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Prevention of radial head instability by augmentation of annular ligament with local triceps tendon sheath autograft in radial head Fixation or Replacement: A case series

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ABSTRACT

During radial head plating or replacement it has been observed that the end to end repair of annular ligament was impossible especially when torn. It may cause radial head instability later on. Use of Bell Tawse technique and its modification has been elaborated in literature for the management of chronic radial head instability using Triceps tendon autograft, but its application for prevention of instability in the first place has not been elaborated. This case series will explain prevention of instability of radial head in those cases. During radial head plating or replacement, torn or resected annular ligament was augmented with a strip of autologous triceps tendon sheath graft. During subsequent follow-ups no patient had any instability in the elbow. The mean of Mayo elbow performance score (MEPS) was 90 in 6 month follow-up. Radial head instability can be prevented in first place by simply augmenting annular ligament with triceps tendon sheath graft.

Keywords: Radial head fracture, Annular ligament reconstruction, Radial head plating, Bell Tawse technique, Radial head arthroplasty, Mayo elbow performance score.

1. INTRODUCTION

According to Akesson et al., (2006) radial head fractures are most common among elbow fractures, which occur 2.5 to 2.9 times per 10,000 persons each year. Stability of the elbow joint is offered by the bony articulations and soft tissue around the elbow. Postero-lateral and the varus stability of the elbow joint is provided by group of ligaments consisting of annular ligament, Lateral Ulnar Collateral ligament (LUCL) and Radial Collateral ligament (RCL), together known as the Lateral Collateral Ligament Complex (LCLc). The common extensor muscles provide varus stability and the common flexor

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muscles provide valgus stability and are particularly important when annular ligament and LUCL got injured respectively. Since most activities of daily living exert a varus force rather than a valgus force at the elbow joint, failure of LCLc mechanism amounts to the persistence of instability in majority of patients. As described by Mason (1954), a Type I fracture are un-displaced marginal sector fracture; Type II fractures are displaced intra-articular fracture and Type III fracture is a comminuted fracture of entire radial head and Type IV fractures are any radial head fracture along with the dislocation of elbow.

According to Herbertsson et al., (2004) Mason type I and II radial head fractures can be managed nonoperatively with good outcomes in most patients. Patients having displaced fracture of radial head associated with concomitant injuries, such as unstable fracture-dislocations or retained intra-articular loose bodies; surgical modality is a better option. Excision of complete or small fragments, osteosynthesis and replacement of radial head are all the possible surgical treatments available. According to Broberg & Morrey, (1986) radial head functions as a key stabiliser in a ligament deficient elbow and given the fact that complex fractures of radial head are often associated with ligamentous injuries, primary excision is not done for unstable radial head fractures. Displaced, non-comminuted radial head fractures restricting forearm rotation are criteria for osteosynthesis; while Radial head replacement is recommended with un-reconstructable comminuted fractures of radial head.

Zhang & Gan (2014) and Paraskevas (2011) reported that the annular ligament prevents radial head dislocation and limits its anterior, posterior and lateral translation. Because suture anchors are nearly impossible to repair in injuries when the static stabilisers are entirely disrupted, patients with fractures of radial head may develop chronic posterolateral rotatory instability and varus instability as a result of inadequate LCL healing. Jones et al., (2012) and Liu et al., (2014) recently reconstructed the annular ligament using a variety of techniques, including the tendinous grafts obtained from Palmaris longus, Triceps tendon, Fascia lata, and also suture anchor, to treat chronic elbow instability and radial head dislocations. Early recognition and prevention of this instability is preferred. Unfortunately, most patients present late following radial head fixation, replacement or excision which leads to poor outcomes and re-surgery.

Primary reconstruction of the lateral collateral ligament and the annular ligaments may play a pivotal role in preventing chronic radial head instability, for which much literature is presently not available. We, in this case series of 10 cases with radial head fracture (either isolated or associated with other injuries) have tried to establish the idea that repair and re-enforcement of annular ligament with triceps tendon sheath, in the very first surgery (along with plating or replacement of radial head) enhanced the functional outcome of patients and negates the possibility for a repeat surgery and is cost effective.

