial plexus and in two cases of high lesion of the median nerve.
Secondary: to demonstrate that the reinnervation of the AIN, contrary to common sense and most traditional textbooks, also promotes the reinnervation of the deep flexors of the 3rd, 4th, and 5th finger, in addition to the FPL and deep flexor of the 2nd finger, as described by Bertelli.[3]

METHODS

This is a prospective cohort study in which four patients underwent neurotizations for AIN between April 2015 and May 2018. The treatment aimed to recover the flexors of the fingers of the affected hand, for recovery of the grip, and the treatment was clinically evaluated by the BRMC strength scale. Preoperatively, potential donor nerves were clinically tested, specifically the pronation and flexion of the wrist to the median nerve and the supination of the forearm and extension of the wrist, fingers, and thumb to the radial nerve.

Description of surgical technique

An oblique "S" incision on the anterior aspect of the elbow between the brachioradial, proximal, and lateral muscle and the round, distal, and medial pronator muscle was performed. Fibrous lacertus was incised to identify the median nerve in the internal bicipital canal, along with the vascular bundle. The dissection of the median nerve extended from proximal to distal between the two heads of the round pronator muscle. Contrary to what Mackinon described, the pronator section was unnecessary for an adequate exposure of the median nerve and its branches. Only a release of the median nerve's superficial fascia and forearm pronation was sufficient and less aggressive than the pronator section. The AIN was easily identified in all cases because it is the only lateral branch and has a path parallel to the median nerve.
Regarding low plexus injury, since part of the median nerve function was preserved (wrist flexion and forearm pronation), we planned the use of one of these branches as a donor nerve for the AIN. Proximal to the origin of the AIN, in the anteromedial portion of the median nerve, we identified the branch for the round pronator muscle and for the radial flexor of the carpal (Figure 1). Intraoperatively, the nerves were tested with a nerve stimulator (StimuplexHNS12; B. Braun Melsungen AG) with intensity between 0.5 and 2.0 mA. One of the pronator branches was distally sectioned and anastomosed to the AIN, which was proximally sectioned.
In cases of high lesion of the median nerve, we chose the motor branch of the radial nerve as donor for the Short Carpal Radial Extensor (SCRE). After locating the medial margin of the brachioradial, it was retracted to lateral, exposing the radial sensory nerve. This branch is then dissected proximally to its origin in the radial nerve. The motor branch of the radial nerve for the SCRE is identified between the sensory branch and the largest main terminal branch, which is the posterior interosseous nerve (Figure 2). These nerve branches were also stimulated with the same protocol mentioned above, to confirm if an adequate contraction was obtained and if the chosen branch was correct. The AIN was dissected as distally as possible, while the SCRE branch of the radial nerve was dissected and sectioned as proximally as possible, along with its origin in the radial nerve. The AIN stump was folded to proximal and lateral, while the branch of the SCRE was folded to distal. Neurorrhaphy was performed via an internal epineural suture without tension with nylon 10-0 with the aid of a microscope and reinforcement with fibrin glue (tissucol).
Postoperatively, the limb was immobilized with an axillopalmar splint, with elbow in flexion and mideum prono-supination for two weeks, followed by a short antebrachial splint for another two weeks to protect neurorrhaphy.

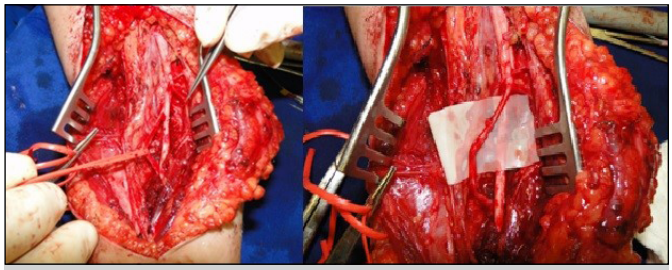

Figure 1. Identification and transfer of the branch of the round pronator to the anterior interosseous nerve.

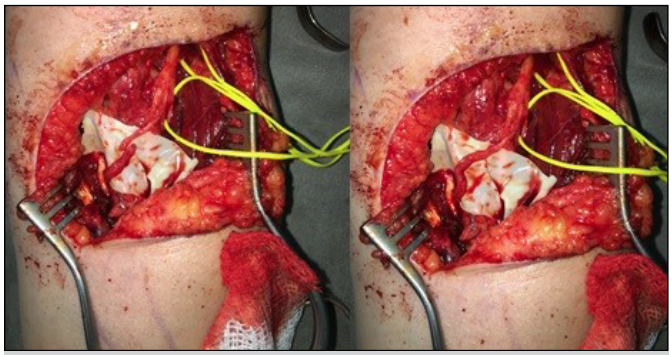

Figure 2. Identification and transfer of the branch of the short carpal radial extensor to the anterior interosseous nerve.

Case 1

Male, nine years old, with a history of car trampling in August 2014, evolving to an injury on the lower trunk of the right brachial plexus. On the physical examination, seven months after the injury, he presented eyelid ptosis, normal shoulder and elbow function, active flexion and extension of the wrist, extension of the wrist and fingers M0, pronation M4/5, flexion of the thumb and fingers of the hand M0, intrinsic M0.
Surgery was performed nine months after the initial date of the injury. The initial plan was to transfer the pronator teres (PT) muscle branch to the AIN and supinator branch to posterior interosseous nerve (PIN). However, only the transfer of the PT branch to AIN was performed, because the PIN responded to the electrical stimulus in the intraoperative period.
At six months postoperative (PO), the patient presented a return of the M3 function of the FPL and Deep Flexor of the 2nd and 3rd finger and absence of active extension of the fingers. After 10 months of PO, this evolved to M4 strength of FPL and 2nd and 3rd finger Deep Flexor.
In the final follow-up, after three years of surgery, the patient presented M4+ strength of the FPL and Deep Flexor of the 2nd, 3rd, 4th, and 5th fingers, active extension with M4 strength of the extensors of the right hand fingers.

Case 2

A 51-year-old patient with a history of schwannoma resection in the left axillary region, with a defect resulting from approximately 4 cm of the median nerve. Repair of the median nerve was performed with a graft of the lateral cutaneous nerve of the forearm at the same surgical time. After six months of PO, the patient maintained the

flexion of the thumb fingers M0 and a neurotization of the branch of the SCRE muscle was performed for AIN.
Two months after the nerve transfer, the patient presented M3 force of the FPL and Deep Flexor of the 2nd, without any deficit in radial nerve function. After two years of follow-up, significant improvement in the strength of FPL and Deep Flexor of the 2nd, 3rd fingers M4+, and 4th and 5th fingers M3/4 were observed.

Case 3

A 35-year-old patient with history of a lymph node biopsy in the left armpit. Intraoperatively, the surgeon found that it was a tumor of the lower trunk of the brachial plexus and opted for resection of the brachial plexus. In the anatomopathological postoperative, the diagnosis of schwannoma was confirmed. In the immediate postoperative period, the patient presented total paralysis of the superficial and deep flexors of all fingers and intrinsic muscles of the left hand, in addition to loss of strength (M2/3) of wrist flexors and pronators. The wrist and fingers extensors presented M3 strength and the triceps was normal. Shoulder and elbow function was not affected at any time. After 4 months of the initial injury, the strength of the extensors of the fingers and wrist, with Force M4/5, improved. However, the flexors of the fingers and the intrinsic of the hand did not recover. The strength of the wrist flexors and pronators remained in M3. At that moment, we performed the neurotization of the SCRE branch for AIN.
Three months postoperatively, the patient presented M3 strength of the FPL and flexors of the 2nd and 3rd finger, maintaining the extensor strength. In the last follow-up, after two years, the patient presented M4+ of the FPL and 2nd and 3rd fingers, and M4 of the 4th and 5th fingers.

Case 4

A 66-year-old patient with a history of reverse prosthesis in the right shoulder presented a motor and sensory deficit in the territory of the median nerve. After four months of injury, the patient showed motor strength M0 of the FPL and the deep flexor of the 2nd finger, and M4 of 3rd to the 5th fingers, characteristic of a paralysis of the AIN. Wrist extenders and fingers remained the same. The patient showed no motor or sensory deficit in ulnar nerve territory.
After clinical follow-up for six months without improvement of the condition, the patient was subjected to the procedure of transfer branch of the SCRE to AIN (10 months after the injury). At two months after surgery, the patient presented motor strength M2/3 for FPL and deep flexor of the 2nd finger. After six months, the patient presented M4+ motor strength for FPL and Deep Flexor M4 of the 2nd finger.

RESULTS

All patients presented FPL reinnervation, and deep flexors of the 2nd, 3rd, and 4th finger. The deep Flexor of the 5th finger also presented reinnervation, but with reduced force (M3/4) compared to the other fingers (M4+).
The mean time to observe the first visible contractions of the FPL and FDP of the 2nd, 3rd, 4th, and 5th finger was around three months, with progressive strength gain in the subsequent months (Table 1). We did not notice strength loss of donor nerves, round pronator, or wrist extensor in any case.

DISCUSSION

Due to the poor functional prognosis of lower trunk lesions in adults, repair of the roots of C8 and T1 are not routinely indicated.[4] In most cases, the emphasis of surgeons is on rebuilding the higher roots. Although isolated lesions of the lower trunk are much less frequent, they result in significant loss of motor function of the hand, since these lesions compromise the median and ulnar nerves.[3] Similarly, in high lesions of the median nerve, post-traumatic or after tumor resection, although the nerve can be repaired with graft interposition, the results are poor in most cases, resulting in loss of grip.
The Anterior Interosseous Nerve (AIN) is the only branch that emerges on the lateral face of the median nerve, approximately

Table 1. Summary of cases, showing patients' age, lesion etiology, time, and postoperative results.

Patient	Age	Etiology	Date of injury	Date of surgery	Pre op Physical examination	Pre op Physical examination	
K/male	15 years old	Collision bike vs. car	Aug 14	**April 2015** (Transfer branch of the round pronator to AIN).	**03/30/2015**	**02/06/2016**	**05/27/2019**
					Elbow 0 – 130	Elbow 0 – 130	Elbow 0 – 130
					Handle flex 80° ext 70°	Handle flex 80° ext 70°	Handle flex 80° ext 70°
					Flexion of fingers and thumb: absent	Flexion fingers and thumb: present GM4, extension of the fingers absent	Flexion fingers and thumb: present GM4, extension of the fingers absent
S/female	51 years old	Left armpit schwannoma	Nov 17	**November 2017** (schwannoma resection)	**05/10/2018**	**07/12/2018**	**01/30/2020**
					Elbow 0 – 130	Elbow 0 – 130	Elbow 0 – 130
				May 2018 (Transfer of the SCRE branch to NIA)	Handle flex 80° ext 70°	Handle flex 80° ext 70°	Handle flex 80° ext 70°
					Flexion of thumb and finger: absent	Flexion of thumb and fingers: present GM4	Flexion of thumb and 2nd finger: present GM5
I/female	35 years old	Right armpit schwannoma	Jan 18	**May 2018** (Transfer of the SCRE branch to NIA)	**05/23/2018**	**08/30/2018**	**03/11/2020**
					Elbow 0 – 130	Elbow 0 – 130	Elbow 0 – 130
					Handle flex 80° ext 70°	Handle flex 80° ext 70°	Handle flex 80° ext 70°
					Flexion of thumb and finger: absent	Flexion of thumb and fingers: present GM3	Flexion of thumb and fingers: present GM3
m/female	66 years old	PO of shoulder arthroplasty	April 20	**Set 2020** (Transfer of the SCRE branch to AIN)	**09/03/2020**	**11/07/2020**	**03/25/2021**
					Elbow – 0 – 130	Elbow – 0 – 130	Elbow – 0 – 130
					Handle flex 80° ext 70°	Handle flex 80° ext 70°	Handle flex 80° ext 70°
					Handle flex 80° ext 70°		
					Flexion of thumb and finger: absent	Flexion of thumb and fingers: present GM2	Flexion of thumb and fingers: present GM5

5 cm distal to the intercondylar line of the humerus. After the origin of AIN, there is a path parallel to the median nerve, located in the interval between the Flexor Pollicis Longus (FPL) and the Flexor Digitorum Profundus (FPD) innervating these two muscles. The AIN has a constant branch for the deep flexor of the indicator and partially innervates the deep flexor of the middle finger. However, Bertelli questions this knowledge and by direct clinical observation, he stated that the AIN also contributes to the innervation of the deep Flexor of the 3rd, 4th and 5th finger.[3]

Although most studies are based on small cases, distal nerve transfer focused on the reinnervation of the AIN, via motor branches of the radial (SCRE) or the preserved portion of the median nerve (PT, CRF), has shown promising results by several authors.[3,5-8]

Mackninon and Novak[6] report several advantages of the transfer of distal nerves to AIN, such as the proximity of motor plate receptors, elimination of the lesion area, and the guarantee of an axon source of a functioning donor nerve. Transferring a distal nerve close to the target muscle decreases the prolonged regeneration time, converting a proximal level lesion into a more distal one.[6]

We reported our results in a consecutive series of four patients treated with nerve transfer as a target to reinnervation of the AIN, aiming to restore the functions of the median nerve in the hand, especially the grip. The surgical procedure proved has low complexity and reproducible. All patients recovered flexion of all fingers, with significant improvement in grip function. Although the muscle strength obtained was higher in the FPL and deep flexor of the 2nd and 3rd fingers, the deep flexor of the 4th and 5th fingers exhibited functional recovery (M3/4) in all cases. The function of the deep flexor of the 5th finger was always inferior to the other fingers; however, it showed strength M3/4, thus, it was useful and satisfactory. Moreover, morbidity was minimal, since we observed no sequelae of donor nerves, either in the branches of the radial nerve or round pronator.

The time interval for recovery of FPL and deep flexor of the 2nd, 3rd, 4th, and 5th finger was surprisingly short, on average three months, with progressive gain of muscle strength during follow-up for up to two years after nerve transfer.

Other authors have also described similar experiences[3,5-8] with the reinnervation of the AIN. Bertelli's study[3] reports experiences in the reconstruction of thumb and finger flexion in four patients with extensive upper limb palsy due to high median nerve injury or C7-T1 brachial plexus avulsion, transferring the branch of the short carpal radial extensor (SREC) nerve to the anterior interosseous nerve (AIN) after eight months of surgery, all patients recovered total flexion of the fingers and thumb in an average period of 13 months postoperatively. The average grip strength was 5 kg and the tightening strength was 2 kg. Wrist extension was preserved in all patients. Despite residual sensory deficits, patients were able to use their hands regularly in daily life.

This technique should always be considered in lower brachial plexus lesions (C8-T1) or in upper lesions of the median nerve, for the restoration of thumb and finger flexion, when viable donor nerves are preserved, in particular the motor branch of PT or CRF or the branch of the SREC.

Restoration of thumb and finger grip function via nerve transfer of the SREC branch or PT to AIN proved to be a reliable and reproducible procedure. All patients recovered flexion of all fingers and not only FPL and FDP of the 2nd finger, with significant improvement in grip function.

CONCLUSION

Despite the limited number of cases in this and other studies, the results were uniformly good, and this treatment may be predictable. Due to the relative rarity of these lesions, prospective multicentric studies should be encouraged to confirm the good reputation of this technique via results with better scientific evidence.

AUTHORS' CONTRIBUTIONS: Each author contributed individually and significantly to the development of this article. ABC: review of the article, performing surgeries, and intellectual concept of the article; CHVF: writing, performing surgeries, data analysis, reviewing the article, and intellectual concept; RMF, GAAM: writing the article and analyzing the data; LYK, LS: article review, data analysis, and performing surgeries.

REFERENCES

1. Oberlin C. Neurotization of the nerve of the biceps muscle by fascicle from the ulnar nerve in C5 C6 avulsion of the brachial plexus. Proceedings of the 11th Symposium on the Brachial Plexus; 1994; Lausanne. Lausanne: [publisher unknown]; 1994.
2. Midha R. Epidemiology of brachial plexus injuries in a multitrauma population. Neurosurgery. 1997;40(6):1182-9.
3. Bertelli JA. Transfer of the radial nerve branch to the extensor carpi radialis brevis to the anterior interosseous nerve to reconstruct thumb and finger flexion. J Hand Surg Am. 2015;40(2):323-328.e2.
4. Caetano EB, Vieira LA, Sabongi Neto JJ, Caetano MBF, Sabongi RG. Anterior interosseous nerve: anatomical study and clinical implications. Rev Bras Ortop. 2018;53(5):575-81.
5. Bertelli JA, Ghizoni MF. Transfer of supinator motor branches to the posterior interosseous nerve in C7-T1 brachial plexus palsy. J. Neurosurg. 2010;113(1):129-32.
6. Mackinnon SE, Novak CB. Nerve transfers. New options for reconstruction following nerve injury. Hand Clin. 1999;15(4):643-66.
7. Zhao X, Lao J, Hung LK, Zhang GM, Zhang LY, Gu YD. Selective neurotization of the median nerve in the arm to treat brachial plexus palsy. An anatomic study and case report. J Bone Joint Surg Am. 2004;86(4):736-42.
8. García-López A, Sebastian P, Martinez F, Perea D. Transfer of the nerve to the brachioradialis muscle to the anterior interosseous nerve for treatment for lower brachial plexus lesions: case report. J Hand Surg Am. 2011;36(3):394-7.

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EFFECTS OF BARIATRIC SURGERY ON KNEE JOINT PAIN

EFEITOS DA CIRURGIA BARIÁTRICA NA DOR DA ARTICULAÇÃO DO JOELHO

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ABSTRACT

The World Health Organization (WHO) estimates that by 2025 about 2.3 billion adults will be overweight, with more than 700 million obese. Obese patients with joint pain and reduced physical function represent a challenging group to treat effectively. Objective: To evaluate patients undergoing bariatric surgery and the implications of this surgery on knee joint pain and to conduct anamnesis and apply specific questionnaires to deepen the discussion and elucidate the knee joint symptoms related to obesity. Methods: Observational cross-sectional study with tabulation and analysis of collected data. Results: We obtained a significant result when comparing knee pain pre and post-surgery, in which pain increased by 15.8%. Conclusion: Although worsening or maintenance of pain may occur, this fact is associated to factors such as the increase of functional activities of a joint that was previously in disuse and the loss of muscle mass as a sustainer. We concluded that the improvement of joint pain complaints were mainly due to the reduction of joint overload. ***Level of Evidence IV, Case Series.***

Keywords: Pain. Joints. Knee. Obesity. Bariatric Surgery.

RESUMO

A estimativa da Organização Mundial da Saúde é que, em 2025, cerca de 2,3 bilhões de adultos estarão com excesso de peso e, destes, mais de 700 milhões com obesidade. Pacientes obesos com dor nas articulações e função física reduzida representam um grupo desafiador para o tratamento efetivo. Objetivo: Avaliar pacientes submetidos à cirurgia bariátrica e as implicações dessa cirurgia na dor da articulação do joelho, assim como realizar anamnese e aplicação de questionários específicos para aprofundar a discussão e elucidar os sintomas articulares no joelho relacionados à obesidade. Métodos: Estudo transversal observacional com tabulação e análise de dados coletados. Resultados: Obteve-se um resultado significativo na comparação da dor no joelho pré e pós-cirurgia, havendo um aumento da dor de 15,8%. Conclusão: Ainda que resultados de piora ou manutenção da dor possam ocorrer, associados ao aumento das atividades funcionais de uma articulação até então em desuso e à perda da massa muscular como sustentador, por exemplo, a maioria dos participantes relatou melhora das queixas álgicas articulares, principalmente em decorrência da diminuição da sobrecarga articular. ***Nível de Evidência IV, Série de Casos.***

Descritores: *Dor. Articulações. Joelho. Obesidade. Cirurgia Bariátrica.*

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INTRODUCTION

The World Health Organization (WHO) estimates that by 2025 about 2.3 billion adults will be overweight, with more than 700 million obese.[1] Obesity affects several systems of the body, including the musculoskeletal system, representing risks that affect the quality of life of affected individuals.[1] Moreover, mechanical factors with increased load on joints contribute to degenerative joint diseases, significant increase in pain, loss of mobility, and arthropathies.[2]

Obese patients with joint pain and reduced physical function represent a challenging group to treat effectively. Joint pain is associated with osteoarthritis, and obesity is a risk factor for its increased incidence and progression. Other key factors that contribute to joint alterations associated with obesity are advanced age, female gender, smoking, diabetes, and physical workload, especially in the knee.[3]

Bariatric surgery has contributed not only to weight reduction but also to the management of comorbidities associated to obesity.[3] With weight loss, it is hypothesized that the reduction of overload and the reduction of joint symptoms may be an ally for a more efficient treatment in this group of patients.[4]

This study is justified by the need to deepen, discuss, and elucidate the articular symptoms of the knee, as well as the support of bariatric surgery as a key factor for weight loss and reduction

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of joint overload. Still by the need to promote new studies related to the casuistry to help in the reflection of such a relevant theme for public health.

Primary objective

To evaluate patients undergoing bariatric surgery and the implications of this surgery on knee joint pain.

Secondary objective

To perform anamnesis, apply specific questionnaires to deepen the discussion and elucidation of knee joint symptoms that are related to obesity.

MATERIALS AND METHODS

The method defined for the study is cross-sectional, observational with tabulation and analysis of data collected throughout the study. For data collection in the study, a questionnaire was used to evaluate the profile of the patients regarding gender, comorbidities, body mass index (BMI), consultation in the orthopedic clinic, physical activity, and use of medications or complementary therapies for pain control. A modified Nordic Musculoskeletal Symptoms Structured Questionnaire (QNSO) was used to evaluate knee pain. The instrument consists of multiple or binary choices as to the occurrence of symptoms in the various anatomical regions in which they are most common. The respondent should report the occurrence of symptoms considering the 12 months and seven routine days in the year preceding the interview, as well as report the occurrence of absence from activities.[5,6]

The osteoarthrosis-specific quality of life questionnaire (WOMAC) was also used. This questionnaire has been widely used in research and was validated in 2002 for use in the Brazilian population, maintaining its original parameters. It assesses three domains: pain, stiffness, and function, considered central to the evaluation of patient outcomes and the gold standard of measurement in knee osteoarthritis. After the answers, they are transformed into a score based on a Likert-type scale ranging from 0 to 4 points. The highest score reached by the sum of the points shows greater impairment in the domains cited.[7]

We evaluated patients seen at the Orthopedics and Traumatology Department of the Hospital do Servidor Público Municipal of São Paulo who underwent bariatric surgery. They met the criteria of BMI of 40 kg/m^2 or BMI of 35 kg/m^2 to 40 kg/m^2 with comorbidities, BMI of 30 kg/m^2 to 35 kg/m^2 in Diabetes Mellitus II refractory to clinical treatment.[8]

All patients signed an informed consent form. The protocol was approved by the Ethics Committee of Hospital do Servidor Público Municipal of São Paulo under opinion number 4.589.682.

Inclusion criteria:

- Patients under outpatient follow-up;
- Clinical diagnosis of obesity subjected to bariatric surgery.

Exclusion criteria:

- Cognitive alterations that prevent the application of the questionnaire;
- Loss of outpatient follow-up;
- Bariatric patients under 18 years.

RESULTS

In the analyzed period, 38 people who underwent bariatric surgery answered the questionnaires. According to the analyses, 32 (84.2%) of the 38 research participants (84.2%) were female and six (15.8) were male.

When analyzing the BMI, we observed a higher prevalence of overweight people (BMI 25 to 29.9) and grade I obesity (BMI 30–34.9); characterized by 12 (32%) and 15 (39%) respectively.

