

Evaluation of results of Total Elbow Arthroplasty with a Linked Semiconstrained Prosthesis

Saran R¹, Saxena A²

¹Dr Rajat Saran, Associate Professor, Department of Orthopaedics, Chirayu Medical College, Bhopal. ²Dr Anand Saxena, Associate Professor, Department of Surgery, L N Medical College, Bhopal, MP, India

Address for correspondence: Dr Rajat Saran, Email: saran.rajat@gmail.com

Abstract

Introduction: Extremity arthroplasties have been performed for 150 to 200 years, but no arthroplasty has been developed that universally meets the needs of every patient with a disabled elbow joint. Although the frequency of total elbow arthroplasty is much less as compared to hip and knee, it has definitely made an emphatic place for itself in the world of joint replacements. **Methods:** This is a study of nine patients out of eleven, as two patients were lost to follow up very early in the process. Between August 2004 to August 2014 nine patients were taken up for total elbow replacement for different indications which included neglected supracondylar fractures of the humerus sustained in childhood, rheumatoid arthritis and grossly comminuted fractures, closed and compound, of the distal humerus. **Results:** Out of the nine patients considered, seven had no pain whereas two patients with a comminuted compound fracture of the lower end of humerus, with one patient in whom myositis was excised, complained of regular pain postoperatively. **Conclusion:** The aim of this prospective study is to evaluate the results of the linked prosthesis in total elbow arthroplasty for different indications.

Keywords: Total elbow arthroplasty, linked prosthesis, Semiconstrained Prosthesis

Introduction

History suggests that non operative treatment was usually suggested for gross traumatic pathologies of the distal humerus. In 1969 Riseborough and Radin [1] opined that operative treatment was usually associated with poor outcomes and was unpredictable for comminuted intra articular distal humerus fractures and recommended conservative treatment.

Brown and Morgan [2] also claimed satisfactory results with early active motion conservatively. Over the last 25 years the Arbeitsgemeinschaft fur Osteosynthesefragen (AO) principles of anatomic articular reduction and rigid internal fixation to allow early post operative motion have however reported good results [3-10]. In younger patients this mode of treatment has come to stay as the gold standard.

Total elbow arthroplasty as a primary treatment has been suggested as an indication in elderly patients because of the poor bone quality which poses problems in restoring anatomical reduction and affording rigid

internal fixation [11]. As compared to other joints, elbow being a small joint its stability mainly depends upon the structure and strength of the ligaments. Although it was initially used in arthropathies caused by rheumatoid arthritis, indications were extended also to other problems which led to increased demands on the implants increasing their failures[12] Rheumatoid arthritis causing inflammatory arthropathy is an absolute indication for elbow arthroplasty. Posttraumatic osteoarthritis, acute distal humerus fractures, non unions and reconstruction after tumour resection surgery may also be included as relatively valid indications. Elbow arthroplasty is very successful in terms of pain relief, motion and function. However, its complication rate remains higher than arthroplasties of other joints.

Materials and Methods

By and large, two designs of implants are in vogue, which have different mechanisms of linking the ulnar and humeral components. The goal is to avoid subluxation or dislocation episodes of the elbow after surgery. Linked implants used earlier were constrained hinges which allowed only flexion and extension transmitting high

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stresses to the interface between the implant and the cement, resulting in failures. The linking mechanism on the other hand in semi constrained implants affords a sloppy hinge with an element of rotation and varus-valgus play. This limited transmission of the stress to the interface with some improvisations in the design has prolonged the viability of the prosthesis.