2. SURGICAL TECHNIQUE

10 cases were operated by single orthopaedic surgeon from March 2020 to March 2021 for fracture of radial head were retrospectively and prospectively followed-up and evaluated for minimum period of 6 months. Out of which 4 were of radial head plating (Group A) and 6 cases were of replacement of radial head with radial head prosthesis (Group B), 6 were female and 4 were male. Pre-op CT scan was done in all patients. Through posterior or lateral approach radial head plating or replacement was done by standard orthopaedic procedure. During those procedures a free graft of size 1x3 cm harvested from ipsilateral triceps tendon sheath. If Annular ligament was torn or resected free graft was augmented over the ends with bioabsorbable sutures and if it was avulsed then one end of graft fixed to the bone with non-absorbable suture through bony tunnels and another end sutured over avulsed annular ligament (Figure 1).

Figure 1 Surgical technique. 1x3 cm Triceps tendon sheath graft harvested (A), Harvested graft augmented over annular ligament end (B), Radial head plate completely covered(C).

Postoperatively above elbow slab applied for two days and a ROM elbow brace was applied for next 4-6 weeks (4 weeks in case of replacement of radial head and 6 weeks for radial head fixation) to initiate early elbow range of motion. Oral Indomethacin 75mg daily was given for 1 month to prevent heterotopic ossification.

CASE 1

Male patient, 24 years old, presented to the casualty with history of road traffic accident 7 days back, sustaining injuries to the right elbow. Patient had pain, swelling and difficulty in movement at the right elbow on presentation. On examination posterior interosseous nerve palsy was present. Mason type II fracture of head of radius along with proximal ulna fracture and coronoid tip fracture was seen on roentgenographs. Posterior incision used with medial and lateral flap. Intra-operatively annular ligament was found to be torn out. He was managed with coronoid fixation by apical lasso suture, radial head plating, 2 recon plates for proximal ulna and ligament augmentation done in the last. Postoperatively the patient was rehabilitated with ROM elbow brace and dynamic cock-up splint given (Figure 2). PIN injury recovered completely within 3 months; MEPS at 6 weeks follow-up – 40 (Poor); 3 months – 65 (Fair); 6 months – 95 (Good); 1 year- 100 (Excellent). Patient had no history of dislocation post-operatively.

Figure 2 Case 1. Pre-op, post-op and 6 months follow-up x-ray(Top row), annular ligament augmentation and coronoid fixation by apical lasso suture over olecranon plate and range of motion at elbow joint at 6 months(Bottom row).

CASE 2

A 47 years old female came with the history of road traffic accident 10 days back, sustaining injuries to the left elbow. Patient presented with complaints of pain, swelling and difficulty in movement at the left elbow. On examination the patient had no distal neurovascular deficit. Roentgenographic images showed fracture head of radius (Mason type IV) with posteriorly dislocated elbow. Posterior incision used with lateral flap. Intra-operatively annular ligament and triceps tendon were found to be avulsed and LUCL was torn. She was managed with replacement of radial head (cemented), annular ligament augmentation, LUCL repair and tenodesis of triceps tendon to olecranon with nonabsorbable suture through bony tunnel (Figure 3); MEPS at 6 weeks follow-up – 40(Poor); 3 months – 60(Fair); 6 months – 80(Good). Patient has had no history of dislocation of elbow post-operatively.

Figure 3 Case 2. Pre-op, Post-op and 6 months follow-up x-rays(Top row), Annular ligament augmentation and LUCL repair and range of motion at elbow joint at 6 months(Bottom row).

CASE 3

Female patient, 52 years old presented to the OPD with history of slip and fall at home 6 weeks back, sustaining injuries to the left elbow. Patient presented with complaints of pain, swelling and difficulty in movement at the left elbow. On examination the patient had posterior dislocation of elbow. Roentgenographic images showed fracture head of radius (Mason type IV) with posteriorly dislocated elbow. Posterior incision used with medial and lateral flap. Intra-operatively the annular ligament was resected and LCL was avulsed from lateral epicondyle. She was managed with coronoid fixation by apical lasso suture, radial head replacement (cemented), LCL fixed to lateral epicondyle by suture anchor and annular ligament augmentation done in the last (Figure 4); MEPS at 6 weeks follow-up – 65(Fair); 3months – 85(Good); 6 months – 95(Excellent). Patient had no history of dislocation of elbow post-operatively.

