

# Treatment of Post-Traumatic Elbow Stiffness Using Soft Tissue Interposition Arthroplasty: A Retrospective Study in the Jordanian Population

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**Abstract— Objective:** Elbow fractures account for 7% of total adult fractures, the aim of this study to determine the functional outcome of post traumatic elbow stiffness managed with soft tissue interposition arthroplasty. **Materials and methods:** This are a retrospective study with data collection From January 2001 to October 2019, in Orthopedics and Trauma Clinic in Royal Medical Services, 12 patients were included in the study. Three different scores were used: The Mayo Elbow Performance Score (MEPS), the Disability of the Arm, Shoulder and Hand (DASH). **Results:** The results showed that the total score calculated with the MEPS in the preoperative (58.3) and in the postoperative (69.6) has an average increase of 11.3 points. There is an increase in the range of movement (from 7.1 to 16.7 points), with a greater degree of extension (from 70.8 ° to 28.3 °) and bending (from 93.7 ° at 126.6 °) and greater autonomy. DASH score performance of daily functions increased with a range (from 2.1 to 21.7 points) after surgery. Pain has an acute increase, rising from 41.3 (very mild pain) to 27.5 (moderate pain level). Joint stability also decreases and its values move from 8.3 to 5.4 points. **Conclusion:** This procedure is recommended for young patients with high functional requirements as an alternative to elbow arthroplasty.

## I. INTRODUCTION

The elbow has complex anatomical and biomechanical articulation. It plays a fundamental role in the upper limb function and allows us to withstand static and dynamic loading forces equal to between three and six times the body weight (1). Elbow fractures account for 7% of total adult fractures; after the shoulder, the elbow is the main site of joint dislocation. Post-traumatic pathology, such as post-traumatic arthrosis, inveterate dislocation and pseudoarthrosis, is also significant and frequently causes pain, stiffness, instability and functional dysfunction.

This study aimed to examine our experience in treating post-traumatic elbow stiffness using soft tissue interposition arthroplasty, report the results and complications observed and highlight the techniques used and their indications, since our cases are relevant, and the reported data have adequate follow-up. Based on a comparison of this study and the most recent literature, we defined the clinical parameters for patient selection and the most appropriate surgical techniques to reduce the risks of failure and complication. We also evaluated the current clinical evaluation questionnaires (MEPS, DASH and SF-36) (2, 3, 4, 5) and considered possible alternatives.

## II. MATERIALS AND METHODS

From January 2001 to October 2019, at the Orthopaedic and Trauma Clinic of the orthopaedics department at the

Royal Medical Services in Jordan, 12 operations were performed, which aimed to treat post-traumatic elbow stiffness using soft tissue interposition arthroplasty. For the clinical evaluation, three different scores were used: The Mayo Elbow Performance Score (MEPS), the Disability of the Arm, Shoulder and Hand (DASH) and the Medical Outcomes Study 36 Item Short Form Health Survey (SF-36). The scores were statistically correlated to analyse the significance of their variations.

Each patient was also asked to state their level of satisfaction with the result based on its impact on their quality of life and their work and non-work activities. The possible causes of dissatisfaction were investigated.

In patients undergoing interposition arthroplasty, the incongruity of the joint components and the presence of post-traumatic osteoarthritis, which were assessed with David Stanley staging, were evaluated instead (6). The presence and location of any heterotopic ossifications were also studied. Moreover, we considered the failures and complications arising from various interventions: 2 patients developed an infection and a subcutaneous haematoma, both of whom underwent a second elbow surgery.

Complications were ulnar nerve paraesthesia, instability and loss of range of motion with respect to that gained with the operation, with a tolerance of 10° both in flexion and extension. we used the student's t-test to compare the motion arcs, and all data were analysed with stata10.0 software.

III. RESULTS

Interposition arthroplasty was performed on 12 patients as a treatment of post-traumatic elbow stiffness in our clinic between 2001 and 2019. The group that underwent arthroplasty with interposition of soft tissue comprised 12 men and no women with an average age of 43.1 years (minimum 29, maximum 71); surgery was performed on 7 right and 5 left elbows. At the time of surgery, the average age was 38.7 years (minimum 27, maximum 62). The average number of previous elbow operations was 2.8 (minimum 1, maximum 4) (Table 1).