When we asked the participants if they had ever been to an orthopedic consultation, 20 people (52.6%) answered that they had never been to the specialty, seven people (18.4%) had been before and after bariatric surgery, four people (10.5%) went after bariatric surgery, and seven people (18.4%) went only before bariatric surgery. Of the people who visited the orthopedic specialist, nine people (23.7%) reported pain or discomfort in the knee (Table 1).

All patients (100%) underwent surgery using the Roux-en-Y gastroplasty technique (gastric bypass).

Of the 38 respondents, 33 (86.8%) did not perform physical exercises before bariatric surgery. Of the five people who reported doing some type of physical activity, two people (94%) walked, one person (2%) danced, one person (2%) did water aerobics, and one person (2%) did weight-training and dance classes. Regarding the weekly frequency, three people (7.9%) did their activities three times per week.

When comparing the performance of physical activities before and after bariatric surgery, we observed a considerable increase of people who started to perform physical activities after the surgery. The number of respondents who started performing physical activities after surgery increased from five (13.2%) to 27 (71.1%). Walking (7; 18.4%) and water aerobics (2; 5.3%) were the most adhered activities. Some also associated two activities, such as hydrogymnastics and weight-training (2; 5.3%). Others performed only weight-training (2; 5.3%).

Regarding the number of times per week, we noticed a significant increase. Most individuals (8; 21.1%) started doing physical activity three to five times per week. Two people (5.3%) started doing activity six times per week, and one person (2.6%) every day of the week.

In the postoperative evaluation with the QNSO, 22 patients (57.9%) reported knee pain that limited their daily activities (Table 2). On the pain scale, from 0 to 10, the reported average was 5.39.

The patients were analyzed in relation to knee pain by the WOMAC. On average, 50% of the interviewees reported feeling no pain during the activities to evaluate knee pain after bariatric surgery. Regarding knee pain after light walking on flat ground, 20 people (52.6%) reported feeling no pain and mild pain in 36.8% of the cases. Only one person (2.6%) reported a great difficulty when walking on flat ground.

About pain when climbing or descending stairs, the patients reported no pain (12; 31.6%), mild pain (14; 36.8%), and moderate pain (9; 23.7%). Analyzing the difficulty when going downstairs,

Table 1. Knee-related pain after orthopedic consultation.

KNEE_PAIN_CLASS				
	Frequency	%	% Valid	% Cumul.
No	10	26.3	26.3	26.3
Yes	9	23.7	23.7	50.0
Not applicable	19	50.0	50.0	100.0
Total	38	100.0	100.0	

%: percentage; % Cumul.: cumulative percentage.

Table 2. Responses to the modified Nordic Musculoskeletal Symptoms Structured Questionnaire regarding the knee.

KNEE_PAIN	Frequency	%	% Valid	% Cumul.
No	15	39.5	40.5	40.5
Yes	22	57.9	59.5	100
Total	37	97.4	100	
No data	1	2.6		
Total	38	100		

%: percentage; % Cumul.: cumulative percentage.

14 people (36.8%) reported mild difficulty or no difficulty (36.8%). We found no difference regarding climbing stairs, as 14 people (36.8%) reported slight difficulty or no difficulty (34.2%).
Regarding pain when lying down at night, 19 people (50%) reported feeling no pain and 16 (42.1%) reported mild pain. A total of 42.1% reported feeling no pain sitting or standing up and 39.5% reported feeling mild pain. Only three people reported feeling moderate (15.8%) or severe (7.9%) pain when standing up. Regarding stiffness when waking, lying down, sitting and/or resting, nine people (23.7%) had moderate or strong stiffness (5.3%).
Only three people (7.9%) reported strong difficulty when getting up from a chair and eight people (21.1%) reported moderate difficulty. Most patients had no (44.7%) or mild (42.1%) difficulty in standing up after 72 h from surgery.
Most patients (18; 47.4%) had no difficulty getting out of bed, lying in bed (22; 57.9%), putting on the stocking (15; 39.5%), and taking off the stocking (16; 42.1%).
Regarding daily activities, more than half (55.3%) had no difficulty getting in or out of the shower; 15 people (39.5%) had mild or no difficulty (39.5%) in sitting down or getting up from the toilet.
When questioned about heavy household tasks, the number of people who reported no difficulty or moderate difficulty was the same, 12 people, representing 31.6% for each level. For light household tasks, one person (2.6%) reported strong difficulty.
Comparing the data compiled in the initial questionnaire that outlined the profile of the research participants and the QNSO, we had a significant result regarding the knee pain pre and post surgery. There was a 15.8% increase in pain (Table 3).

DISCUSSION

With the rising levels of obesity in Brazil, the risk of osteoarthritis increases. Obesity is one of the risk factors for osteoarthritis that can be modified, thus maintaining adequate body weight at all ages is recommended to avoid complications.[9] A variety of methods can be used to treat osteoarthritis, including medications, exercise (with or without diet), and bariatric surgery.
In the United States of America (USA), the overall prevalence of knee pain in the adult population is 20%, with more than 61 million people affected. By 2025, it is projected to increase to 25% of the affected population.[3]
Studies show that for every kilogram lost, the load on the knee from excess weight is reduced twice. With this comorbidity increasingly present in young patients, the demand for "faster" weight loss has increased dramatically, and thus bariatric surgery is widespread.[3]
Vicent et al.[4] found data suggesting that individuals with knee joint pain complaints in the preoperative period of bariatric surgery had improvements, and it was considered a predictor of a better quality of life.
According to Abu-Abeid et al.[10] the female population (68%) was the most affected by obesity, whereas in the study by Groen et al.,[11] it corresponded to (72%) of people with obesity. These studies corroborate the results of our study, in which the female population (84%) composed most cases. The prevalence of obesity in the female population increases in the age group starting at 54 years, and our average among women is 48.5 years.[12]
Patients subjected to weight loss present gait alterations, such as increased flexion and extension range of motion, external and internal rotation, and better distribution of joint stress. Improvements in gait kinematics, stride length, and cadence are also observed. This contributed to the results found, such as an increase in physical activity after bariatric surgery, considering the facilitation of patient mobility.[13]
Several authors correlate knee pain and obesity due to the overload that this joint suffers with overweight.[3,11,14,15] Growing evidence indicates that regardless of the method of weight loss, reducing body fat can reduce the mechanical and biochemical stressors that contribute to joint degeneration. Compared with our survey, although all patients had bariatric surgery, there was a significant increase in exercise post surgery.[16] Before bariatric surgery, five people (13.2%) did some type of physical activity. After the surgery, this number increased to 27 (71.1%).
According to the study by Vincent et al.,[15] the improvement in lower back and knee pain after three months of bariatric surgery was significant. Those who reported no pain went from 25% to 50% in the third month after the surgery. The most obvious pain reduction effects occurred in the knee and lower back compared to other joints. Weight loss seemed to be directly related to the magnitude of pain relief in the lower back and knee, but not as strongly related for other joints. In our study, several joints were evaluated through the questionnaires. The biggest complaints of the patients are lower back pain (60.5%), knee pain (57.9%), and shoulder pain (44.7%), corroborating the studies.
When we compared our survey with other studies in comparison to the WOMAC Questionnaire, we noticed that the complaint of pain is mostly none (36.8%) or mild (47.4%) if evaluated after bariatric surgery.[17]
Regarding stiffness, we found most patients complained of none (44.7%) or mild stiffness (23.7%). Patients complained of no (42.1%) or mild (34.2%) degree of difficulty in function, which may be correlated with the significant increase in patients who started exercises after bariatric surgery. The performance of constant exercises as an aid in improving functional capacity and reducing joint stiffness is cited in several studies.[3,17,18]
Regarding the data collected with the QNSO, we verify that 57.9% complained of knee pain after bariatric surgery. However, when we compared the knee pain reported in the pre-surgery questionnaire, we observed an increase in pain of 15.8%.
Bariatric surgery with the Roux-en-Y gastric bypass technique triggers considerable loss of lean body mass, a reflection of the inadequate energetic-protein supply, which may cause a disorder in metabolism, increased proteolysis due to major restrictions to provide substrate to gluconeogenesis. This tends to worsen joint pain, corroborating the results found of increased joint pain in 15.8% of patients in the postoperative period.[19]
Hamdi et al.[3] reinforces that there is a need for personalized exercise programs for bariatric surgery patients to strengthen their muscles, preserve their lean mass and thus prevent the progression of knee pain due to overexertion.

Table 3. Cross between knee pain reported at initial visit to orthopedics (pre bariatric surgery) and after response to questionnaires (post bariatric surgery).

KNEE_PAIN_PRE × KNEE_PAIN_POST crossing				
		Post knee pain		Total
		No	Yes	
Pre knee pain	No	36.8%	15.8%	52.6%
	Yes		47.4%	47.4%
Total		36.8%	63.2%	100%
Fisher's test: p = 0.002				

CONCLUSION

This research assumed that weight loss and the reduction of joint overload would contribute to the reduction of joint pain complaints. During the study, we found that female subjects constituted the largest number of participants in the research. After the surgery, more people started to perform physical activities and the frequency of regular physical exercises increased.

There was also considerable or total improvement in pain complaints, stiffness, and functionality when the WOMAC questionnaire was analyzed. When the QNSO and the patient profile questionnaire were analyzed, we observed the maintenance or non-expressive but significant increase in the pain complaint of the knee.

We concluded that the improvement of joint pain complaints were mainly due to the reduction of joint overload. Even though worsening or maintenance of pain may occur, this fact is associated to factors such as the increase of functional activities of a joint that was previously in disuse and the loss of muscle mass as a sustainer.

AUTHORS' CONTRIBUTIONS: Each author contributed individually and significantly to the development of this article. CCR: writing of the draft, formal analysis, investigation, conceptualization, supervision, review, editing; RSP, IAP, HEFC: writing of the original draft, formal analysis, investigation; RYS, PPC: data curation, review, editing.

REFERENCES

1. Birn I, Mechlenbur I, Liljensøe A, Soballe K, Larsen JF. The association between preoperative symptoms of obesity in knee and hip joints and the change in quality of life after laparoscopy Roux-en-Y gastric bypass. Obes Surg. 2016;26(5):950-6.
2. El-Khani U, Ahmed A, Hakky S, Nehme J, Cousins J, Chahal H, Purkayastha S. The impact of obesity surgery on musculoskeletal disease. Obes Surg. 2014;24(12):2175-92.
3. Hamdi A, Albaghdadi AT, Ghalimah B, Alnowiser A, Ahmad A, Altaf A. Bariatric surgery improves knee function and not knee pain in the early postoperative period. J Orthop Surg Res. 2018;13(1):82.
4. Vincent HK, Vincent KR, Seay AN, Hurley RW. Functional impairment in obesity: a focus on knee and back pain. Pain Manag. 2011;1(5):427-39.
5. Pinheiro FA, Tróccoli BT, Carvalho CV. Validação do Questionário Nórdico de Sintomas Osteomusculares como medida de morbidade. Rev Saude Publica. 2002;36(3):307-12.
6. Kuorinka I, Jonsson B, Kilbom A, Vinterberg H, Biering-Sørensen F, Andersson G, Jørgensen K. Standardised Nordic questionnaires for the analysis of musculoskeletal symptoms. Appl Ergon. 1987;18(3):233-7.
7. Fernandes MI. Tradução e validação do questionário de qualidade de vida específico para osteoartrose WOMAC (Western Ontario and McMaster Universities) para a língua portuguesa [master's thesis]. São Paulo: Unifesp; 2002.
8. Conselho Federal de Medicina (BR). Resolução CFM nº 2.172/2017: reconhece a cirurgia metabólica para o tratamento de pacientes portadores de diabetes mellitus tipo 2, com IMC entre 30 kg/m^2 e 34,9 kg/m^2, sem resposta ao tratamento clínico convencional. Diário Oficial da União. 2017 Dec 27;1:205.
9. Santos MTN, Freitas AE, Lamounier JA. Obesidade e osteoartrite: atualização em implicações clínicas e metabólicas. Rev Med Minas Gerais. 2008;18(4 Suppl 1):S167-72.
10. Abu-Abeid S, Wishnitzer N, Szold A, Liebergall M, Manor O. The influence of surgically-induced weight loss on the knee joint. Obes Surg. 2005;15(10):1437-42. Erratum in: Obes Surg. 2006;16(4):530.
11. Groen VA, van de Graaf VA, Scholtes VAB, Sprague S, van Wagensveld BA, Poolman RW. Effects of bariatric surgery for knee complaints in (morbidly) obese adult patients: a systematic review. Obes Rev. 2015;16(2):161-70.
12. Brasil. Ministério da Saúde. Secretaria de Vigilância em Saúde. Departamento de Análise em Saúde e Vigilância de Doenças Não Transmissíveis. Vigitel Brasil 2019: vigilância de fatores de risco e proteção para doenças crônicas por inquérito telefônico: estimativas sobre frequência e distribuição sociodemográfica de fatores de risco e proteção para doenças crônicas nas capitais dos 26 estados brasileiros e no Distrito Federal em 2019. Brasília (DF): Ministério da Saude; 2020.
13. Li JS, Tsai TY, Clancy MM, Li G, Lewis CL, Felson DT. Weight loss changed gait kinematics in individuals with obesity and knee pain. Gait Posture. 2019;68:461-5.
14. Vincent HK, Heywood K, Connelly J, Hurley RW. Obesity and weight loss in the treatment and prevention of osteoarthritis. PM R. 2012;4(5 Suppl):S59-67.
15. Vincent HK, Ben-David K, Conrad BP, Lamb KM, Seay AN, Vincent KR. Rapid changes in gait, musculoskeletal pain, and quality of life after bariatric surgery. Surg Obes Relat Dis. 2012;8(3):346-54.
16. Thomaz AC. Efeito do aconselhamento nutricional no emagrecimento e consumo alimentar de idosas com osteoartrite de joelho [master's thesis]. Curitiba: UFPR; 2017.
17. Colares WTHC, Chixaro JO, Pimenta YS, Oliveira Filho KP, Gentil YSA, Ferreira R, et al. Prevalência de dor musculoesquelética nos pacientes antes e após cirurgia bariátrica: uma avaliação sistêmica. Brazilian Journal of Health Review. 2020;3(6):16549-58.
18. Brigato LLJJ. Efeito da mobilização articular sobre a funcionalidade em indivíduos com osteoartrite do joelho. Uberlândia: UFU; 2018.
19. Cunha SFC, Sanches M, Faria A, Santos JE, Nonino-Borges CB. Evolução da massa corporal magra após 12 meses da cirurgia bariátrica. Rev Nutr. 2010;23(4):535-41.

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EPIDEMIOLOGICAL PROFILE AND EVOLUTION IN MUSCULOSKELETAL TUMORS AT THE LEVEL OF THE ELBOW

PERFIL EPIDEMIOLÓGICO E EVOLUÇÃO NOS TUMORES MUSCULOESQUELÉTICOS AO NÍVEL DO COTOVELO

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ABSTRACT

Objective: To present the epidemiological profile of bone and soft tissue tumors that affect the elbow region treated at an oncology referral center in Brazil. Methods: Retrospective observational case series study to evaluate the results of elbow cancer undergoing clinical and/or surgical treatment with the first visit from 1990 to 2020. The dependent variables were benign bone tumor, malignant bone tumor, benign soft tissue tumor, malignant soft tissue tumor. Independent variables were sex, age; presence of symptoms (pain/increase in local volume/fracture); diagnosis; treatment and recurrence. Results: In total, 37 patients were included, 51.35% of whom were female, with a mean age at diagnosis of 33.5 years. Soft tissue neoplasms correspond to 51% of cases against 49% of bone tumors. Among the symptoms, the general prevalence of pain was 56.75%, the general increase in local volume occurred in 54.04% of the patients and the presence of fractures in 13.43%. Surgical treatment occurred in 75.67% of cases and recurrence in 16.21% of cases. Conclusion: The tumors that affect the elbow in our series correspond mostly to benign tumors, involving bone or soft tissues, with a higher occurrence in young adult patients. ***Level of Evidence IV, Case Series.***

Keywords: Neoplasms. Sarcoma. Elbow. Amputation. Tumor Local Recurrence.

RESUMO

Objetivo: Apresentar o perfil epidemiológico dos tumores ósseos e de partes moles que acometem a região do cotovelo. Métodos: Estudo observacional retrospectivo de série de casos para avaliação dos resultados de neoplasia do cotovelo submetidos a tratamento clínico e/ou cirúrgico cujo primeiro atendimento se deu entre 1990 e 2020. As variáveis dependentes foram: tumor ósseo benigno, tumor ósseo maligno, tumor de partes moles benigno, tumor de partes moles maligno. A variáveis independentes foram: sexo; idade; presença de sintomas (dor, aumento de volume local, fratura); lateralidade; diagnóstico; tratamento; e recidiva. Resultados: Foram incluídos 37 pacientes, sendo 51,35% do sexo feminino, com média de idade ao diagnóstico de 33,5 anos. As neoplasias de partes moles correspondem a 51% dos casos contra 49% de tumores ósseo. Dentre os sintomas a prevalência geral de dor foi de 56,75%, foi observado o aumento geral de volume local em 54,04% pacientes e a presença de fraturas em 13,43%. O tratamento cirúrgico ocorreu em 75,67% dos casos e a recidiva em 16,21%. Conclusão: Nesta série, os tumores que acometem o cotovelo são majoritariamente tumores benignos, de acometimento ósseo ou de partes moles, com maior ocorrência em pacientes adultos jovens. ***Nível de Evidência IV, Série de Casos.***

Descritores: *Neoplasias. Sarcoma. Cotovelo. Amputação. Recidiva Local de Neoplasia.*

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INTRODUCTION

Bone tumors, malignant or benign, are rare lesions compared to other neoplasms, and the involvement of the elbow region is even less common, corresponding to about 1% of bone neoplasms.[1] Although bone and soft tissue tumors of the elbow and forearm are rare, the general orthopedist should be aware that these tumors may occur and should be prepared to treat them properly.[2]

Most available texts in the medical literature on neoplastic elbow lesions are related to case reports. Few articles address the incidence of bone neoplasms in this region due to their rarity; but they generally show similar data reporting the distal end of the humerus

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as the part of highest incidence,[1,3] and corresponding to benign neoplasms.[3,4] To date, the literature only has two case series review studies, with groups of 25[3] and 75[1] patients.

The study of the elbow is particularly important due to the anatomical complexity of the main neurovascular structures that are close to each other (median nerve and brachial artery with its division into ulnar artery and radial artery in the anterior part, ulnar nerve at the medial edge, and radial nerve at the lateral edge) and the small amount of soft tissue, especially in the posterior part. This may hinder resection with a wide oncological margin, as these neurovascular structures and coverage and reconstruction options may be affected.[5] Moreover, tumors in the elbow region usually have higher rates of residual disease and, thus, a higher incidence of local recurrence.[5]

Differential diagnosis of a patient with bone or soft tissue mass includes infection, neoplasia, trauma, and inflammatory processes; pain is the most common but non-discriminatory symptom. With a good anamnesis, careful physical examination and aid of imaging tests, such as plain radiographs, diagnosis can usually be made or at least the possibilities may be limited to specific conditions.[5] Magnetic resonance imaging is essential for local evaluation of the lesion, size, characteristics of neoplastic tissue, and involvement of close neurovascular structures. Other diagnostic modalities, such as computed tomography and scintigraphy are performed only in cases of lesions with aggressive characteristics. A histological sample should be obtained in aggressive bone lesions to imaging tests and in those whose diagnosis is unclear and is essential for treatment, usually by bone biopsy needle, and can be performed under radioscopy, tomography, or ultrasound.[6] An inadequate or inaccurate biopsy may lead to poor results regarding limb recovery and patient survival.[7,8]

This study aimed to characterize tumors in the elbow that presented the epidemiological profile of these lesions treated in an oncology reference center in Brazil.

MATERIAL AND METHODS

A retrospective observational study of case series was conducted to evaluate the results of musculoskeletal tumors in the elbow. Data were collected from medical and imaging records of patients, and a specific database was built for this study with total protection regarding the identification of patients. The study was approved by the Institutional Ethics Committee and is registered on Plataforma Brasil under number 41308720.0.0000.5505.

Medical records of 37 patients diagnosed with elbow neoplasia subjected to clinical and/or surgical treatment with the first service care from 1990 to 2020 were analyzed.

The inclusion criteria were patients of both sexes, with no age limit, monitored in the institution, with musculoskeletal neoplasia in the elbow region, defined as: the region between the medial and lateral epicondyle of the distal humerus, capitulum, head of the radius, and olecranon.

i. Bone injury in the distal humerus at the upper limit of Heim's square including medial epicondyles and articular surface;
ii. Bone injury of the proximal end of the radius, defined by the metaphyseal region (upper limit of Heim's square) to the articular surface;
iii. Bone injury in the olecranon;
iv. Soft tissue lesions covering the distal anatomical regions to the upper limit of the metaphyseal region of the distal humerus and proximal to the distal limit of the metaphyseal region of the head of the radius.

Lesions that made a differential diagnosis with musculoskeletal neoplasms, such as musculoskeletal infections (osteomyelitis, soft tissue infection) of this region, were excluded.

All patients with tumors of proximal or distal upper limbs to the area of interest or lesions with contiguity extension to the elbow, but whose epicenter was not in the studied region were excluded. The lack of patient compliance to participate in the study, at any time, was also considered an exclusion criterion.

All patients were evaluated according to general epidemiological variables: (1) sex; (2) age; (3) presence of symptoms (pain/increase in local volume/fracture), (4) laterality; (5) diagnosis; (6) treatment; (7) recurrence of the lesion after surgical treatment. This study considered the following elbow lesions a dependent variable: Benign Bone Tumor, Malignant Bone Tumor, Benign Soft Tissue Tumor, and Malignant Soft Tissue Tumor.

The studied variables were collected by analysis of medical records. Bone tumors were confirmed by biopsy.

The construction of the database and graph creation was performed using the Excel (Microsoft®) software. The SPSS® software (IBM, V21) was used for statistical analysis. Descriptive analyses are presented in absolute number (n) and relative frequency (%), mean, and standard deviation. Fisher's exact test was used to compare relative frequencies lower than five. ANOVA was used to compare the means of numerical variables of three or groups. Epidemiological analyses of the studied variables were performed, describing categorical and continuous variables.

RESULTS

The study included 37 patients with tumor lesions in the elbow region, of which 19 (51.35%) were female and 18 (48.64%) were male. Age ranged from 3 to 77 years, with a mean of 33.5 ± 21.92 years. Right-sided involvement occurred in 51.35% (n = 19) and left-sided involvement in 48.64% (n = 18). Among the most common symptoms, pain complaints were present in 21 (56.75%) patients, local volume increase occurred in 20 (54.05%), and fractures in six (16.21%). Surgical intervention was performed in 28 patients (75.67%). Recurrence was diagnosed in 16.21% (n = 6) of the cases (Table 1).

Figure 1 shows the prevalence of elbow injuries. A higher prevalence of benign bone tumors occurred, with 32.43% (n = 12) followed by benign soft tissue tumors, with 27.0% (n = 10). Table 2 shows the distribution of diagnoses of tumors that affected the elbow, with Synovial Sarcoma being the most prevalent (10.8% of cases).

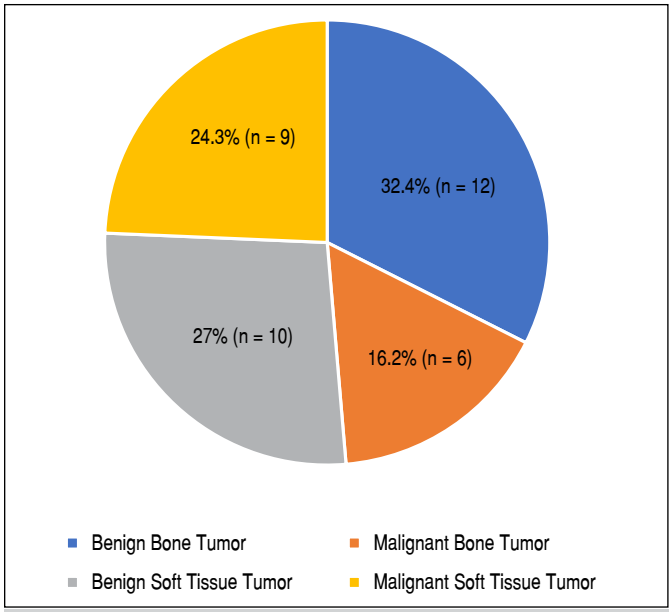

Figure 1. Prevalence of elbow injuries.

