

Research Article**Evaluation and Outcome of Surgical Management of Supracondylar Fracture Humerus with Intercondylar Extension in Adults****Krishnamurthy M.O^{*1}, Sreenivasulu P.S.B¹, RajKumar K¹, Mahaboob V.S²**¹Department of Orthopaedics, Narayana Medical College & Hospital, SPSR Nellore, A.P., India²Department of A.R.C, Narayana Medical College & Hospital, SPSR Nellore-524003, A.P., India***Corresponding author**

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Abstract: Supracondylar humerus fractures with intercondylar extension in adults are uncommon injuries and present the most difficult challenge of the fracture of lower end of humerus. Restoration of the articular surface of distal humerus must be nearly perfect and sufficiently rigid to permit early mobilization of the elbow if the result is to be satisfactory. Acceptable results have been reported in majority of patients treated by open reduction and internal fixation. The aim of this study is to assess the functional outcome of surgical management of Supracondylar humerus fractures with Intercondylar extension in adults by various surgical methods and to study advantages and complications of various surgical procedures for the same. This is a prospective study of 20 cases of supracondylar humerus fractures with intercondylar extension in adults admitted to Narayana Medical College and Hospital, Nellore between November 2012 to October 2014. All the cases were evaluated with pre-operative x-rays of concerned elbow joints both in antero-posterior and lateral views and their post-operative outcome after ORIF with plate. The outcome was evaluated in terms of pain relief, range of movement of elbow joint, rate of union, intra operative and postoperative complications. Cases were taken according to inclusion and exclusion criteria. In this study of 20 cases, there were 11 males and 9 females with average age of 43.4 years and an average follow up of 11 months. 10 cases each were due to direct fall and road traffic accident, with predominance of left side (11). Out of 20 cases 5 (25%) were of RR type II, 12(60%) were of RR III and 3 (15%) were of RR IV. Good results seen in 8 cases, fair results in 9 cases and poor results in 3 cases. There were 2(10%) cases each of superficial infection, implant failure, ulnar neuropathy and one (5%) case of non- union and they were treated accordingly. Operative treatment with rigid anatomical internal fixation should be the line of treatment for all grades of Riseborough and Radinintercondylar fracture as it gives best chance to achieve good elbow function. During open reduction internal fixation, anatomic nature of articular surface should be given prime importance. Stable fixation allows early active and aggressive postoperative mobilization.

Keywords: Supracondylar fracture, Intercondylar Fracture, ORIF, Humerus, Riseborough, Radin

INTRODUCTION

Supracondylar humerus fractures with intercondylar extension are uncommon injuries in adults and present most difficult challenge of fracture of lower end of humerus. The complex shape of this joint (Elbow) and it's associated vascular & nerve structures and the sparse soft tissue envelope combine to make these fractures difficult to treat. Acceptable results have been reported in a majority of patients treated by open reduction and internal fixation [1]. The only reliable method for restoring the normal alignment and contour of the distal humerus is operative exposure and direct manipulation of fracture fragments. However fixation of fracture fragments must be stable enough to allow motion while ensuring union. In the early and middle parts of twentieth century, operative treatment was combined with devascularizing exposure, inadequate fixation, and cast immobilization. The result was often

elbow stiffness and delayed healing. In this context, non operative treatments, such as the so called bag- of - bones technique were established as treatment alternatives [2]. Restoration of painless and satisfactory elbow function after a fracture of the distal humerus requires anatomic reconstruction of the articular surface, the overall restitution geometry of distal humerus, and stable fixation of the fractured fragments to allow early and full rehabilitation [3]. Depending upon the frequency of comminution and displacement, open reduction and internal fixation with 1/3 tubular plate, reconstruction plate, Kirschner wire and double tension band wiring can be done individually or in combination. The result of operative fixation of fractures of the distal humerus remained unpredictable until improved techniques for the fixation of small, articular fractures as developed by the Arbeitsgemeinschaft fur osteosynthesefragen /

association for the study of internal fixation (AO/ASIF) and others were applied. On the basis of the results reported in the more recent series, fixation with two plates at 90 degrees angle with one another has become the standard against which all other treatments are measured. Some have even suggested total elbow arthroplasty as an alternative to operative fixation. Although it is wise to be prepared to perform a total elbow arthroplasty in the event that a complex fracture is not amenable to internal fixation, one must keep in mind the functional limitations and eventual failure associated with total elbow arthroplasty. A surgeon treating a healthy active patient with a fracture of distal humerus should make every attempt to reconstruct and preserve the distal humerus [4]. Residual elbow stiffness still remains the worst complication of intercondylar fractures as it is poorly tolerated because of lack of compensatory motions in adjacent joints. The aim of the present study is to evaluate the functional outcome of surgical management of supracondylar fracture humerus with intercondylar extension.

MATERIALS AND METHODS

This is a prospective study of 20 cases of supracondylar fracture humerus with intercondylar extension treated surgically and assessed for functional outcome, which were admitted to Narayana Medical College and Hospital, Nellore, A.P. between November 2012 to October 2014.