Table 2 shows the Overall MEPS results for interposition arthroplasty in this study with all variables and results.

TABLE 1.

n° interposition arthroplasty		12
	n° male	12
	n° female	0
Side	Elbow Rt	7
	Elbow Lt	5
	Ratio Rt/Lt	1.4/1
Average age in years		43.1 (min 29, max 71)
Average age at the time of surgery in years		38.7 (min 27, max 62)
Follow-up average in months		55.5 (min 10, max 104)
Average of previous interventions		2.8 (min 1, max 4)

TABLE 2. Overall MEPS results for interposition arthroplasty.

		MEPS preoperative	MEPS post-operative
Pain		41.3	27.5 (-13.8)
Stability		8.3	5.4 (-2.9)
Flexion-extension		7.1°	16.7 (+9.6)
Extension		70.8°	28.3° (+42.5°)
Flexion		93.7°	126.6° (+32.9°)
Daily activity		2.1	21.7 (+19.6)
Total MEPS		58.3	69.6 (+11.3)
Total results	excellent	0 (0%)	2 (16.7%)
	good	2 (16.6%)	3 (25%)
	fair	5 (41.7%)	4 (33.3%)
	poor	5 (41.7%)	3 (25%)

Preliminary analysis of the results obtained, considering all 12 interventions, showed that the average total score calculated with the MEPS increased by 11.3 points from preoperative (58.3) to post-operative (69.6). The range of movement increased (from 7.1 to 16.7 points), with a greater degree of extension (from 70.8° to 28.3°) and bending (from 93.7° to 126.6°) and greater autonomy in activities of daily living (from 2.1 to 21.7 points). However, the other two aspects showed deterioration. Pain showed an acute increase from 41.3 (very mild pain) to 27.5 (moderate pain). Joint stability also decreased, with scores dropping from 8.3 to 5.4 points.

Preliminary and post-operative extension, flexion, pronation, supination and MEPS data of all patients were compared statistically using the Student's t-test. This analysis indicated that their differences were all statistically significant ( $p < 0.05$ ) except that of the MEPS ( $p = 0.0717$ ).

Based on the post-operative evaluation of the patients, 5 cases (41.7%) were excellent or good, according to the MEPS criteria, and 7 cases (58.3%) sufficient or insufficient.

At the follow up control, 10 patients (83.3%) were satisfied with the intervention, while only 2 were dissatisfied (16.7%), both due to the development of instability that did not significantly limit activities of daily living.

The pain score decreased significantly. The average preoperative score was 41.3 points: elbow pain in 3 cases (25%) was mild and in the remaining 9 cases (75%) was absent. In the post-operative period, pain assessment gave an average score of 27.5 (-13.8 points compared with preoperative), with only 3 cases stating absence of pain (25%), 4 cases stating minimal pain (33.3 %) and 5 cases stating moderate pain (41.7%).

Regarding joint stability, in 2 patients (16.65%) the elbow was grossly unstable in the preoperative evaluation, while in 1 patient (8.35%), moderate instability was evident. In the remaining cases (75%), the elbow was stable. The average stability score increased from 8.3 in the preoperative to 5.4 in the post-operative period.

Particularly, 9 out of 12 patients (75%) started with stable joints: these were preserved in only 5 patients in the post-operative period, while 4 had worse stability, with 3 cases developing a high degree of instability and 1 case intermediate stability. Of 12 patients, 3 (25%) were left with already compromised stability (1 severe and 2 moderate); of these, only 1 showed complete recovery while the other 2 developed severe instability. In total, therefore, 6 (50%) patients showed no stability alteration, 1 (8.3%) had moderate instability and 5 (41.7%) had unstable elbows.

