



# Long-Term Follow-up of Salvage Surgery Following Failed Primary Surgery for Terrible Triad Injury of the Elbow: A Case Report

Saito T\*, Matsumura T and Takeshita K

Department of Orthopedic Surgery, Jichi Medical University, Japan

## Abstract

We present an 8-year follow-up experience and outcomes of Terrible Triad Injury of the elbow (TTI) salvage surgery after failed primary surgery. A 61-year-old man injured his right elbow during a fall. Initial radiographs showed elbow joint dislocation with comminuted radial head fracture and coronoid process fracture. The diagnosis was TTI. Primary surgery included repair of Lateral Ulnar Collateral Ligament (LUCL) disruption on the humeral side with a suture anchor, fixation of a comminuted coronoid fracture with K-wire, and 3 weeks of casting. The elbow remained dislocated, however, and stress examination indicated Posterolateral Rotational Instability (PLRI). He was referred to our hospital, where salvage surgery was performed 11 weeks after the injury. As the dislocation could not be reduced even under general anesthesia, we excised the osteophyte and released the anterior and posterior capsule and intra-articular adhesions. We then reconstructed the coronoid process by obliquely excising the radial head followed by radial head arthroplasty. As PLRI remained, the LUCL was reconstructed using double-stranded palmaris longus, after which the PLRI disappeared. The final surgical step was application of a hinged external fixator for 6 weeks. At 8 years after surgery, the patient has no elbow pain. His elbow extension/flexion range of motion is from 20° to 120°, and for supination/pronation it is 60°/45°. Stress examination revealed a stable elbow joint without pain. The Mayo Elbow Performance Score was 100. Preoperative planning is important for a successful outcome.

## OPEN ACCESS

### \*Correspondence:

Tomohiro Saito, Department of Orthopedic Surgery, Jichi Medical University, 3311-1 Yakushiji, Shimotuke, Tochigi 329-0498, Japan, Tel: 285-58-7374; Fax: 285-44-1301; E-mail: tr-saitou@kkf.biglobe.ne.jp

Received Date: 10 May 2019

Accepted Date: 17 Jun 2019

Published Date: 24 Jun 2019

### Citation:

Saito T, Matsumura T, Takeshita K. Long-Term Follow-up of Salvage Surgery Following Failed Primary Surgery for Terrible Triad Injury of the Elbow: A Case Report. *Clin Surg*. 2019; 4: 2483.

Copyright © 2019 Saito T. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

## Introduction

Terrible Triad Injury of the elbow (TTI) is characterized by posterior or posterolateral dislocation of the elbow joint along with fractures of the radial head or neck and coronoid process of the ulna. This injury is one of the most challenging surgical dilemmas for elbow surgeons because of posttraumatic elbow instability. A salvage case could be even more difficult because of both elbow instability and stiffness. We present an 8-year follow-up experience and outcomes of salvage surgery following failed primary surgery for TTI.

## Case Presentation

A 61-year-old, right hand-dominant man injured his right elbow after a fall down stairs. He presented with pain and swelling of the right elbow but no apparent neurovascular injury. Initial radiographs revealed dislocation of the elbow joint along with radial head and coronoid process fractures (Figure 1).

According to the Morrey-Mason classification [1], the radial head fracture was diagnosed as type IV. The coronoid fracture was diagnosed as type II according to the Regan and Morrey classification [2]. We could not use the information gained from computed tomography concerning the initial injury. The patient's history included treatment for ipsilateral distal radius and ulnar fractures that had occurred 10 years prior and had caused restricted forearm pronation and supination (Figure 2).

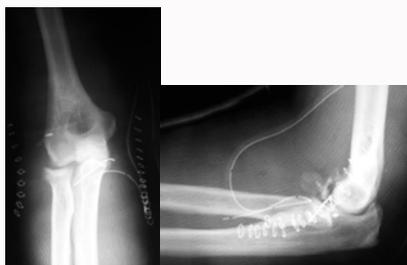
The primary surgery was performed at another clinic. Two incisions, located mediolaterally, were used for the surgical approach. The disrupted lateral collateral ligament on the humeral side was repaired with a suture anchor, the coronoid fracture was fixed with K-wire, and casting from the mid-upper arm to the metacarpophalangeal joint with the elbow at 90° flexion and the forearm in neutral rotation was applied for 3 weeks (Figure 3). At 3 weeks after the primary surgery, however, the elbow was still dislocated, and a stress examination indicated Posterolateral Rotational Instability (PLRI) despite the primary surgery. He was referred to our hospital for a salvage operation (Figure-



**Figure 1:** Initial radiograph shows dislocation of the elbow joint along with radial head and coronoid process fractures.



