

STIFF ELBOW TREATMENT BY INTERPOSING ARTHROPLASTY ASSOCIATED TO HINGED EXTERNAL FIXATOR

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ABSTRACT

Objective: Assess the results of the elbow/ *fascia lata* interposing arthroplasty technique associated to the use of a hinged external fixator in the treatment of stiff elbow. **Methods:** Between 2001 and 2006, five cases of stiff elbow were operated and followed up by the Shoulder and Elbow Group of the Santa Casa Misericórdia de São Paulo Medical Sciences School, establishing the following as inclusion criteria: patients with below-functional elbow range of motion associated to degeneration on that joint, for whom total prosthesis had not been indicated. Patients' ages ranged from 21 to 55 years (mean: 38). Male gender was prevalent (four cases), and, in all cases, the dominant side was operated. Concerning etiology, two cases of infectious arthritis sequels, one post-trauma sequel, and two

rheumatoid arthritis were found. Preoperative range of motion ranged from 20° to 30° of flexion-extension; in two cases, fixed contracture existed in flexion at 30° and 65°. The patients were assessed according to Bruce-modified AMA criteria. **Results:** The mean follow up time was 54 months. All patients showed improvement of the Bruce index, which, preoperatively, was 43.5, increasing to 88.2 postoperatively. We found two excellent cases, one good, one fair, and one poor. **Conclusion:** *Fascia lata* interposing arthroplasty associated to the use of a dynamic external fixator on stiff elbows is a feasible alternative for patients not indicated to total elbow arthroplasty.

Keywords – *Elbow joint; Arthroplasty; Range of motion, articular; External fixators*

INTRODUCTION

The sequelae of severe elbow fractures, rheumatoid and infectious arthritis, contribute in varying degrees to the stiffness of this joint⁽¹⁻³⁾. According to Morrey *et al.*⁽⁴⁾, most activities performed with the arms depend on a 100° range of motion of the elbow (Morrey's functional arc), ranging between 30° and 130°, and 100° of pronosupination. The loss of degrees of movement generates functional deficits, impeding the simple activities of daily living, such as

taking the hand to the mouth and personal hygiene, among others, as well as progressive and incapacitating pain^(5,6).

Resection and elbow interposition arthroplasty, the first arthroplasty techniques, were developed in the period between 1885 and 1947^(7,8). After 1947, replacement arthroplasty with partial or total prosthesis (restricted or hinged), fixed by polymethylmethacrylate cement⁽⁷⁾, became and remain one of the main forms of treatment of all conditions, whether

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We declare no conflict of interest in this article

traumatic or not, that lead to widespread destruction of the articular surface of the elbow^(7,8). Although partial or total arthroplasty of the elbow is well-known and widely used, it should not be the treatment choice in young and/or active patients^(2,9-10), in which the use of the upper limb is constant and requires strength, as it causes a high index of release of components^(2,9-10). For these cases, arthrodesis is an alternative, but patients do not always accept it well due to the resulting major limitation of motion^(8,10).

In recent years, interposition arthroplasty of the elbow has been rescued as a treatment of joint stiffness when the indication of other surgeries, such as by replacement arthroplasty or arthrodesis, cannot meet all of the patient's needs⁽⁶⁻¹⁰⁾.

Interpositions with biological tissues such as *fascia lata* and adipose tissue to coat bone ends was introduced by Murphy in 1902, cited in Wright and Sisk⁽⁷⁾. In 1918, Baier, cited in Wright and Stewart⁽⁸⁾, used silicone, rubber, and chromium-based membrane as tissue for interposition, obtaining satisfactory results. However, the *fascia lata* remains the most commonly used tissue in interposition arthroplasty due to the ease of its removal and because it causes less damage to the donor site^(1,3,7-8).

The determination of the center of rotation of the humeral head by Steindler^(9,11) was instrumental in the current treatment of elbow stiffness. The center of rotation is the exact point in the three-dimensional plane at which elbow flexoextension occurs with no changes to the central axis of the arm relative to the forearm^(9,11-13).

With information regarding the center of rotation, Volkov and Oganessian⁽⁶⁾ were the first authors that linked the use of external fixation in conjunction with the interposition of *fascia lata*, using this technique successfully in 28 cases of elbow stiffness.

This paper aims to present the results of interposition arthroplasty of the elbow with *fascia lata* associated with the use of hinged external fixator in the treatment of stiff elbow.