In the preoperative period, the patients ability to perform the activities of daily living was evaluated with a score of 2.1 out of a total of 25 points. Post-operatively, interposition enabled 83.3% of patients (10 out of 12) to recover sufficient limb function, and this improvement was evidenced by an excellent average score of 21.7, with an increase of 19.6 points compared with the preoperative evaluation. However, 2 patients (16.7%) only partially recovered their ability to perform activities of daily living, both due to the recurrence of limitations in the range of motion, including an alkalosis.

The average score related to the flexion-extension of the elbow for these patients increased from 7.1° in the preoperative to 16.7° in the post-operative period; particularly, both the extension and bending improved considerably, from an average extension of 70.8° to 28.3° (average increase of 42.5°) and from an average flexion of 93.7° to 126.6° (average increase of 32.9°).

Analysing changes in the range of motion from the preoperative to the intraoperative phase, up to the current follow up (Table 3), showed a change from an average preoperative flexion-extension arc of 22.9° to an average intraoperative movement range of 122.5°, culminating in the post-operative period with an average value of 98.3°. The initial average gain was therefore 99.6°, which was reduced to 75.4° at the time of the check, with an average loss of 24.2° from intra- to post-operative.

This group showed a significant difference between the patients who had surgery on their dominant limb and those who had surgery on their secondary limb: the former changed from an average intraoperative flexion-extension of 117.1° to

a post-operative mean value of 79.3° with an average decrease of 37.8°; the others changed from a preoperative average of 130° to a post-operative mean value of 125° with an average decrease of only 5°. The final gain was greater in patients who had surgery on their secondary limb (+84° against +69.3°).

The movement that decreased most in the post-operative period was the extension, changing from an average intraoperative value of 14.6° to a post-operative average of 28.3° (average decrease of 13.7°).

As part of our series, recovery of extension reached 0° to 30° in 66.6% of our patients (8 cases); a decline, however, in 33.3% of cases (4 patients) exceeded 130°, reaching 145° (complete bending) only in 1 patient (8.3%).

In the preoperative period, only 1 patient (8.3%) had a functional range of motion, equal to 100°; in the post-operative period, this was reached by 66.6% of patients (8 cases), with 1 case (8.3%) achieving complete recovery of 145°. In the preoperative period, only 1 patient (8.3%) had a range of motion from 50° to 100°, and 10 patients (83.3%) presented with a movement arc of less than 50°; in the post-operative period, a range of movement from 50° to 100° was achieved in 2 patients (16.6%) and a range of movement of less than 50° in another 2 (16.6%).

A total of 8 patients (66.6%) reported a decreased range of motion after the operation: 4 patients (33.3%) suffered significant functional losses, 3 (25%) saw their range of motion decrease to a ROM less than 100°, which is defined as non-functional according to Morrey’s criteria, and 1 patient (8.3%) lost all movement, developing ankylosis and reverting to their initial condition. However, 3 patients (25%) improved their range of motion, even if only by a few degrees, due to post-operative functional re-education.

In the preoperative period, pronation-supination was blocked at 0° in all patients. In the post-operative period, pronation improved to reach an acceptable average value of

51.3°, while supination reached 35°, which was unsatisfactory (ROM of 86.3°). No patients achieved complete recovery in both pronation and supination, and in 50% of cases (6 patients), a range of motion was configured that did not meet Morrey’s criteria on functionality (less than 100°).

Among these patients, only 1 case (8.3%) involved failure. In this patient, it was opportune to intervene 2 years after the first operation, performing a radial head resection, due to the need to improve the pronation and supination, which were almost completely restored.

Radiographic results for patients treated with interposition arthroplasty showed conserved congruity between the coated surface of the humerus and the articular surface of the ulna in 11 patients out of 12 (91.7%). In 1 case (8.3%) complete reabsorption of the olecranon and the humeral palette occurred due to a lack of patient compliance during post-operative functional rehabilitation.

There were 5 cases of heterotopic ossification (3 in the anterior and 2 in the posterior area), 1 case of ossification and 1 case of radioulnar synostosis.

