

Replacement of radial head versus reconstruction terrible triad elbow injury

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Abstract

The extraordinarily congruous nature of the joint and the interaction between the articular surfaces and soft-tissue stabilisers are the two factors that contribute to the stability of a normal elbow. A profoundly unstable elbow is the outcome of TTIE, which is characterised by the loss of the anterior coronoid buttress, the posterolateral stabilisation of the lateral ulnar collateral ligament (LUCL), and the valgus buttress of the radial head. This study aims to compare and evaluate the outcomes of patients who received radial head reconstruction (REC) or replacement (REP) following a TTIE in order to see if there are any changes in patient outcomes between the two treatment groups.

Keywords: Elbow Dislocation; Olecranon Fracture; Displaced Fracture

1. Introduction

Elbow dislocations come in two varieties: simple and complex. While complex dislocations have associated bone injuries, simple dislocations of the elbow are capsuloligamentous injuries without fractures. Hotchkiss [1] called a complex elbow dislocation involving fractures to the radial head and coronoid process the "TERRIBLE TRIAD" due to the generally poor prognosis associated with it. Despite the intricacy of this injury, understanding the relevant anatomy and the factors influencing elbow stability is necessary to use a systematic methodology for therapy.

By ensuring that sufficient elbow stability is reached to allow for early motion, this approach can improve most patients' outcomes. However, the reporting of several clinical series suggests that the eventual prognosis may be good or poor even with the best efforts at reconstruction, particularly in those with experience treating serious injuries. [1,2] Further research is required to improve the outcomes of these severe injuries.

Stability in a typical elbow is provided by the extremely congruous nature of the joint and the interplay between the articular surfaces and soft-tissue stabilizers [2]. The loss of the anterior coronoid buttress, the posterolateral stabilization of the lateral ulnar collateral ligament (LUCL), and the valgus buttress of the radial head in TTIE results in a profoundly unstable elbow [3]. Conservative treatment has a poor success rate and often leaves patients with a chronically unstable, painful, and stiff elbow because of the unstable nature of this injury. As a result, it is widely accepted that, in the majority of cases, TTIE management should be in place [4].

Increased understanding of elbow biomechanics, advancements in implants and fixation techniques, use of treatment algorithms, and adoption of standardised surgical protocols have all been linked to better outcomes [2, 5–9]. By treating the various bone and soft-tissue components of the injury sequentially, usually from deep to superficial, surgical therapy aims to create a stable elbow that facilitates early recovery [2, 7]. This includes correcting the coronoid fracture, replacing the radial head, repairing the LUCL, and, in some cases, restoring the medial collateral ligament and utilizing

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a hinged external fixator if there is persistent instability following [10]. The optimal method for handling each of these particular components is still up for debate, despite the fact that this protocol is currently widely recognized. In particular, there is still disagreement over whether the radial head should be replaced or repaired. Nonetheless, a recent trend has been observed towards a greater use of REP in radial head fractures [11, 12], since arthroplasty provides early stabilization and may enable mobilization sooner, perhaps improving the functional prognosis.

This study aims to compare and evaluate the outcomes of patients who received radial head reconstruction (REC) or replacement (REP) following a TTIE in order to see if there are any changes in patient outcomes between the two treatment groups.

2. Material and methods

This is a Prospective comparative study on patients in the department of orthopedics admitted

2.1. Sample size

Sample size was calculated 35 subjects for each of two groups at Alpha error 0.05 and Power 80% assuming difference of means to be detected with cases managed by radial head replacement and reconstruction procedure with standard deviation 3. (as per seed article)

2.2. Exclusion criteria

- Conservative management of radial head fractures in undisplaced radial head fracture
- Patient not fit for surgery

2.3. Statistical analysis

The collected data will be revised, coded, tabulated and introduced to a PC as a master sheet 1. Quantitative variables will be expressed as Mean and SD. 2. Qualitative variables will be expressed as frequency and percent. 3. Appropriate statistical tests will be applied to obtain results. 4. A significance level of $p < 0.05$ will be used in all tests

2.3.1. Examination of other associated symptoms will be based on history and clinical examination

Collection of the data was as follows:

- History
- Clinical examination – systemic and local
- Radiological evaluation using- X-ray and 3D CT
- Investigations- baseline and others
- Diagnosis- clinical and radiological
- Surgery- radial head replacement vs reconstruction
- Post operative oral antibiotics and analgesic/anti-inflammatory drugs
- Post operative evaluation by clinical examination , X-ray
- Assessment of complications-
 - Perioperative - difficulty in reduction, neurovascular injury, bleeding
 - Immediate Post operative - pain
 - Late post operative - elbow stiffness, capitellar overloading, implant loosening

2.4. Operative procedures

A tourniquet was applied to the proximal arm while the patient was laying flat and under general anaesthesia. The RH was replaced through a lateral incision (Kocher approach). All coronoid fractures classified as Regan-Morrey II and III were treated with surgery.

