Functional outcome of supracondylar - intercondylar fractures of humerus in adults treated by Y plate fixation

Subramanian V¹, Rajanish R Menon², Kumaran CM³

Abstract

Background

Supracondylar intercondylar fractures of the humerus have been treated surgically by various methods using standard approaches. But none of the authors have reported fixation of these fractures with a Y plate. In this study we report the functional outcome of a series of patients with supracondylar - intercondylar fractures treated by Y plate fixation, using a standard approach.

Materials & Methods

18 adult patients with supracondylar - intercondylar fractures of humerus admitted in our institution between August 2009 and November 2010 were treated with open reduction and internal fixation with Y plate. These plates were ideally designed for the fixation of calcaneal fractures. A standard posterior approach with Chevron osteotomy was used for a better visualisation of the articular fragments.

Patients with medical contraindications for surgery, those with paralytic disease of the injured elbow, pre-existing disease or deformity of the elbow, vascular injury at elbow and those with pathological fractures were excluded from the study. Clinical assessment include pain, range of movements, stability of elbow and activities of daily living. The Mayo Elbow Performance Score (MEPS) was used as criteria to evaluate the functional outcome. Statistical analysis was performed with the help of the biostatistical department in our institution.

Results

Out of 18 cases, nine cases (50%) were type C2 according to the classification by Mullers et al, 5 were type C3 (27.7%) and 4 (22.2%) were C1 type. Three open fractures were encountered of which two were type C2 and one was type C3. The mean age of the patient was 40.83 (23 – 68 years).

The average duration of follow up was 28.8 months (range 24-36 months). The mean period for solid radiological fracture union was 16 weeks. The Mayo Elbow Performance Score was used to evaluate the functional result in C1, C2 and C3 fractures and was found to be 90, 87 and 76 respectively.

Conclusion

Supracondylar - intercondylar fractures of humerus in adults, treated by the method of Y plate fixation is a good and easy method of fixation with a good functional outcome.

Key words: Supracondylar intercondylar fractures, distal humerus fractures, y plate, humerus
The unsatisfactory functional outcome is contributed by the most common complications of complex injuries around the elbow like capsular contractures, arthrofibrosis and heterotopic ossification. In the elbow, the principle of absolute stabilisation and early mobilisation is of more importance than in any other joint.

Various authors who supported open reduction differed widely in their opinion regarding the type and extent of fixation and the timing of mobilisation. Recently there has been an on-going surge of newer type of devices designed for accurate osteosynthesis of articular fractures.

Materials and methods
In this prospective study, we review the functional outcome of a series of 18 cases of supracondylar intercondylar fractures of the humerus treated by open reduction and internal fixation with Y-plate in our institution from August 2009 to November 2010.

There were 11 males and 7 females. The mean age was 40.83, with the age ranging from 23 to 68 years. 10 fractures were left sided and 8, right sided.

Based on the classification system by Muller et al, four fractures were classified as type C1, nine as type C2 and five as type C3. The average age of patients with comminuted type 3 fractures was 37 years.

Three fractures (16.66%) were open; two being type C2, and one type C3. Type C2 was grade 1 and type C3 was grade 2 according to the Gustilo and Anderson classification. Thirteen fractures occurred due to domestic fall and five fractures were sustained by road traffic accidents. Only two patients had associated injuries in this group; one with ipsilateral single rib fracture and one patient had fracture of 5th metacarpal neck on the same side. One patient had ipsilateral post traumatic ulnar nerve palsy.

Operative technique
In our study, the timing of surgery varied from 24 hours to 5 days. Five cases were operated on the day of injury; nine cases within 72 hours. Among the remaining four, 3 cases were operated after 72 hours after the swelling subsided. Surgery for a case with associated rib fracture delayed to the fifth day after trauma.

Regional supraclavicular block was used in 14 patients and general anaesthesia in four patients. All cases were operated in the lateral decubitus position with the elbow 90° flexion and forearm hanging on the side of the table over an arm support. Pneumatic tourniquet was used routinely in all patients. We used a posterior midline longitudinal incision. Chevron osteotomy of the olecranon was performed in all cases to improve the exposure so as to ensure anatomical reduction and approximation of articular fragments. All osteotomies in our series were later stabilised as the last step by tension band wiring with two 2 mm k wires. The ulnar nerve was isolated, protected and after fracture fixation, anterior transposition was performed in all cases.