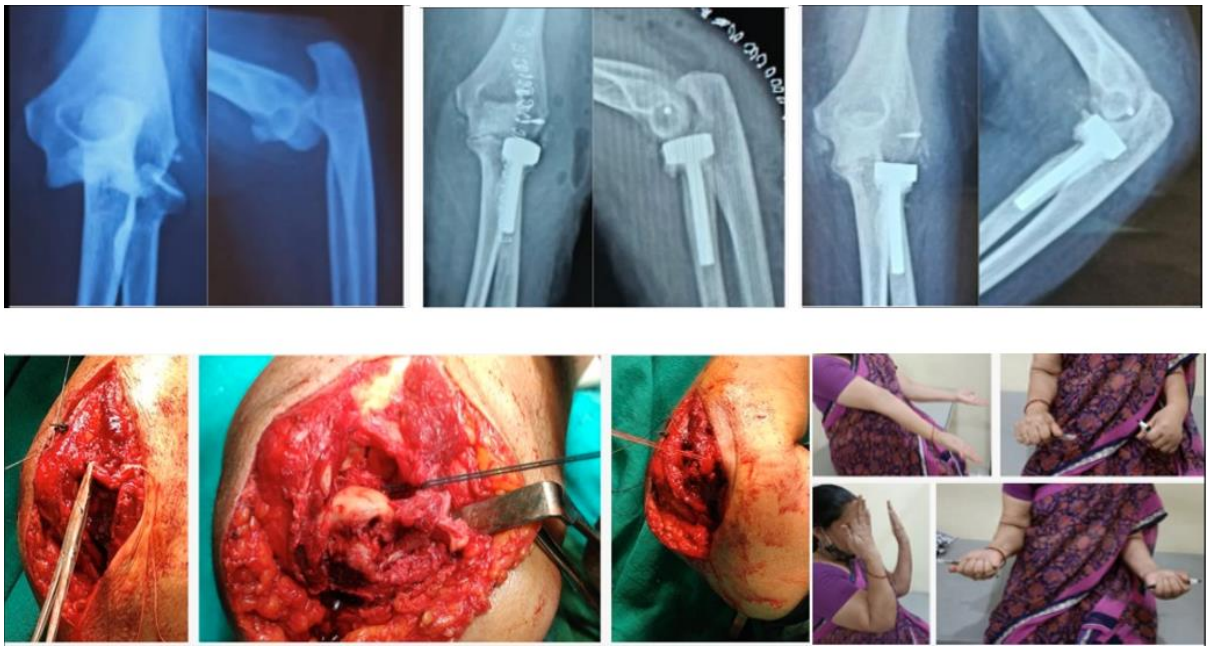


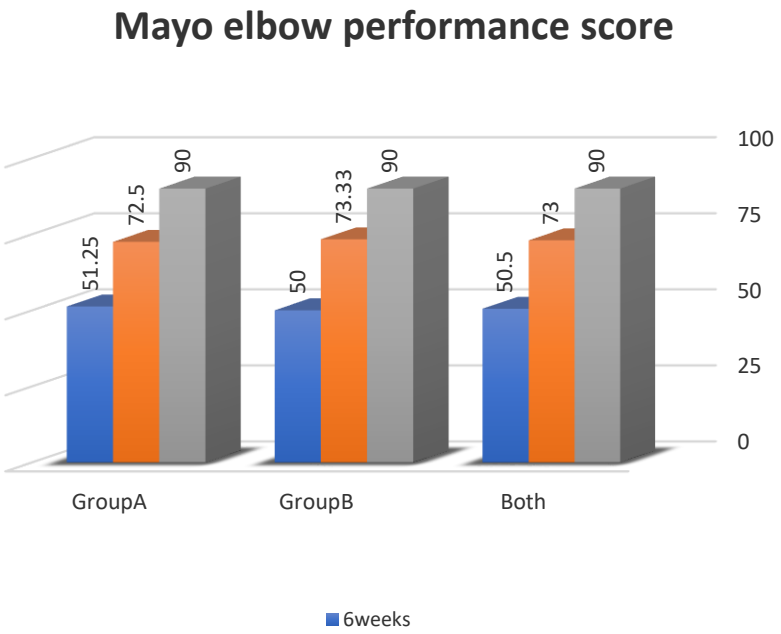
Figure 4 Case 3. Pre-op, post-op and 6 months follow-up x-ray (Top row), annular ligament augmentation and coronoid fixation by apical lasso suture over olecranon plate and range of motion at elbow joint at 6 months (Bottom row).

