CASE REPORT

Treatment of complete ankylosed elbow with total arthroplasty

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SUMMARY

We reported the case of a 38-year-old patient who in 2017 presented to our institution after post-traumatic complete ankylosis of the elbow. He complained of stiffness and pain, and the radiographs revealed complete fusion of the humeroulnar joint. The Mayo Elbow Performance Score (MEPS) on admission was 31, and the elbow was fused at 90° flexed position. The patient underwent semiconstrained total elbow arthroplasty with Bryan-Morrey approach; after a 2.1 years follow-up, active arc of movement was 120°. The MEPS was excellent with a 100 points score, the patient was able to complete all activities of daily living. We did not report any complications. Total elbow arthroplasty has shown to be a good therapeutic option that make it possible to restore adequate functional range of motion and relieve pain in young patients with post-traumatic stiffness/arthritis of the elbow.

BACKGROUND

Complete fusion of the elbow joint may occur because of trauma, rheumatic disease, burns, congenital stiffness and other conditions and causes the loss of the ability in free placement of hand in space.

Morrey classified causes of elbow stiffness into extrinsic, intrinsic and mixed, based on aetiology and location: extrinsic when only the soft tissues are involved, sparing the joint space, for example heterotopic ossification (HO), capsular or muscular contracture and burns; intrinsic when there is intra-articular origin such as arthritis, osteophytes or loose bodies.[1]

The elbow is one of the most mobile joints, and unrestricted movement is necessary to allow complete functionality of the upper arm. In case of ankyloses the functionality is compromised, despite an increased dependence on spine, wrist and shoulder compensatory movement.[2] The range motion of the elbow joint varies considerably, and the average arc of flexion–extension is 0−145°; proximal forearm joint is also involved and the normal rotation of radio is about 160°.[3] The functional range of motion required for daily activities has been described as 30–130° of flexion extension and a minimum of forearm rotation of 50° of supination to 50° of pronation, but larger ranges of movement may be required for some activities.[4] Elbow stiffness is defined as a flexion–extension arc of <100° or flexion contracture of >30°, and many authors consider this condition an indication for treatment.[5–7]

Total elbow arthroplasty (TEA) is a surgical option in patients with advanced arthritis to relieve pain and restore functionality. Since the first description in 1972 by Dee, to treat patients with rheumatoid arthritis (RA), TEA has constantly evolved through modification in implant design and surgical techniques.[8]

The most frequently reported indication for performing a TEA still remains an RA but, considering the successful results, in the last decade, the use of TEA has been extended to the treatment of post-traumatic arthritis, complex elbow fractures, ankylosis and post-traumatic sequelae, becoming today a reliable long-term option for many conditions.[9–15] Recently, indications were expanded to low-demand young patients with elbow arthritis.[16–18]

In patients with a history of fracture or trauma, linked implants have been recommended to provide stability of the elbow. In fact, the extensive release of the capsule and of the soft tissues associated with bony resection required can compromise the stability of the elbow, and the non-linked implants do not provide the necessary guarantees.[10 19]

In particular, Peden and Morrey reported a long-term follow-up (12 years) in patients treated with TEA for ankylosed elbow reporting a markedly positive impact on patient function and satisfaction.[19]

We present the case of a young patient who was treated with total elbow arthroplasty after post-traumatic complete ankylosis of the elbow.

CASE PRESENTATION

A 38-year-old man showed up at our institution in 2017 with a history of post-traumatic stiffness and pain of the elbow. Fifteen years prior to presentation, he was involved in a car accident and sustained right olecranon fracture, zygomatic arch fracture, thoracic trauma associated to rib fractures and severe burn injuries involving the upper arms. He was treated in an intensive care unit and underwent plastic surgery for burns, closed reduction of zygomatic fracture and conservative tratment of the the rib fractures. In view of the patient's condition, surgery for olecranon fracture was delayed and conservative treatment was chosen. Eight months later, the patient presented deformity of elbow and non-union of distal ulnar fracture so he underwent open reduction and internal fixation by tension band wiring that were later removed. In the postsurgery period, he developed stiffness and heterotopic bone formation (HO) so he underwent surgery for the excision of the HO.

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Figure 1 Preoperative figures showing the elbow of the patient fixed at 90° with the arc of forearm pronosupination of 30°.

At the time of presentation at our institute, the patient had recurrence of stiffness and pain. He was not able to work because of functional limitation of the elbow. In fact, he worked like a metalworker, and he did not achieve the range of motion that were required for work activities. Clinically, the elbow was fixed at 90°, and the arc of forearm pronosupination was 30° (figure 1). The elbow was stable, and there was no vascular injury or deficit in sensory and motor function of the ulnar nerve.