From August 2004 to February 2013, eleven cases were operated upon for total elbow arthroplasty for different indications. Out of these eleven cases, two were lost to follow up after three and eight weeks respectively and hence were not included in this study. The maximum follow up of the nine patients in this study has been for eight and a half years and the minimum has been for five months. The age of the patients ranged from 23 years to 62 years which included six males and three females. The indications for which the patients were included in this study were namely neglected supracondylar fractures of the humerus, rheumatoid arthritis and badly comminuted fractures of the lower end of humerus (bag of bones). Two males aged 23 and 32 years had flail, weak and wasted elbows with no flexion or extension at the proper elbow joint. However, the forearm was dangling from a deformed false joint which had developed because of a non union of the supracondylar fracture just above it, sustained in childhood which had been neglected ever since. One of the above mentioned patients, aged 24 years had undergone a French osteotomy for correction of

cutibitus varus, but unfortunately suffered a non union. One male patient had multiple fractures of the forearms bilaterally two years back and at the time of presentation had developed severe myositis ossificans over the right elbow. His right elbow was operated for total elbow arthroplasty after completely excising the mass of ossificans. Two females, aged 46 and 52 years had developed a serious painful fibrous ankylosis of their elbows due to clinically established rheumatoid arthritis. Three males aged 38, 48, 51 years and one female aged 62 years had sustained badly comminuted fractures of the lower end of humerus, of which the lady's fracture was compound. The preoperative range of movements of the elbows considered for replacements were nil in the patients having false, flail joints due to neglected supracondylar fractures, were very painful and restricted in cases of ankylosed rheumatoid arthritis and the elbows in comminuted fractures (bag of bones) were immobilized in a supportive cast. The lady with the compound fracture was treated with regular dressings in a supportive cast, with culture sensitivity and appropriate antibiotics and was considered for surgery only eight weeks after the infection subsided. After thorough investigations and pre anaesthetic checkups these patients were considered for total elbow replacements with a linked semiconstrained metal to metal prosthesis. The components were fixed in the bones with polymethyl methacrylate bone cement in five cases. The components used in this series were from INOR Company.

The operative technique: The patient was placed supine on the operating table with the arm in front of the chest and a sandbag below the ipsilateral shoulder. Under a tourniquet a midline postero medial skin incision was given and the ulnar nerve was protected. The triceps mechanism was elevated along with the periosteum and separated to both sides (fig.2) of the proximal ulna to expose it. The replacement of the extensor mechanism becomes easier.

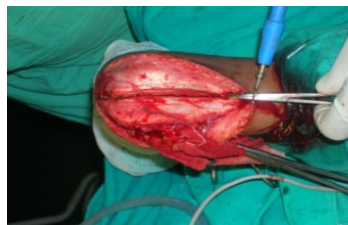


Fig 1: Midline incision in triceps after ulnar nerve

only enough bone from the lower end of humerus is removed to allow insertion of the humeral component (fig.3).

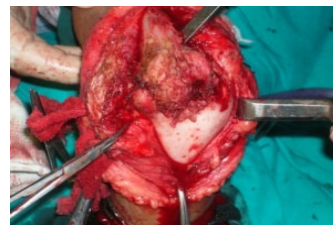


Fig 2: Triceps elevated on both sides along protecting with the periosteum Collateral ligaments are preserved and



Fig 3: The cut end of distal humerus.

Only enough articulating surface of ulna was removed to allow the insertion of the ulnar stem.

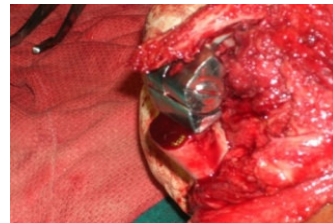


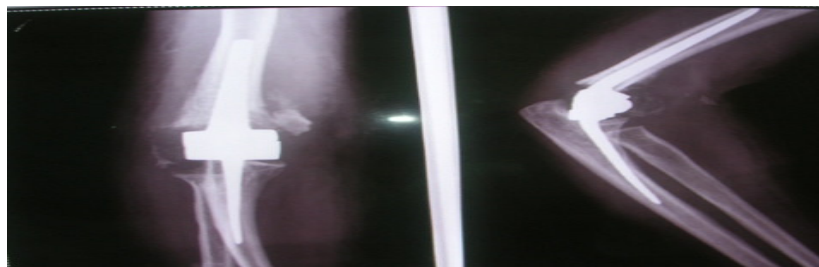
Fig 4: Insertion of the components.