With the elbow flexed to 100°, the intercondylar trochlear configuration was first reconstituted by inter fragmentary fixation with one or two 4 mm partially threaded cannulated screws, followed by temporary assembly with the supracondylar fragment using k wires. A posteriorly applied Y plate was used for the fixation of articular reconstruction to the distal humerus. The two limbs of the plate fixed to the posterior aspect of medial and lateral columns with screws.

Additional fixation was added as needed depending on the geometry of the fracture. The olecranon osteotomy was secured by tension band wiring. The average operative time was 91 minutes. The wounds were closed in layers over suction drains, which were removed on the third post-operative day. Intravenous antibiotics were given for 72 hours. Sutures were removed on 12th post-operative day. The elbows were immobilised in a posterior above elbow slab for two weeks. After 2 weeks, controlled assisted active mobilisation was done.

There were three open fractures in our series, two were Gustilo and Anderson type 1 and one, type 2. These cases were operated within 24 hours with wound debridement, fixation by the same technique as described above and a primary wound closure was done.

Post-operative check x-rays were taken and repeated at 3, 6, 12, 24 weeks and then every 6 months. Patients were assessed clinico radiologically for union of fracture and elbow function at each follow up.

Results
Out of 18 cases, nine cases (50%) were type C2 according to the classification by Mullers et al; 5 were type C3(27.7%) and only 4 cases (22.2%) were C1 type. Only 3 open fractures were encountered; 2 type C2 and one type C3. The average duration of follow up was 28.8 months (range 24-36 months). The mean period for solid radiological fracture union was 16 weeks. The Mayo Elbow Performance Score was used to evaluate the functional result.
Among C1 fractures, only one patient (25%) had mild pain within range of movement. 3 patients (75%) had an arc of movement > 100°. One patient had 10° restriction of pronation. All C1 patients had good stability and function of the elbow. One patient developed minor surgical site infection which resolved with antibiotics and wound care. 50% patients in this group had a Mayo score of 100 and excellent results. Remaining 50% had good results. No poor results were observed in this group. The mean Mayo score in this group was 90 which showed an excellent result.

9 cases (50%) were Mullers type C2 fractures; 5 patients (55.5%) had mild pain, all patients had an excellent arc of motion except one with 80°. One C2 fracture had post traumatic ulnar nerve palsy which has not completely recovered at 24 months. Two fractures united with a deformity of 10° varus. One patient had ipsilateral mal-united supracondylar fracture. Two grade 1 open fractures in this group had uneventful healing of wound and solid union. One patient required implant removal at 8 months due to pain during movement. One case was found to have mild valgus instability without gross functional limitation. The mean Mayo score in this category was found to be 87, which was considered as good result.

Four cases (27.7%) were Mullers type C3 fractures which include one type 2 open fracture. 4 patients had mild pain; all patients had arc of movement more than 100°. All C3 fractures had solid bone union at 6 months follow up. 2 fractures had 10° varus mal-union, one with moderate valgus instability. 2 patients had 20° restriction of supination. One patient developed late implant infection which necessitated implant removal 9 months post operatively. The mean Mayo score in this group was 76, which was found to be a good result.

**DISCUSSION**

Distal intrarticular fractures comprise only 0.5% of humeral fractures. There are various criteria for classification. Numerous studies are reported by authors like Riseborough and Radin, Jupiter and Muller. The functional results vary with the method of evaluation. The main causes for unsatisfactory results in the past were due to insufficient stabilisation and prolonged immobilisation.

Rigid fixation and early mobilisation are essential goals of treatment. Complex anatomy and accompanying comminution in most cases makes fixation more difficult. Articular restoration should be the priority in these fractures followed by large column fixation. Many multidisciplinary studies are still to be performed to find answers to questions as to the best time for early rehabilitation, the role of little free fragments and the effect of olecranon osteotomy in fracture healing.

The accurate comparison of internal fixation with different types of implants is difficult. The stability of fixation with the 90-90 or posterior double plating has been well
recognised and practiced all over the world. Most authors have used the same principle in all their studies. While the normal arc of flexion-extension of the elbow is considered to be from 0° (full extension) to 145° of flexion, many investigators have noted that most functional tasks can be performed with somewhat less motion.\textsuperscript{9,10,11}

Moray et al used thirty-three normal volunteers and an electrogoniometer designed to measure three-dimensional motion of the joint in daily activities. Most activities were accomplished successfully within a functional arc of 100° (30 to 130°) of flexion and extension of the elbow and 100° of rotation of the forearm (50° each of pronation and supination).\textsuperscript{12} The aim is a painless stable elbow with nearly full range of movement.