**Figure 2:** Ipsilateral wrist radiograph shows radiocarpal osteoarthritis and ulnar plus variance.



**Figure 3:** After the first surgery, Lateral Ulnar Collateral Ligament (LUCL) reconstruction, coronoid K-wire fixation, and casting.

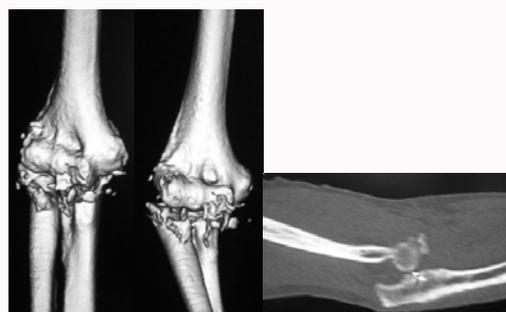
4).

During examination, the patient experienced severe elbow pain with motion. Physical examination showed restricted elbow motion that included 40° flexion and 30° extension. It was difficult to measure the range of pronation and supination because of the pain. Computed tomography showed elbow joint dislocation and fractures of the comminuted radial head and comminuted coronoid process (Figure 5). The O'Driscoll classification was applied at the time of the initial injury, but we could not currently assess the coronoid fracture pattern using this classification [3].

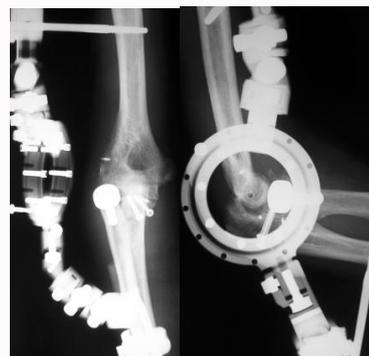
The second, salvage surgery was performed 11 weeks after the initial injury with the patient under general anesthesia in supine position. We were unable to reduce the dislocated elbow joint manually and decided to manipulate and reduce the elbow joint operatively. We used the extended Kocher lateral approach, by which we entered the space between the anconeus and extensor carpi ulnaris. The comminuted radial head was excised to improve access to the coronoid. We then performed capsulotomy, removing the thickened anterior and posterior fibrous soft tissue to reduce the elbow joint. The coronoid process was then reconstructed. The remainder of the



**Figure 4:** Radiograph 11 weeks after surgery shows re-dislocation.



**Figure 5:** Computed tomography 11 weeks after the initial surgery.



**Figure 6:** Radiographs after the second, salvage surgery.

radial head was cut obliquely to match the articulation of the coronoid process. Radial head osteochondral bone was fixed posteriorly with a Cannulated Cancellous Screw (CCS).

The next surgical step was replacement of the radial head to maintain radial length. We used a modular radial head implant. At this point, PLRI was still present, so we reconstructed the Lateral Ulnar Collateral Ligament (LUCL) with double-stranded palmaris longus. The PLRI disappeared. A valgus stress test of the elbow joint indicated that the medial collateral ligament did not require repair.

The final surgical step was to apply a hinged external fixator (Figure 6). Postoperative rehabilitation was started under the supervision of a physical therapist. Active assisted Range of Motion (ROM) exercise under the condition of the hinged external fixator was permitted immediately after this second surgery. The hinged external fixator, however, precluded supination and pronation exercises. The fixator was removed 6 weeks postoperatively, after which active ROM was permitted. The CCS was removed from the coronoid process 1 year postoperatively (Figure 7).



Figure 7: Radiographs 1 year after the second, salvage surgery.



Figure 8: Radiographs 8 years after the second, salvage surgery.



Figure 9: Range of elbow motion 8 years after the second, salvage surgery.

At 8 years after the salvage surgery, the patient had no elbow pain and exhibited extension/flexion ROM ranging from 20° to 120° and supination/pronation ROM of 60°/45°. Stress tests indicated that the joint was stable and without pain. The Mayo Elbow Performance Score was 100, and the patient currently enjoys playing golf. There was no postoperative ulnar nerve injury or heterotopic ossification, but he has mild osteoarthritis (Figure 8 and 9).