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The canals were reamed and then curetted with special contoured rasps. The right and left ulnar rasps correspond to ulnar stem configuration. A trial prosthesis was inserted. The prosthesis should seat exactly with the cut end of the humerus and both the components are connected with the link screw. The range of flexion and extension was examined (fig.5& 6).

**Fig 5:** Full flexion after insertion of components**Fig 6:** Full extension

Before seating the final prosthesis with poly methyl methacrylate, reassure that the radial head does not impinge on the prosthesis. The triceps tendon and the periosteum were sutured and the ulnar nerve was placed in a bed anteriorly. The tourniquet was released and hemostasis obtained. Closure was done after inserting a drain. A thick padded dressing with the elbow in a plaster splint elevated at right angles was provided. Post operatively, the extremity was elevated for 4 to 5 days with the elbow above the shoulder. The drains were removed after 48 hours, and the compressive dressing was removed on the fifth day. A light dressing was applied, and elbow flexion and extension are allowed as tolerated. An elbow immobilizer was used, and regular physiotherapy was instituted. A formal physical therapy program rarely is necessary. The patient was encouraged to avoid lifting more than 5 pounds with the involved arm for the first 3 months after surgery.

**Fig 7:** Post operative skiagram.**Results**

Although there is no standard method of evaluating the results of elbow implant arthroplasty, Morrey et al [13], Inglis and Pellici [14], and Ewald [15] have evolved rating systems for evaluating the results of elbow arthroplasties. Morrey et al uses three criteria: Roentgenographic appearance, pain, and motion to determine good, fair and poor results.

**Fig 8:** Before Surgery**Fig 9:** After Surgery**Rating system of Morrey et al [13]**

Good result

No roentgenographic change at the bone cement interface, no pain, more than 90 degrees flexion, 60 degrees of pronation and supination.

Fair result

More than 1mm of widening of any bone cement prosthesis interface, mild pain, between 50 and 90 degrees of flexion, less than 40 degrees of pronation and supination.

Poor result

More than 2mm of widening of any bone cement prosthesis interface, pain that significantly limits activity, less than 50 degrees of flexion and extension, less than 40 degrees of pronation and supination, revision of elbow arthroplasty.

Inglis and Pellici [14] use a scoring system with a maximum of 100 points. Pain, function, range of motion, extension contractures and pronation and supination each are assigned a numeric value. Ewald's [15] scoring system also rates pain, function, range of motion and deformity with a perfect score of 100.



Fig 10: Limited range of flexion in a TER for a compound, comminuted fracture of distal humerus (infected).

Out of the nine patients considered, seven had no pain whereas two patients with a comminuted compound fracture of the lower end of humerus, with one patient in whom myositis was excised, complained of regular pain postoperatively. These patients developed infection post operatively. The range of movement after six weeks of surgery was more than satisfactory with a flexion of up to 130 degrees in all the cases except in one which got infected. Extension of the elbow was 180 degrees in seven cases and in one case of compound comminuted fracture and in a case of rheumatoid arthritis it fell short by 15 degrees. Supination and Pronation was more than 60 degrees in seven cases and partially restricted in two.

All the eight patients were satisfied with the range of movements achieved and the correction of deformity cosmetically. Two patients with a comminuted compound fracture suffered from pain and infection and eventually had to get the implant removed and the joint fused in the functional position. The operated elbows were stable and there was no toggling mediolaterally. According to the criteria of Morrey et al, eight cases out of nine considered were rated as good and one as poor.