MATERIALS AND METHODS

Between October 2001 and July 2006, five patients with stiff elbow were operated and monitored by the Shoulder and Elbow Group of the Department of Orthopedics and Traumatology, School of Medical Sciences, Santa Casa de Misericórdia de São Paulo, Fernandinho Simonsen Pavilion, where we used interposition arthroplasty with *fascia lata* associated with the use of a hinged external fixator of the elbow.

The inclusion criteria were patients whose range of motion in the affected elbow was less than the functional⁽⁴⁾, along with destruction of the articular surface demonstrated by imaging studies, coupled with contraindications for total elbow prosthesis. We excluded all patients who did not fit the criteria set forth above.

The patients' ages ranged from 21 to 55 years, with an average of 38 years. There was a prevalence of males (four cases), and in all cases, the dominant limb was the one operated (Table 1).

The mean duration of symptoms after initiation of the causative agent was six years (Table 1).

The etiology of the lesions is described in Table 1.

In four patients, surgery had been attempted previously to gain joint mobility, without success. In case 3, the radial head was resected, and in case 4, a humeroulnar arthroplasty, that is, a hole in olecranal fossa of the distal humerus⁽⁵⁾ (Table 1).

The transposition of the ulnar nerve was performed in three cases (Table 1).

The dynamic external fixator remained for 60 days, on average, and was removed after this period (Table 1).

Tabela 1 – Patient data

	Patient	Gender	Age (years)	Dom.	Etiology	Evolution Δt (months)	Follow-up Δt (months)	Previous surgeries	Ant. Ulnar n.	Δt external fixation (months)	Observations
1	A.R.L.	Male	47	+	Post-traum.	5	87	-	+	57	
2	A.P.	Male	34	+	Infec. Art.	1	72	1	+	73	Ligament reconstruction
3	C.M.F.	Male	55	+	Rheum Art.	4	60	1	-	54	
4	J.M.S.	Male	43	+	Tub. Art.	17	30	2	+	60	
5	J.S.A.	Fem.	21	+	JRA	5	24	3	-	55	

Source: Archives (SAME), Department of Orthopedics and Traumatology, Santa Casa de São Paulo

Legend: Fem.: female; Dom: dominance; Evolution Δt : time interval between diagnosis and interposition surgery; Δt : time interval; Traum.: Traumatic; Infec.: infectious; Art.: arthritis; Rheum.: rheumatoid; Tub: tuberculous; JRA: juvenile rheumatoid arthritis.

Elbow ligament reconstruction was necessary in one case where the flexor tendon of the knee (gracilis) was used as a graft to repair the medial and lateral elbow (Table 1).

The preoperative range of motion of the elbow ranged from 20° to 30°; in two cases there was fixed contracture at 30° and 65°, respectively (Table 2).

Table 2 – Patient data

	Patients	Preop. Mob.		Intraop. Mob.		Bruce Preop.	Postop. Δt (years)	Current Mob.		Bruce Postop.
		F	E	P	S			F	E	
1	A.R.L.	90°	-70°	140°	-10°	43	6	140°	-40°	92
2	A.P.	65°	-65°	90°	-5°	40	5	130°	-35°	86
3	C.M.F.	90°	-60°	140°	0°	50	4	110°	-10°	96
4	J.M.S.	70°	-70°	140°	0°	40	2	90°	-30°	96
5	J.S.A.	90°	-70°	140°	-30°	43	1.5	90°	-70°	71
	Mean	81°	-67°	130°	-9°	43.5	3.7	112°	-37°	88.2

Source: Hospital archives (SAME)

Legend: Preop.: preoperative, Mob.: mobility; postop.: Intraop.: intraoperative; Postop.: postoperative; Δt: time interval. F: flexion; E: extension, P: pronation; S: supination.

DESCRIPTION OF THE SURGICAL TECHNIQUE

The patients were operated in supine position through a posterior approach. The ulnar nerve was isolated and anteriorized when it was in its usual location. Anterior and posterior capsulectomy was performed and then elbow dislocation. If such was not possible due to fibrosis or ankylosis that was too intense, osteotomy was performed where the joint interline should be. All remaining scar tissue and articular

cartilage were resected with a uniform regularization of the distal third of the humerus, trying to simulate the contour of normal bone (Figure 1).

