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Terrible triad injury of the elbow joint treated with total elbow arthroplasty: a case report

Ryosuke Takahashi, MD[a,*], Yukihiro Kajita, MD, PhD[a], Yohei Harada, MD, PhD[b]

[a]Department of Orthopaedic Surgery, Ichinomiya Nishi Hospital, Aichi, Japan
[b]Department of Orthopaedic Surgery, Hiroshima University, Hiroshima, Japan

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Terrible triad injury of the elbow (TTIE) is a complex elbow fracture-dislocation (coronoid fracture, radial head fracture, and posterior displacement of the elbow) that is associated with disruptions of the elbow soft-tissue stabilizers.[7,11,12] The injury is characterized by elbow instability, arthrosis, and concomitant joint restrictions.[7,9] The outcomes for patients with TTIE are often poor due to arthrosis, recurrent instability, and/or stiffness caused by prolonged immobilization.[11,12] Salvage of the injured elbow is difficult, and conservative treatment often has poor results.[3,11] Most cases are treated surgically by correcting or replacing the radial head, fixing the coronoid process, and repairing the collateral ligaments if needed.[4,11,12,16]

The main goal of the surgery is to re-establish sufficient elbow stability so that early movement can be instituted to restore a functional arc of motion (100° of flexion-extension and 100° of pronation-supination) to the joint, thereby preventing late complications such as joint stiffness and disability.[2,11] However, previous studies have shown that TTIE poses a difficult challenge for surgeons resulting in poor prognoses.[11,14] Moreover, there is no consensus regarding the optimal surgical management of TTIE.[14]

Total elbow arthroplasty (TEA) was initially proposed for rheumatoid arthritis, but more recently its use has been recommended for end-stage elbow arthritis, posttraumatic arthritis, adverse trauma-related sequelae, and unrepairable fractures in elderly patients.[19] TEA can help manage pain around the elbow by restoring its functional range of motion (ROM).[19] In this case report, we assessed patients 12 months after treatment with primary TEA for TTIE. The elbow ROM of each patient was evaluated using the Japanese Orthopaedic Association elbow score and the Mayo Elbow Performance Score (MEPS). Previous studies have reported the treatment of TTIE with secondary TEA[5,13]; however, to the best of our knowledge, this is the first report of TTIE treated with primary TEA.

Case report

Case history

A 74-year-old right-handed dominant female patient had fallen from the second floor. There was no history of injury or trauma, and her past medical history consists of medically controlled hypertension and hyperlipidemia. She was admitted to a nearby hospital with severe left elbow pain and screened using radiography and computed tomography. Imaging revealed a TTIE. The computed tomography scan revealed a Mason type 2 radial head fracture and Regan and Morrey type 2 coronoid fracture (Fig. 1). The first doctor to treat her injuries performed a closed reduction. The patient was referred to our hospital one day after the injury. Open reduction and internal fixation (ORIF) was deemed to be an ineffective means of treatment because the patient was elderly, lived alone, and postoperative complications, such as elbow stiffness and heterotopic ossification, were expected. TEA, which allows for the induction of early ROM exercises, was therefore performed. The patient was informed that the data concerning this case would be submitted for publication, and her informed consent was obtained.

Surgical procedure

Surgery was performed under general anesthesia, with an optional brachial plexus block catheter positioned in the

*Corresponding author: Ryosuke Takahashi, MD, Department of Orthopaedic Surgery, Ichinomiya Nishi Hospital, 1 Kaimei-hira, Ichinomiya, Aichi 494-0001, Japan.
E-mail address: takahashi.ryosuke0617@gmail.com (R. Takahashi).

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Figure 1 Plain radiography and computed tomography (CT) show a terrible triad injury of the elbow (TTIE) with posterior dislocation of the elbow joint. The CT scan shows a Mason type 2 radial head fracture associated with a Regan and Morrey type 2 coronoid fracture.