There were no burns at the level of skin incision.

The pain score was 8 out of 10. The Mayor Elbow Performance Score (MEPS) was 31 out of 100.[20]

Radiographs and computed tomography scan (CT) revealed complete ankylosis of the humeroulnar joint that was fused at 90° flexed position. The radiohumeral joint was not involved (figures 2–4).

The patient complained of severe disability and functional limitation in activities of daily living (ADL), and this condition interfered with performing work activities.

The patient's request was to recover a pain-free functionality compatible with the performance of daily activities. We discussed the possible alternatives with the patient, excluding the open release, which had been performed in the past with unsatisfactory results for patient and which, in the literature, had shown to have poor outcomes in case of joint cartilage damage.[21] The conservative treatment or the arthrodesis was excluded because it was not compatible with the patient's functional demands.

Figure 2 Preoperative CT scan showing complete ankylosis of the omeroulnar joint.

Figure 3 Preoperative CT scan showing preservation of the radiohumeral joint.

The goal of treatment was to eliminate pain, restore mobility needed to be able to perform ADL normally, improve functionality and eventually give the patient the opportunity to return to work activities.

Although TEA is not generally a first-line treatment in patients under 60 years of age, we considered prosthetic replacement to be the most reliable and consistent alternative for the patient's conditions and functional demands.

TREATMENT

Surgical technique

A semiconstrained linked implant, the Discovery Elbow System (Biomet, USA), was used, and cemented fixation was employed for both humeral and ulnar component.[22] Osseous deformity and soft tissue contracture improved complexity to the procedure. The operating time was 188 min, with a tourniquet time of 90 min. The operation was performed with the patient in supine position. The Bryan-Morrey approach was used, and a posterior incision was performed.[23] First, the ulnar nerve was carefully isolated, protected and translocated anteriorly from its origin (figure 5). The triceps was then released from the olecranon insertion and reflected laterally. The tip of the olecranon was removed along a line tangent to the posterior-most portion of the olecranon articulation. Since osseous ankylosis

Figure 4 Preoperative X-ray of the elbow showing complete fusion of the humeroulnar joint

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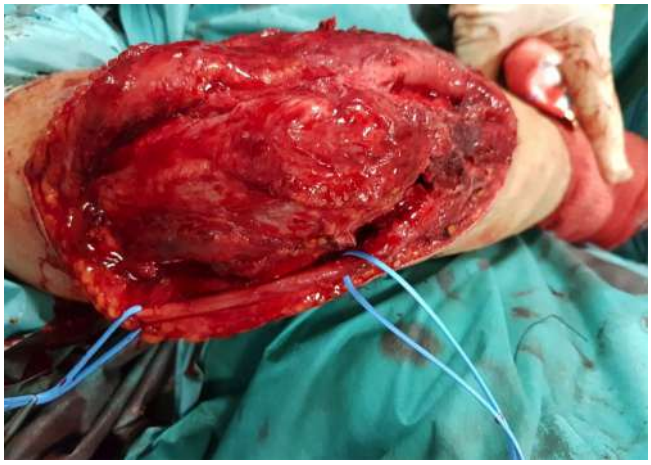

Figure 5 Intraoperative image showing the Bryan-Morrey approach used and isolation of the ulnar nerve.

had occurred, it was necessary to re-estabilish the original humeroulnar joint. After radial head resection, the humeroulnar joint line was opened using a microsagittal saw and small osteotome. The osteotomy was performed as close as possible to the centre of rotation of the humeroulnar joint to optimise the biomechanical function of the prosthesis. Care was taken to preserve the olecranon process to provide a functional lever arm for the triceps. The anterior capsule was released to improve extension, and the triceps muscle was released from the humerus and the olecranon to improve flexion. An anterior capsulotomy was performed. Since the flexors were contracted too, they were released. The ectopic bone in proximity to the interosseous membrane was excised. After preparation of both humerus and ulna medullary canal, a trial reduction was performed. Care was taken that the olecranon and coronoid did not impinge on bone or provisionals. Then the definitive cemented components were implanted. Under general anaesthesia, the range of motion of the elbow ranged from 10° of extension to full flexion after the implants had settled. A 5×150 humeral component and 4×115 ulnar component was chosen (figure 6). The triceps was secured to the ulna with no absorbable sutures placed through drill holes in the olecranon, undertaken with the elbow in 90° of flexion. One suction drain was positioned in the deep wound. A bulky dressing and splint were applied with the elbow in 60°