3. RESULTS

No patient had instability during follow up. At 6 month follow up total mean MEPS was 90. Both the groups had a mean MEPS was also 90 at 6 month (Table 1 and graph 1). Score improved for all patients in every next follow-up and were comparable in both groups. One patient, who was managed with replacement with radial head prosthesis, got superficial surgical site infection and was managed with dressing and antibiotics. Another patient who was managed with plating of radial head developed a vascular necrosis of head of radius at his 3 months follow-up.

Table 1 Mayo Elbow Performance Score (MEPS).

		6 Weeks	3 Months	6 Months
Group A	Case 1	40	65	95
	Case 7	60	70	85
	Case 8	65	85	95
	Case9	40	70	85
	Average	51.25	72.5	90
Group B	Case 2	40	60	80
	Case 3	65	85	95
	Case 4	60	80	90
	Case 5	50	65	85
	Case 6	35	80	100
	Case10	50	70	90
	Average	50	73.33	90
Both groups Average		50.5	73	90



Graph 1 Mayo elbow performance score.

4. DISCUSSION

According to Jian et al., (2015) chronic dislocation of radial head is a major problem when annular ligament was not repaired. Wang et al., (2015) suggests that suture anchors could be a dependable treatment option for children suffering with chronic and recurrent dislocation of radial head or patients for whom closed reduction failed. In a 16-year-old girl who had been treated conservatively had recurrent anterior radial head dislocation. Itadera & Ueno (2014) mentioned a technique by a tendinous graft prepared with

Palmaris longus to repair the annular ligament, which cured the instability. Thompson and Lipscomb, (1989) reported good results in a 21 years old man with recurrent subluxation of radial head when treated with annular ligament repair with no instances of subluxation of the 4 year follow-up.

According to Marinello et al., (2016) reconstruction with an isolated free triceps autograft (modified Bell Tawse treatment) could be considered as a viable surgical method in long standing cases of dislocation of radial head. Stiffness, elbow instability, non-united osteotomies , Subluxation, dislocation, nerve injury, osteonecrosis of radial head, degenerative arthritis, and infection are all possible complications following reduction of the radial head by open or closed method, annular ligament repair and temporary fixation of the head of radius with a trans-articular k-wire (Futami et al., 1992; Hirayama et al., 1987; De Boeck, 1997; Kalamchi, 1986; Oner & Diepstraten, 1993; Rodgers et al., 1996; Verneret et al., 1989). All the above studies have proven the fact that most fractures of radial head and other concomitant injuries are followed by radial head dislocations or instability after initial surgery, where end to end approximation of annular ligament was not achieved. This warrants the need for second surgery, reconstruction of annular ligament by various techniques which has shown excellent functional outcome. Moreover the advantage of using the triceps graft over the palmaris longus or fascia latta graft is using same single incision.

In our case series of 10 cases, no patient had any residual instability and all patients showed improved range of movement at the elbow and proximal radio-ulnar joint in subsequent follow-ups by adding simple less time consuming procedure of annular ligament augmentation. Both the groups are similar in the clinical and the functional outcomes.

5. CONCLUSION

Fixation or replacement of radial head along with augmentation of annular ligament using an autograft made from a tendon sheath of triceps is a novel idea which improves the functional outcome, reduces the possibility of repeat surgery for radial head instability and in turn proves to be cost effective. This case series warrants the need for study in large groups to evaluate statistical results of this novel technique.

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Informed Consent

Informed Consent was obtained from the patient.

Author's Contribution

All the authors contributed equally to the case series.

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Conflicts of interest

The authors declare that there are no conflicts of interests.

Data and materials availability

All data associated with this study are present in the paper.

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