Safely initially. RH was taken out after opting to replace it, and the coronoid process from the lateral space was concentric reduced and fixed. If repair to RH was haphazard or if adequate exposure of the medial aspect of the coronoid fracture was challenging, a typical medial approach was preferred to correct the coronoid fracture. A non-absorbable suture lasso device or lag screws that were put via pre-drilled holes were used for coronoid fixation.

Dorsal plates were applied when the fragments were classified as Regan-Morrey III.

Internal fixation of the RH fracture was performed on the operating table in the RH repair group to determine the size of the prosthesis that would be needed. In order to avoid lengthening or shortening the radiocapitellar joint by more than 2.5 mm after the prosthesis was implanted, the radial neck was cut in a position that corresponded to the relative position of the prosthesis and the capitulum humerus. To facilitate any necessary adjustments, a RH prosthesis was implanted without the use of bone cement. Both groups thoroughly repaired any damaged annular ligaments.

Finally, non-absorbable sutures or anchor sutures were used to attach the lateral-collateral ligament complex (LCL) to the lateral epicondyle through holes drilled into the lateral epicondyle. The concentric reduction and stability over the whole range of elbow motion were verified using a C-arm. Since all instances gained stability with the elbow in $>45^\circ$ of flexion, the medial-collateral ligament was not restored.

Patients were fitted with braces if their elbow was bent at 70 degrees, their forearm was somewhat pronated, and their wrist was neutral. Passive flexion-extension exercises were started after 5 or 7 days of surgery and were to be done for the first 3 weeks under supervision.

Exercises involving pronation and supination were prohibited for three weeks following surgery. If there was no discomfort, exhaustion, or swelling, all patients were gradually given permission to move their elbows actively throughout rehabilitation procedures. Six weeks after surgery, the brace was taken off, and weight bearing on the elbow was gradually permitted.

if the RH neck was broken, done with screws or plates using a lateral approach. The RH pieces were put together on the

3. Results

A total of 70 study participants were included in this study. Group A is the repair group, while group B is the replacement group.

Study population demographics and outcomes- the number of participants included in each group was found to be 35. In Table 1, we can observe the demographic details as well as the clinical parameters of all the study participants.

The mean age of the entire study population

Table 1 Demographic parameters and clinical details of all the study participants of both groups combined

	N	Minimum	Maximum	Mean	SD
Age	70	20	78	42.58	14.44
weight	70	50	70	59.71	6.42
ARC OF MOTION	70	75	140	115.14	22.35
DASH	70	0	43	16.63	2.97
Broberg-Morrey index	70	64	100	90.20	2.86
Surgery duration	70	180	240	205.00	15.08

We find that the maximum study subjects were in the younger group in the repair group, while in the replacement group, there two decades older. This difference, however, was not statistically significant (p value 0.092)

In both the groups, males were found to the majority. However, this difference was not statistically significant. (p value 0.114)

The repair and replacement groups were compared in terms of arc of motion, DASH points, and Broberg Morrey scale.

In this study, we find that the arc of motion (flexion/extension) was found to be higher in replacement group than in repair group. This difference was statistically significant.

Table 2 Arc of motion between two groups

Group	ARC OF MOTION			P-value
	N	Mean	SD	
Group A	35	112.5°	16.7°	0.005*
Group B	35	117.6°	26.3°	

In this study, we find that the Broberg Morrey scale and DASH point was found to be higher in replacement group than in repair group. This difference was statistically significant.

Table 3 Broberg morrey index

Group	Broberg Morrey Index			P-value
	N	Mean	SD	
Group A	35	88.32	0.56	0.001*
Group B	35	92.22	0.57	

Table 4 DASH scale between two groups

Group	DASH points			P-value
	N	Mean	SD	
Group A	35	14.27	2.22	0.002*
Group B	35	15.76	2.89	

In our study, the surgeries were all performed by the same surgeon. In this study, we find that the duration of surgery was found to be higher in replacement group than in repair group. This difference was not statistically significant.