Age, bone quality, degree of displacement, comminution, soft tissue trauma, neurovascular damage and other associated injuries have negative influence in the surgical treatment and rehabilitation of these fractures. Good anatomical knowledge with surgical experience is fundamental to solve these issues.\textsuperscript{7,13}

Our study presents the functional results of a limited number of cases treated in a single institution, using a single type of implant, a well recognised single operative technique and a controlled post operative rehabilitation protocol, irrespective of the patient factors.

The critical factors for a successful outcome remains those advocated by Cassebaum.\textsuperscript{14} These include meticulous surgical technique, stable internal fixation and controlled mobilisation.\textsuperscript{6} The implant we used does not appear to be related to the distal humeral fractures at the time of this study but, recognised by various surgeons in calcaneal fracture fixation.

We made use of this plate for stabilisation of articular segment to both columns of humerus while the intercondylar element fixation purely relied on the principles of articular fracture fixation. The trans-olecranon approach was used to avoid the soft tissue trauma associated with triceps splitting approach which may interfere with post operative rehabilitation. It also provided better visualisation of the articular surfaces and easier identification and protection of ulnar nerve which was anteriorly transposed in all cases.

We find this approach more feasible even if the surgery was delayed to several days. In all 18 cases operated, olecranon osteotomy united at mean duration of 12 weeks and it does not appear to interfere with controlled mobilisation. We do not routinely advice plate removal except the tension band wiring, unless otherwise the hardware caused limitation of movement or pain.

Ulnar nerve injury and dysfunction has been increasingly recognised in recent literatures and is very frequently debated with respect to operative treatment of these fractures.\textsuperscript{15} Post-operative ulnar nerve injury in distal humeral fractures has been reported as high as 13%.\textsuperscript{16} In cases where ulnar nerve anterior transposition has been done it goes as high as 22%.\textsuperscript{11} In our study only one patient had post operative ulnar palsy which did not completely recovered at the end of 24 month follow up.

The incidence of post operative infection appeared to increase with the prolongation of surgical time and in compound fractures.\textsuperscript{18} All open fractures in our series achieved solid union without developing infection. We emphasise the importance of thorough wound lavage and internal fixation possibly within 24 hours to reduce the incidence of sepsis.

In 21 patients with complex distal humeral fractures, Ata Can Atalar and Mehmet Demirhan evaluated the functional results of parallel plate technique. They reported a mean Mayo elbow score of 86.1+/−12.6. Heterotopic bone formation in varying degrees was observed in seven patients and chondrolysis of elbow in one patient. Patients with open fractures had significantly lower range of motion than closed fractures; but Mayo score did not differ significantly.\textsuperscript{19}

The only negative prognostic factor in their study was open fractures. In our study, we had no incidence of heterotopic ossification during our follow up. We have encountered three open fractures in our study and the final functional result did not appear to differ. The only negative prognostic factor observed in our study is the type of fracture as Mayo elbow performance score decreased from C1 to C3 fractures.

Chi-Fat C and Grace Y, reviewed elderly patients treated by locking compression plates. The mean elbow performance scores in type A, B and C fractures were 97, 85 and 89 respectively and post operative performance of type A fracture was significantly better than type B and C.\textsuperscript{20} We had only type C fractures in this study and the mean mayo scores in type C1,C2 and C3 fractures were 90, 87 and 76 respectively.

In our study, the mean Mayo elbow performance score in type C fractures was 84.33 which showed comparable results with other studies (\textit{P Value} = <0.01). Although this study was conducted with a limited number of patients, we would like to highlight that the technique was found to be easier. It was less
time consuming and involved less stripping of the soft tissue to place the y-plate to the posterior aspect compared to mediolateral parallel plate or 90° - 90° plate fixation.

We also find this fixation reasonably stable in osteopenic weak bones as about half of our patients were more than 40 years of age with osteoporosis which is common especially in this region of South India.

CONCLUSION

The functional outcome of supracondylar intercondylar fractures of humerus in adults, treated by Y plate fixation is found to be equally effective, easy method of fixation with fewer complications using a standard approach even in osteopenic bones.

REFERENCES


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