preoperative holding area. The patient was placed in the lateral decubitus position for surgery, and the Campbell posterior triceps-splitting approach was used. Nexel TEA (Zimmer-Biomet, Warsaw, IN, USA) was performed. The ulnar nerve was identified in the upper arm and decompressed through the cubital tunnel by releasing the fascia in the proximal-to-distal direction. After releasing the soft tissues (such as the lateral collateral ligament [LCL], medial collateral ligament, and anterior capsule from the distal humerus), the elbow joint was dislocated, and the radial head was resected. The provisional ulnar and humeral components were positioned to ensure a proper fit. Once a satisfactory fit was obtained, the elbow joint was arranged, ensuring full flexion and extension ROM without the use of any mechanical block. The provisional components were removed, and the implants were placed into the ulna and humerus. An autologous bone graft was placed behind the anterior flange of the humeral component. Cement was inserted into both the ulna and humerus. At the end of surgery, the ulnar nerve was transposed anteriorly. Once the operation was complete, we examined the intraoperative radiograph of the completed reconstruction in both the anteroposterior and lateral views to confirm the proper positioning of the implant and exclude any complications, such as periprosthetic fractures (Fig. 2).

Postoperative rehabilitation

Postoperatively, the patient's elbow was immobilized with a sling for 1 week. The patient was encouraged to use her shoulder and hand immediately after surgery. One week after surgery, active and active-assisted elbow ROM exercises were initiated to reestablish nonpainful ROM and prevent muscular atrophy. Rehabilitation was performed at least 3 months after surgery with the assistance of a physical therapist.

Postoperative assessment

At the 12-month follow-up, the patient was satisfied with the surgical outcomes. She complained of a limited extension due to heterotopic ossification; however, she was pain-free. The elbow ROM was 125° of flexion, −20° of extension, 70° of pronation, and 80° of supination (Fig. 3). The Japanese Orthopaedic Association and MEPS scores were 86 and 80, respectively. At the 60-month follow-up, the elbow ROM was 140° of flexion, −10° of extension, 70° of pronation, and 80° of supination, suggesting good functional outcomes. Radiographs showed no osteolysis or loosening of the humeral or ulnar components (Fig. 4).

Discussion

TTIE includes posterior dislocation of the elbow with radial head and coronoid fractures and associated ligament injuries of the medial collateral ligament and LCL, leading to elbow instability.[7,11] TTIE is a high-energy injury sustained from incidents such as traffic accidents and falls.[6,18] These traumas often lead to extensive soft-tissue injuries and comminuted fractures. These factors adversely affect the surgical treatment and recovery of elbow function.

Severe elbow joint fractures often cause complications. Common postoperative complications include elbow stiffness, heterotopic ossification around the elbow joint, and pain in the elbow joint.[6,11] A stiff elbow joint is more common and is defined as a joint that cannot move through its functional ROM.[6] It has been reported that 5%-15% of patients with elbow joint fractures experience elbow stiffness after surgery.[21] A period >1 week between injury and surgery and a postoperative joint immobilization period >2 weeks have been reported as independent risk factors contributing to elbow stiffness after incurring a TTIE.[6] Zheng et al reported 169 cases of posttraumatic elbow stiffness and showed that high-energy injury was an independent risk factor for severe elbow stiffness.[20] Some studies have reported that a long period between injury and surgery leads to postoperative complications in the recovery of elbow function.[6,18]

Surgical treatment is currently advocated mainly for the repair of damaged ligaments and reconstruction of bony structures; however, there is still controversy regarding which surgical method to choose.[14] Some authors reported good clinical outcomes after ORIF for coronoid fractures and/or repair of the anterior capsule, repair or replacement of the radial head, and repair of the lateral ligament complex for TTIE.[4,11,12] Pugh et al reported a series of 36 patients who underwent fixation or replacement of the radial head, fixation of the coronoid fracture, and repair of associated capsular and lateral ligamentous injuries.[12] At a mean follow-up of 34 months, they reported the flexion-extension arc of the elbow averaged at 112° ± 11° and forearm rotation averaged at 136° ± 16°. The mean MEPS score was 88 points, with the results for 15, 13, 7, and 1 patient rated as excellent, good, fair, and poor, respectively. Forthman et al reported 30 patients with terrible triad injuries who underwent ORIF, or prosthetic replacement of all fractures and reattachment of the LCL origin.[4] At a mean follow-up of 32 months, they reported that the average arc of motion was 117° (range, 75°-145°) and forearm rotation was 137°, with good to excellent results.