Discussion

The Coonrad-Morrey prosthesis, a linked semiconstrained implant with a humeral component, porous-coated distally and an anterior flange is most commonly used currently. It increases the rotational stability of the implant. The benefit of an anterior flange has been investigated for other implants also [16]. Joint stability even with bone and ligamentous insufficiency is ensured with linked implants. A major advantage with linked implants is the ease of soft tissue dissection even in the presence of preoperative deformity and stiffness. Unlinked prosthesis is prone to dislocations and entails extensive soft tissue dissection. Their designs often demand the presence of humeral condyles and ulnar notch for their component fixation, whereas the linked prosthesis may also be used in the presence of bone loss.

According to Little *et al.*[17] the revision rates have been similar for linked and unlinked implants, although radiographic loosening seems to be higher with unlinked implants, especially the humeral component. Levy *et al.* reported a higher rate of revision for unlinked compared to linked implants. [18]

Depending on the rigidity of the fixation of the humeral component to the ulnar component, the implant arthroplasties are designated as constrained, semiconstrained, and unconstrained [19]. In general, the constrained prostheses rarely are used because of their tendency to loosen and break. In salvage situations in which bone loss has been extensive, prosthesis with a firmly connected humero ulnar articulation might be

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appropriate. Totally constrained, metal-to-metal prostheses include the Stanmore, Dee, McKee, GSB I (Gschwend, Scheier, and Bähler), and Mazas designs. The totally constrained elbow arthroplasties generally have a metal-to-metal hinge with polymethylmethacrylate bone cement fixation.

The semiconstrained prostheses are two- or three-part prostheses that have a metal-to-high-density-polyethylene articulation, which may be connected with a locking pin or with a snap-fit device. The semiconstrained hinged prostheses have built-in valgus and varus laxity to provide for dissipation of forces. The GSB III, HSS-Osteonics, and the Coonrad-Morrey prostheses are semiconstrained [19].

The unconstrained prostheses usually are two-part devices consisting of metal articulating with high-density polyethylene. They usually do not have a snap-fit, link, or pin connection. Some designs consist of a resurfacing device, and some have stems for the humeral component. The unconstrained implant arthroplasties include the capitellocondylar (Ewald), London, Kudo, Ishizuki, Lowe-Miller, Wadsworth, and Souter designs. Most of these prostheses are unlinked in an attempt to anatomically duplicate the articular surfaces of the elbow.

They restore the joint's anterior offset from the humerus and have a single center of rotation. All resurfacing or unconstrained prostheses require normal intact ligaments and anterior capsule, as well as appropriate static alignment. The resurfacing arthroplasties can be divided further into two groups: those that maintain the normal relationship between the humerus and the forearm in the frontal plane and those that realign the medullary canal of the ulna with the medullary canal of the humerus. If bone loss or capsuloligamentous destruction is extensive, an unconstrained prosthesis generally cannot be used.

Unlinked implants are attractive for patients with relatively well preserved bone stock and ligaments, but many favor linked implants, since they prevent instability and allow replacement for a wider spectrum of indications. Inflammatory arthropathies such as rheumatoid arthritis represent the classic indication for elbow arthroplasty [20]. Indications have been expanded to include posttraumatic osteoarthritis, acute distal humerus fractures, distal humerus nonunions and reconstruction after tumor resection [21]. Elbow arthroplasty is very successful in terms of pain relief, motion and function. However, its complication rate remains higher than arthroplasty of other joints. The overall success rate is best for patients with inflammatory arthritis and elderly patients with acute distal humerus

fractures, worse for patients with posttraumatic osteoarthritis [22]. The most common complications of elbow arthroplasty include infection, loosening, wear, triceps weakness and ulnar neuropathy [23]. When revision surgery becomes necessary, bone augmentation techniques provide a reasonable outcome.

Conclusion

Selection of the type of prosthesis implant depends to a great extent on the state of capsuloligamentous structures about the elbow and the integrity of musculature, as well as the amount of bone remaining at the elbow joint. It is important to remember that the goals of reconstructive elbow surgery are to restore function through the relief of pain and the restoration of motion and stability.

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