## Discussion

The standard treatment protocol for TTI includes coronoid repair, Open Reduction and Internal Fixation (ORIF) or replacement of the radial head, and lateral collateral ligament repair. Medial collateral ligament repair and/or external fixation are required for patients with

persistent instability. This protocol reliably restores congruent elbow stability, allows early motion, enhances functional outcome, and minimizes complications [4-6]. We used the same surgical strategy for the salvage surgery in this case.

We also used a lateral Kocher surgical approach, which is preferable only if (1) no medial abnormality is identified and (2) the surgeon is confident that the coronoid-brachialis complex can be repaired through a lateral incision [7]. We expected that resection of the radial head would facilitate inspection of the coronoid process so we could inspect it fully.

In contrast to the patient's first surgery, we could not reduce the dislocation manually even after giving the patient general anesthesia. In this case, 11 weeks had passed after the injury, and there were now mixed conditions of elbow instability and stiffness. Classification of posttraumatic elbow stiffness as intrinsic, extrinsic, or combined allows better understanding of the cause of stiffness and provides more logical guidance to management [8,9]. In this case, elbow stiffness was due to a combination of intrinsic and extrinsic components. We therefore used a lateral column procedure [10] to treat the other fracture and reconstruct the ligament. This procedure, which consists of arthrotomy, capsular release, and osteophyte excision, allows release of the anterior and posterior capsule and intra-articular adhesions. After the procedure, elbow joint reduction was successful. For salvage cases, this step is important as it reduces the dislocation.

There are two major options for treating a coronoid fracture: ORIF and reconstruction. In our case, because the coronoid process had suffered a comminuted fracture, it would be difficult to perform ORIF. Coronoid process reconstructions have been accomplished with autologous iliac crest bone grafts, ipsilateral olecranon osteochondral grafts, and/or fragments of the discarded radial head [11-14]. The radial head had been resected because of its comminuted fracture, and we used it for the reconstruction. Oblique resection of the radial head provides an osteochondral segment that offers a contour that can effectively articulate with the trochlea [14]. We used the CCS to fix the graft to the coronoid base posteriorly.

Watters et al. [15] Compared patients with TTI whose radial head fractures were treated with either ORIF or radial head arthroplasty. There were no differences between groups in terms of ROM or the clinical score. All patients who underwent radial head arthroplasty for their index procedure had a stable elbow at the final follow-up, whereas some of the elbows of patients who underwent ORIF were unstable. However, patients who underwent arthroplasty had radiographic signs indicating arthrosis versus none in the ORIF group. In the present case, because radiographs indicated mild osteoarthritis of the elbow at the final follow-up, additional observation will be needed.

Disruption of the lateral collateral ligament complex on the humeral side usually occurs in patients with elbow dislocation [16]. LUCL has been known to be a primary stabilizer of the elbow (avoiding PLRI), and reconstruction of the LUCL has been shown to be reliable for restoring elbow stability in patients with PLRI [17]. Double-stranded LUCL reconstruction has been used commonly with successful clinical results [18,19]. One of the theoretical advantages of double-stranded LUCL reconstruction is that varus and PLRI of the elbow can both be achieved by having two separate strands of grafting material. After reconstruction of coronoid and radial head fractures in our patient, varus and PLRI remained. We therefore decided to

undertake double-stranded LUCL reconstruction with palmaris longus. In this case, LUCL reconstruction stabilized the elbow.

A hinged external fixator is sometimes used to stabilize the elbow joint in patients with TTI [20]. Zhang et al. [21] Reported that delaying the initial surgery risked subluxation after operative treatment for TTI of the elbow, especially when the delay was for more than 2 weeks after the injury. They concluded that patients treated more than 2 weeks after injury might benefit from ancillary fixation to limit the occurrence of subluxation. In our case, as 11 weeks had passed before the final definitive surgery was undertaken, we conducted hinged external fixation to prevent subluxation or dislocation. Thus, neither problem was apparent after removing the hinged external fixation.

In this case, the final supination/pronation range of 45°/45° was limited. We believe that the old distal radius and ulnar fractures were probably responsible for the limited supination/pronation range.

In conclusion, we described the long-term follow-up of a successful salvage surgical procedure following failed primary surgery for TTI. Preoperative planning is important for a successful outcome.

## Acknowledgement

Written informed consent was obtained from the patient for publication of this case report.