<< SUMÁRIO

Table 1. Sample characterization (n = 37).

	Total n (%)	BBT n (%)	MBT n (%)	Benign STT n (%)	Malignant STT n (%)
		12 (32.43%)	**6 (16.21%)**	10 (27.02%)	9 (24.32%)
Sex					
Female	19 (51.35%)	5 (41.66%)	3 (50%)	9 (90%)	2 (22.22%)
Male	18 (48.64%)	7 (58.33%)	3 (50%)	1 (10%)	7 (77.77%)
Age (mean/SD)	33.5 21.92	17.08 10.58	33.25 26.5	46.56 19.63	42.44 18.93
Affected side					
Left	18 (48.64%)	6 (50.55%)	5 (83.33%)	4 (40%)	3 (33.33%)
Right	19 (51.35%)	6 (50%)	1 (16.66%)	6 (60%)	6 (66.67%)
Pain					
No	16 (43.24%)	5 (41.66%)	4 (66.66%)	3 (30%)	4 (44.44%)
Yes	21 (56.75%)	7 (58.33%)	2 (33.33%)	7 (70%)	5 (55.55%)
Local volume increase					
No	17 (45.94%)	8 (66.66%)	6 (100%)	2 (20%)	1 (11.11%)
Yes	20 (54.04%)	4 (33.33%)	0 (0%)	8 (80%)	8 (88.88%)
Fracture					
No	31 (83.78%)	9 (75%)	4 (66.67%)	10 (100%)	9 (88.88%)
Yes	6 (16.21%)	3 (25%)	2 (33.33%)	0 (0%)	1 (11.11%)
Surgical treatment					
No	9 (24.32%)	5 (41.66%)	0 (0%)	3 (30%)	1 (11.11%)
Yes	28 (75.67%)	7 (58.33%)	6 (100%)	7 (70%)	8 (88.88%)
Recurrence					
No	31 (83.78%)	12 (100%)	5 (83.33%)	9 (90%)	4 (44.44%)
Yes	6 (16.21%)	0 (0%)	1 (16.66%)	1 (10%)	5 (55.55%)

BBT: benign bone tumor; MBT: malignant bone tumor; STT: soft tissue tumor.

Table 2. Distribution of elbow injury diagnoses.

	Total n (%)
	37 (100%)
Benign bone tumor	
Aneurysmal bone cyst	3 (8.1%)
Fibrous dysplasia	3 (8.1%)
Osteoid osteoma	3 (8.1%)
Charcot	1 (2.7%)
Solitary bone cyst	1 (2.7%)
Osteochondroma	1 (2.7%)
Malignant bone tumor	
Osteosarcoma	3 (8.1%)
Cavernous hemangioma	1 (2.7%)
Multiple myeloma	1 (2.7%)
Metastasis	1 (2.7%)
Ewing sarcoma	1 (2.7%)
Benign STT	
Lipoma	3 (8.1%)
Schwannoma	2 (5.4%)
Chondromatosis	1 (2.7%)
Fibromatosis	1 (2.7%)
Neurofibroma	1 (2.7%)
Inflammatory granuloma	1 (2.7%)
Malignant STT	
Synovial sarcoma	4 (10.8%)
Squamous cell carcinoma	1 (2.7%)
Malignant fibrohistiocytoma	1 (2.7%)
Lymphoma	1 (2.7%)
Liposarcoma	1 (2.7%)
Malignant PEComa	1 (2.7%)

STT: soft tissue tumor.

Table 1 also shows the results of prevalence and means of elbow lesions according to the variables studied.

DISCUSSION

Bone and soft tissue tumors in the elbow are rare, with 37 tumors identified over a 40-year period in this case series. Relevant literature on the subject is sparse, for this reason this study brings relevant information to the area of studies on musculoskeletal tumors in the elbow region. Despite the rarity, it is important that the orthopedic surgeon knows the epidemiological profile and characteristics of the lesions so that they can properly care or refer the patient to the reference center in oncologic orthopedics.

Benign Bone Tumor was the most found lesion in this study; n = 12 (32.43%). The most common tumor in this series was Aneurysmal Bone Cyst, along with Osteoma Osteoid and Fibrous Dysplasia. This type of tumor was more present in adolescents and had a higher prevalence in cases of pathological fracture and second higher prevalence in pain. No case had lesion recurrence after undergoing the surgical procedure. These results are consonant with the study by Halai et al.[1]

Malignant Bone Tumors were more diagnosed in young adults (33.25 ± 26.5 years), with a similar prevalence among genders. Osteosarcoma was the most prevalent diagnosis in this type of tumor. These results agree with Halai et al.,[1] who report in their study that most cases presented painful edema or mass detectable on physical examination, different from those of this study.

Benign Soft Tissue Tumor represented 27.02% of the cases in this study, with prevalence in women. In total, 70% of the cases showed complaint of pain and 80% of increased volume in the region. The most common diagnoses of this type of tumor were Lipoma (8.1%) and Schwannoma (5.4%).

When malignant soft tissue tumors were analyzed, a predominance in men, adults (mean age of 42 years) were observed, and a higher

prevalence of the diagnosis of Synovial Sarcoma (10.8%). Recurrence rate was the highest among all types of tumors studied, 55.5%. Creighton et al.[9] reported 10 patients with tumors in the elbow region in their series of 61 sarcomas of upper limb soft tissues. Correa-González et al.[5] described that the elbow region usually has higher rates of residual disease and, thus, a higher incidence of local recurrence, due to the anatomical complexity of the elbow, which hinders resection with a wide oncological margin.

This study aimed to collect and define the epidemiological profile of patients with lesions in the elbow region. However, this study has limitations, such as the study design (case series) and data obtained from a single center, which limits the interpretation of the findings in the national context.

CONCLUSION

The tumors that affect the elbow in our series are mainly benign tumors, of bone involvement or soft tissue. Knowing the epidemiological profile of elbow lesions can help to improve the understanding of the pathology and, consequently, therapeutic success. Early referral to a specialist is the fastest way to provide specialized multidisciplinary team care for these rare tumors.

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REFERENCES

1. Halai M, Gupta S, Spence S, Wallace D, Rymaszewski L, Mahendra A. Primary osseous tumours of the elbow: 60 years of registry experience. Shoulder Elbow. 2015;7(4):272-81.
2. Springfield DS, Sweet S. Tumors of the elbow. In: Baker CL, Plancher KD, editors. Operative treatment of elbow injuries. New York: Springer; 2002. p. 295-302.
3. Bruguera JA, Newman RJ. Primary tumors of the elbow: a review of the Leeds Regional Bone Tumors Registry. Orthopedics. 1998;21(5):551-3.
4. Savvidou OD, Koutsouradis P, Chloros GD, Papanastasiou I, Sarlikiotis T, Kaspiris A, Papagelopoulos PJ. Bone tumours around the elbow: a rare entity. EFORT Open Rev. 2019;4(4):133-42.
5. Correa-González N, De La Calva C, Miranda I, Amaya JV, Angulo M, Baixauli-García F. Sarcomas de partes blandas en la región del codo e influencia de sus particularidades anatómicas en su tratamento. Experiencia en una Unidad de Tumores Musculoesqueléticos. Rev Esp Cir Ortop Traumatol. 2020;64(5):301-9.
6. Traina F, Errani C, Toscano A, Pungetti C, Fabbri D, Mazzotti A, et al. Current concepts in the biopsy of musculoskeletal tumors: AAOS exhibit selection. J Bone Joint Surg Am. 2015;97(2):e7.
7. Garcia JG, Marques DS, Viola DCM, Petrilli MT, Alves MTS, Jesus-Garcia Filho R. Biopsy path contamination in primary bone sarcomas. Rev Bras Ortop. 2019;54(1):33-6.
8. Oliveira MP, Lima PMA, Silva HJ, Mello RJV. Neoplasm seeding in biopsy tract of the musculoskeletal system. A systematic review. Acta Ortop Bras. 2014;22(2):106-10.
9. Creighton JJ Jr, Peimer CA, Mindell ER, Boone DC, Karakousis CP, Douglass HO. Primary malignant tumors of the upper extremity: retrospective analysis of one hundred twenty-six cases. J Hand Surg Am. 1985;10(6 Pt 1):805-14.

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RELIABILITY OF THE ISOMETRIC DYNAMOMETER IN CONTROL, PARAPLEGIC, AND AMPUTEE INDIVIDUALS

CONFIABILIDADE DO DINAMÔMETRO ISOMÉTRICO EM INDIVÍDUOS CONTROLE, PARAPLÉGICOS E AMPUTADOS

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ABSTRACT

Objective: To determine the Intraclass Correlation Coefficient (ICC), Standard Error of Measurement (SEM), Minimum Detectable Change (MDC), and the Minimum Clinically Important Difference (MCID) of the isometric measurements of muscle strength of trunk extension and of flexion and knee extension at maximum contraction in healthy, paraplegic, and amputee individuals, by using an isometric dynamometer with a belt for stabilization. Methods: An observational cross-sectional study was carried out to assess the reliability of a portable isometric dynamometer in the trunk extension and flexion and knee extension movements of each group. Results: In all measurements, ICC ranged from 0.66 to 0.99, SEM from 0.11 to 3.73 kgf, and MDC from 0.30 to 10.3 kgf. The MCID of the movements ranged from 3.1 to 4.9 kgf in the amputee group and from 2.2 to 3.66 kgf in the paraplegic group. Conclusion: The manual dynamometer demonstrated good intra-examiner reliability, presenting moderate and excellent ICC results. Thus, this device is a reliable resource to measure muscle strength in amputees and paraplegics. ***Level of Evidence II, Cross-Sectional Study.***

Keywords: Data Accuracy. Muscle Strength Dynamometer. Lower Extremity.

RESUMO

Objetivo Determinar o coeficiente de correlação intraclasse (CCI), o erro padrão da medida (EPM), a mínima mudança detectável (MMD) e a mínima mudança clinicamente importante (MMCI) das medidas isométricas de força muscular da extensão de tronco e da flexão e extensão de joelho em contração máxima de indivíduos saudáveis, paraplégicos e amputados, usando um dinamômetro isométrico com cinto para estabilização. Métodos: Foi realizado um estudo observacional transversal para avaliar a confiabilidade de um dinamômetro portátil isométrico nos movimentos de extensão de tronco e de flexão e extensão de joelho de cada grupo Resultados: Em todas as medidas o CCI apresentou uma variação de 0,66 a 0,99, o EPM de 0,11 a 3,73 kgf e a MMD de 0,30 a 10,3 kgf. A MMCI dos movimentos variou de 3,1 a 4,9 kgf no grupo de amputados e de 2,2 a 3,66 kgf no grupo de paraplégicos. Conclusão: O dinamômetro manual demonstrou boa confiabilidade intraexaminador, com variação de CCI de moderada à excelente, apresentando-se como um recurso confiável para mensurar força muscular de amputados e paraplégicos. ***Nível de Evidência II, Estudo Observacional Transversal.***

Descritores: *Confiabilidade dos dados. Dinamômetro de Força Muscular. Extremidade Inferior.*

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INTRODUCTION

Global data estimate that about 250,000 to 500,000 individuals suffer some type of spinal cord injury,[1] caused mostly by traumatic accidents and firearms.[1,2] Spinal cord injury (SCI) can cause a deficit in strength, with consequent impairment of motor functions, limiting the performance of daily activities[3] and lowering rates of life expectancy.[4] Lower limb amputation causes changes in body functions and structures, modifying muscle tone, range of motion, and local sensitivity related to the stump.[5] Authors estimate that by 2017 about 35.3 million people lived with lower limb amputation due to traumatic accidents.[6]

Individuals with SCI, as well as amputee patients, require attention and monitoring of muscle strength during the rehabilitation process, since sensory-motor deficiencies compromise the functionality of the patient, and these should be identified during clinical evaluation and settled in the intervention process.[7,8] Several health professionals use muscle strength assessment in their routine, providing quantitative data for criteria of monitoring of functional recovery.[9]

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

The study was conducted at Dell's Research, Development and Innovation Center – Lead.
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Muscle strength is considered an important physical component for the performance of motor and functional skills; thus, evaluating muscle strength and biomechanical conditions of the patient is relevant for the restoration of daily activities.[10-12]

Portable dynamometry is one of the methods most used in clinical practice to evaluate muscle strength intensity, because it is easy to handle and low cost, compared to isokinetic dynamometers.[3,13,14] The muscle manual test is a fast and easily applicable method. Using this tool to evaluate knee flexor and extensor muscles in healthy individuals showed a good reproducibility and it is clinically acceptable when compared with the gold standard of strength measurements, such as the isokinetic dynamometer.[15]

The study that evaluated the intra-examiner reliability of amputees observed the measurements of strength of hip movements, considering the remaining movements depending on the level of amputation.[16] Changes are expected on the amputated side, such as strength loss and atrophy or hypotrophy; however, the last two can occur not only in the amputated side, but also globally.[17] Since unilateral amputation leads to changes in gait kinematics, the monitoring of strength gain in the preserved limb is essential in the process of prosthesis adaptation, reinforcing the need to evaluate the remaining limb to plan for the balance recovery, confidence for movement, and gait.[18]

In individuals with paraplegia, upper limbs strength measurements are a way to monitor the treatment evolution of these patients.[18] The rehabilitation process of paraplegics and amputees should monitor trunk control for sedestation and activation of the lower limbs for assisted orthostatism by using orthotics and gait. However, to our knowledge, no studies evaluate the influence of the condition of rachimedular trauma and unilateral amputation of the lower limbs on muscle strength. Therefore, this study aimed to determine the intra-examiner reliability, measurement errors, and minimal clinically relevant change of an isometric dynamometer in healthy, paraplegic, and amputee individuals.

MATERIALS AND METHODS

Study characteristics

A cross-sectional observational study and analysis of measurement properties of an isometric evaluation instrument was performed. The study was approved by the ethics committee of the Hospital Geral de Fortaleza (no. 3,995,609) and all participants read and signed the informed consent form.

Inclusion and exclusion criteria of the sample

In total, 45 volunteers participated in the study, 15 in the control group, 15 in the group of paraplegics, and 15 in the group of amputees. Adults between 18 and 50 years old, of both sexes, without associated vascular pathologies (coagulation disorders, decompensated diabetes) were eligible for the experiment. Participants of the amputee group should present unilateral transtibial, femoral, or hip amputation and already use a prosthesis for at least six months instead of still being in the adaptation process. In the paraplegic group, participants with bilateral incomplete paraplegia of the lower limbs, without history of pressure ulcers in any part of the body and with stable hemodynamic parameters in the month prior to the study (heart rate, blood pressure, and saturation) were included. In the control group, participants who did not present changes in the lower limbs were included. For all groups, patients' blood pressure should be stabilized.

Exclusion criteria were individuals who presented associated neuropathological brain alterations such as stroke, Parkinson, Alzheimer, and/or recent traumatic brain injury with cognitive impairment. Individuals with any severe cognitive/psychological dysfunction that could interfere in the performance of the tests, such as panic syndrome, anxiety crises, and/or depression during the evaluation, or individuals with relevant speech impairments that inhibit the communication during tests, were also excluded.

Dynamometer and use characteristics during tests

To analyze the isometric strength, the SP Tech® portable isometric dynamometer (Manufactured in Brazil), with the maximum strength capacity of 90.72 kgf (200 lbf), was used. The dynamometer has a Bluetooth function to communicate with the My SP Tech® Android app, installed on a Samsung Galaxy Tab A® tablet, for data collection. By Bluetooth communication, the strength data is sent to the connected device. The Android app shows the strength graph in real time and at the end of the experiment the mean and peak strength values achieved during the experiment are also available to access (Figure 1).

Evaluator training and familiarization

Initially, the evaluator performed a two-hour training that was applied via internet (online), by a specialized technician of the manufacturer company of the portable dynamometer. During the training, theoretical/practical guidance on how to handle the equipment and app was given and possible questions of the evaluator were clarified. The evaluator, after understanding the equipment operation, performed the pilot test to become acquainted with the movements and ensure that the reading and positioning were adequate. These pilot tests lasted one hour and were carried out for one week, ensuring that the evaluator was able to perform the tests using the device and software.

Performing strength measures in movements of interest

For each movement, three attempts were performed, with a stimulation of contraction of 15 seconds for each. Between each attempt, a rest period of 15 seconds was given to the participants. During the test, a verbal command was given to the participants at each contraction using the following encouragement expressions:

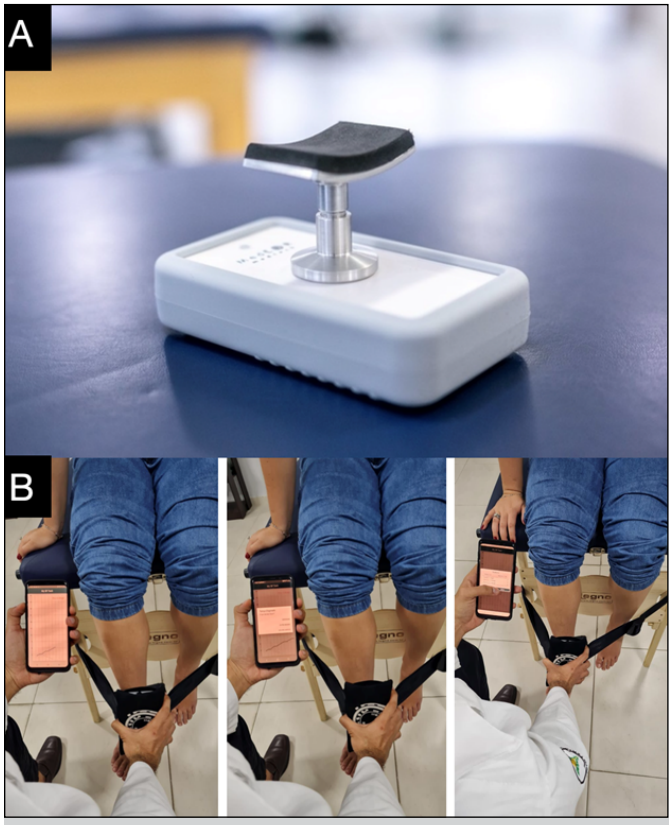

Figure 1. A) Manual dynamometer; B) App operation and reading of information during data collection.

"Be strong, be strong, be strong," "Let's go" and "To the limit," The evaluated movements were trunk extension, flexion, and knee extension. For patients with amputations, knee strength was evaluated on the preserved side (Figure 2).

Lumbar spine extensors: Participants remained in ventral decubitus with the upper limb throughout the body. An inelastic stabilization brace was placed around the thorax to position the dynamometer between the lower angles of the scapulae. Then, the patient was asked to elevate the trunk, removing their contact with the stretcher, keeping the cervical in neutral position. The lower limbs were stabilized with another inelastic brace in the medial part of the femur (Figure 1A).[19] Stabilization was standardized for all patients.

Knee extension: The patient remained seated, with the lower limbs out of the stretcher and their hands relaxed on the legs. The brace was fixed between the stretcher and the lower limbs of the participant and the dynamometer was positioned 15 cm below the anterior tuberosity of the knee. Then, the patient was asked to extend the knee (amputees performed the test with the preserved side) and, during the contraction, there was stabilization of the spine only by voluntary control, allowing the patient to hold the side of the stretcher to avoid compensations (Figure 1B).[20] This positioning was adopted due to the limitation for posture shifts of patients with paraplegia.

Knee flexion: The patient stayed in ventral decubitus and, by using a belt, the dynamometer was fixed between the sural triceps and the calcaneus tendon (region posterior to the ankle). The participant was asked to bend the knee (amputees performed the test with the preserved side) to measure the strength of the knee flexor muscles (Figure 1C).[21] The patient was instructed to keep the hip supported on the stretcher to avoid any compensation of movement.

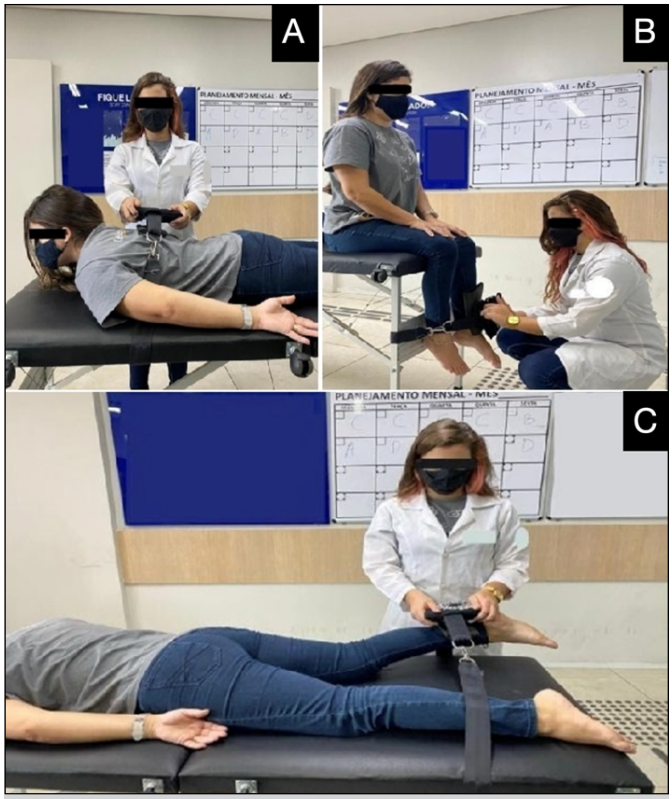

Figure 2. Evaluation with the dynamometer performed in the study. A) Measurement of strength for trunk extension movement; B) Measurement of strength of the knee extensors using the hand dynamometer with the support of a brace; C) Measurement of strength of the knee flexors using the hand dynamometer with the support of a brace.

Statistical analysis

The demographic data of the patients were presented by mean and standard deviation. Data reliability was performed by the mean of the three repetitions during the test and analyzed by the Intraclass Correlation Coefficient (ICC), associated with a 95% confidence interval. These data were interpreted as poor (< 0.40), moderate (≥ 0.40 and ≤ 0.75), and excellent reliability (> 0.75).[22] The Standard Error of Measurement (SEM) analyzes the error inherent to the instrument associated with a single measurement and was estimated by the formula: $SEM = SD \times \sqrt{1-ICC}$.[23] The Minimum Detectable Change (MDC) was estimated by the formula: $MDC = SEM \times 1.96 \times \sqrt{2}$ considering a 95% confidence interval.[23] All analyses were performed using the Statistical Package for the Social Sciences (SPSS, version 24.0; SPSS Inc., Chicago, IL). The estimation of the effect size and the minimum clinically important change (MCIC) was performed according to Armijo-Olivo et al.,[24] in which were considered moderate effect size equal to or greater than 0.5.[25]

RESULTS

We evaluated 45 patients. Of the 15 participants in each group, four were from the control group, 12 from the paraplegic group, and nine from the amputee group were males (Table 1). Of those who reported being active and practicing some physical activity, eight individuals were from the control group, 14 from the paraplegic group, and 11 from the amputee group. In the group of amputees, 10 with amputation at the transfemoral level, three of transtibial level, and two at the hip level were included. In the group of paraplegics, the levels of injury were in the thoracic region (T1 to T12).