Regarding the postoperative complications, Pugh et al reported that eight patients (22%) who underwent fixation or

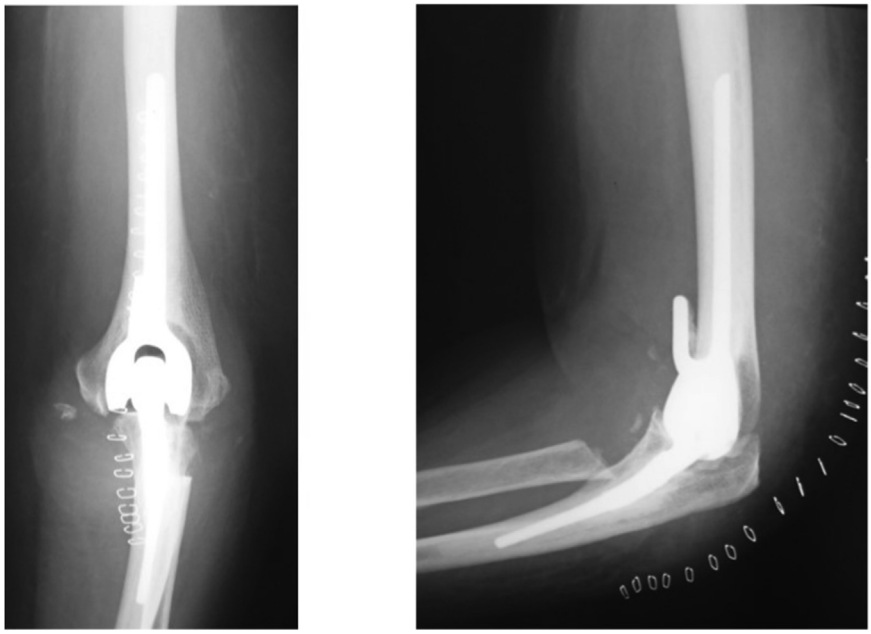

Figure 2 Postoperative radiograph.

Figure 3 The elbow range of motion 12 months after surgery.

replacement of the radial head, fixation of the coronoid fracture, and repair of associated capsular and lateral ligamentous injuries had complications requiring reoperation.[12] Kyriacou et al reported that the number of complications requiring reoperation in the radial head replacement and radial head reconstruction groups were 18.4% and 17.9%, respectively, for the treatment of TTIE.[8] Li et al reported that the postoperative complication rate of the radial head arthroplasty and ORIF groups were 22% and 31%, respectively.[10] Regarding the postoperative protocol, Pugh et al reported that the arm was positioned with a well-padded posterior slab splint at 90° flexion and the forearm in full pronation.[11] The splint was removed, and supervised motion was initiated 7-10 days after surgery. Patients were trained to avoid extension and full supination, as these are the positions that cause maximal elbow instability. For the first 6 weeks, flexion and extension exercises were performed with the forearm in pronation, and active forearm rotation exercises were performed with the elbow at 90° to protect lateral soft tissue repair. Unrestricted motion and strengthening were initiated at 8 weeks. These postoperative protocols are important for maintaining elbow stability after surgery; however, they can be difficult to implement, particularly for elderly patients living alone.

Figure 4 The elbow range of motion and radiograph 60 months after surgery.

TEA is indicated for juvenile idiopathic arthritis, hemophilic arthropathy, and elbow reconstruction after surgical removal of primary or metastatic tumors.[1,17,19] Elbow arthroplasty aims to decrease pain and restore functional ROM of the elbow joint.[1] Moreover, TEA is a useful option in cases of osteoporotic bone stock, fixation failure, or nonunion in older patients and may lead to earlier functional recovery of the elbow.[15,19] The postoperative complications of TEA include infection, joint instability, dislocation, intraoperative fracture, component loosening, restricted ROM, ulnar neuropathy, and triceps disruption.[1,17,19] In previous studies, the overall complication rate after TEA ranged from 20% to 45%.[17]

In this case, considering the patient's status as an elderly individual living alone, we selected TEA, allowing for the early implementation of ROM exercises and restoring functional recovery of the elbow without the need for a specialized postoperative protocol. This solution was considered to be more reliable for expeditious pain relief and functional stability of the elbow. No severe complications were observed, except heterotopic ossification, within 60 months of surgery.

Conclusions

Although we only followed up for 60 months, this case study suggests that TTIE treated with primary TEA can lead to satisfactory functional recovery of the elbow. ORIF is the standard surgical procedure for TTIE, achieving adequate functional scores after surgery; however, considering the social background of elderly patients, we suggest primary TEA as a robust alternative.

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