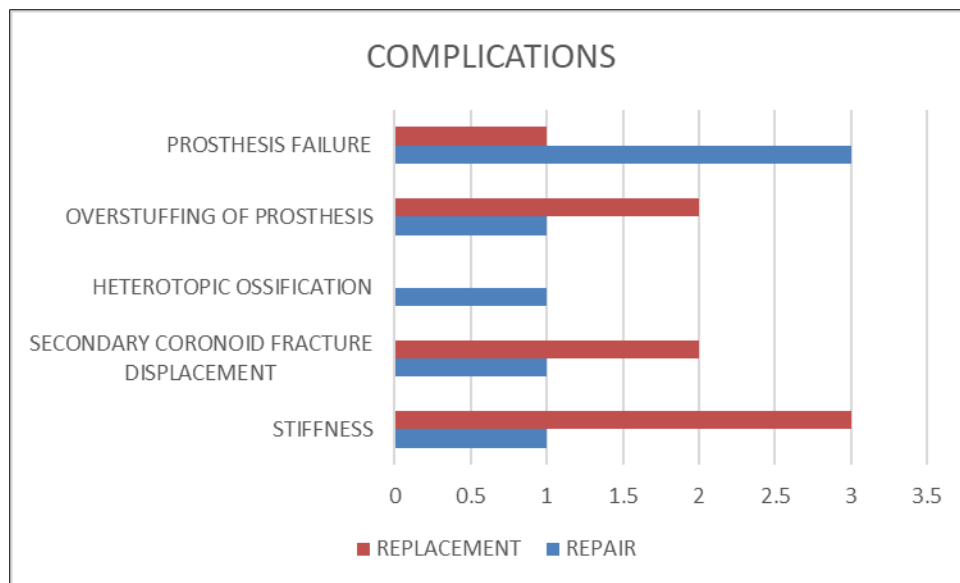


Figure 1 Complications after each procedure compared between the two groups

The rate of reoperation and arthrosis formation was found to be higher with repair than with replacement. However, the difference was statistically not significant.

4. Discussion

In accordance with accepted surgical standards, our study demonstrated that two distinct therapies might preserve the elbow's post-fracture persistent concentric reduction and stability. Additionally, treatment of the Mason type-III RH fracture in a terrible triad of the elbow with arthroplasty showed improved clinical DASH point and Broberg Morrey scale, better elbow flexion-extension arc, and lower post-operative complication rates when compared to those treating the same types of fracture with ORIF.

Our findings showed that characteristics including age and the mean duration from surgery to injury did not differ significantly, indicating that the comparison was conducted without prejudice against the patients who were enrolled.

According to the literature, the surgical protocols for treating a terrible triad of elbow injuries, from deep to superficial, were as follows: (i) prefer the global posterior approach to expose the injury; (ii) adhere the coronoid fracture first to obtain a stable concentric reduction and fixation; (iii) second, repair or replace the RH fracture; (iv) repair the LCL; and (v) repair the medial collateral ligament or use an external hinged fixator if the elbow still (4,7–9). In order to disclose the RH fracture, LCL damage, and coronoid process fracture in our patients, the lateral technique was favoured. In the meanwhile, if the exposure of the coronoid process fracture was challenging, the medial technique was also used. The lateral and medial approaches were chosen over the posterior approach because the posterior approach had a higher incidence of complications like haemorrhage, heterotopic ossification, and flap necrosis due to the posterior approach's rough reflection of soft tissue to achieve adequate exposure of the RH and coronoid process fractures. According to what we know, the lateral and medial capsules and ligaments were damaged in this pattern of injury. (13) Without making a stiff incision in the soft tissue, it was possible to reach the joint through the opening left by the injured structure. As a result, the soft tissue healing was stronger and the fracture was easier to expose. (13)

RH plays a crucial role in the stability of the elbow during valgus and varus loading. (14)

Due to the high incidence of catastrophic consequences, including prolonged instability, wrist degeneration, loss of muscle strength, and proximal displacement of the radius, traditional resection of RH was not advised in this complex injury pattern. (15) Both Watters et al. (16) and Leigh et al. (17) published reports that contrasted with our findings by demonstrating management of RH fracture with ORIF or arthroplasty in patients with a terrible triad of the elbow without statistically significant differences in MEPS, total flexion-extension of the elbow, total pronation-supination of the elbow, or post-operative complication rates at the end of the follow-up period. However, they did not include patients with In their studies, patients with more serious RH fractures typically underwent arthroplasty rather than ORIF. The severity of the RH fracture was not matched between the patients who received RH repair and those who got RH replacement, which may have hampered the ability to compare the outcomes. Mason type-III RH fractures have extremely high rates of failure, non-union, and functional disability when treated with ORIF because they involve the entire RH and are characterised by communicating fracture.