The ICC showed a variation of all measurements from 0.66 to 0.99, presenting a moderate intra-examiner reliability. The percentage of standard error of measurement showed variations from 3% to 50% between all measurements and the minimum detectable change showed variations from 0.30 to 10.3 kgf among all measurements. In the isometric evaluations for trunk extension, the dynamometer presented ICC values from 0.93 to 0.98, demonstrating excellent reliability in all groups evaluated. In the knee flexion movement, the ICC values also demonstrated excellent reliability in all groups, with variations from 0.95 to 0.99. The knee extension movement had ICC values from 0.66 to 0.92, demonstrating a lower value in the control group with moderate reliability; however, the paraplegic and amputee groups presented excellent intra-examiner reliability. The standard error values of the measurement ranged from 1.23 to 2.52 for trunk extension; 0.19 to 3.73 for knee extension; and 0.1 to 1.41 for knee flexion. Tables 2 and 3 show the specific values of each group and each movement.

The minimum clinically important change in the paraplegic group was 3.66 kgf for trunk extension movement; 2.39 kgf for knee extension movement; and 2.22 kgf for knee flexion movement. The amputee group presented minimum clinically important change values of 4.9 kgf for trunk extension movement; 4.6 kgf for knee extension and 3.1 kgf for knee flexion.

DISCUSSION

This study determined the intra-examiner reliability of an isometric dynamometer in healthy, paraplegic, and amputee individuals. We observed excellent levels of intra-examiner reliability for trunk extension and knee flexion movements in all groups evaluated. Regarding the knee extension, we found excellent reliability in the paraplegic and amputee groups and moderate reliability in the control group. The performance of muscle strength measurements

Table 1. Demographic data.

	CONTROL (n = 15) Mean (SD)	PARAPLEGIC (n = 15) Mean (SD)	AMPUTEES (n = 15) Mean (SD)
Sex (male)	4	12	9
Age (years old)	23 (3)	35 (9)	31 (8)
Height (meters)	1.63 (0.09)	1.65 (0.07)	1.68 (0.11)
Weight (kg)	67.85 (14.72)	73.26 (12.67)	62.13 (14.33)
BMI (kg/m)	25.51 (4.70)	26.88 (5.12)	21.74 (2.85)
Physically active (n)	8	14	11

The values were expressed as mean ± standard deviation (SD). n: number of participants.

Table 2. Mean and standard deviation (SD) of muscle strength measurements in control, paraplegic, and amputee individuals.

	CONTROL (n = 15) Mean (SD)			PARAPLEGIC (n = 15) Mean (SD)			AMPUTEE (n = 15) Mean (SD)		
	TEST 1 (kgf)	TEST 2 (kgf)	TEST 3 (kgf)	TEST 1 (kgf)	TEST 2 (kgf)	TEST 3 (kgf)	TEST 1 (kgf)	TEST 2 (kgf)	TEST 3 (kgf)
Trunk extension	19.01 (9.52)	21.41 (10.13)	22.84 (11.43)	6.88 (4.08)	8.28 (5.25)	8.06 (4.80)	18.76 (10.02)	19.24 (8.89)	19.23 (7.88)
Knee extension	23.47 (6.75)	25.03 (7.37)	24.08 (5.29)	0.38 (0.54)	0.38 (0.65)	0.45 (0.82)	31.95 (11.06)	31.30 (8.98)	32.76 (8.65)
Knee flexion	22.25 (6.18)	21.31 (5.54)	21.28 (5.10)	0.57 (1.03)	0.66 (1.13)	0.63 (1.21)	22.6 (6.37)	23.4 (6.26)	23.15 (6.77)

n: number of participants.

Table 3. Intra-evaluator reliability of muscle strength measurements in control, paraplegic, and amputee individuals.

	CONTROL (n = 15)			PARAPLEGIC (n = 15)			AMPUTEE (n = 15)		
	ICC (95%)	SEM (%SEM)	MDC	ICC (95%)	SEM (%SEM)	MDC	ICC (95%)	SEM (%SEM)	MDC
Trunk extension	0.94 (0.85-0.98)	2.52 (0.13)	6.98	0.93 (0.84-0.97)	1.23 (0.18)	3.42	0.98 (0.94–0.99)	1.24 (0.07)	3.44
Knee extension	0.66 (0.18-0.88)	3.73 (0.16)	10.36	0.92 (0.82-0.97)	0.19 (0.50)	0.52	0.87 (0.70–0.95)	3.39 (0.11)	9.41
Knee flexion	0.95 (0.87-0.98)	1.23 (0.05)	3.42	0.99 (0.97-1)	0.11 (0.19)	0.30	0.95 (0.89–0.98)	1.41 (0.06)	3.92

ICC: intraclass correlation coefficient; SEM: standard error of measurement; MDC: minimum detectable change.

in amputees[7] and paraplegics[8] is a relevant element in the clinical evaluation, as well as the monitoring of the evolution of this population during treatment.

Leijendekkers et al.,[16] conducted a study with amputees, which one of the objectives was to test the intra-examiner reliability and the validity of the use of portable dynamometer, with and without external stabilization. The result was a good reliability, especially when the techniques were applied with stabilizers during the test. We also used stabilization devices in our study, obtaining a satisfactory intra-examiner reliability in all movements evaluated. Another study in the literature observed that the evaluation performance of muscle strength of the lower limbs of physically active individuals tends to present difficulties in the necessary stabilization, because it depends on the strength that the examiner should have to avoid compensation of other joints.[26] The brace use minimizes the stabilization difficulties, which may favor the results of the evaluation and provide greater reliability.[9] We evaluated the reliability of the movements of the present study by using non-elastic straps, which may have allowed greater stabilization of movements and minimized the evaluator influence, contributing to better values of intra-examiner reliability.

Trunk control is crucial for postural stability and propulsion between[27] paraplegics and amputees and their muscle strength should be a widely investigated element throughout the therapeutic process. The present study showed that the amputation in one of the lower limbs did not affect the ability to generate enough muscle strength for trunk extension to impact reliability values. Moreover, the use of isometric dynamometers may be an alternative to other low-reliability assessment tools, such as manual tests,[28] offering a greater accuracy regarding the clinical evolution of the evaluated individuals.

Strengths and limitations of the study

This is a pioneering study that analyzed the intra-examiner reliability of an isometric dynamometer, to the best our knowledge, not yet scientifically evaluated, and in clinical conditions little investigated such as amputation and paraplegia. The study presents limitations regarding the sample size, according to the guidelines of COSMIN for conducting reliability studies, and presents methodological limitations due to the absence of the inter-examiner reliability measure. We emphasize that the limitations mentioned are mainly related to the difficulties of this population in the displacement to the research center due to the social distancing resulting from the COVID-19 pandemic. Moreover, we included as a limitation the non-stabilization of the hip in the evaluation of knee flexors. We emphasize that the reproducibility of our data depends on the individual's positioning and stabilization with inelastic straps according to the methodology proposed in this study.

CONCLUSION

We identified that the intra-examiner reliability of the equipment used varied from moderate to excellent in the control group and was excellent in the amputee and paraplegic groups for the analyzed movements.

AUTHORS' CONTRIBUTIONS: Each author contributed individually and significantly to the development of this article. JPAF: writing, data collection, and analysis; GHH, DPA, VBSO: data analysis and writing; FCMBO: writing and revision and intellectual concept; FFUSJ: collection, writing, statistical analysis, intellectual concept, and preparation of the entire research project.

REFERENCES

1. World Health Organization; International Spinal Cord Society. International perspectives on spinal cord injury. Geneva: WHO; 2013.
2. Brasil. Ministério da Saúde. Secretaria de Atenção à Saúde. Departamento de Ações Programáticas Estratégicas. Diretrizes de atenção à pessoa com lesão medular. 2nd ed. Brasília (DF): Ministério da Saúde; 2015.
3. Sisto SA, Dyson-Hudson T. Dynamometry testing in spinal cord injury. J Rehabil Res Dev. 2007;44(1):123-36.
4. Devivo MJ. Epidemiology of traumatic spinal cord injury: trends and future implications. Spinal Cord. 2012;50(5):365-72.
5. Gonçalves E Jr, Knabben RJ, Luz SCT. Portraying the amputation of lower limbs: an approach using ICF. Fisioter Mov. 2017;30(1):97-106.
6. McDonald CL, Westcott-McCoy S, Weaver MR, Haagsma J, Kartin D. Global prevalence of traumatic non-fatal limb amputation. Prosthet Orthot Int. 2021;45(2):105-14.
7. Vieira RI, Luz SCT, Santos KPB, Gonçalvez R Jr, Campos PVC. Physiotherapy intervention during pre and post-prosthetic fitting of lower limb amputees: a systematic review. Acta Fisiatrica. 2017;24(2):98-104.
8. Gagnon D, Verrier M, Masani K, Nadeau S, Aissaoui R, Popovic M. Effects of trunk impairments on manual wheelchair propulsion among individuals with a spinal cord injury: a brief overview and future challenges. Top Spinal Cord Inj Rehabil. 2009;15(2):59-70.
9. Suzuki T. Reliability of measurements of knee extensor muscle strength using a pull-type hand-held dynamometer. J Phys Ther Sci. 2015;27(3):967-71.
10. Jaric S. Muscle strength testing: use of normalisation for body size. Sports Med. 2002;32(10):615-31.
11. Grgic J, Schoenfeld BJ, Davies TB, Lazinica B, Krieger JW, Pedisic Z. Effect of resistance training frequency on gains in muscular strength: a systematic review and meta-analysis. Sports Med. 2018;48(5):1207-20.
12. Suchomel TJ, Nimphius S, Bellon CR, Stone MH. The importance of muscular strength: training considerations. Sports Med. 2018;48(4):765-85.
13. Martin HJ, Yule V, Syddall HE, Dennison EM, Cooper C, Aihie Sayer A. Is hand-held dynamometry useful for the measurement of quadriceps strength in older people? A comparison with the gold standard Biodex dynamometry. Gerontology. 2006;52(3):154-9.
14. Reis MM, Arantes PMM. Medida da força de preensão manual – validade e confiabilidade do dinamômetro saehan. Fisioter Pesqui. 2011;18(2):176-81.
15. Muff G, Dufour S, Meyer A, Severac F, Favret F, Geny B, et al. Comparative assessment of knee extensor and flexor muscle strength measured using a hand-held vs. isokinetic dynamometer. J Phys Ther Sci. 2016;28(9):2445-51.
16. Leijendekkers RA, Hinte GV, Sman AD, Staal JB, Nijhuis-van der Sanden MWG, Hoogeboom TJ. Clinimetric properties of hip abduction strength measurements obtained using a handheld dynamometer in individuals with a lower extremity amputation. PLoS One. 2017;12(6):e0179887.
17. Tugcu I, Safaz I, Yilmaz B, Göktepe AS, Taskaynatan MA, Yazicioglu K. Muscle strength and bone mineral density in mine victims with transtibial amputation. Prosthet Orthot Int. 2009;33(4):299-306.
18. Miller CA, Williams JE, Durham KL, Hom SC, Smith JL. The effect of a supervised community-based exercise program on balance, balance confidence, and gait in individuals with lower limb amputation. Prosthet Orthot Int. 2017;41(5):446-54.
19. Kasukawa Y, Miyakoshi N, Hongo M, Ishikawa Y, Kudo D, Kijima H, et al. Lumbar spinal stenosis associated with progression of locomotive syndrome and lower extremity muscle weakness. Clin Interv Aging. 2019;14:1399-405.
20. Katoh M, Hiiragi Y, Hirano M, Gomi M, Tozawa R, Sakai Y, Tanaka M. Isometric knee muscle strength measurement using a belt-stabilized hand-held dynamometer and an isokinetic dynamometer with and without trunk fixation: investigation of agreement of measurement values and factors influencing measurement. J Phys Ther Sci. 2019;31(11):878-83.
21. Luc-Harkey BA, Safran-Norton CE, Mandl LA, Katz JN, Losina E. Associations among knee muscle strength, structural damage, and pain and mobility in individuals with osteoarthritis and symptomatic meniscal tear. BMC Musculoskelet Disord. 2018;19(1):258.
22. Fleiss JL. Reliability of measurement. In: Fleiss JL. The design and analysis of clinical experiments. Hoboken: Wiley; 1986. p. 1-32.
23. Weir JP. Quantifying test-retest reliability using the intraclass correlation coefficient and the SEM. J Strength Cond Res. 2005;19(1):231-40.
24. Armijo-Olivo S, Warren S, Fuentes J, Magee DJ. Clinical relevance vs. statistical significance: using neck outcomes in patients with temporomandibular disorders as an example. Man Ther. 2011;16(6):563-72.
25. Cohen J. Statistical power analysis. Curr Dir Psychol Sci. 1992;1(3):98-101.
26. Vasconcelos RA, Bevilaqua-Grossi D, Shimano AC, Paccola CJ, Salvini TF, Prado CL, Mello WA Jr. Confiabilidade e validade de um dinamômetro isométrico modificado na avaliação do desempenho muscular em indivíduos com reconstrução do ligamento cruzado anterior. Rev Bras Ortop. 2009;44(3):214-24.
27. Desroches G, Gagnon D, Nadeau S, Popovic MR. Effects of sensorimotor trunk impairments on trunk and upper limb joint kinematics and kinetics during sitting pivot transfers in individuals with a spinal cord injury. Clin Biomech (Bristol, Avon). 2013;28(1):1-9.
28. Moreland J, Finch E, Stratford P, Balsor B, Gill C. Interrater reliability of six tests of trunk muscle function and endurance. J Orthop Sports Phys Ther. 1997;26(4):200-8.

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DEVELOPMENT OF ORTHOPEDIC SIMULATOR TO PRACTICE CLOSED REDUCTION OF PEDIATRIC FRACTURES OF THE MIDDLE THIRD OF FOREARM

DESENVOLVIMENTO DE UM SIMULADOR ORTOPÉDICO PARA PRÁTICA DE REDUÇÃO INCRUENTA DE FRATURAS PEDIÁTRICAS DO TERÇO MÉDIO DO ANTEBRAÇO

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ABSTRACT

In the current scenario of medical education, a trend of using models and simulators to train operational skills, especially in the practice of basic orthopedic techniques, is growing. This form of teaching allows academics to maximize learning opportunities and contributes to improving the quality of care for their future patients. However, the realistic simulation has high costs as a major limitation. Objective: To develop a low-cost orthopedic simulator for practicing pediatric forearm reduction skills in the preclinical setting. Methods: A model of an arm and forearm with a fracture in the middle third was developed. Orthopedists, residents, and medical students evaluated the simulator's ability to reproduce fracture reduction. Results: The simulator had a significantly lower cost than the others in the literature. The participants agreed that the model had a good performance, and that the manipulation was consistent with the reality of reducing closed pediatric forearm fracture. Conclusion: The results suggest that this model can be used to teach orthopedic residents and medical students the skill of closed reduction of fractures in the middle third of the forearm. ***Level of Evidence III, Case Control Study.***

Keywords: Simulation Training. Forearm Injuries. Closed Fracture Reduction. Education, Medical.

RESUMO

No cenário atual de ensino médico existe uma tendência crescente do uso de modelos e simuladores para o treino de habilidades operacionais, principalmente na prática de técnicas ortopédicas básicas, que permite aos acadêmicos maximizarem as oportunidades de aprendizado e contribui para melhorar a qualidade de atendimento dos futuros pacientes atendidos. A simulação realística, no entanto, tem como grande limitação os altos custos. Objetivo: Desenvolver um simulador ortopédico de baixo custo para a prática de habilidades de redução incruenta do antebraço pediátrico no cenário pré-clínico. Métodos: Desenvolveu-se um modelo de braço e antebraço com fratura no terço médio, que foi avaliado por médicos ortopedistas, residentes e acadêmicos de medicina quanto à capacidade do simulador de reproduzir a redução da fratura. Resultados: O simulador desenvolvido teve custo significativamente inferior aos existentes na literatura. Os participantes concordaram que o modelo teve um bom desempenho e que a manipulação foi condizente com a realidade de redução de fratura incruenta do antebraço pediátrico. Conclusão: Os resultados levam a crer que esse modelo pode ser usado para ensinar a redução incruenta de fratura no terço médio do antebraço para residentes de ortopedia e acadêmicos de medicina. ***Nível de Evidência III, Estudo de Caso-Controle.***

Descritores: *Treinamento por Simulação. Traumatismos do Antebraço. Redução Fechada. Educação Médica.*

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INTRODUCTION

Medical education aims to provide the best training possible for students at a reasonable operational cost. Students should be able to repeat technical activities or clinical procedures as many times as necessary to adequately develop their skills. However, this requires patient exposure and high costs.[1] Alternatively, realistic simulation provides a controlled, safe, error-tolerant teaching environment for training of medical skills.[2]

The use of orthopedic simulators, even during medical school and residency, seeks to prepare health professionals to be

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The study was conducted at Orthopedics Service of Hospital Universitário Cajuru of Pontifícia Universidade Católica do Paraná.
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able to identify, manipulate, and/or immobilize a patient with a fracture, and refer the patient to a specialized service where they will receive the final treatment. With an adequate initial care, the patient will benefit from reduced pain, reduced risk of compartment syndrome, and other complications, as well as greater comfort when moving.

In pediatric orthopedics, mastering basic orthopedic techniques for closed reduction of fractures is especially important. This is because, unlike in adults, conservative procedures are considered the best therapeutic option in many situations due to the specific bone characteristics of pediatric patients.[3]

Among the most common childhood traumas, 45% are represented by forearm fractures, with 80% of the time involving the ulna and radius.[3] In these cases, the goal of treatment is to achieve fracture healing in good position and maintain normal range of motion of the elbow, wrist, and prono-supination. Bone remodeling allows the acceptance of certain deviations, and the adequate closed reduction maintained with cast immobilization is the best therapeutic option.[4]

In view of the social and epidemiological importance of forearm fractures in children, this study aimed to develop a device that portrays the clinical practice necessary for students and residents to practice closed reduction of these types of fractures.

In the literature reviewed, three relevant forearm fracture closed reduction simulators were found, all of them of distal fractures, two pediatric and one adult. The cost of these simulators ranged from 175 to 455 US dollars.[5-7]

Objective

To develop a low-cost orthopedic simulator for teaching and training closed reduction of pediatric fractures during undergraduate and residency training.

MATERIALS AND METHODS

For the technical development, the interface chosen for the construction of the simulator was that of a pediatric arm and forearm, compatible with an eight-year-old child with a fracture in the middle third of the forearm. The external structure and bones were made by Pacific Research Lab – Sawbones®. The structure consists of a silicone and polyurethane envelope that mimics skin and soft tissue. Radiolucent bones (humerus, ulna, and radius) with the presence of articular movements were used.

To stabilize the simulator during reduction practice, the elbow joint was fixed using a metal plate at a right angle, whereas the ulna and radius were distally fixed using plastic rods connecting the radius and ulna to the first and fifth fingertip, respectively. The use of screws for fixation was discarded due to the friable nature of the synthetic bone material, and the materials were attached to the bones using 0.9 mm stainless steel wires.

To mimic the tension forces exerted by the thick periosteum and soft parts on the drill, 1.25-mm thick latex strips were used. Three five-centimeter latex strips were glued to the anterior, lateral, and medial margins of each bone (Figure 1). The objective was to create the need to apply a force of approximately 80 N on the fracture to proceed with the fracture reduction.

For the evaluation of the simulator, the process was divided into two stages and the research met the fundamental ethical and scientific requirements of Resolution No. 466/2012,13 in both. All participants signed the informed consent form, since the study was referred to the Research Ethics Committee of the Pontifical Catholic University of Paraná via Plataforma Brasil and obtained a favorable opinion (CAAE: 09525919.5.0000.0020).

The first stage of the simulator evaluation consisted of practical tests with orthopedic physicians at different levels of training. The goal was to obtain their opinion on the simulator's ability to reproduce fracture reduction by their practical experience. To this end, a questionnaire designed by the researchers was applied, using a Likert psychometric scale. The participants answered about the simulator's resemblance to reality, its external appearance, the traction force needed to perform the fracture reduction, and the reduction technique that could be performed on the simulator. Ten physicians participated in this stage, five were third-year orthopedic residents from the Cajuru University Hospital of the Pontifical Catholic University of Paraná, and five were orthopedic specialists from the same institution. During the fracture reduction practice, the professionals were also evaluated using the OSATS form (Objective Structured Assessment of Technical Skill). Such form was initially developed to evaluate surgical techniques but was adapted for the evaluation of orthopedic skills and today is one of the most used instruments in the literature for simulator validation. This instrument evaluates five criteria and scores from zero to five points for each criterion, namely: respect for the model, knowledge, handling, operation flow, and operation time.[8]

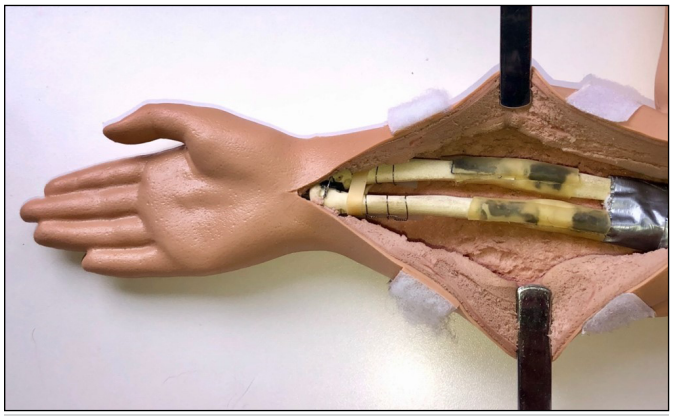

Figure 1. The stress system on the fracture seen through the anterior median opening of the simulator.

In the second stage of the simulator evaluation, 16 medical students attended a theoretical class on pediatric forearm fractures and had a practical demonstration of the reduction technique performed on the simulator. Then, the students practiced the technique and the performance of the skills acquired with the activity was evaluated using the OSATS. Note that the form was applied by an orthopedic surgeon, not directly involved with the development of the simulator.

RESULTS

The final cost of the project was 125 US dollars. The model built is of a pediatric arm and forearm, 35-cm long and weighing 900 g. It features an anterior medial opening to visualize and manipulate the fracture prior to the training.

The way it was developed, the simulator allows the training of reduction of some fracture types in different techniques, since the fracture fragments can be manipulated in a way to mimic greenstick fractures, complete, with or without deviation or rotations. The skin and soft parts of the simulator allow palpation, so that one can feel the bone landmarks as well as the unevenness generated by the fracture (Figure 2).

In the result of the physicians' evaluation regarding the simulator's similarity with reality. Eight of the 10 participants partially agreed with the statement "the simulator is quite realistic, matching with the reality of closed pediatric forearm fracture reduction," and two of them totally agreed.