Removal of the *fascia lata* graft (15 x 5 cm) was performed by an approximately 20cm lateral incision in the thigh and closing of the donor area was performed with the help of a *Marlex*® mesh. The graft was folded in three, shaped like a square of 5 cm wide, placed covering the entire distal humerus, and fixed through transosseous points with nonabsorbable sutures. After reducing the joint, the center of rotation of the elbow was identified, which is midway between the trochlea and the humeral head where the anterior flange of the cortex of the distal humerus is normally found, and installed the hinged external fixator in its lateral portion (Figure 2)⁽¹⁴⁾.

In all cases we achieved mobility of at least 100°⁽⁴⁾ of both flexoextension and pronosupination of the elbow during surgery (Table 2).

Patients were evaluated by the AMA criteria modified by Bruce *et al.*⁽¹⁵⁾ regarding the range of motion in the postoperative period, during activities of daily living and professional activities, besides pain and anatomy related to possible residual deformities. Finally, X-ray analysis was performed.

RESULTS

Patients had a mean follow-up period of 54 months, ranging between 24 and 84 months. All had postoperative improvement in the index of Bruce *et al.*⁽¹⁵⁾ (Table 2).

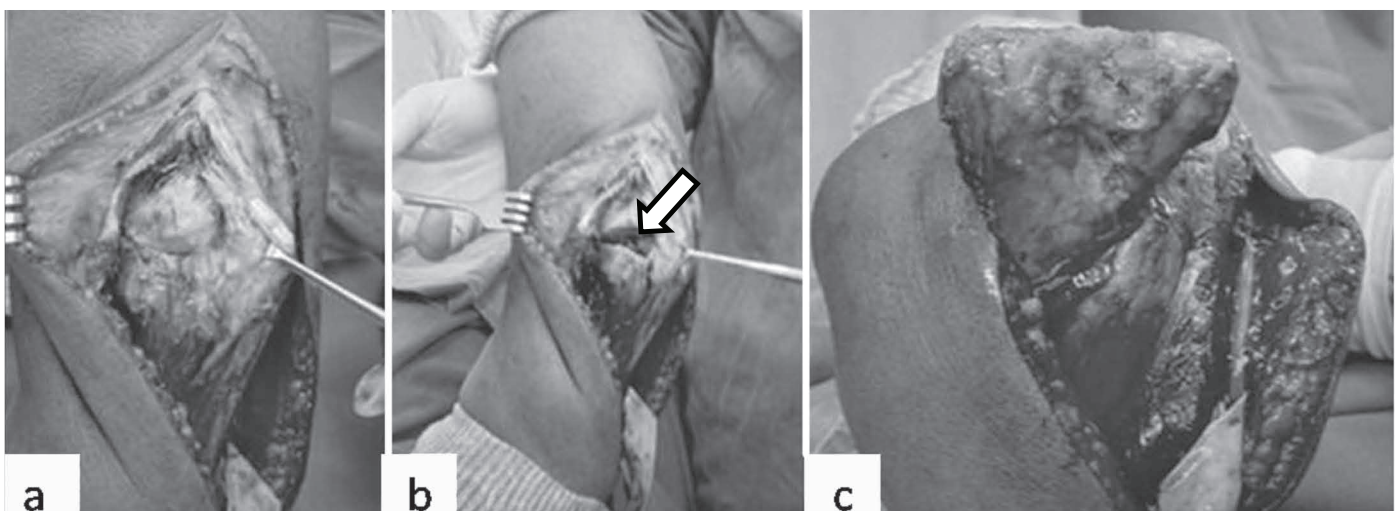


Figure 1 – Intraoperative images: (a) posterior approach passage with isolation of the triceps tendon, folded to the side, (b) osteotomy performed at the site of the joint interline (arrow), (c) posterior view of the distal humerus