Patients with merely a small RH fracture can achieve satisfactory results after having RH replacement, according to reports from Grewal et al.,¹⁸ Chen et al.,¹⁹ and Harrington et al.,²⁰. Additionally, RH replacement might be carried successfully without requiring additional distal soft tissue exposure or annular ligament incision, reducing the chance of intraoperative posterior interosseous nerve damage. Because high-energy trauma almost invariably leads in a catastrophic triad of the elbow, the typical anatomical systems that maintain elbow stability are severely damaged. For arthroplasty to be successful, minimally invasive harm to the important elbow stabilising components must occur during the procedure.⁽²¹⁾

To avoid oversizing and overstuffing the RH prosthesis, there is a learning curve that must be taken into account. One patient in our study required a secondary operation as a result of prosthesis overstuffing. A radio capitellar joint that has been lengthened or shrunk by more than 2.5 mm might change the pressure and kinematics of the brachioradial articulation, causing pain, stiffness, pathological changes to the varus-valgus laxity, and ulnar rotation of the elbow. 20

The sample size of our study was small, and inadequate to make a proper comparison between the two methods. Large, double-blind, random perspective trials are required to confirm the benefits of RH replacement in addressing a terrible triad of the elbow because some of the patients who underwent RH replacement were young and a longer follow-up period was required to determine whether there were any late-term complications from arthroplasty, such as prosthesis loosening, laxity, subsidence, and erosion.

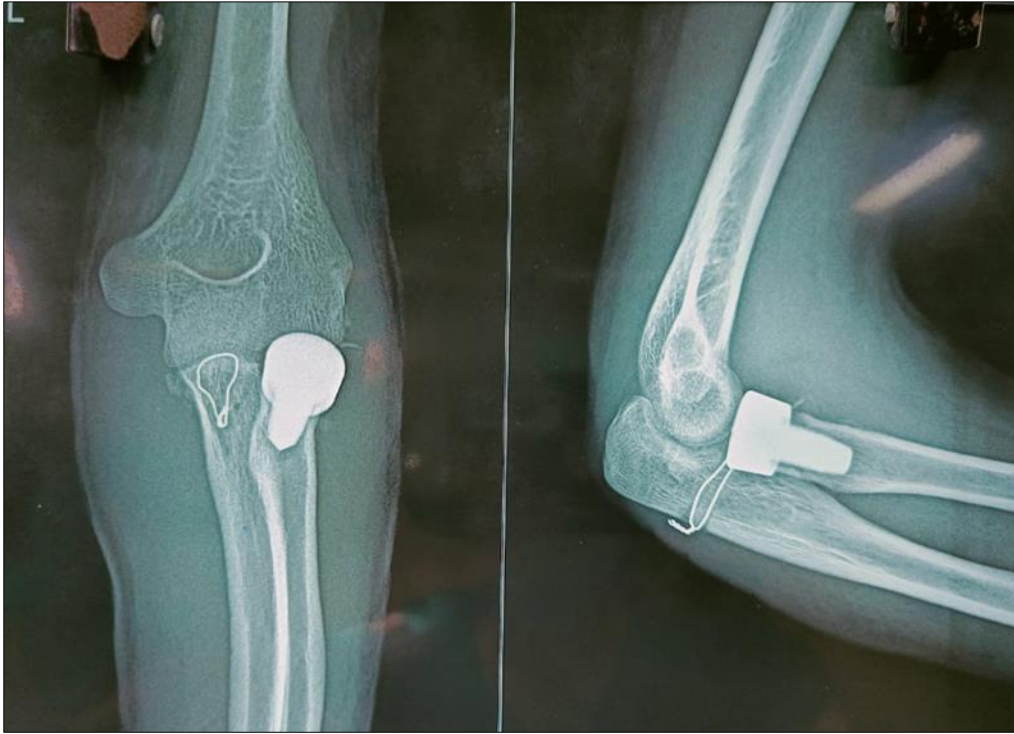


Figure 2 Postoperative image of radial head replacement

5. Conclusion

To avoid disastrous results, pay close attention to a horrible elbow triad. While RH replacement exhibits greater MEPS, greater total flexion-extension of the elbow, greater total pronation-supination of the elbow, and lower post-operative complication rates for RH fracture in a terrible triad of the elbow, standard protocols can achieve comparable results with RH prosthesis and ORIF.

Ineffective elbow triad management may be successfully managed with RH replacement.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of ethical approval

IEC clearance sought

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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