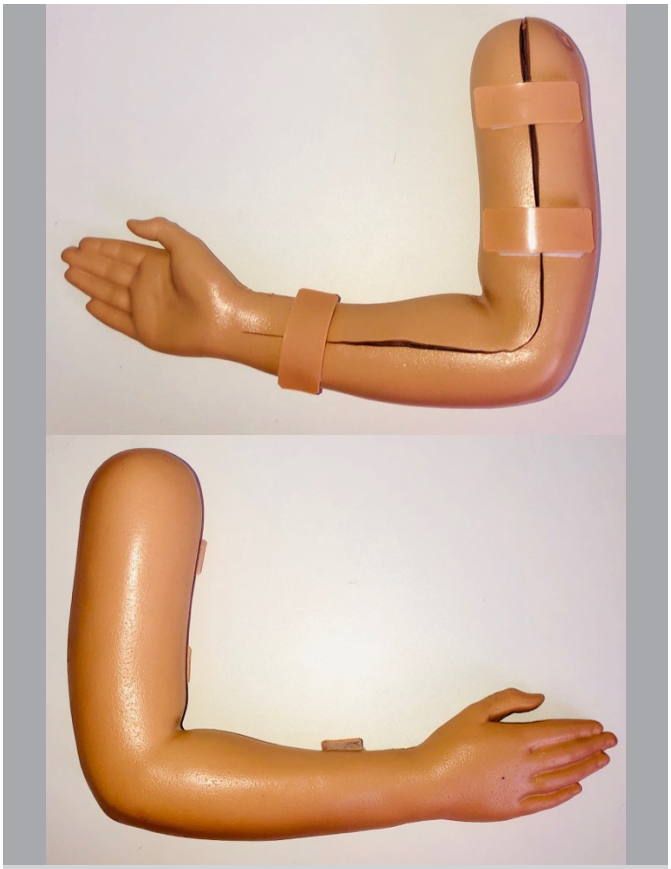

Figure 2. External and internal appearance of the orthopedic simulator.

As for the external appearance, three of the interviewees stated that it is very similar, and seven of them said that the simulator is similar to the case of a real person.

Regarding the traction force required to perform the fracture reduction on the simulator, seven participants stated that it is similar to a real fracture. Two respondents considered the traction force not very similar, and both belong to the group of third-year orthopedic residents.

Regarding the reduction technique that could be performed in the simulator, seven participants said it was similar or very similar to the real thing. In this step, the participants have not received guidance on how to perform a specific technique; they were able to perform the technique they use the most in their day-to-day medical practice.

The participants' overall performance during the reduction practice was obtained by the evaluation with the OSATS form. The results were analyzed using the mean ± standard deviation for each group. The results were: academics 14 ± 5.1 (5-21); 3rd year orthopedic residents 23.6 ± 1.34 (22-25); orthopedic specialists 24.5 ± 0.57 (24-25). The overall average score obtained by each group was proportional to their respective level of training. That is, the performance of medical students was the lowest and presented the highest standard deviation. In contrast, the more experienced groups had better and more uniform performances.

In analyzing the performance of the participants in the different criteria assessed by the OSATS, the criteria in which the students showed most difficult are the ones with the lowest scores: knowledge about the procedure and the flow of the operation, as shown in Figure 3. The students were very cautious when handling the simulator, as represented by the good scores obtained in the criterion of respect for the model (4.12 ± 1.45).

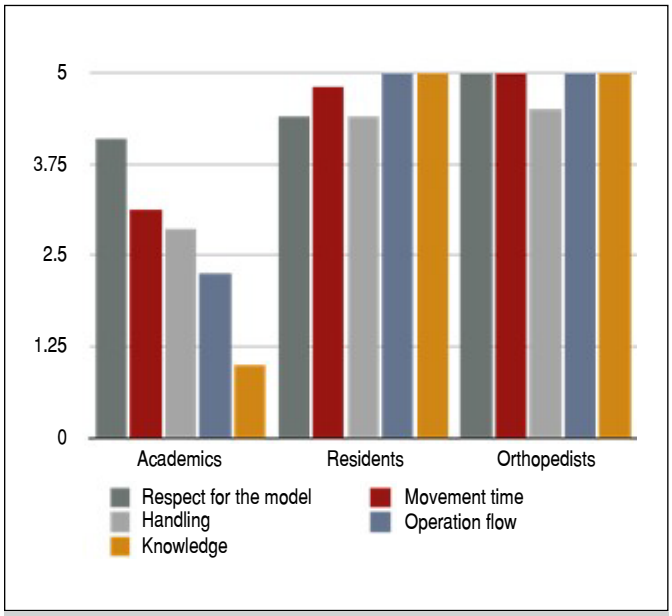

Figure 3. Graph of the performance of the participants in the specific criteria evaluated by the Objective Structured Assessment of Technical Skill form.

DISCUSSION

The physicians agreed that the simulator performed well in manipulation and technique, and faithfully represents a real case. All participants agreed, to some degree, that the simulator is very realistic and matches the reality of closed reduction of pediatric forearm fractures. Among the criteria evaluated, external appearance was the best evaluated, while the traction force required for fracture reduction had the lowest evaluation.

As for the performance of the participants evaluated by the OSATS form, the overall average score obtained by each group was proportional to their respective level of training. The scholars' mean scores in all evaluated criteria were the lowest. In other words, the simulator proved to be able to level out the participants according to different levels of training. It was indeed more difficult for the less experienced participants. If this were not the case, and the scores of the three groups were similar, it is likely that the stress force on the fracture and/or the reduction technique required would be so weak that an inexperienced person could easily perform the fracture reduction successfully.

The highest standard deviation perceived in the overall performance of the groups was that of the medical students. This fact objectifies what was seen in practice during the tests, that some students have a greater instinctive ease with the technique, although it is their first time practicing. Meanwhile, others had greater difficulty and insecurity to perform the reduction. These differences show the variety of profiles of the students, and how necessary it is for medical education to adapt to meet the different demands.

The validation of this simulator estimated the participants' ability to reduce the proposed fracture; however, the quality of the reduction was not evaluated. Some papers in the literature used artificial radiopaque bones and control X-rays before and after reduction.[5,6] In these cases, bone alignment and residual deviations were compared to the results obtained through OSATS.

Our study aimed to develop a simulator with the purpose of being used for teaching medical students, as well as being the probable first contact with a closed reduction. Thus, the methodological and budgetary difficulties generated by the use of the control

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X-ray would not be justifiable. However, if the model is used for the purpose of training orthopedic specialists or residents, validations to estimate the quality of the applied closed reduction are necessary.

This skills practice in the preclinical setting allows students to maximize the learning opportunities presented to them in the clinical setting, build self-confidence, and contribute to improving the quality of care for their future patients. This is because it familiarizes general practitioners with the care of a patient with a fracture, and in this situation, to be able to identify, manipulate, and/or immobilize the patient and refer them to a specialized service, where they will receive the final treatment.

Validations that estimate the quality of the employed closed reduction are necessary if the model is meant to be used for the purpose of training orthopedic specialist physicians.

CONCLUSION

A low-cost simulator was developed for teaching the technique of closed reduction of pediatric mid-third forearm fractures. The evaluation of the model was satisfactory and provides a good approximation of the basic orthopedic skill of manipulating and reducing a middle third forearm fracture. Thus, the model can be used as a teaching tool for training orthopedic residents and medical students.

AUTHORS' CONTRIBUTIONS: Each author contributed individually and significantly to the development of this article. JS: simulator development, analysis, article writing; LKG: simulator development, analysis, data collection; FSB: simulator development, literature review; FK: literature review, data collection.

REFERENCES

1. Moreno-Ger P, Torrente J, Bustamante J, Fernández-Galaz C, Fernández-Manjón B, Comas-Rengifo MD. Application of a low-cost web-based simulation to improve students' practical skills in medical education. Int J Med Inform. 2010;79(6):459-67. Available from: https://linkinghub.elsevier.com/retrieve/pii/S1386505610000420
2. Ziv A, Root Wolpe PR, Small SD, Glick S. Simulation-based medical education: an ethical imperative. Acad Med. 2003;78(8):783-8.
3. Sociedade Brasileira de Ortopedia e Traumatologia; Colégio Brasileiro de Radiologia. Fraturas do terço distal do antebraço na criança [Internet]. São Paulo: AMB; 2007 [accessed on 2022 Nov 18]. Available from: https://amb.org.br/files/_BibliotecaAntiga/fraturas-do-terco-distal-do-antebraco-na-crianca.pdf
4. Beekman F, Sullivan JE. Some observations on fractures of long bones in children. Am J Surg. 1941;51(3):722-38.
5. Seeley MA, Fabricant PD, Lawrence JTR. Teaching the basics: development and validation of a distal radius reduction and casting model. Clin Orthop Relat Res. 2017;475(9):2298-305.
6. Mayne IP, Brydges R, Moktar J, Murnaghan ML. Development and assessment of a distal radial fracture model as a clinical teaching tool. J Bone Joint Surg Am. 2016;98(5):410-6.
7. Egan C, Egan R, Curran P, Bryan K, Fleming P. Development of a model for teaching manipulation of a distal radial fracture. J Bone Joint Surg Am. 2013;95(5):433-8.
8. Martin JA, Regehr G, Reznick R, MacRae H, Murnaghan J, Hutchison C, Brown M. Objective structured assessment of technical skill (OSATS) for surgical residents. Br J Surg. 1997;84(2):273-8.

ORIGINAL ARTICLE
SHOULDER AND ELBOW
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TREATMENT OF RECURRENT ANTERIOR SHOULDER DISLOCATION USING THE LATARJET TECHNIQUE

TRATAMENTO DA LUXAÇÃO ANTERIOR RECIDIVANTE DO OMBRO PELA TÉCNICA DE LATARJET

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ABSTRACT

Objective: To describe the functional results, recurrence rate, postoperative radiographic appearance, and complications of patients undergoing the Latarjet procedure over 24 months. Methods: Retrospective case series, including adult patients with recurrent traumatic anterior glenohumeral dislocation undergoing the Latarjet procedure. We clinically evaluated patients preoperatively by the Rowe score and at six, 12, and 24 months after the procedure. The positioning, consolidation, and resorption of the graft were analyzed by plain radiography. The recurrence rates and other complications were also described. Results: We analyzed 40 patients (41 shoulders). The Rowe score median increased from 25 before surgery to 95 at 24 months after surgery ($p < 0.001$). We observed graft resorption in three cases (7.3%) and consolidation in 39 (95.1%). Most grafts presented adequate placement. We observed two recurrences (4.8%), one case of dislocation and one of subluxation. Seven patients (17.1%) had a positive apprehension test. The study had no cases of infection, neuropraxia, or graft breakage. Conclusion: Latarjet surgery is a safe and effective procedure in the treatment of recurrent anterior dislocation of the shoulder. This surgery enables a statistically significant improvement according to the Rowe score, with a low number of recurrences. ***Level of Evidence IV, Case Series.***

Keywords: Shoulder Dislocation. Joint Instability. Orthopedic Procedures.

RESUMO

Objetivo: Descrever os resultados funcionais, a taxa de recidiva, o aspecto radiográfico pós-operatório e as complicações de pacientes submetidos ao procedimento de Latarjet ao longo de 24 meses. Métodos: Série de casos retrospectiva que inclui pacientes adultos com luxação glenoumeral recidivante anterior traumática submetidos ao procedimento de Latarjet. Avaliamos clinicamente os pacientes pela escala de Rowe pré-operatória e aos 6, 12 e 24 meses após o procedimento. O posicionamento, a consolidação e a reabsorção do enxerto foram analisados por radiografia simples. Descrevemos ainda as taxas de recidiva e as demais complicações. Resultados: Analisamos 40 pacientes (41 ombros). A mediana da escala de Rowe evoluiu de 25,0 antes da cirurgia para 95,0 passados 24 meses desde a cirurgia ($p < 0,001$). Foi observada reabsorção do enxerto em três casos (7,3%), e consolidação em 39 (95,1%). A maioria dos enxertos apresentava posicionamento adequado. Ocorreram duas recidivas (4,8%), sendo um caso de luxação e outro de subluxação. Sete pacientes (17,1%) referiam sensação de apreensão. Não ocorreram casos de infecção, neuropraxia ou quebra do enxerto. Conclusão: A cirurgia de Latarjet é um procedimento seguro e eficaz no tratamento da luxação anterior recidivante do ombro, possibilitando melhora funcional significativa de acordo com a escala de Rowe, com baixo número de recidivas. ***Nível de Evidência IV, Série de Casos.***

Descritores: *Luxação do Ombro. Instabilidade Articular. Procedimentos Ortopédicos.*

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INTRODUCTION

The shoulder is the most common joint to dislocate,[1] and the treatment of traumatic anterior recurrent dislocations is preferably surgical.[2] In the presence of significant bone loss of the glenoid cavity or humerus, or in patients at high risk for recurrence, Bankart repair has high recurrence rates.[3] In these cases, the techniques of Latarjet[4] and Bristow[5] provide better results to capsular ligament repairs,[6] in a reliably and enduringly way in the long term.[7,8]

The Latarjet procedure leads to consistent clinical improvement and low number of recurrences, according to a recent meta-analysis including 3,917 cases.[9] Nationwide, some studies evaluate the effectiveness of bone blocks.[10-21] Of these, only four evaluate patients with a minimum of 24 months of follow-up,[15,17,19,20] and six analyze series of 40 or more patients.[10,12,18-21]

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

The study was conducted at Institute of Orthopedics and Traumatology of Hospital das Clínicas, School of Medicine of Universidade de São Paulo.
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Primarily, this study aimed to describe the clinical results of patients subjected to the Latarjet procedure, according to the Rowe score,[22] at 24 months of follow-up. To describe the recurrence rate, the postoperative radiographic aspect of the graft, and the complications are secondary objectives.

MATERIAL AND METHODS

A retrospective case series, with prospectively collected data, were conducted. The surgeries were performed by four physicians of the same institution, all effective members of the Sociedade Brasileira de Cirurgia do Ombro, with more than 10 years of experience. The procedures were carried out between 2013 and 2019. The study was approved by the local Ethics Committee with the number 68863417.2.0000.0068.

Skeletally mature patients with traumatic anterior glenohumeral recurrent dislocation were included in the study and subjected to the Latarjet procedure. The following indications were considered for the procedure: Instability Severity Index Score (ISIS)[23] score with ≥ 4 score, bone loss of the glenoid cavity greater than 20%, off-track injury[24] or recurrence after Bankart repair. All of them had clinical and pre and post operative evaluation and by image a two-year follow-up. Patients with multidirectional or posterior shoulder instability, or with a single episode of dislocation, were not included. Patients with associated rotator cuff tear or fractures other than those of the anterior rim of the glenoid cavity or of Hill-Sachs, were also not included.

Surgical procedure and rehabilitation

The anesthesia used was the interscalene block associated with general anesthesia. The positioning used was the horizontal dorsal decubitus with the dorsum elevated at about 30°. Antibiotic prophylaxis with Cefazolin 2 g from 8 to 8 h, for a period of 24 h, was performed. The implantable materials consisted of cancellous screws or 4 mm diameter cannulated with partial thread and washers.

The surgeries were performed via deltopectoral approach. The coracoacromial ligament and the pectoralis minor muscle were disinserted from the lateral and medial face of the coracoid process, keeping the conjoint tendon intact. Using a curved osteotome, we performed osteotomy of the coracoid process near its base, sparing the coracoclavicular ligaments, obtaining a graft about 2.5-cm long. Bone spicules at the base of the graft and remaining soft tissues were removed. The lower surface of the graft was then decorticated with oscillating saw. Using a 2.5-mm drill, two holes were drilled perpendicular to the longitudinal axis of the graft, 5 to 10 mm apart. The glenoid neck was accessed by a longitudinal incision in the direction of the subscapularis fibers (split), performing the resection of the glenoid labrum and the cruentation of the bone surface. The graft was provisionally fixed to the anterior rim of the glenoid cavity with Steinmann wires. Once the correct positioning of the graft was verified (alignment with the joint surface and below the "equator" of the glenoid) with radioscopy, the neck of the glenoid cavity was drilled and the graft was fixed with two 4-mm diameter partially-threaded cancellous screws. Washers were used in all cases.

Patients used a sling for 21 days and movements for the hand, wrist, and elbow were stimulated from the first postoperative day. The passive movement arc gain was initiated at 14 days, while the active gain at 21 days. Isometric exercises were initiated at 30 days and active resisted at 45 days. Sports that used the upper limbs and manual labor were allowed between four and six months, depending on the arc of movement gain and re-establishment of strength.

Outcomes

Rowe[22] score was adopted as the primary outcome at 24 months postoperatively. Were considered secondary outcomes: scores by the Rowe score at six and 12 months, recurrence rate, postoperative radiographic aspect of the graft, and presence of complications.

Variables analyzed

Clinical evaluation: Rowe score[22] and ISIS[23].

Factors intrinsic to the patient: age at the time of surgery, gender, dominance, smoking, epilepsy, number of previous dislocations, previous surgeries, and sports activity.

Factors related to the injury: bone loss of the glenoid cavity, Hill Sachs interval, and on-track or off-track pattern verification.

Recurrence: complete dislocation, subluxation, or positive apprehension test.

Postoperative aspect of the graft: presence of consolidation, resorption, and vertical and horizontal positioning.

Clinical complications: neurological lesions (specifically of the axillary, musculocutaneous, and suprascapular nerves), infections (superficial or deep), hematoma, and need for reoperation.

Evaluation methods

Clinical evaluation: the clinical scores were applied by a research assistant, non-study participant, one week before the procedure, and additionally at six, 12, and 24 months for the Rowe score.

Image evaluation: computed tomography of all patients was performed preoperatively. The measurement of the glenoid bone loss was performed by the best-fit circle,[25] while the humerus bone loss by the Hill-Sachs interval[24] (Figure 1). The on-track or off-track pattern verification was also performed.[24] The postoperative evaluation of the graft, regarding to the consolidation, resorption, and positioning, was performed by simple radiographs, taken at 24 months.

Statistical analysis

The data normality, performed by the Shapiro-Wilk test, showed that most continuous data have nonparametric distribution. Thus, continuous data were expressed as mean, standard deviation, median, and interquartile interval. Categorical data were expressed as absolute and percentage values. The Rowe score evaluation over time was performed by Friedman's test. The comparison between sequential evaluation times was performed by the Wilcoxon test, with Bonferroni adjustment for multiple comparisons. The $p \leq 0.05$ value was considered statistically significant. The SPSS program version 22.0 (SPSS Inc®, Chicago, IL, USA) was used.

RESULTS

We performed 44 Latarjet surgeries in the evaluated period. We did not include two patients with full-thickness rotator cuff repair

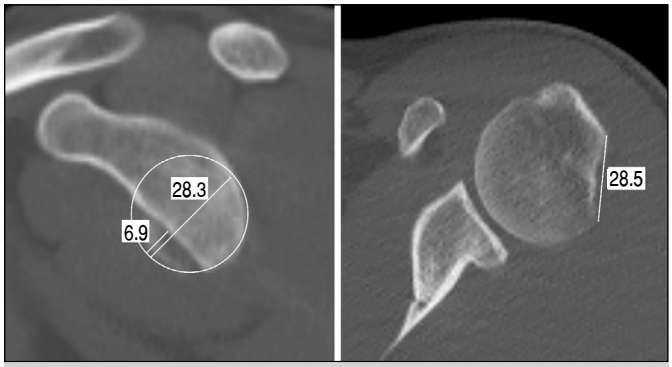

Figure 1. Bone loss of the glenoid cavity, measured by the best fit circle method, and of the humerus, measured by the Hill-Sachs interval.

and one patient with multidirectional instability, in which reverse remplissage was performed together with bone block. Then, 40 patients (41 shoulders) were analyzed. Table 1 shows the general characteristics of the sample referring to patients.

Of the 20 patients who practiced sports, ten played soccer, two rugby, two weight training, one judo, one cycling, one volleyball, and one swimming.

Patients had a median of 20% (IQR 9.2) of glenoid bone loss, and 19.6 mm (IQR 5.3) of Hill-Sachs Interval. Table 2 shows the results. A total of 29 patients (70.7%) presented an off-track lesion. The ISIS score had a median of 4.0 (IQR 2.0).

The Rowe score evaluation showed a median of 25 before surgery and 95 at 24 months, with statistically significant changes over time ($p < 0.001$). Improvement occurred between the preoperative period and six months. Table 3 shows these data.

We observed graft resorption in three cases (7.3%), and consolidation in 39 (95.1%). Most grafts presented adequate positioning. Table 4 shows these data. Figures 2, 3, 4, and 5 show, respectively, well-positioned and consolidated graft, medialized graft, lateralized graft, and graft resorption. Four patients (9.8%) had grade I glenohumeral arthrosis of Samilson and Prieto before surgery, and we observed no worsening in joint degeneration or emergence of new cases.

We had two recurrences (4.8%), one case of dislocation and another of subluxation. Dislocation occurred in a female patient, without traumatic event. She presented ligament laxity, although without multidirectional instability, 27.6% of glenoid bone loss, and 18.5 mm of Hill-Sachs interval. Subluxation occurred in a male patient, with 10% of glenoid bone loss and 12.1 mm of Hill-Sachs interval, after traumatic event. In both cases the graft was consolidated and well positioned, and the patients did not practice sports. Seven patients (17.1%) had a positive apprehension test when positioning the shoulder in elevation and lateral rotation. We reported no cases of infection, neuropraxia, or graft breakage.

Table 1. General characteristics of the sample (variables of patients).

Age [median (IQI)]	28	(13.0)
Male [n (%)]	39	(95.1)
Dominant side affected [n (%)]	26	(63.4)
Tobacco use [n (%)]		
Smoker	6	(14.6)
Former smoker	2	(4.9)
Number of previous dislocations [n (%)]		
2 to 5	7	(17.1)
6 to 10	5	(12.2)
11 to 20	8	(19.5)
21 to 50	10	(24.4)
> 50	11	(26.8)
Epilepsy [n (%)]	1	(2.4)
Sports activity [n (%)]	20	(48.8)
Previous Bankart repair [n (%)]	2	(4.9)

Table 2. Preoperative bone loss.

	Mean	sd	Median	IQI
Glenoid width (mm)	27.8	2.6	28.0	2.7
Glenoid defect (mm)	5.6	2.4	5.6	2.8
% Glenoid loss	19.9	8.2	20.0	9.2
Hill-Sachs Interval	19.3	4.9	19.6	5.3

sd: standard deviation; IQI: interquartile range.

Table 3. Pre and postoperative functional evaluation.

	Mean	sd	Median	IQI	p*	p**
Rowe Score						
Preoperative	29.1	15.6	25.0	25.0		< 0.001
6 months	83.2	16.6	90.0	20.0	< 0.001	
12 months	85.1	16.1	95.0	22.5	0.726	
24 months	84.4	17.3	95.0	17.5	> 0.999	

* Bonferroni correction for multiple comparisons, considering sequential evaluation times; ** Friedman test; sd: standard deviation; IQI: interquartile range.

Table 4. Postoperative characteristics.

	N	%
Resorption	3	7.3
Vertical positioning		
Below the equator	40	97.6
At the equator	1	2.4
Horizontal positioning		
Well positioned	37	90.2
Medialized 2-5 mm	1	2.4
Medialized > 5 mm	2	4.9
Lateralized 2-5 mm	1	2.4
Consolidation	39	95.1

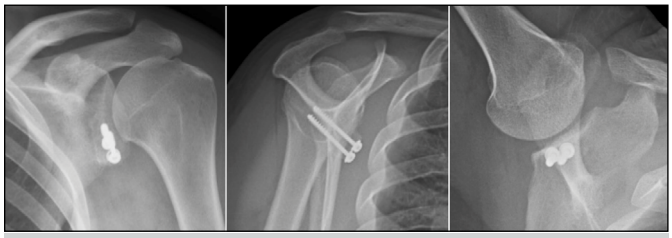

Figure 2. Consolidated and properly positioned graft.

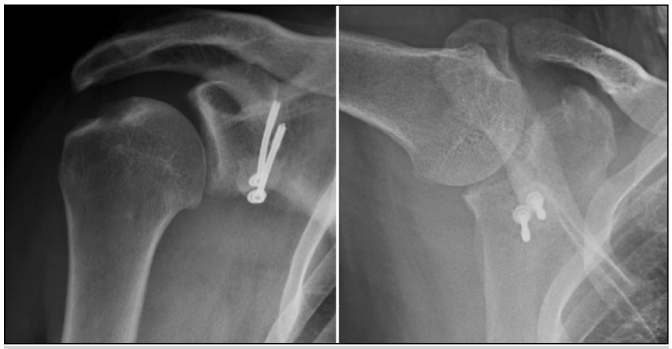

Figure 3. Medialized graft.