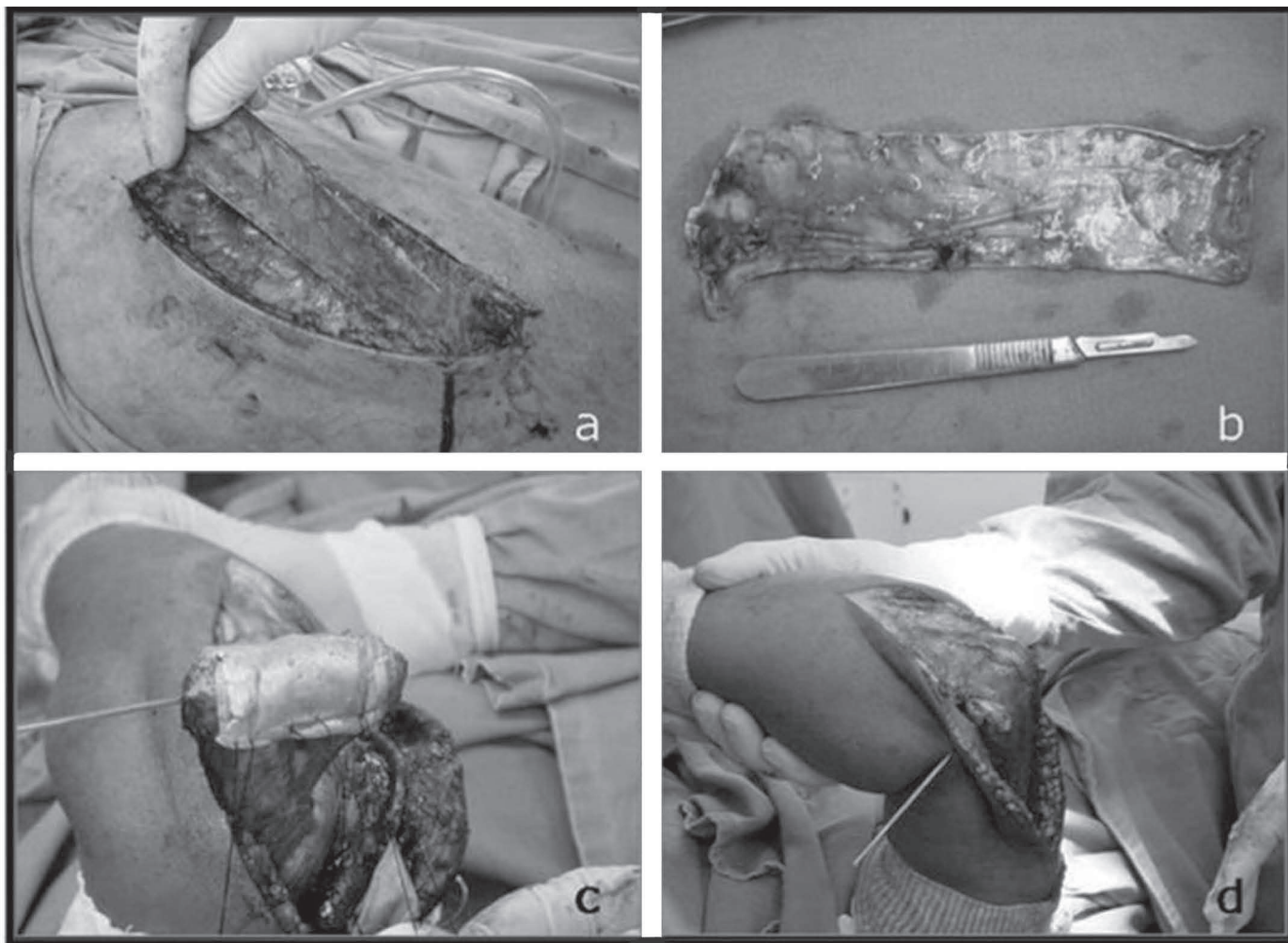


Figure 2 – Intraoperative images: (a) lateral approach passage of the thigh with *fascia lata* isolation, (b) image of ± 15 by 4.0 cm *fascia lata*, (c) covering of the distal humerus with the fascia, fixed through transosseous sutures, (d) final view with the elbow reduced

We obtained two excellent results (Cases 3 and 4) (Figure 3), one good (Case 1), one satisfactory (Case 2), and one poor result (Case 5) (Table 2).

There was a mean gain of 39° flexion and 22° extension in the elbow joint range of motion (Table 2).

The follow-up period ranged from two to seven years, with an average of 4.5 years.

We had no complications at the donor site (*fascia lata*) or the elbow.

DISCUSSION

Interposition elbow arthroplasty has emerged as an alternative for the treatment of severe limitation of movement in the elbow, especially in young patients, in whom the indication for total arthroplasty should be postponed as long as possible^(2,9,10, 16-18).