The average post-operative DASH score was 28.5 (minimum 0, maximum 68.3). Within the group, 4 patients (33.3%) had scores of <10 (minimum 0, maximum 5.8), 1 patient (8.3%) had a score between 10 and 25 and 7 patients (58, 4%) had scores of >25 (minimum 25.8, maximum 68.3).

The overall average SF-36 score was 79.6 (standard reference value 72.95).

In summary, after 47.4 months of follow-up, only 41.7% of patients (5 out of 12) obtained excellent or good results. Nevertheless, 83.3% of patients (10 out of 12) expressed complete satisfaction, while 16.7% (2 out of 10) said they were dissatisfied with the result due to post-operative joint instability.

TABLE 3. Changes in MEPS and complications in patients treated with arthroplasty with elbow soft tissue interposition.

	Gender	Age	Preoperative							Post-Operative							Complications					Follow-Up Months
			PAIN	FLE-EX	FLEXION	EXTENSION	STABILITY	DAILY FUNCTION	MEPS	PAIN	FLE-EX	FLEXION	EXTENSION	STABILITY	DAILY FUNCTION	MEPS	ULN. N. INJ	instability	INFECTION	ROM LOSS	RREVISION	
1	M	71	45	5	90°	90°	10	0	60	30	5	90°	90°	10	15	60						104
2	M	46	45	5	110°	70°	10	0	60	45	20	140°	15°	10	25	85				P.R.		97
3	M	39	30	5	90°	90°	10	0	45	15	5	110°	70°	0	15	35	P.	I.		P.R.		70
4	M	52	45	5	90°	90°	5	0	50	15	20	110°	0°	0	20	55	P.	I.				65
5	M	58	45	15	80°	20°	10	5	75	45	20	145°	0°	10	25	100						58
6	M	42	30	20	125°	20°	10	20	80	30	20	140°	5°	5	20	75	P.	I.			R.	64
7	M	38	45	5	90°	80°	0	0	50	30	20	140°	30°	10	25	85				P.R.		57
8	M	40	45	5	90°	90°	10	0	60	15	20	130°	10°	10	25	65				P.R.		51
9	M	29	45	5	90°	90°	10	0	60	15	20	130°	20°	0	25	60	P.	I.		P.R.		37
10	M	39	30	5	90°	60°	10	0	45	45	20	125°	10°	10	25	100				P.R.		39
11	M	33	45	5	90°	60°	5	0	55	15	15	130°	45°	0	20	50	P.	I.		P.R.		14
12	M	30	45	5	90°	90°	10	0	60	30	15	130°	45°	0	20	65	P.	I.		P.R.		10
<b>Average</b>	<b>43.1</b>		<b>7.1</b>	<b>93.8</b>	<b>70.8</b>	<b>8.3</b>	<b>2.1</b>	<b>58.3</b>	<b>27.5</b>	<b>16.7</b>	<b>126.7</b>	<b>28.3</b>	<b>5.4</b>	<b>21.7</b>	<b>69.6</b>							<b>55.5</b>

TABLE 4. Variations of the ROM in patients treated with arthroplasty with interposition of soft tissue.