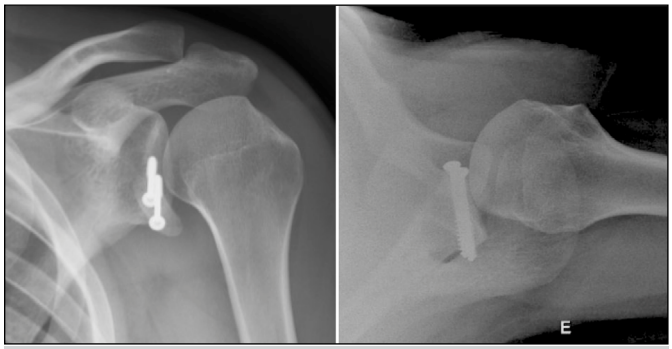

Figure 4. Lateralized graft.

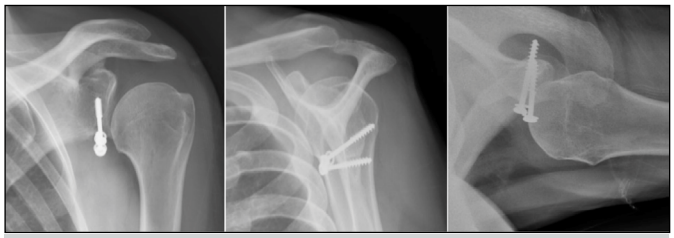

Figure 5. Graft with resorption.

DISCUSSION

The Latarjet procedure led to statistically significant improvement according to Rowe score, with the median going from 25 preoperatively to 95 after 24 months. This datum is in accordance with the other authors, who report a mean Rowe from 89 to 95[11-13,17,20] after the procedure.

We observed a recurrence rate of 4.9%, one dislocation and one subluxation, values close to that reported by meta-analysis by Gilat et al.[9] (2.2% and 2.7%, respectively). In national studies, the recurrence rate ranges from 0%[10,11,13,14,16,17,19,20] to about 4%.[12,15,18] However, these data should be analyzed with caution, since the follow-up time varies widely in studies evaluating long-term results,[15] while others include in their sample patients with a minimum follow-up of six months.[13,16,21] Moreover, because the sample of most studies is not very broad, significant percentage variations may occur, given a low level of events.

The cases also demonstrated that 17% of patients had a positive apprehension test and, although this number is similar to that pointed out by Belangero et al.,[19] it is higher than the other national studies, which reported rates from 0%[10,13,14,16,18,20] to about 10%.[12,17] Gilat et al.,[9] in the largest sample on the subject, recorded 2% of patients with this symptom. We believe that had a positive apprehension test is an often neglected symptom and it is not specifically evaluated by most clinical scores, except Rowe's.[22,26] We do not consider this symptom a failure of the procedure, but to evaluate it in a standardized way is crucial.

The pseudarthrosis incidence in our case series was 4.9%. These values are in accordance with those reported by other authors, with rates from 0 to 12%.[10-14,16,17,19-21] Meanwhile, Ferreira Filho et al.,[18] reported a much higher incidence, with 38% of the grafts without radiographic consolidation; however, they used single screw fixation (Bristow technique) in most cases. Graft resorption occurred in 7.3% of the cases. Other authors report rates from 0 to 15%.[10,11,14,16-21] Cohen et al.[17] report 50% of resorption, but these authors perform the evaluation by computed tomography, while the others by plain radiography.

Radiographic analysis demonstrated adequate graft positioning in most cases (vertically in 98% and horizontally in 90%). These data are in accordance with the other studies, in which positioning errors are described in 3.7% to 10.5% of the samples.[13,15-19,21] Grafts fixed too high or low may be responsible for residual instability, in the same way as excessive medial positioning. Meanwhile, lateral grafts, can lead to limitation range of motion and development of early arthrosis. Moreover, few studies evaluate the graft positioning by computed tomography.[13,17,21]

We reported no cases of infection in our series. The other national authors either do not describe this complication[11,12,14-18] or report rates from 2 to 5%.[10,13,19-21] We also did not observe any neurological lesion, as well as most national authors.[10-15,17,18,20,21] Neuropraxias of the axillary or musculocutaneous nerves are mentioned by some authors.[16,19,21] According to the meta-analysis by Gilat et al.,[9] infection occurs in 0.7% of cases, and neurological injury in 0.1%.

Our study presented limitations. This is a retrospective case series, although data collection occurred prospectively, and presents the inherent biases to this type of study. The sample, although robust in national standards, limits the performance of secondary analyses. The analysis of graft positioning, consolidation, and resorption was performed by radiography, other than by computed tomography, a more accurate method used by other authors.[13,17,21] Finally, the follow-up of the patients occurred for two years, a time that, superior to other authors but not ideal for assessing shoulder instability. We believe that a five-year follow-up, as done by Belangero et al.,[19] is ideal for the evaluation of shoulder instability.

As favorable points, we highlight the 41 shoulder series, similar to the other large national series,[10,12,18-20] with patients followed in a standardized way over two years, clinically and radiographically.

CONCLUSION

Latarjet surgery is a safe and effective procedure in the treatment of recurrent anterior shoulder dislocation. This surgery leads to statistically significant improvement according to Rowe score, with low number of recurrences.

AUTHORS' CONTRIBUTIONS: Each author contributed individually and significantly to the development of this article. EAM: substantial contribution to the conception or design of the work, or acquisition, analysis or interpretation of the data for the work, writing of the work or critical review of its intellectual content; JABS: substantial contribution in the conception or design of the work, or acquisition, analysis or interpretation of the data for the work, final approval of the version of the manuscript to be published; JHA, MECG, FBAS, AMFN: final approval of the manuscript version to be published.

REFERENCES

1. Cutts S, Prempeh M, Drew S. Anterior shoulder dislocation. Ann R Coll Surg Engl. 2009;91(1):2-7.
2. Handoll HHG, Almaiyah MA, Rangan A. Surgical versus non-surgical treatment for acute anterior shoulder dislocation. Cochrane Database Syst Rev. 2004;2004(1):CD004325.
3. Burkhart SS, De Beer JF, Barth JRH, Cresswell T, Criswell T, Roberts C, Richards DP. Results of modified Latarjet reconstruction in patients with anteroinferior instability and significant bone loss. Arthroscopy. 2007;23(10):1033-41.
4. Latarjet M. Treatment of recurrent dislocation of the shoulder. Lyon Chir. 1954;49(8):994-7.
5. Helfet AJ. Coracoid transplantation for recurring dislocation of the shoulder. J Bone Joint Surg Br. 1958;40-B(2):198-202.
6. Bessière C, Trojani C, Carles M, Mehta SS, Boileau P. The open Latarjet procedure is more reliable in terms of shoulder stability than arthroscopic bankart repair. Clin Orthop Relat Res. 2014;472(8):2345-51.
7. Gordins V, Hovelius L, Sandström B, Rahme H, Bergström U. Risk of arthropathy after the Bristow-Latarjet repair: a radiologic and clinical thirty-three to thirty-five years of follow-up of thirty-one shoulders. J Shoulder Elbow Surg. 2015;24(5):691-9.
8. Longo UG, Loppini M, Rizzello G, Ciuffreda M, Maffulli N, Denaro V. Latarjet, Bristow, and Eden-Hybinette procedures for anterior shoulder dislocation: systematic review and quantitative synthesis of the literature. Arthroscopy. 2014;30(9):1184-211.
9. Gilat R, Haunschild ED, Lavoie-Gagne OZ, Tauro TM, Knapik DM, Fu MC, Cole BJ. Outcomes of the Latarjet procedure versus free bone block procedures for anterior shoulder instability: a systematic review and meta-analysis. Am J Sports Med. 2021;49(3):805-16.
10. Godinho GG, Monteiro PCVF. Tratamento cirúrgico da instabilidade anterior do ombro pela técnica de Didier-Patte. Rev Bras Ortop. 1993;28(9):640-4.
11. Ikemoto RY, Murachovisky J, Nascimento LGP, Bueno RS, Almeida LHO, Strose E, Helmer FF. Resultados da cirurgia de Latarjet no tratamento da instabilidade anterior traumática do ombro associada à erosão óssea da cavidade glenoidal – seguimento mínimo de um ano. Rev Bras Ortop. 2011;46(5):553-60.

12. Silva LA, Lima AGC, Kautsky RM, Santos PD, Sella GV, Checchia SL. Evaluation of the results and complications of the Latarjet procedure for recurrent anterior dislocation of the shoulder. Rev Bras Ortop. 2015;50(6):652-9.
13. Nascimento AT, Claudio GK, Rocha PB, Zumárraga JP, Camargo OP. Arthroscopic Latarjet technique combined with endobuttons: functional outcomes in 26 cases. Acta Ortop Bras. 2018;26(5):328-31.
14. Stirma GA, Lima EBS, Chaves DH, Belangero PS, Andreoli CV, Ejnisman B. Latarjet procedure on anterior shoulder instability in professional soccer players. Acta Ortop Bras. 2020;28(2):84-7.
15. Guiotti Filho J, Leite MC, Borges ACW, Souza GT, Prado OF. Clinical and radiographic evaluation of patients operated by the Bristow-Latarjet technique with a minimum follow-up of 20 years. Rev Bras Ortop. 2020;55(4):455-62.
16. Castropil W, Schor B, Bitar A, Medina G, Ribas LH, Mendes C. Arthroscopic Latarjet: technique description and preliminary results. Study of the first 30 cases. Rev Bras Ortop. 2020;55(2):208-14.
17. Cohen M, Zaluski AD, Siqueira GSL, Amaral MVG, Monteiro MT, Motta Filho GR. Risk factors for coracoid graft osteolysis after the open Latarjet procedure. Rev Bras Ortop. 2020;55(5):585-90.
18. Ferreira Filho AA, Malavolta EA, Gracitelli MEC, Assunção JH, Silva FBA, Bolliger Neto R, et al. Treatment of recurrent anterior shoulder dislocation with Bristow-Latarjet procedure. Acta Ortop Bras. 2021;29(1):39-44.
19. Belangero PS, Lara PHS, Figueiredo EA, Andreoli CV, Pochini AC, Ejnisman B, Smith RL. Bristow versus Latarjet in high-demand athletes with anterior shoulder instability: a prospective randomized comparison. JSES Int. 2021;5(2):165-70.
20. Garcia JC. Arthroscopic Bristow: assessments of safety and effectiveness, 12 years of experience. Rev Bras Ortop. 2021;56(2):205-12.
21. Cohen M, Fonseca R, Gribel B, Galvão MV, Monteiro M, Motta Filho G. Incidence and risk factors of the complications related to the Latarjet surgery. Rev Bras Ortop. 2021;56(3):307-12.
22. Rowe CR, Patel D, Southmayd WW. The Bankart procedure: a long-term end-result study. J Bone Joint Surg Am. 1978;60(1):1-16.
23. Balg F, Boileau P. The instability severity index score. A simple pre-operative score to select patients for arthroscopic or open shoulder stabilisation. J Bone Joint Surg Br. 2007;89(11):1470-7.
24. Di Giacomo G, Itoi E, Burkhart SS. Evolving concept of bipolar bone loss and the Hill-Sachs lesion: from "engaging/non-engaging" lesion to "on-track/off-track" lesion. Arthroscopy. 2014;30(1):90-8.
25. Itoi E, Lee SB, Amrami KK, Wenger DE, An KN. Quantitative assessment of classic anteroinferior bony Bankart lesions by radiography and computed tomography. Am J Sports Med. 2003;31(1):112-8.
26. Marcondes FB, Vasconcelos RA, Marchetto A, Andrade ALL, Zoppi Filho A, Etchebehere M. Tradução e adaptação cultural do Rowe score para a língua portuguesa. Acta Ortop Bras. 2012;20(6):346-50.

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INCIDENCE AND EPIDEMIOLOGY OF ADHESIVE CAPSULITIS DURING THE COVID-19 PANDEMIC

INCIDÊNCIA E EPIDEMIOLOGIA DE CAPSULITE ADESIVA DURANTE A PANDEMIA DE COVID-19

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ABSTRACT

Objective: To evaluate a possible increase of adhesive capsulitis incidence during the COVID-19 pandemic. Methods: A total of 1,983 patients with shoulder disorders were retrospectively analyzed regarding gender, age, development of adhesive capsulitis and comorbidities (systemic arterial hypertension, diabetes mellitus, dyslipidemia, hypothyroidism, hyperthyroidism, depression, and anxiety) in two different periods: from March 2019 to February 2020 and from March 2020 to February 2021. Descriptive and quantitative variables were statistically analyzed. The program used for the calculations was SPSS 17.0 for Windows. Results: During the pandemic, there was a 2.41-fold increase ($p < 0.001$) in cases of adhesive capsulitis (compared to the previous year). Patients with depression and anxiety had a significantly increased risk by 8.8 ($p < 0.001$) and 14 ($p < 0.001$) times, respectively, of developing frozen shoulder (regarding the two periods studied). Conclusion: A significant increase in the incidence of frozen shoulder was observed after the onset of the COVID-19 pandemic in addition to a simultaneous increase of psychosomatic disorders. Prospective studies would help to ratify the idea contained in this research. ***Level of Evidence III, Observational Cross-Sectional Study.***

Keywords: Joint Capsule. Pathology. Shoulder. Bursitis. SARS-CoV-2. COVID-19.

RESUMO

Objetivo: Avaliar se houve aumento da incidência de capsulite adesiva durante a pandemia de COVID-19. Métodos: Foram analisados, retrospectivamente, 1.983 pacientes com desordens do ombro quanto a sexo, idade, desenvolvimento de capsulite adesiva e comorbidades (hipertensão arterial sistêmica, diabetes mellitus, dislipidemia, hipo/hipertireoidismo, depressão e ansiedade) em dois períodos distintos: de março de 2019 a fevereiro de 2020 e de março de 2020 a fevereiro de 2021. Procedeu-se à análise estatística das variáveis descritivas e quantitativas, utilizando o software SPSS 17.0 for Windows para os cálculos. Resultados: Durante a pandemia, houve aumento de 2,41 vezes ($p < 0,001$) de casos de capsulite adesiva em relação ao ano anterior. Considerando os períodos estudados, pacientes com depressão e ansiedade apresentaram um risco significativamente aumentado em 8,8 ($p < 0,001$) e 14 ($p < 0,001$) vezes, respectivamente, de desenvolver a patologia em questão. Conclusão: Observou-se um aumento significativo da incidência de ombro congelado após o início da pandemia de COVID-19, além de sua relação com distúrbios psicossomáticos. São necessários estudos prospectivos futuros para ratificar a ideia contida nesta pesquisa. ***Nível de Evidência III, Estudo Transversal Observacional.***

Descritores: *Cápsula Articular. Patologia. Ombro. Bursite. SARS-CoV-2. COVID-19.*

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INTRODUCTION

Adhesive capsulitis (AC), or frozen shoulder, is a pathology characterized by progressive pain of spontaneous onset in the shoulder associated with a loss of passive and active movement of the joint.[1] Such restriction is secondary to inflammation of the joint capsule with consequent thickening and adherence of this structure to itself or to the anatomical neck of humerus.[2]

Although it is often referred to as being anterior,[3] it may radiate to the anterolateral aspect of the arm and generate discomfort in the region of the deltoid muscle insertion.[1,3-5] It sometimes significantly interferes with shoulder functionality and the patient's quality of sleep.[1]

Such comorbidity has an incidence of approximately 2-5% in the general population,[1,4] occurring mainly in females aged between 40 and 60 years.[1,4,5]

Its diagnosis is clinical, and the disease can be classified in primary (the frozen shoulder itself) or secondary forms. The latter is subdivided into intrinsic causes (related to shoulder pathologies,

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

The study was conducted at Hospital IFOR, Rede D'Or São Luiz.
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such as rotator cuff injuries), extrinsic causes (comorbidities that do not occur in the shoulder but may have a contiguous relation with it, such as Pancoast tumor), or systemic causes (associated to systemic disorders, such as diabetes or thyroid diseases).[5-9]
In most cases, due to the self-limited nature of the disease, non-surgical treatment is effective. Therapeutic options include physical therapy, the use of symptomatic drugs and intra-articular corticosteroid injections, capsular hydrodilatation, manipulation under anesthesia, and even surgery in refractory cases.[8]
The purpose of this study is to compare the incidence of adhesive capsulitis before and during the pandemic in patients subjected to outpatient care in our department, as well as to evaluate their epidemiological profile.

MATERIALS AND METHODS

This is an observational retrospective cohort study conducted at an orthopedic hospital located in the municipality of São Bernardo do Campo/SP. This study was approved by the Research Ethics Committee under protocol number 53400321.6.0000.5373.
We used our database to access the medical records of patients subjected to consultations performed at the shoulder and elbow outpatient clinics of our institution in two distinct and consecutive periods: from March 2019 to February 2020 and from March 2020 to February 2021.
During these periods, 5,325 consultations were performed, and the total number of patients was 2,531.
Of these patients, 548 (21.6%) had complaints not related to the shoulder and were excluded from the study.
The remaining 1,983 (79.4%) patients were evaluated for gender, age, development of adhesive capsulitis, and the presence of the following comorbidities: systemic arterial hypertension, diabetes mellitus, dyslipidemia, hypothyroidism, hyperthyroidism, depression, and anxiety.
For frozen shoulder to be considered as adhesive capsulitis, the patient could not present an upper extremity fracture in previous visits, as well as upper extremity surgeries for at least one year.
Since this study aims to analyze the incidence of frozen shoulder in the studied periods, the patients whose medical records contained reports of adhesive capsulitis in consultations before those periods were not considered as having the disease.

Statistical analysis

Initially, all variables were analyzed descriptively. For quantitative variables, this analysis was performed by observing the minimum and maximum values and the calculation of means, standard deviations, and median. For the qualitative variables, absolute and relative frequencies were estimated.
The student's *t*-test was used to compare the means of two groups.[10] The chi-square test[10] or Fisher's exact test were used to evaluate homogeneity of proportions.[10] The program used for calculations was SPSS 17.0 for Windows. The significance level used for the tests was 5%.

RESULTS

Of the 1983 patients with shoulder-related complaints, 971 (49.0%) were seen in the first period (from March 2019 to February 2020) and 1012 (51.0%) in the second period (from March 2020 to February 2021).
The age of these patients ranged from 5 to 97 years, with a mean of 47.77 years (with a standard deviation of 13.44 years and a median of 47.21 years). A total of 1,126 (56.9%) were male.
During these two years, 57 patients (2.9%) developed adhesive capsulitis.
Table 1 shows the comorbidities evaluated, as well as their prevalence compared to the total number of patients.
Table 2 shows the comparison between the two periods regarding age, gender, development of adhesive capsulitis, and comorbidities studied.
Table 3 shows the comparison of patients with and without adhesive capsulitis in relation to age, gender, and presence of comorbidities studied.

DISCUSSION

Adhesive capsulitis is a pathology with a predominance in females aged between 40 to 60 years old.[1,4,5]
In our study, surprisingly, the number of reported cases was slightly higher in males (50.9%). The mean age of the patients was 52.43 years, within the range normally affected, according to the literature.
We observed that in the second period analyzed, there was a significantly higher percentage of patients with anxiety ($p < 0.01$)

Table 1. Comorbidities and their prevalence in relation to patients.

Disease	n	%
SAH	154	6.1
DM	85	3.4
DLP	53	2.1
Hypothyroidism	34	1.3
Hyperthyroidism	4	0.2
Depression	27	1.1
Anxiety	31	1.2

SAH: systemic arterial hypertension; DM: diabetes mellitus; DLP: dyslipidemia.

Table 2. Comparison of the two periods (1st period: from March 2019 to February 2020; 2nd period: from March 2020 to February 2021).

	Period		
Variable	First	Second	p
Age (in years)	47.75 ± 13.49	47.88 ± 13.40	0.708[a]
Male	564 (58.3%)	562 (55.5%)	0.220[b]
SAH	53 (5.5%)	77 (7.6%)	0.053[b]
DM	31 (3.2%)	45 (4.5%)	0.146[b]
DLP	23 (2.4%)	28 (2.8%)	0.576[b]
Hypothyroidism	11 (1.1%)	20 (2.0%)	0.130[b]
Hyperthyroidism	2 (0.2%)	1 (0.1%)	0.617[c]
Depression	6 (0.6%)	18 (1.8%)	0.018[b]
Anxiety	5 (0.5%)	22 (2.2%)	0.001[b]
Capsulitis	16 (1.7%)	41 (4.1%)	0.001[b]

SAH: systemic arterial hypertension; DM: diabetes mellitus; DLP: dyslipidemia; [a] descriptive level of Student's *t*-test probability; [b] descriptive level of probability of the chi-square test; [c] descriptive level of probability of Fisher's exact test.

Table 3. Comparison of groups of patients with and without adhesive capsulitis.

	Capsulitis		
Variable	No	Yes	p
Age (in years)	46.90 13.65	52.43 9.82	< 0.001[a]
Male	1,435 (58.1%)	29 (50.9%)	0.275[b]
SAH	148 (6.0%)	6 (10.5%)	0.156[c]
DM	77 (3.1%)	8 (14.0%)	< 0.001[c]
DLP	49 (2.0%)	4 (7.0%)	0.030[c]
Hypothyroidism	30 (1.2%)	4 (7.0%)	0.007[c]
Hyperthyroidism	3 (0.1%)	1 (1.8%)	0.087[c]
Depression	22 (0.9%)	5 (8.8%)	< 0.001[c]
Anxiety	23 (0.9%)	8 (14.0%)	< 0.001[c]

SAH: systemic arterial hypertension; DM: diabetes mellitus; DLP: dyslipidemia; [a] descriptive level of Student's *t*-test probability; [b] descriptive level of probability of the chi-square test; [c] descriptive level of probability of Fisher's exact test.

and depression ($p = 0.018$) who sought the Shoulder Outpatient Clinic, as well as a significant increase in new cases of adhesive capsulitis, whose incidence increased from 1.7% in the pre-pandemic period to 4.1% in the post-pandemic period. This means that the incidence of the disease was 2.41 times higher in the second period ($p < 0.001$).

Comparing patients who did or did not develop adhesive capsulitis, we observed a significantly higher prevalence of diabetes mellitus, hypothyroidism, anxiety, and depression in the first group.

The prevalence of diabetes mellitus was four times higher in patients with frozen shoulder compared to other patients, approaching the data we have available in the literature, which show that the prevalence of adhesive capsulitis is five to nine times higher in patients with such endocrinopathy.[7,8]

We evaluated the prevalence of hypothyroidism in our sample, whose patients had a five times greater chance of developing frozen shoulder ($p = 0.011$), agreeing with the work of Cohen et al.,[6] which showed that in the presence of these disorders (especially hypothyroidism and the presence of nodules in the gland), the chance of a patient developing AC may increase 2.69 times.

In our study, patients with depression and anxiety had a significantly increased risk by 8.8 ($p < 0.001$) and 14 ($p < 0.001$) times, respectively, of developing the pathology in question, in agreement with other studies.

In an orthopedic center in Iran, Ebrahimzadeh et al.[11] analyzed patients with frozen shoulder and showed that 77% of patients had depressive symptoms, while 32% had anxiety symptoms. Both were related to increased pain and limb dysfunction when compared with the control group. Ding et al.[1] found similar results, showing increased pain, decreased range of motion, and a higher incidence of nocturnal pain in these patients.

Bagheri et al.[12] concluded that the pain, quality of life (as assessed by the patient), and dysfunction secondary to AC were related more to psychological factors than to the physical parameters evaluated, such as age, gender, and education level.