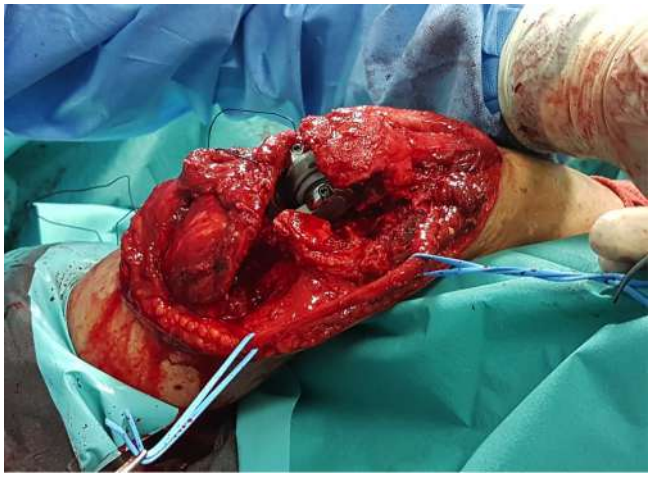

Figure 6 Introperative image showing the correct placement of prosthetic components.

Figure 7 Anteroposterior X-ray performed the day after surgery showing the correct placement of the components and the restoration of normal anatomy.

of flexion to minimise posterior wound tension. Suction drains were removed at 48 hours, and postsurgery antibiotics were continued for 24 hours. The splint was removed at 2 days, and an articulated brace was applied. The patient was allowed to move the elbow as tolerated and passive extension and active extension assisted by gravity were allowed. Postoperative X-rays showed a correct alignment of the components (figures 7 and 8).

OUTCOME AND FOLLOW-UP

After a follow-up of 3 months, the active arc of movement of the patient's elbow was 120°, ranged between 20° of extension to 140° of flexion, and pronosupination was 140°. X-rays showed a correct alignment of prosthetic components, and no osteolysis, loosening signs or ossification were observed. The MEPS was excellent with a 100 points score, which represents an improvement of 70 points. The patient was able to complete all activities of daily living, with varying degrees of difficulty.

At 2.1 years follow-up, the result was maintained, he was very satisfied with the surgical outcome, did not experience any pain or numbness and was free of complications like wound problems, infection, loosening or any further intervention at the time (figure 9).

Figure 8 Lateral X-ray performed the day after surgery showing the correct placement of the components and the restoration of normal anatomy.

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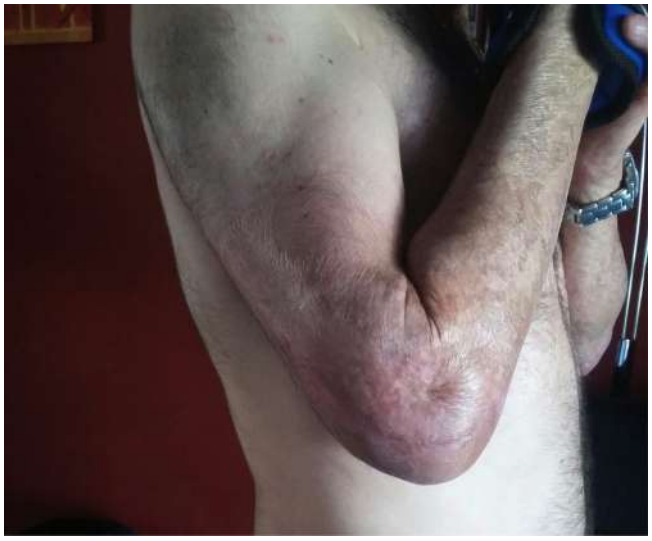

Figure 9 Clinical control 2 years after the operation, which shows the almost complete recovery of flexion by the patient.

DISCUSSION

Total elbow arthroplasty has shown to be a successful option to improve function and relieve pain in severe elbow arthritis.[11 24–26] There have been several studies of total elbow arthroplasty, but only a few reports have focused on TEA in ankylosis of the elbow in young patients. In fact, in past years, the high rate of reoperation and implant failures reported in patients younger than 65 has discouraged surgeons from performing TEA.[27 28] Age at arthroplasty, previous operations, level of activity and functional demand have been all reported to be risk factors for complications in the literature.[11] Alternative options including interposition arthroplasty and arthrodesis have been described, but they were burdened by a high rate of complications, poor functional results, instability and a reoperation rate similar to TEA.[29–32]

Ersen *et al*, in their study of distraction interposition arthroplasty, reported postoperative flexion–extension range increased of 81°, a postoperative good MEPS in four patients and fair in one, which were worse than that reported in the literature in case of TEA.[33]