	Gender	Age	Preoperat.			Intraoperat.			Rom Initial Gain	Post-Operat.			Rom Loss	Rom Final Gain	Follow-Up Months	Preoper .		Post-Oper.	
			flexion	extension	ROM	flexion	extension	ROM		flexion	extension	ROM				Pronation	Supination	Pronation	Supination
1	M	71	90°	90°	0°	110°	20°	90°	90°	90°	90°	0°	90°	0°	104	0°	0°	30°	30°
2	M	46	110°	70°	40°	145°	30°	115°	75°	140°	15°	125°	-10°	85°	97	0°	0°	0°	0°
3	M	39	90°	90°	0°	145°	5°	140°	140°	110°	70°	40°	100°	40°	70	0°	0°	75°	30°
4	M	52	90°	90°	0°	110°	0°	110°	110°	110°	0°	110°	0°	110°	65	0°	0°	45°	45°
5	M	58	80°	20°	60°	135°	0°	135°	75°	145°	0°	145°	-10°	85°	58	0°	0°	70°	65°
6	M	42	125°	20°	105°	145°	0°	145°	40°	140°	5°	135°	10°	30°	64	0°	0°	75°	80°
7	M	38	90°	80°	10°	145°	30°	115°	105°	140°	30°	110°	5°	100°	57	0°	0°	65°	65°
8	M	40	90°	90°	0°	145°	0°	145°	145°	130°	10°	120°	25°	120°	51	0°	0°	30°	0°
9	M	29	90°	90°	0°	145°	20°	125°	125°	130°	20°	110°	15°	110°	37	0°	0°	60°	60°
10	M	39	90°	60°	30°	130°	20°	110°	80°	125°	10°	115°	-5°	85°	39	0°	0°	75°	45°
11	M	33	90°	60°	30°	145°	20°	125°	95°	130°	45°	85°	40°	55°	14	0°	0°	45°	0°
12	M	30	90°	90°	0°	145°	30°	115°	115°	130°	45°	85°	30°	85°	10	0°	0°	45°	0°
	<b>43.1</b>		<b>70.8</b>	<b>22.9</b>	<b>137.1</b>	<b>14.6</b>	<b>122.5</b>	<b>99.6</b>	<b>126.6</b>	<b>28.3</b>	<b>98.3</b>	<b>24.2</b>	<b>75.4</b>	<b>55.5</b>	<b>0</b>	<b>0</b>	<b>51.3</b>	<b>35.0</b>	

IV. DISCUSSION

Over the past years, important changes have occurred in the treatment of elbow trauma and post-trauma stiffness. This has moved from the use of techniques such as arthrodesis and arthroplasty resection to the more recent endoprosthetic humeral replacement. Furthermore, the development of arthroscopy has further widened the margins of intervention and recovery. We have passed from acceptance of the pathology and irreversibility of the loss of movement to increasing confidence in complete recovery. Therefore, satisfying the patient has become increasingly difficult. Hence, it is necessary to re-evaluate the indications for the different surgical approaches to assign the right patient to the right intervention to obtain the best possible results, balancing patients' expectations with the possibility of recovery.

The assignment to different types of intervention must consider the general condition of the patient and the pathological cause of rigidity. These must be the first selection criteria. Unfortunately, in Jordan, we have limited experience in elbow arthroplasty, with limited options in the treatment of such cases.

Interposition arthroplasty is considered as the main alternative to total arthroplasty in young patients and those

with high functional demand, in cases where involvement of the articular surface exceeds 50%.

At our clinic, 12 patients were treated with this method, interposing a fascia lata graft in 10 cases and an Achilles tendon graft in 2 cases.

The values for pain and instability worsened rather than increased. Regarding pain, 13.8 points were lost in the post-operative period compared to the preoperative period, and there were 3 cases of complete absence of pain (25%), 4 cases of minimal pain (33.3%) and 5 cases of modest pain (41.7%). In these patients, the pain appeared after work. Evaluation of the causes of pain showed that 80% of patients with moderate pain (4 cases out of 5) presented both instability and sensory symptoms affecting the ulnar nerve, as well as 50% of patients with minimal pain (2 cases of 4), comprising a total of 6 cases out of 12. These complications (instability and neuropathy), were both present only in patients with pain; therefore, it can be hypothesised that they were closely correlated with the surgery.

At the check-up, 6 patients (50%) had instability, with 6 cases occurring after surgery. Instability is therefore confirmed as the main complication of interposition arthroplasty.

Our data reflect those in the literature (Table 5).

TABLE 5. Comparison with the most recent studies on arthroplasty with interposition in elbow stiffness (E. = excellent results, G. = good results).