We believe that the association between mental disorders and adhesive capsulitis justifies the significant increase of the latter, evidenced in our study after the beginning of the pandemic, considering the notorious increase in the number of people with symptoms of stress, depression, and anxiety around this period. Deng et al.[13] showed, in their study conducted at the beginning of the pandemic, that more than 28% of the respondent's reported symptoms of anxiety and more than 37% of depression. In total, 53.8% rated these impacts as moderate or severe, and more than 20% of patients with previous psychological disorders reported worsening symptoms.

Furthermore, Fawas and Samaha[14] evidenced a proportionality relation between the duration of quarantine and the development of different symptoms of post-traumatic stress disorder. Their study, conducted with Lebanese people undergoing lockdown, compared participants' complaints after two and four weeks from the start of quarantine. Reports of feeling sad when recalling past experiences, distance from other people, and feelings of hyperactivity or increased wakefulness increased by 29.1%, 25.5%, and 37.3% in the second period participants.

The study had some weaknesses such as its retrospective design and the fact that the diagnosis of psychosomatic illnesses was provided by the patient himself. Further studies on the subject will help to corroborate all these findings.

CONCLUSION

The study showed a significant increase in the incidence of frozen shoulder after the onset of the COVID-19 pandemic, coinciding with the increase and intensification of psychosomatic symptoms in the population caused by sudden lifestyle changes.

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REFERENCES

1. Ding H, Tang Y, Xue Y, Yang Z, Li Z, He D, et al. A report on the prevalence of depression and anxiety in patients with frozen shoulder and their relations to disease status. Psychol Health Med. 2014;19(6):730-7.
2. Neviaser AS, Neviaser RJ. Adhesive capsulitis of the shoulder. J Am Acad Orthop Surg. 2011;19(9):536-42.
3. Disser NP, De Micheli AJ, Schonk MM, Konnaris MA, Piacentini AN, Edon DL, et al. Musculoskeletal consequences of COVID-19. J Bone Joint Surg Am. 2020;102(14):1197-204.
4. Ramirez J. Adhesive capsulitis: diagnosis and management. Am Fam Physician. 2019;99(5):297-300.
5. Lynch TS, Edwards SL. Adhesive capsulitis: current concepts in diagnosis and treatment. Curr Orthop Pract. 2013;24(4):365-9.
6. Cohen C, Tortato S, Silva OBS, Leal MF, Ejnisman B, Faloppa F. Association between frozen shoulder and thyroid diseases: strengthening the evidences. Rev Bras Ortop. 2020;55(4):483-9.
7. Park HB, Gwark JY, Jung J. What serum lipid abnormalities are associated with adhesive capsulitis accompanied by diabetes? Clin Orthop Relat Res. 2018;476(11):2231-7.
8. Whelton C, Peach CA. Review of diabetic frozen shoulder. Eur J Orthop Surg Traumatol. 2018;28(3):363-71.
9. Zuckerman JD, Rokito A. Frozen shoulder: a consensus definition. J Shoulder Elbow Surg. 2011;20(2):322-5.
10. Rosner B. Fundamentals of biostatistics. 2nd ed. Boston: Duxbury; 1986.
11. Ebrahimzadeh MH, Moradi A, Bidgoli HF, Zarei B. The relationship between depression or anxiety symptoms and objective and subjective symptoms of patients with frozen shoulder. Int J Prev Med. 2019;10:38.
12. Bagheri F, Ebrahimzadeh MH, Moradi A, Bidgoli HF. Factors associated with pain, disability and quality of life in patients suffering from frozen shoulder. Arch Bone Jt Surg. 2016;4(3):243-7.
13. Deng J, Zhou F, Hou W, Silver Z, Wong CY, Chang O, et al. The prevalence of depression, anxiety, and sleep disturbances in COVID-19 patients: a meta-analysis. Ann N Y Acad Sci. 2021;1486(1):90-111.
14. Fawaz M, Samaha A. COVID-19 quarantine: post-traumatic stress symptomatology among Lebanese citizens. Int J Soc Psychiatry. 2020;66(7):666-74.

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WHAT IS THE KNOWLEDGE OF ELEMENTARY SCHOOL TEACHERS ABOUT SCOLIOSIS?

QUAL O CONHECIMENTO DE PROFESSORES DE ENSINO FUNDAMENTAL SOBRE ESCOLIOSE?

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ABSTRACT

Objective: To evaluate the knowledge about scoliosis in teachers of municipal public schools. Methods: In total, 126 professionals were interviewed using a standard questionnaire containing issues related to scoliosis. Results: 31% of interviewees did not know what scoliosis is. Of those who knew 89.65% were partially correct about the definition. Of those who claimed to know how the scoliosis diagnosis is made, only 25.58% were completely correct. When questioned about the Adams test, 84.9% did not know it. Among the interviewees, 57.9% answered that it is impossible to identify scoliosis by a simple examination of their students and, off these, 86.3% stated the lack of knowledge about the subject; and 92.1% considered that training for the diagnosis and early identification of scoliosis in students. Conclusion: This study holds social impact since the interviewed teachers were not knowledgeable about the subject and had difficulty in providing a definition of the condition and in how to proceed with the investigation. Continuous education activities and the inclusion of this subject on the curricula of teacher education programs would improve the early diagnosis and treatment of scoliosis, with high success rates. ***Level of Evidence IV, Economic and Decision Analyses.***

Keywords: Scoliosis. School Teachers. Adolescent. Prevalence.

RESUMO

Objetivo: Avaliar o conhecimento de professores de escola municipal sobre escoliose. Métodos: Foram entrevistados 126 profissionais por meio de formulário online padronizado contendo perguntas relativas à escoliose. Resultados: Dos entrevistados, 31% não sabiam o que é escoliose. Dos que sabiam, 89,65% estavam parcialmente corretos quanto à definição. Dos professores que responderam saber como era feito o diagnóstico de escoliose, apenas 25,58% estavam totalmente corretos. Quando questionados sobre o teste de Adams, 84,9% não sabiam do que se tratava. Dos entrevistados, 57,9% disseram que não é possível identificar escoliose por meio de um exame simples de seus alunos em sala de aula e, destes, 86,3% alegaram falta de conhecimento sobre o assunto; e 92,1% consideraram que é importante haver uma capacitação sobre o diagnóstico de escoliose para identificação precoce nos alunos. Conclusão: Este estudo tem impacto social, pois os professores entrevistados não apresentavam domínio sobre o assunto, demonstrando dificuldade em definir a condição e como proceder com a investigação. A realização de capacitações e a inclusão dessas questões no currículo profissional aumentaria o diagnóstico precoce de escoliose nas escolas, possibilitando o tratamento precoce e maiores chances de sucesso terapêutico. ***Nível de Evidência IV, Análise Econômica e de Decisão.***

Descritores: *Escoliose. Professores Escolares. Adolescente. Prevalência.*

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INTRODUCTION

Adolescent Idiopathic Scoliosis (AIS) is an anatomical and structural alteration of the spine with a lateral curve in the coronal plane, often with a rotational component, measured above 10° using the Cobb method.[1] AIS affects people over 10 years of age and is more prevalent in women. The etiology is unclear and different causal factors are suggested, including neuromuscular or connective tissue changes, asymmetric growth of the trunk and limbs, changes in the sagittal configuration of the spine and hereditary and environmental factors, such as feeding.[2]

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

The study was conducted at Human Motion Analysis Laboratory, Institute of Health Sciences, Universidade Federal do Triângulo Mineiro.
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Studies about the prevalence of scoliosis in Brazil are restricted to isolated populations, but estimations show a worldwide prevalence of AIS ranging from 1% to 13%.[3] The progression of the scoliosis curve is greater during the growth spurt phase, which occurs before skeletal maturity, so its detection in the school years is important. Despite this, the lay population still neglects the disease in its early stages, which can result in severe consequences in adulthood. Greater knowledge about the subject on behalf of elementary school teachers should improve the early detection of abnormal curvatures of the spine and lead to better treatment and prevent the evolution of scoliosis. However, studies on the previous knowledge of teachers of public or private schools regarding AIS are rare.

This study aimed to verify the knowledge about scoliosis of teachers of municipal schools in a medium-sized city.

MATERIALS AND METHODS

With the help of the Municipal Education Department, 126 teachers from municipal public schools in Uberaba, Minas Gerais, Brazil, who met the following inclusion criteria were selected: being Brazilian and teaching classes for children aged 10 to 13 years.

This was a quantitative cross-sectional study, conducted with the application of an online questionnaire via the Google Forms platform® from September to October 2020, containing 10 basic questions on scoliosis to verify the knowledge of the professionals.

This study was approved by the Research Ethics Committee of the University of Uberaba (CAAE 20150919.3.0000.5145). All participants signed an Informed Consent Form.

The objective of the research was explained to the teachers in a previous e-mail and the interviewees were then invited to participate. The responses were archived on Google Drive® for analysis.

The study included 126 municipal public school teachers working with children aged 10 to 13 years. The questionnaire was prepared by the authors and consisted of simple objective and subjective questions. The following subjects were questioned: (1) if teachers knew what scoliosis is, (2) if they could define scoliosis, (3) how it is diagnosed, (4) if they knew what the Adams test is, whether scoliosis can be identified by a simple examination in students in the classroom and if not, what would be the reason, (5) if the training of teachers to diagnose scoliosis early in their students is important, (6) if the teacher knew someone with scoliosis. The results were transcribed for analysis. No similar study was found in the literature to compare the data obtained.

The representativeness of the teacher population was achieved by defining the minimum sample size according to the statistical formula for a simple random sample, finite universe, 95% confidence level, and 5% tolerable sampling error. Thus, the sample of 126 teachers presented significant relevance with a 95% confidence level. All results were first tabulated in spreadsheets to verify the variables. The Chi-squared test was then applied.

RESULTS

In total, 126 responses were obtained from the questionnaires sent via Google Forms®. In our sample, 31% of respondents did not know what scoliosis is. Of the interviewees who knew (69%), 89.65% were partially correct when defining it. Only one teacher presented the correct definition, 6.9% provided wrong definitions, and two teachers did not answer (Figure 1).

When asked about how scoliosis would be diagnosed, 65.4% did not know how to answer. Of the teachers who answered that they knew, only 25.58% were totally correct, 69.78% were partially correct, and 1% incorrect. Still regarding the diagnosis when asked about what the Adams test was, 84.9% did not know (Table 1).

Teachers were asked if scoliosis can be identified by a simple examination in students in the classroom and 57.9% said no. Of these, 86.3% said that the difficulty would be due to the lack of knowledge on the subject; 92.1% consider that training on the diagnosis of scoliosis for early identification in students is important (Table 2).

Of the interviewees, 54% know someone with scoliosis, of which 60.3% are co-workers or relatives (Figure 2). Only 8.82% reported knowing a student with scoliosis. This study has a social impact, since interviewees lacked knowledge on scoliosis, had difficulty in defining and diagnosing it, and in how to examine students in the classroom.

DISCUSSION

When scoliosis is detected early, the involvement of people close to adolescents is also needed. Knowledge about scoliosis, conceptual or about prevention and treatment, is crucial for early detection and better solvability.

The prevalence of scoliosis diagnosed with Cobb angle greater than 10 degrees in the general population is around 0.93% to 12%. However, some studies show a variation of 2% to 3% according to the literature review by SOSORT.[4]

AIS is usually present during pre-adolescence or adolescence, a period of growth spurt. Postural changes in adolescence should be observed because they are a predisposing factor, that is, they may be related to the onset of the disease.[5] Suspected cases

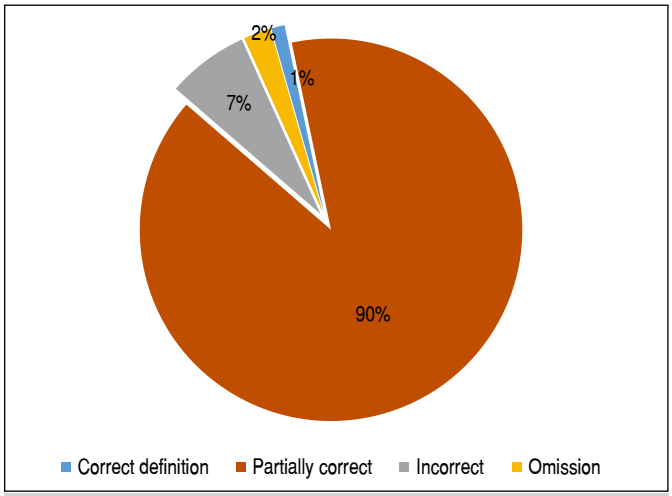

Figure 1. Percentage of accuracy regarding the definition of scoliosis.

Table 1. Absolute numbers and percentage about the knowledge on the diagnosis of scoliosis.

Type of answer	Number of answers (%)
Correct	11 (25.58%)
Partially correct	30 (69.76%)
Incorrect	1 (2.33%)
Omission	1 (2.33%)

Table 2. Justifications presented by teachers about the possibility of identifying scoliosis in students by a simple examination.

Justification for not identifying scoliosis	Number of answers (%)
Lack of knowledge	63 (86.3%)
Lack of time to perform it	3 (4.11%)
Does not understand it as a teacher's duty	5 (5.48%)
Other reasons	3 (4.11%)

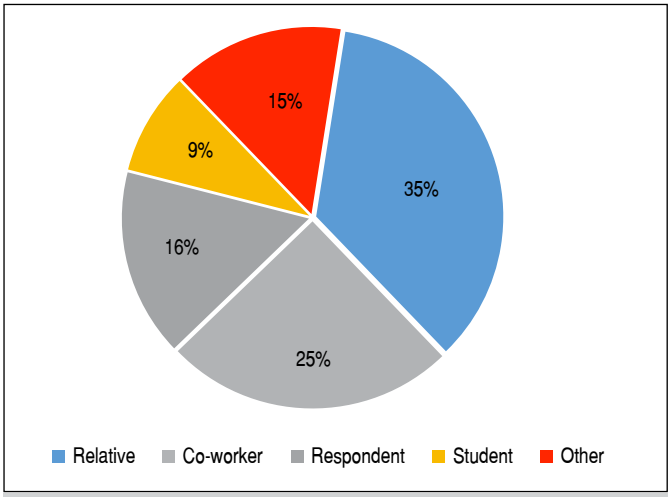

Figure 2. Percentage of teachers who know someone with scoliosis, whether a student, co-worker, relative, the respondent themselves, and other individuals.

of scoliosis require appropriate physical examination, as it is a pathology with no other symptom but deformity at first.[6]

Given the need to plan early diagnosis, professionals other than health ones should hold knowledge about the disease to direct adolescents to the appropriate health care. School teachers are an important population that could fill such a detection role, or that of being further observers of adolescent health. However, when one observes the undergraduate curricula of school teacher courses, no classes on the early detection of structural diseases, such as scoliosis, are present, which could be considered a gap given the importance of this diagnosis in school-age students.

The prognosis for adolescents with scoliosis evaluated past their growth phase is more unfavorable, evolving into chronic pain, mechanical and respiratory restrictions and, in more severe cases, cor pulmonale.[7] This meets the need presented above.

Studies show a 1% to 13% worldwide incidence rate for AIS. The incidence rate generally reported for the school student population is 0.5% to 3%. The prevalence rates of scoliosis in school screening vary by country; in Brazil, it ranges from 2% to 4% in adolescents aged 10 to 16 years.[4] The literature describes cases in relation to the epidemiology of AIS, such one conducted in Belo Horizonte, MG, Brazil, which found scoliosis in 4.8% of the 358 students observed.[8]

A study conducted in Niterói, RJ, Brazil, evaluated 4,750 asymptomatic adolescents and showed a 1.03% prevalence for idiopathic scoliosis, with a curve from 11 to 20 degrees by the Cobb method. This study evaluated 418 adolescents and found 18 cases, for a 4.3% prevalence, being compatible with the literature.[9] Another study in Maranhão, Brazil, evaluated 7,295 students and the AIS prevalence by gender was 7.3% 15.8% in boys and girls, respectively.[10]

Another study used the Adams test for screening and found a 48.4% prevalence of lateral postural changes in students aged 10 to 12 years, and 49.5% of lateral alterations in students aged 13 to 15 years. Another study, also using the plumb line, but with younger students (6 to 15 years of age), of both sexes, found a 38.88% prevalence of lateral alterations and 33.27% prevalence of anteroposterior alterations.[11]

According to data from the Brazilian Institute of Geography and Statistics (IBGE), from 2010, the schooling rate from 6 to 14 years of age in Uberaba, Minas Gerais corresponds to 97.7%. In total, 36,729 adolescents were enrolled in elementary school in 2018 (from 11 to 16 years old).[12] Considering that the age of 11 to 13 years represents 50% of the students enrolled, an estimation shows 18,000 students in this age group. Observing that the prevalence of scoliosis in adolescents aged between 11 and 13 years is, on average, 3%[4] and of the estimated 18,000 students enrolled in this age group, 540 students should have scoliosis in the schools of the municipality.

Early diagnosis enables the effective treatment, almost always without the need for surgery, which is both costly and risky.[13] When the curve becomes structured, that is, after the growth spurt phase, clinical treatment options lose efficiency. The curvature can thus impact important postural changes, pain, and changes in the respiratory pattern.[14]

Because scoliosis is more common in school-age adolescents, early detection can be optimized by training elementary school teachers to perform basic diagnostic procedures, such as the Adams test.[15] This test uses a noninvasive method and consists of detecting spinal deformity on the patient's back when they perform anterior trunk flexion.[16] Early detection can be done by people in adolescents' daily living, such as family members or teachers, which would function as a screening prior to diagnosis and refer them for the evaluation of primary health care professionals. This action could significantly contribute to the early treatment of scoliosis.

Preventive measures aiming at ergonomic aspects are also needed to evaluate postural changes early and educate children about the appropriate postures when studying, carrying school objects, and practicing physical exercises, thus avoiding the impairment of the musculoskeletal system,[15] and informing them about the importance of maintaining a good posture to avoid current and future postural problems.[1]

This study bears social impact, as the interviewed teachers' knowledge on scoliosis was lacking and they had difficulty in defining it and how to conduct a prior examination of students in the classroom. The inclusion of this topic on the curricula of these professionals could improve the early diagnosis of scoliosis, leading to early treatment and higher success rates.

Thus, knowledge of these data is important for its use in public and private health systems, as well as a resource for other studies on adolescent idiopathic scoliosis, better guiding improvements to health policies with an interface to education.

CONCLUSION

Elementary school teachers, especially those of adolescent years, are unaware of basic concepts about idiopathic scoliosis.

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REFERENCES

1. Cobb J. Outline for the study of scoliosis. Instr Course Lect. 1948;5:261-75.
2. Hengwei F, Zifang H, Qifei W, Weiqing T, Nali D, Ping Y, Junlin Y. Prevalence of idiopathic scoliosis in Chinese school children: a large population-based study. Spine (Phila Pa 1976). 2016;41(3):259-64.
3. Souza FI, Di Ferreira RB, Labres D, Elias R, Sousa APM, Pereira RE. Epidemiologia da escoliose idiopática do adolescente em alunos da rede pública de Goiânia-GO. Acta Ortop Bras. 2013;21(4):223-5.
4. Reamy BV, Slakey JB. Adolescent idiopathic scoliosis: review and current concepts. Am Fam Physician. 2001;64(1):111-6.
5. Politano RC. Levantamento dos desvios posturais em adolescentes de 11 a 15 anos em escola estadual do município de Cacoal – RO [master's thesis]. Brasília (DF): Universidade de Brasília; 2006.
6. Widhe T. Spine: posture, mobility and pain. A longitudinal study from childhood to adolescence. Eur Spine J. 2001;10(2):118-23.
7. Piątek E, Kuczynski M, Ostrowska B. The effects of active self-correction on postural control in girls with adolescent idiopathic scoliosis: the role of an additional mental task. Int J Environ Res Public Health. 2020;17(5):1640.
8. Leal JS, Leal MCPS, Gomes CER, Guimarães MDC. Inquérito epidemiológico sobre escoliose idiopática do adolescente. Rev Bras Ortop. 2006;41(8):309-19.
9. Elias N, Teixeira JCM. Escoliose idiopática do adolescente: diagnóstico precoce através de exame ortopédico rotineiro. Rev Bras Ortop. 1992;27(4):275-7.
10. Figueiredo JD, Figueiredo UM. Incidência de escoliose no Maranhão. Rev Bras Ortop. 1981;16(4):121-7.
11. Detsch C, Luz AMH, Candotti CT, Scotto de Oliveira D, Lazaron F, Guimarães LK, Schimanoski P. Prevalência de alterações posturais em escolares do ensino médio em uma cidade no Sul do Brasil. Rev Panam Salud Publica. 2007;(4):231-8.
12. Instituto Brasileiro de Geografia e Estatística. Cidades e estados: Uberaba [Internet]. Rio de Janeiro: IBGE; [accessed on 2021 Feb 10]. Available from: https://www.ibge.gov.br/cidades-e-estados/mg/uberaba.html
13. Montenegro EG, Sette RBT, Bezerra ALD, Sousa MNA. Avaliação da qualidade de vida em pacientes portadores de escoliose submetidos ao tratamento conservador. Coluna/Columna. 2020;19(1):18-21.
14. Bueno RCS, Rech RR. Desvios posturais em escolares de uma cidade do Sul do Brasil. Rev Paul Pediatr. 2013;31(2):237-42.
15. Saraiva BMA, Vieira TM, Alexandre AS, Araújo GS, Sperandio EF, Dourado VZ, et al. Reliability measure of the rib cage deformity by a postural assessment software in patients with adolescent idiopathic scoliosis. Rev Bras Cineantropom Desempenho Hum. 2020;22:e59870.
16. Ferreira DMA, Fernandes CG, Camargo MR, Pachioni CAS, Fregonesi CEPT, Faria CRS. Avaliação da coluna vertebral: relação entre gibosidade e curvas sagitais por método não-invasivo. Rev Bras Cineantropom Desempenho Hum. 2010;12(4):282-9.