Another alternative for young patients would be arthrodesis of the elbow; however, this results in a

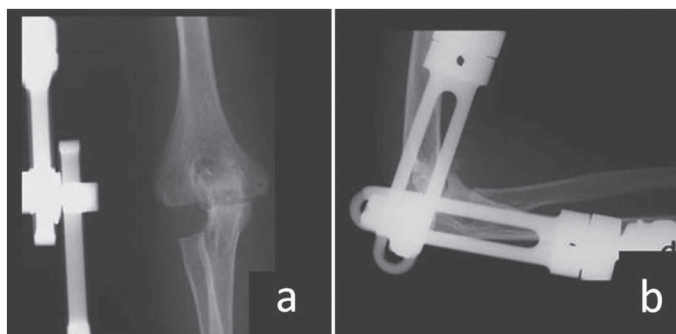


Figure 3 – Case 4 – X-ray images of the elbow in the immediate postoperative period with an external fixator: (a) front view, (b) profile view

complete and final functional limitation, overburdens adjacent joints, and besides, arthrodesis can be performed after the failure of any treatment, even interposition; one should reserve it as a last resort or for patients who require strength in their daily work⁽¹⁹⁾.

In all cases in studies by Pignatti *et al.*⁽¹⁾, Volkov and Oganessian⁽⁶⁾, Cobb and Morrey⁽¹⁹⁾ and Nolla *et al.*⁽¹⁰⁾, and in most cases in Cheng and Morrey⁽³⁾, traumatic causes are responsible for the sequelae of elbow stiffness, while rheumatoid arthritis was the main issue in a study by Ljung *et al.*⁽²⁾. In our series, two patients had stiffness resulting from trauma, one of which evolved into infectious arthritis (Case 2), one patient had ankylosis due to tuberculous arthritis (Case 4), and two had inflammatory arthritis (RA, JRA), showing similar proportions between the traumatic, inflammatory, and infectious causes of stiff elbow. Any statistical analysis is impossible with five cases.

Patients who have inflammatory disease and/or infectious disease as the etiology for stiffness have, in general, undergone various surgical procedures⁽²⁾. The failure of these procedures precedes interposition arthroplasty. We can observe this very fact when we evaluate our patients, with the exception of case 1, which was post-traumatic, the others underwent several surgical interventions, such as resection of the radial head (Cases 4 and 5), humeroulnar arthroplasty (Case 5), and arthroscopic release (Cases 4 and 5) in an attempt to gain mobility.

The average age of the patient at the time of the surgical procedure varies according to the mechanism of injury. As in the literature^(1,3,8,10-20), in cases of trauma, the average is usually between the second and fourth decades of life, and in inflammatory cases, the sixth decade⁽²⁻⁵⁾. Our experience agrees with the above, with the exception of case 5 (age 21), in which the patient had juvenile rheumatoid arthritis (JRA) and was subjected to three previous procedures (arthroscopic elbow release, new release with resection of the radial head, and a last attempt with humeroulnar arthroplasty) without success (Table 1).

Regarding the surgical technique, we should mention that we made a modification in what was first described by Froimson⁽¹⁴⁾. We covered only the surface of the humerus with *fascia lata*, leaving the surface of the ulna uncovered, because we believe that covering only one side with a thick graft (the *fascia lata* is folded in three parts) is sufficient to maintain the joint space and facilitate postoperative rehabilitation after removal of the fixator, facilitating the surgical procedure (Figure 2).

The gains in the range of motion observed during surgery are maintained with the aid of the dynamic external fixator, as described by Cobb and Morrey⁽¹⁹⁾,

Pignatti *et al.*⁽¹⁾, Cheng and Morrey⁽³⁾, and Nolla *et al.*⁽¹⁰⁾ (Figure 3). However, these authors used postoperative analgesia with a catheter for brachial plexus block for 24 to 48 hours, and physical therapy with a device for continuous passive motion (CPM) for seven to 10 days. In our clinic, analgesia is controlled intravenously during the immediate postoperative period; a physical therapy team specialized to monitor these patients perform exercises at least three times a day to try to maintain the elbow range of motion achieved intraoperatively. The patient remains hospitalized for seven days, on average.

The patient's motivation has been a determining factor of gains in mobility^(1,6,9,19-21). In general, these patients have complete or almost complete restriction of joint mobility and in the immediate postoperative period can already achieve a functional range of motion. This is certainly a great motivation for patients to continue performing the exercises indicated in physical therapy. One of the critical moments in the postoperative evolution and for the patient's motivation is the removal of the external fixator. Upon removing the device, there are varying degrees of instability and loss of muscle strength, accompanied by pain. The external fixator is what provides stability and mechanical support for movement and the continuity of exercise is key to successful treatment⁽¹⁰⁾. For a period of approximately six months, the pain progressively decreases and there is a gradual gain of stability and movement (Figure 4).