## References

- Morrey BF. Current concepts in the treatment of fractures of radial head, olecranon, and the coronoid. *J Bone Joint Surg Am.* 1995;77:316-27.
- Regan W, Morrey B. Fractures of the coronoid process of the ulna. *J Bone Joint Surg Am.* 1989;71(9):1348-54.
- O'Driscoll SW, Jupiter JB, Cohen MS, Ring D, McKee MD. Difficult elbow fractures: pearls and pitfalls. *Instr Course Lect.* 2003;52:113-34.
- Beingessner DM, Dunning CE, Beingessner CJ, Johnson JA, King GJ. The effect of radial head fracture size on radiocapitellar joint stability. *Clin Biomech (Bristol, Avon).* 2003;18(7):677-81.
- Gupta A, Barei D, Khwaja A, Beingesser D. Single-staged treatment using standardized protocol results in functional motion in the majority of patients with a terrible triad elbow injury. *Clin Orthop Relat Res.* 2014;472(7):2075-83.
- McKee MD, Pugh DM, Wild LM, Schemitsch EH, King GJ. Standard surgical protocol to treat elbow dislocations with radial head and coronoid fractures: surgical technique. *J Bone Joint Surg Am.* 2005;87(Suppl 1, Pt 1):22-32.
- Zeiders GJ, Patel MK. Management of unstable elbows following complex fracture-dislocations-the "terrible triad" injury. *J Bone Joint Surg Am.* 2008;90(Suppl 4):75-84.
- Charalambous CP, Morrey BF. Posttraumatic elbow stiffness. *J Bone Joint Surg Am.* 2012;94(15):1428-37.
- Morrey BF. The posttraumatic stiff elbow. *Clin Orthop Relat Res.* 2005;431:26-35.
- Mansat P, Morrey BF. The column procedure: a limited lateral approach for extrinsic contracture of the elbow. *J Bone Joint Surg Am.* 1998;80(11):1603-15.
- Garrigues GE, Wray WH 3<sup>rd</sup>, Lindenhovius AL, Ring DC, Ruch DS. Fixation of the coronoid process in elbow fracture-dislocations. *J Bone Joint Surg Am.* 2011;93(20):1873-81.
- Kohls-Gatzoulis J, Tsiridis E, Schizas C. Reconstruction of the coronoid process with iliac crest bone graft. *J Shoulder Elbow Surg.* 2004;13(2):217-20.
- Morimoto H, Tada K, Yoshida T, Kawatsu N. Reconstruction of the coronoid for chronic dislocation of the elbow: use of a graft from the olecranon in two cases. *J Bone Joint Surg Br.* 1998;80(3):490-2.
- Van Riet RP, Morrey BF, O'Driscoll SW. Use of osteochondral bone graft in coronoid fractures. *J Shoulder Elbow Surg.* 2005;14(5):519-23.
- Watters TS, Garrigues GE, Ring D, Ruch DS. Fixation versus replacement of radial head in terrible triad: is there a difference in elbow stability and prognosis? *Clin Orthop Relat Res.* 2014;472(7):2128-35.
- O'Driscoll SW, Bell DF, Morrey BF. Posterolateral rotatory instability of the elbow. *J Bone Joint Surg Am.* 1991;73(3):440-6.
- O'Driscoll SW, Morey BF, Korinek S, An KN. Elbow subluxation and dislocation: a spectrum of instability. *Clin Orthop Relat Res.* 1992;280:186-97.
- Jones KJ, Dodson CC, Osbahr DC, Parisien RL, Weiland AJ, Altchek DW, et al. The docking technique for lateral ulnar collateral ligament reconstruction: surgical technique and clinical outcomes. *J Shoulder Elbow Surg.* 2012;21(3):389-95.
- Nestor BJ, O'Driscoll SW, Morrey BF. Ligamentous reconstruction for posterolateral rotatory instability of the elbow. *J Bone Joint Surg Am.* 1992;74(8):1235-1241.
- Lindenhovius AL, Jupiter JB, Ring D. Comparison of acute versus subacute treatment of terrible triad injuries of the elbow. *J Hand Surg Am.* 2008;33(6):920-6.
- Zhang D, Tarabochia M, Janssen S, Ring D, Chen N. Risk of subluxation or dislocation after operative treatment of terrible triad injuries. *J Orthop Trauma.* 2016;30(12):660-3.