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S53P4 BIOACTIVE GLASS PUTTY IN THE LOCAL TREATMENT OF CAVITARY CHRONIC OSTEOMYELITIS

BIOVIDRO ATIVO S53P4 EM PASTA NO TRATAMENTO LOCAL DA OSTEOMIELITE CRÔNICA CAVITÁRIA

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ABSTRACT

Objective: Evaluating the clinical results of bioactive glass S53P4 putty for the treatment of cavitary chronic osteomyelitis. Methods: Retrospective observational study, including patients of any age with clinical and radiological diagnosis of chronic osteomyelitis, who underwent surgical debridement and implantation of bioactive glass S53P4 putty (BonAlive® Putty, Turku, Finland). Patients who underwent any plastic surgery on the soft tissues of the affected site or had segmental bone lesions or septic arthritis were excluded. Statistical analysis was performed using Excel®. Demographic data, as well as data on the lesion, treatment, and follow-up, were collected. Outcomes were classified as "disease-free survival," "failure," or "indefinite." Results: This study included 31 patients, of which 71% were men and had with a mean age of 53.6 years (SD ± 24.2). In total, 84% were followed-up for at least 12 months and 67.7% had comorbidities. We prescribed combination antibiotic therapy for 64.5% of patients. In 47.1%, *Staphylococcus aureus* was isolated. Finally, we classified 90.3% of cases as "disease-free survival" and 9.7% as "indefinite." Conclusion: Bioactive glass S53P4 putty is safe and effective to treat cavitary chronic osteomyelitis, including infections by resistant pathogens, such as methicillin-resistant *S. aureus*. ***Level of Evidence IV, Case Series.***

RESUMO

Objetivo: Avaliar a atividade do vidro bioativo S53P4 em pasta no tratamento de osteomielite crônica. Métodos: Estudo observacional retrospectivo, com inclusão de indivíduos de qualquer idade com diagnóstico clínico e radiológico de osteomielite que realizaram tratamento cirúrgico com limpeza e desbridamento, seguido do preenchimento da cavidade com biovidro S53P4 em pasta (BonAlive® Putty, Turku, Finland). Foram excluídos pacientes submetidos a procedimentos de cirurgia plástica nos tecidos moles do local afetado, com lesões ósseas segmentares e com presença de artrite séptica. A análise estatística foi realizada em Excel®. Foram coletados dados demográficos, sobre a lesão, o tratamento e o acompanhamento. O desfecho foi classificado em "sobrevida livre de doença", "falha" ou "indeterminado". Resultados: Dos 31 pacientes analisados, 71% eram homens, com idade média de 53,6 anos (DP ± 24,26). Do total, 84% foram acompanhados por no mínimo 12 meses, e 67,7% apresentaram comorbidades. A terapia antibiótica combinada foi realizada em 64,5% dos pacientes, sendo o patógeno mais frequente o Staphylococcus aureus (47,1%). Ao final, 90,3% dos pacientes obtiveram "sobrevida livre de doenças" e 9,7% foram considerados "indeterminados". Conclusão: O vidro bioativo S53P4 em pasta é seguro e eficaz no tratamento da osteomielite cavitária e de infecções por patógenos resistentes, incluindo o S. aureus multirresistente. ***Nível de Evidência IV, Série de Casos.***

Keywords: Bioactive Glass S53P4. Biocompatible Materials. Bone Substitute. Chronic Osteomyelitis. *Staphylococcus Aureus.*

Descritores: *Vidro Bioativo S53P4. Materiais Biocompatíveis. Substitutos Ósseos. Osteomielite Crônica. Staphylococcus Aureus.*

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INTRODUCTION

Among all types of osteomyelitis, the chronic form has a higher risk of recurrence. Chronic osteomyelitis occurs due to the intracellular invasion of microorganisms in osteoclasts, osteoblasts, and osteocytes and causes biofilm formation, persistent bone sequestration, and continuous bone resorption.[1] Bone sequestration can create an

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The study was conducted at Hospital Nove de Julho.
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infectious niche, in which bacteria perpetuate in biofilms, hindering the immune response and the action of systemic antibiotics. Therefore, a successful treatment depends on the resection of the bone sequestration and the consequent eradication of the microorganism involved.[1]

Surgical debridement removes the dead bone and biofilm, but produces bone defect. Bone lesions may have cavitary and segmental formation. Bone substitutes usually fill the bone defect.[2] Besides providing structural strength, the ideal substitute must have three attributes to enable bone recovery: (1) osteoconduction, (2) osteoinduction, and (3) osteogenesis.[2] Osteoconduction provides a biocompatible structure that works as a structural matrix for the adhesion of osteogenic cells and the growth of new blood vessels.[2] Osteoinduction supports mitogenesis of undifferentiated mesenchymal cells, forming osteoprogenitor cells able to form new bone.[2] Osteogenesis occurs when the graft material has cells capable of synthesizing a new bone. This property can only exist in the autograft or when bone substitutes are enriched with cultured autologous cells.[2,3] A new generation of biomaterials, called "bioactives," emerged with better biological interaction with bone tissue and bioactive glass is among them.[4] This bioglass works as a bone substitute and has shown *in vitro* the ability to inhibit bacterial growth without the use of antibiotic substances.[5]

Bioactive glass S53P4 (BonAlive® Putty, Turku, Finland) consists of natural elements, as its composition includes 53% silicon dioxide (SiO_2), 23% sodium oxide (Na_2O), 20% calcium oxide (CaO), and 4% phosphorus pentoxide (P_2O_5).[6] This biomaterial promotes osteoinduction and osteoconduction and attaches firmly to the living tissue, facilitating the growth of bone tissue, due to a chemical bond with the surrounding bone, and enabling the formation of a new bone.[6] Moreover, it inhibits the growth of several species of plankton and biofilm-forming bacteria without the need for local antibiotic compounds. Studies show that its antibacterial properties result from increased local pH levels and, consequently, increased osmotic pressure, due to the exchange of alkaline ions with protons in solution in body fluid.[7]

The bioglass forms a chemical bond with the bone, but can also bond with soft tissues.[8] Active bioglasses can come in the form of granules or putty. Considering their property of osteoinduction, heterotopic ossification must be avoided during its use.[8] The formation of fistulas similar to those caused by chronic osteomyelitis is a possible manifestation.[9] Bioactive glass putty could facilitate the filling of the bone defect, providing lower risk of the product to bond with soft tissues. This study aimed to evaluate the clinical use of bioactive glass S53P4 putty (BonAlive® Putty, Turku, Finland) for the treatment of cavitary bone defects in patients diagnosed with chronic osteomyelitis.

MATERIALS AND METHODS

Study design and population

This retrospective observational cohort study was performed in a private tertiary care hospital in the municipality of São Paulo, São Paulo, Brazil. All participants signed an informed consent form. This study was approved by the Research Ethics Committee of the coordinator hospital under CAAE 77277617.0.1001.5455 on 02/19/2018.

All patients who used bioactive glass S53P4 putty (BonAlive® Putty, Turku, Finland) for the treatment of osteomyelitis were identified by the orthopedic team. The inclusion criteria were: (1) patients of any age; (2) clinical (fistulas and pus at the site of the original bone lesion and dehiscence of the surgical wound) and radiological diagnosis (soft tissue edema, bone demineralization, periosteal reaction, and/or trabecular and cortical osteolysis) of chronic osteomyelitis; (3) having undergone surgery for debridement of the affected tissue and filling of the resulting cavity or segment with bioactive glass S53P4 putty from April 2017 to November 2019. The exclusion criteria were: (1) having undergone plastic surgery on the soft tissues of the site affected by osteomyelitis; (2) patients with segmental bone lesions (measuring < 2 cm, 2–5 cm, or > 5 cm); (3) having septic arthritis associated with osteomyelitis.

Clinical data collection

Patient data were collected by the review of medical records. Clinical information included demographic characteristics, infected bones, comorbidities of patients and their life habits, antimicrobials relevant for prophylaxis and empirical and specific therapies, microbiological results of sample collections performed intraoperatively, duration of treatment, and follow-up time. Among comorbidities, diabetes, heart disease, neoplasia, paraplegia, tetraplegia, and thrombosis were analyzed. Clinical follow-up was performed by the orthopedic and trauma team that performed the surgery. Data collected during outpatient visits were used to classify the outcome of patients as "disease-free survival," "failure," or "indefinite."

Definitions

Criteria for defining osteomyelitis are not uniform in the scientific literature. In this study, the following criteria were used: (1) acute osteomyelitis as a surgical site infection detected within 30 days after trauma and chronic bone infection diagnosed after this period; (2) outcome classified as "disease-free survival" when the patient recovered without signs or symptoms of osteoarticular infection and the need for antibiotics or surgery to treat bone infection; outcome classified as "indefinite" in the case of loss of bone segment, death, or amputation due to vascular insufficiency; outcome classified as "failure" in the case of need for additional antimicrobial surgery or therapy; (3) considering only the collection of soft tissue and bone samples; (4) polymicrobial bone infection defined as the isolation of two or more microorganisms in at least one soft tissue or bone tissue sample or monomicrobial infection described as the identification of only one pathogen in these culture samples; (5) bacterial multiresistance, such as resistance of microorganisms to at least two classes of antibiotics, and detected in the hospital by the standardized sensitivity test.

Microbiological criteria

Soft tissue and/or bone samples were collected after extensive surgical debridement of the infectious focus, inserted in identified sterile jars, and then sent to the microbiology laboratory of the hospital, where they were cultured and identified using traditional microbiological techniques.

Statistical analysis

In statistical analysis, all data were initially entered in an Excel table. Categorical data were presented as absolute and percentage numbers and the continuous variables were presented as median.

RESULTS

We analyzed 31 patients, of which 71% were men and had with a mean age of 53.6 years (SD ± 24.26 years). Most patients (84%) were followed up for at least 12 months, with a minimum period of six months, maximum of 39 months, and average of 22 months (SD ± 8.81 months).

In 93.5% of cases, lower limbs were affected, including fractured ankle (32.2%), foot bones (16.1%), femur (12.9%), fibula (12.9%),

humerus (6.5%), tibia (6.5%), acetabulum (6.5%), and hip (6.5%). A total of 9.7% of patients had pseudoarthrosis and 19.4% had fistulas. All patients had chronic osteomyelitis: 48.4% had infection with *in situ* osteosynthesis and 51.6% infection without synthesis material. The infection occurred up to three months after surgery in 58% of patients and after more than three months in 42%.

Table 1 shows the comorbidities observed. In total, 67.7% of patients had one or more comorbidities. Hypertension (38.7%) and diabetes (32.3%), followed by neoplasia (6.5%), were the most prevalent comorbidities. No patient was a smoker or alcoholic or used immunosuppressive drugs.

Regarding the proposed treatment, Table 2 shows that most patients (64.5%) underwent combination systemic antibiotic therapy. Teicoplanin and meropenem (30%) was the most used combination, followed by clindamycin and ceftriaxone (25%). The maximum duration of systemic antibiotic therapy was six weeks and teicoplanin was the most used antibiotic (44.8%). Two patients (6.5%) did not undergo systemic antibiotic therapy.

Table 1. Distribution of patient comorbidities.

Comorbidity	n	%
Systemic arterial hypertension	12	38.7
Diabetes mellitus	10	32.3
Neoplasia	2	6.5
Paraplegia	1	3.2
Tetraplegia	1	3.2
Thrombosis	1	3.2

Table 2. Use of antibiotic therapy after surgical cleaning.

Antibiotic therapy	n	%
Did not undergo	2	6.5
Monotherapy	9	29.0
Combination therapy	20	64.5
Antibiotics used	**n**	**%**
Teicoplanin	13	41.9
Meropenem	9	29.0
Daptomycin	7	22.6
Ceftriaxone	6	19.4
Clindamycin	5	16.1
Other	11	35.5

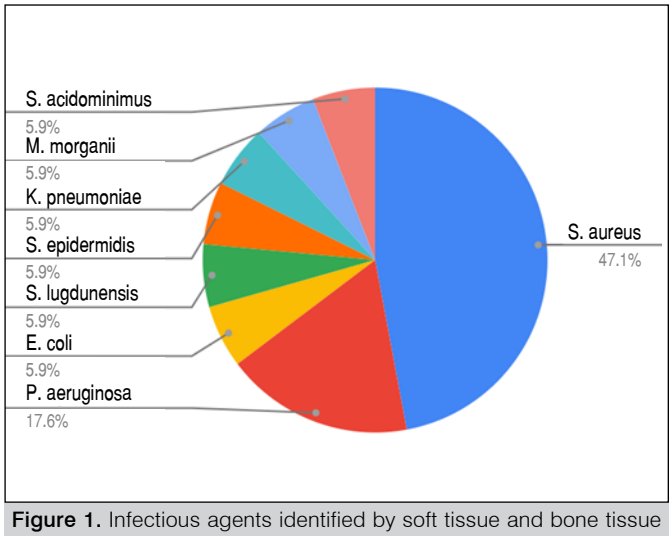

Figure 1. Infectious agents identified by soft tissue and bone tissue cultures collected during surgeries.

We collected deep soft tissue and bone fragment samples of all patients for culture analysis and 51.6% were positive. Two patients had polymicrobial infection (two pathogens identified). Figure 1 shows that *Staphylococcus aureus* (47.1%) was the most frequent agent, followed by *Pseudomonas aeruginosa* (17.6%).

Regarding the prospective follow-up time, we followed up 83.9% of patients (n = 26) for more than one year and 48.4% (n = 15) for at least two years. We followed up only 16.1% of patients (n = 5) from six to 11 months. For 90.3% (n = 28), the primary outcome of the study was "disease-free survival." We followed up 85.7% of those (n = 24) for at least one year. The outcome of only 9.7% of patients (n = 3) was "indefinite." Of these, one case resulted in amputation due to vascular insufficiency and the other two evolved to death unrelated to bone infection (neoplasia). No patient presented heterotopic ossification. Figure 2 shows the treatment of a patient with cavitary chronic osteomyelitis in the calcaneus treated with surgical implantation of bioactive glass S53P4. During outpatient follow-up, images showed cavitary filling in the calcaneus three weeks and 20 weeks after surgery. These controls and the clinical picture did not present signs of recurrence of the infection.

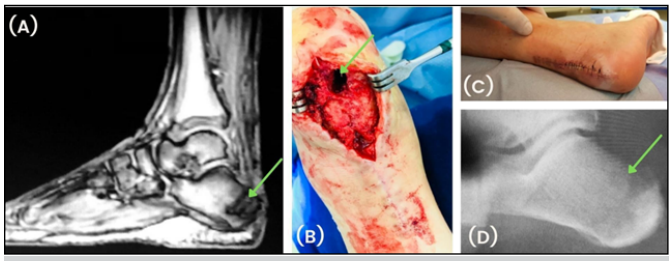

Figure 2. Calcaneus with osteomyelitis treated with bioactive glass S53P4 as a bone substitute: (A) preoperative magnetic resonance image showing osteomyelitis in the calcaneus (arrow); (B) intraoperative image showing the lesion (arrow); (C) image three weeks after surgery; (D) radiography showing bioactive glass S53P4 in the treated bone cavity (arrow) five months after surgery.

DISCUSSION

This study showed the possibility of treating osteomyelitis with bioactive glass S53P4 putty. In this study, in association with systemic antibiotic therapy, which was used for a relatively short time, bioactive glass S53P4 putty was effective for the treatment of osteomyelitis in 90.3% of patients and no patient presented heterotopic ossification. This finding is similar to other studies on the use of bioglass granules, which showed success rates in the treatment of osteomyelitis in 90% of cases.[7,10-12]

In the conventional treatment of patients with osteomyelitis, in which bone substitutes with orthopedic cement (polymethylmethacrylate) and local antibiotics have similar high success rates, multiple extra surgeries are necessary for the removal of the polymer.[7] The possible necrosis of bone tissue due to exothermic injury and fat embolism are other disadvantages of the use of polymers.[3] In the treatment with bioglass, only one surgical procedure is sufficient. Therefore, the chance of comorbidities is lower, health costs are lower, and the length of hospital stay is short.[13] Moreover, bioactive glass S53P4 allows the remodeling of the natural bone over time, which ensures the conservation of bone stock.[11] This is important because many patients with chronic osteomyelitis may need additional surgeries throughout life.

Multiple surgical procedures and diabetes influence the risk of infection in orthopedic surgery[13] and the infection rate in the presence of implants is usually higher.[14] In this study, one third of patients had

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diabetes and half of them had synthesis material, and the bioglass used was able to treat bone infection.

Previous studies show that the bond between bioglass and bone forms more rapidly when the bioactive glass has 45–52% SiO_2 by weight. This glass form a chemical bond with the bone, but also with soft tissues.[8] Bioglasses with 55–60% SiO_2 react more slowly, last more, have bioactivity, and do not bond with soft tissues. Depending on the composition of the bioglass, especially its percentage of SiO_2, its bond with soft tissues may favor heterotopic ossification.[8]

Bioglass granules or putty present antimicrobial activity against gram-positive and gram-negative bacteria and do not select resistance to microbial strains,[15] which makes them ideal bone substitutes for the treatment of bone infections, including in the presence of multiresistant strains.[15] *In vitro* bioglass acts against diverse agents, even in osteomyelitis and infections related to prostheses caused by multiresistant organisms; thus, bioglass is antibacterial.[5] In this study, we evaluated the clinical evolution of patients treated with bioglass putty in association with systemic antibiotics and observed the antimicrobial action of bioactive glass S53P4 and a favorable evolution in bone infections caused by *S. aureus*, *P. aeruginosa*, *Escherichia coli*, *Staphylococcus lugdunensis*, *Staphylococcus epidermidis*, *Klebsiella pneumoniae*, *Streptococcus acidominimus*, and *Morganella morganii*.

In line with previous studies, *S. aureus* was the most common agent (47.1%) in bone infections.[16] The use of bioglass putty was safe, as its antimicrobial activity makes it capable of eradicating oxacillin-sensitive and -resistant *S. aureus* infections.

For many years, the treatment of bone infections was based on prolonged use of antimicrobials.[17] Patients usually underwent long antibiotic therapies, which could last up to six months for staphylococcal infections.[18] However, several studies show that shorter treatments may be appropriate for most cases of prosthetic joint infection or osteomyelitis[19] and may be associated with a reduction in the length of hospital stay, incidence of adverse events, and predisposition to proliferation of multiresistant microorganisms.[20] Several clinical trials evaluated 4-, 6-, or 12-week therapies,[19,20] aiming to reduce the time of antibiotic use. In this study, we used bioglass putty as an adjuvant in the treatment of bone infections with and without implants. The maximum antibiotic therapy time observed in this study was six weeks and two patients did not underwent this treatment.

As this was a retrospective study, in which we extracted data from medical records, we could not diagnose bones anatomopathologically. We based the diagnostic criterion for osteomyelitis on clinical, microbiological, and radiological criteria.

CONCLUSION

Bioactive glass S53P4 putty was safe and effective for the treatment of osteomyelitis and no patient presented heterotopic ossification. This bioactive glass was capable of eradicating infection caused by several types of bacteria, including multiresistant *S. aureus*, which is the main agent in osteoarticular infections.

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REFERENCES

1. Ferguson J, Diefenbeck M, McNally M. Ceramic biocomposites as biodegradable antibiotic carriers in the treatment of bone infections. J Bone Jt Infect. 2017;2(1):38-51.
2. Giannoudis PV, Dinopoulos H, Tsiridis E. Bone substitutes: an update. Injury. 2005;36 Suppl 3:S20-7.
3. Kurien T, Pearson RG, Scammell BE. Bone graft substitutes currently available in orthopaedic practice: the evidence for their use. Bone Jt J. 2013;95-B(5):583-97.
4. Filipović U, Dahmane RG, Ghannouchi S, Zore A, Bohinc K. Bacterial adhesion on orthopedic implants. Adv Colloid Interface Sci. 2020;283:102228.
5. Cunha MT, Murça MA, Nigro S, Klautau GB, Salles MJC. In vitro antibacterial activity of bioactive glass S53P4 on multiresistant pathogens causing osteomyelitis and prosthetic joint infection. BMC Infect Dis. 2018;18(1):157.
6. Virolainen P, Heikkilä J, Yli-Urpo A, Vuorio E, Aro HT. Histomorphometric and molecular biologic comparison of bioactive glass granules and autogenous bone grafts in augmentation of bone defect healing. J Biomed Mater Res. 1997;35(1):9-17.
7. van Gestel NAP, Geurts J, Hulsen DJW, van Rietbergen B, Hofmann S, Arts JJ. Clinical applications of S53P4 bioactive glass in bone healing and osteomyelitic treatment: a literature review. Biomed Res Int. 2015;2015:684826.
8. Välimäki VV, Aro HT. Molecular basis for action of bioactive glasses as bone graft substitute. Scand J Surg. 2006;95(2):95-102.
9. Edwards DS, Clasper JC. Heterotopic ossification: a systematic review. J R Army Med Corps. 2015;161(4):315-21.
10. Romanò CL, Logoluso N, Meani E, Romanò D, De Vecchi E, Vassena C, Drago L. A comparative study of the use of bioactive glass S53P4 and antibiotic-loaded calcium-based bone substitutes in the treatment of chronic osteomyelitis: a retrospective comparative study. Bone Joint J. 2014;96-B(6):845-50.
11. McAndrew J, Efrimescu C, Sheehan E, Niall D. Through the looking glass; bioactive glass S53P4 (BonAlive®) in the treatment of chronic osteomyelitis. Ir J Med Sci. 2013;182(3):509-11.
12. Lindfors NC, Hyvönen P, Nyyssönen M, Kirjavainen M, Kankare J, Gullichsen E, Salo J. Bioactive glass S53P4 as bone graft substitute in treatment of osteomyelitis. Bone. 2010;47(2):212-8.
13. Bachoura A, Guitton TG, Smith RM, Vrahas MS, Zurakowski D, Ring D. Infirmity and injury complexity are risk factors for surgical-site infection after operative fracture care. Clin Orthop Relat Res. 2011;469(9):2621-30.
14. Zimmerli W, Waldvogel FA, Vaudaux P, Nydegger UE. Pathogenesis of foreign body infection: description and characteristics of an animal model. J Infect Dis. 1982;146(4):487-97.
15. Drago L, De Vecchi E, Bortolin M, Toscano M, Mattina R, Romanò CL. Antimicrobial activity and resistance selection of different bioglass S53P4 formulations against multidrug resistant strains. Future Microbiol. 2015;10(8):1293-9.
16. Dell'Aquila AM, Finelli CA, Fernandes HJA, Reis FB, Marra AR, Pereira CAP, Morais JF. Therapeutic strategies for post-osteosynthesis osteomyelitis. Journal of Infectious Diseases & Therapy. 2017;5(1):312.
17. Cobo J, Miguel LGS, Euba G, Rodríguez D, García-Lechuz JM, Riera M, et al. Early prosthetic joint infection: outcomes with debridement and implant retention followed by antibiotic therapy. Clin Microbiol Infect. 2011;17(11):1632-7.
18. Osmon DR, Berbari EF, Berendt AR, Lew D, Zimmerli W, Steckelberg JM, et al. Executive summary: diagnosis and management of prosthetic joint infection: clinical practice guidelines by the Infectious Diseases Society of America. Clin Infect Dis. 2013;56(1):1-10.
19. Bernard L, Arvieux C, Brunschweiler B, Touchais S, Ansart S, Bru JP, et al. Antibiotic therapy for 6 or 12 weeks for prosthetic joint infection. N Engl J Med. 2021;384(21):1991-2001.
20. Bernard L, Dinh A, Ghout I, Simo D, Zeller V, Issartel B, et al. Antibiotic treatment for 6 weeks versus 12 weeks in patients with pyogenic vertebral osteomyelitis: an open-label, non-inferiority, randomised, controlled trial. Lancet. 2015;385(9971):875-82.

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ECONOMIC IMPACT OF COVID-19

IMPACTOS ECONÔMICOS DA COVID-19

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To the Editor, we would like to share ideas on the publication "Economic impact of COVID-19 on Brazilian orthopedists."[1] Stirma et al. concluded that "There was a direct relationship between the professional experience in this subspecialty and a higher percentage of fixed income, as well as a greater impact on the reduction percentage in the monthly budget and a longer time off the job."[1] The pandemic affected many people worldwide, including medical personnel. People working at a private establishment were probably affected by the lockdown. Some kinds of clinic, especially surgery clinics, had to be closed during COVID-19. The lockdowns may have significantly increased workload. In this period, more than 15% loss of income was reported.[2]

In developing countries, the use of new technology might help solve the problem. A recent report from USA showed that orthopedic surgeon still maintain income via teleconsultant.[3] However, this might be impossible in many settings, such as our setting in Asia, where the infrastructure is poor and the patient cannot access the telemedicine system. The negative effect of lockdown on orthopedic surgery and decrease of income is a common problem.

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REFERENCES

1. Stirma GA, Belangero PS, Pochini AC, Andreoli CV, Ejnisman B. Economic impact of COVID-19 on Brazilian orthopedists. Acta Ortop Bras. 2021;29(2):61-6.
2. Simon MJK, Regan WD. COVID-19 pandemic effects on orthopaedic surgeons in British Columbia. J Orthop Surg Res. 2021;16(1):161.
3. Paul KD, Levitt E, McGwin G, Brabston EW 3rd, Gilbert SR, Ponce BA, Momaya AM. COVID-19 impact on orthopedic surgeons: elective procedures, telehealth, and income. South Med J. 2021; 114(5):311-6.

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

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