Only recently has the role of the elbow prosthesis in young patients been re-evaluated, and the indications have been extended to low-demand young patients with elbow arthritis. A retrospective study of Park *et al* of 23 semiconstrained TEA, in patients who were 40 years of age or younger (mean age 33 years), showed a survival rate of 95% at 8 years and 89% at 15, which is as good as those previously described in older patients.[18] Park's results are similar to those reported by Welsink *et al* in a recent review of the literature which included 9379 TEA performed for different conditions, in which they reported a mean survival rate of 85.5% at 7.8 years follow-up and 74% at 12.3 years.[25]

Celli and Morrey also reported good results in 55 prostheses performed in patients aged 45 or younger (mean age 32 years). In their series, 51 elbows (93%) had a good or excellent MEPS, and the revision rate was 22% at a mean of 91 months.[17]

The complication rates in Walsik's review ranged from 11% to 38%, similar to what was previously reported by Voloshin, with clinical loosening being the most frequently reported (7%).[25 34 35] The other complications described in the literature were deep infection, ulnar nerve palsy, periprosthetic fracture, intraoperative fracture of the humeral condyle, elbow instability, dislocation, subluxation and ectopic bone formation and triceps-related complications.[28 35–39]

The literature show that the worst results were observed in post-traumatic elbows, in which there were the higher failure and complication rates.[40 41] Schneeberger *et al* reported a complication rate of 37% after 5.8 years of follow-up in TEA for the treatment of post-traumatic osteoarthrosis.[42] This is probably due to the difference in populations considered. Post-traumatic osteoarthritis of the elbow is in fact reported more frequently in young and active patients, and the elbow often has soft tissue contractions, subverted anatomy, looseness of bone stock or fixed deformities. Moreover, these patients had often undergone previous surgery that increased the complication rates.[10]

The technical difficulties and high complications rate in performing TEA for ankylosed elbow should be considered before surgery.

Through progress in implant design and surgical techniques, the long-term outcome of TEA in ankylosed elbow has dramatically improved, and TEA has become a reliable long-term option. In 1993, Kasten and Skinner published the results of semiconstrained total elbow arthroplasty performed in ankylosed or very stiff elbows.[43] They had only one good result, with a range of flexion of 15° to 135°, one fair result and one poor result. Afterwards, Peden and Morrey reported 13 consecutive patients treated with TEA for ankylosed elbows.[19] Five were evaluated as excellent, three were good, four were fair, and one was poor. Functional ability was restored in most patients in which ADL could be performed normally after surgery.

Figgies *et al* also described good results in their 19 case series of ankylosed elbows in patients with various diagnoses, included RA, treated with TEA using different linked implants.[44] The mean arc of motion improved from 0° preoperatively to 80° (range 35–115°) and was maintained 5.75 years after the operation. Of the 19 cases, 4 were rated as excellent, 11 as good, 3 as fair and 1 as a failure. The failed case occurred after a deep infection. They had a 23% complications rate, with five reported complications: three wound problems, one fracture of the tip of olecranon and one case of deep infection which was the only one to fail and require the removal of the elbow prosthesis.

Mansat and Morrey reported 14 cases. The mean increase in the arc of movement was 60° (range 5–115°) with a mean increase of 33° in flexion and 27° in extension.[10] Four cases were rated as excellent, four were good, one was fair and five were poor. He observed two deep infection developed in patients with a history of previous surgery operations prior to the arthroplasty; both of these patients required revision surgery. They also reported two fractures associated with a loose component and four patients who lost motion within the first month following the surgery and required a manipulation under anaesthesia.

A large range of movement is necessary for upper extremity function, and limitations may cause severe disability. In post-traumatic ankyloses of the elbow, semiconstrained total elbow arthroplasty has proven to be a good therapeutic option that makes it possible to restore adequate functional range of motion needed in ADL with a pain-free elbow. The indication for TEA in post-traumatic patients under 60 should be carefully considered in relation to alternative treatment options, but age as well as a history of a previous trauma did not appear to prejudice a successful outcome.

Contributors RD is the first author. RD and FF: conception, design, drafting the article, revising it critically for important intellectual content and final approval of the

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Learning points

- Complete fusion of the elbow joint may occur because of trauma, rheumatic disease, burns, congenital stiffness and other conditions and causes the loss of the ability in free placement of hand in space.
- A large range of movement is necessary for upper extremity function, and limitations may cause severe disability.
- Total elbow arthroplasty (TEA) is a surgical option in patients with advanced arthritis to relieve pain and restore functionality.
- The indication for TEA in post-traumatic patients under 60 should be carefully considered in relation to alternative treatment options, but age as well as a history of a previous trauma did not appear to prejudice a successful outcome.

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