We removed the external fixator 60 days postoperatively, on average, because we believe that during that period the soft parts already have achieved a degree of healing capable of providing sufficient stability for the patient to begin his or her rehabilitation program. Cobb and Morrey⁽¹⁹⁾, Morrey⁽⁹⁾, and Nolla *et al.*⁽¹⁰⁾ remove it around 40 days, and Pignatti *et al.*⁽¹⁾, at 50 days.

Complications such as ulnar nerve injury (neuropraxia and neurites) have been described^(3,9), however, we did not experience this kind of complication. We performed careful dissection of the nerve as one of the first surgical steps and at the end of surgery we performed anterior transposition of the nerve, when it is in its normal location. Often, these patients have had the nerve anteriorized in a previous procedure, as in Cases 1, 2, and 4.

Other complications mentioned^(2,9-10) such as infection did not occur in our sample. As for the residual varus and valgus instability cited by Nolla *et al.*⁽¹⁰⁾ as an important limiting factor of patient activities, it was

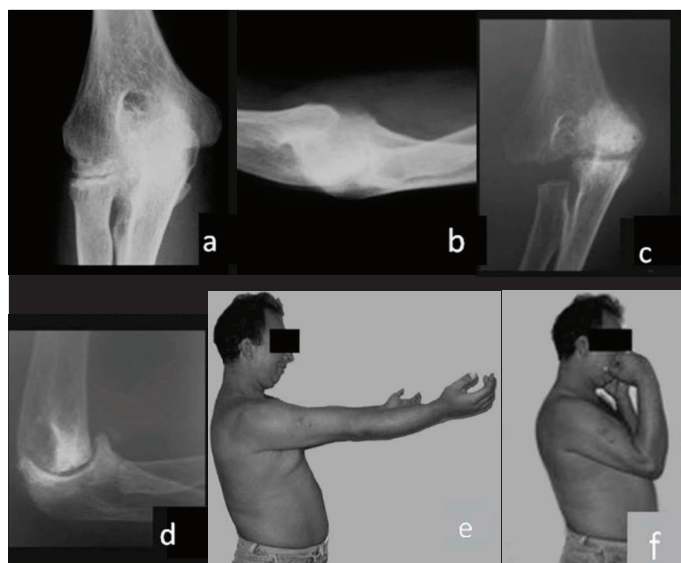


Figure 4 – Case 4 – Frontal and lateral radiographic images of the affected elbow preoperatively (a, b) and one year post-surgery (c, d). Patient's current mobility in maximum extension (e) and flexion (f)

present to a greater or lesser degree in all cases except case 5, where there was gradual loss of movement of the elbow, which today remains virtually ankylosed. Patients were trained to adapt to this type of instability in occupational therapy, by modifying the way the upper limb is used in certain positions.

The results of surgery were evaluated according to the AMA criteria modified by Bruce *et al.*⁽¹⁵⁾, unlike the works of Cheng and Morrey⁽³⁾, Pignatti *et al.*⁽¹⁾, and Nolla *et al.*⁽¹⁰⁾, which used the Mayo Elbow Performance Score (MEPS). We believe that the first method better assesses the function of the upper limb.

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In all cases except for case 5, we found increased Bruce rates when comparing pre- scores (43.5) to those of the postoperative period (88.2), demonstrating the efficiency of the method for cases of elbow stiffness.

In Case 5, the patient has juvenile rheumatoid arthritis (JRA) and progressively lost the range of motion of the elbow after removal of the external fixator, returning to degrees of range of motion similar to those found in the preoperative period. We believe that this failure may be caused by a lack of control of the underlying disease (JRA), which continued to be active, confirmed by recent blood tests. The patient is being monitored regularly by the hospital's rheumatology department, but the disease seems to be difficult to control.

Another factor that contributed to treatment failure was the use of a single size of external fixator. It seemed to us that at the end of surgery, it was too large for this patient, the pins did not remain in the ideal position, that is, we were not able to make the center of rotation of the elbow the fulcrum of flexoextensive movement of the fixator⁽¹¹⁾. In the immediate postoperative period, with the patient still under anesthesia, complete joint movement was not possible, unlike all other cases.

CONCLUSION

Stiff elbow treatment via interposition arthroplasty with *fascia lata*, associated with the use of a dynamic external fixator, was, in the present study, a viable alternative to increase joint mobility in four of five patients so treated.