STUDY	YEAR	NUM	MEPS		Results E. + G.	ROM F-E		ROM P-S		Satisfied PT
			pre	post		pre	post	pre	post	
This study	2010	12	58.3	69.6	5 (41.7%)	22.9°	126.6°	0°	86.3°	10 (83.3%)
Fox et al. (7)	2000	11	/	/	8 (72.7%)	35°	78.6°	/	/	6 (54.5%)
Cheng & Morrey (8)	2000	13	37	76	8 (61.5%)	74.4°	106.1°	/	/	9 (69.2%)
Larson & Morrey (9)	2005	38	41	65	13 (34.2%)	51°	97°	85°	123°	31 (81.5%)
Nolla et al. (10)	2008	13	/	/	5 (38.4%)	38.5°	92.8°	85.8°	127.3°	/
Larson & Morrey (11)	2010	9	49	65	3 (33.3%)	/	/	/	/	5(55.5%)

In Knight and Van Zandt (12), a series of 45 fascial elbow arthroplasties, 23 of which were performed for post-traumatic aetiology. Their data include 56% satisfactory results and a 73% satisfaction rate at an average follow-up of 14 years. Subsequently, Kita (13) reported results for 31 patients with

rigidity due to different aetiological factors, treated with interposition of lata band without distraction. A 19-year follow-up showed a significant decrease in pain, with worse results and satisfaction in patients with traumatic aetiology than in those with inflammatory causes. Shahriaree et al. (14)

presented a study of 30 patients treated with arthroplasty with interposition of Gelfoam and early mobilisation. Patients were re-evaluated 4 years or more after the operation: 80% presented without pain, and 90% could return to their previous occupations. Only 1 patient was re-operated on, configuring a poor result.

In our study, in comparison to the above mentioned studies, the correct choice of patients led to post-operative conditions resembling those found in the various studies considered. The most important difference is in movement and range of motion recovery, which is greater in our study. The MEPS scores, outcomes and satisfaction fluctuated between similar values.

An important detail, which our study shares with others in the literature, is the correlation between poor results from a clinical point of views (which exceeded 50% of patients only in two studies) and high percentages of patient satisfaction (greater than 50% of patients). This relationship can be explained based on the preoperative pathological picture and the patient's expectation. Candidates for interposition arthroplasty present with subverted anatomical pictures and low expectations of complete recovery of movement. They are aware that a poor result is possible on arrival in the operating room. Therefore, even a slight improvement in the initial condition will lead to a feeling of well-being. In our study, only 2 patients were dissatisfied: not due to failed recovery of movement but due to apparent joint instability.

Regarding joint stability, our study confirms a concept that is present in the literature: the main complication of interposition arthroplasty, which is joint instability. For example, Knight and Van Zandt (12) reported that a 20% failure rate was related to joint instability, and Kita (13) and Fox (7) stated that all insufficient outcomes were associated with this procedure.

The main problems of arthroplasty with interposition of soft tissue are the difficulty in reshaping the articular surfaces to make them congruent and the progressive deterioration of the interposed tissue, which is amplified by the stresses, especially in varus and valgus, which develop during work activities. Therefore, our data allow us to hypothesise that interposition arthroplasty does not provide, in the long term, optimal recovery of function, due to high incidence of pain and instability in the post-operative period. This is because, while painless rigidity would allow the patient, even with serious movement limitations, to perform heavy manual activities, interposition arthroplasty, after a period of apparent well-being, would force the patient to avoid them and to undertake only sedentary activities.

## V. CONCLUSION

Our study showed that this method, recommended for young patients with high functional requirements as an alternative to arthroplasty, achieves unsatisfactory results in a

large percentage of cases. Despite good recovery of the range of motion, which is reflected in an increased ability to perform the activities of daily living, the final result is often insufficient due to high incidences of post-operative instability and pain. Based on the results of our study, we hypothesised that this type of intervention in patients with high functional demands is no longer feasible. The worst results were obtained in cases where the intervention was performed on the dominant limb, which is usually subjected to higher stress and loads. However, the indication inherent to the young age of the patients remains valid because they cannot be treated with total arthroplasty, given the limited duration of the prosthetic components, and the lack of experience among Jordanian orthopaedic surgeons, which would involve numerous subsequent revisions.

These considerations indicate that in young patients with high functional demands, endoprosthesis replacement of the distal humerus may be introduced rather than interposition arthroplasty. This method obtains excellent results in terms of ROM and daily functions, improving stability and reducing pain.

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