Inclusion criteria

Patients with supracondylar fracture humerus with intercondylar extension; Patients above the age of 20 years; Patients medically fit for surgery.

Exclusion criteria

Compound fractures of the distal humerus ; Old fractures of the distal humerus ; Patients not willing for surgery; Patients medically unfit for surgery; Any associated fractures.

Pre-Operative work up

On arrival of patients at casualty or at OPD level, the various points were noted down according to the proforma. On admission of the patient, a careful history was elicited from the patient and/or attendants to reveal the mechanism of injury and the severity of trauma. The patients were then assessed clinically to evaluate their general condition and the local injury. The general condition of person & vitals are recorded. The injured elbow revealed swelling, deformity and loss of function. Any nerve injury was looked for and noted. On palpation, tenderness, abnormal mobility and crepitus were looked for. Distal neurovascular deficits were ruled out by palpating radial artery and testing for sensory loss distally. Radiographic study was done taking anteroposterior and lateral x-ray of the involved elbow. The limb was then immobilized in above elbow plaster of paris slab with sling. Routine investigations were done as follows: Hb%, Urine for sugar, FBS,

Blood urea, Serum creatinine, HIV, HbSAg and ECG. Informed and written consent were taken prior to surgery. A dose of tetanus toxoid and antibiotic were given preoperatively. Instruments to be used were checked before hand and sterilized. All patients were treated surgically with open reduction and rigid internal fixation. Patients treated surgically were done so in routine operation theatre as soon as possible. Most of the patients were operated within 8 days of admission. Pneumatic tourniquet is recommended. Patient in lateral position with arm supported and forearm hanging. In all the patients a posterior trans-olecranon approach was used to give better exposure of the articular surface.

Operative Procedure

General anesthesia was used in 12 cases and brachial block in 8 cases. Pneumatic tourniquet was used in all cases and time noted. Painting and draping of the part was done. The distal end of the humerus was approached using trans-olecranon approach. Elbow was exposed posteriorly through an incision beginning 5cm distal to the tip of the olecranon and extending proximally midline of the arm 8cm above the tip of the olecranon, reflected the skin and subcutaneous tissue to either side carefully to expose the olecranon and triceps tendon. The ulnar nerve is isolated and fascia over the flexor carpi ulnaris is longitudinally splint over 6cm to enhance the nerve mobility, then gently retracted from its bed with a moist tape. Distal end of the humerus is exposed through transolecranon approach. Prior to performing the olecranon osteotomy the proximal ulna was predrilled with 3.2mm bit and then partially tapped for a 6.5mm AO cancellous bone screw. An intra-articular olecranon osteotomy was made in a shallow 'V' or Chevron fashion in the center of the olecranon sulcus that is approximately 2cm from the tip of the olecranon. The location was best identified by elevation of the anconeus muscle on the olecranon to directly visualize the articular surface. A sponge was placed from lateral to medial and used as a counter traction of the osteotomy created with thin bladed oscillating saw and completed with a thin bladed osteotome. The osteotomized olecranon fragment was elevated proximally leaving a margin of the triceps tendon on either side to suture upon completion of the surgery. The fracture hematoma was cautiously removed. Fragments of the humerus were assembled in 3 steps

- i) Reduction and fixation of condyle together
- ii) Fix the medial or lateral epicondylar ridge to the humeral metaphysis.
- iii) Reassembled condyles are fixed to the humeral metaphysis.

Reduction and fixation of the condyles were reduced and held with a bone holding clamp. Reduced condyle was provisionally fixed with Kirschner wire. Malleolar or AO cancellous screw was inserted across the reduced condyles. Reduction and fixation of the condyles to metaphysis. Reduction and temporary stabilization of the medial and lateral columns was done by using

crossed Kirschner wire. Medial and lateral pillars were reconstructed using contoured 3.5mm reconstruction plate and screws or Y plate with screws. To enhance the mechanical strength the plates were placed as closed to 90° to each other as possible. The stability of the internal fixation was tested by putting the elbow through a range of motion. The olecranon osteotomy was reduced under direct vision and held with reduction clamp. 6.5mm AO cancellous screw was introduced from the tip of the olecranon. Periosteum was stripped from the shaft of the ulna distal to the osteotomy site and transverse hole was drilled approximately 3-5cm distal to osteotomy site. A No.16 stainless steel malleable wire passed through thin transverse hole and crossed over the posterior surface of the olecranon in a figure of eight manner and then passed around the neck of the screw and tightened. Instead of 6.5mm AO cancellous screw with tension band wiring, it can also be fixed with tension band wiring with obliquely placed Kirschner wire. At the completion of the fixation the elbow was again put through a range of motion to test the security of the internal fixation. The tourniquet was let down and hemostasis carefully secured over a large suction drain the wound was closed in layers. Pressure bandage was applied and limb immobilized with above elbow plaster of paris slab. Patients were instructed to keep the limb elevated and move their fingers and shoulder joint. Suction drain was removed after 24-48 hours. Wound was inspected after 3-4 days postoperatively. Antibiotics and analgesics were given to the patient till the time of suture removal. Suture/staples were removed on the 10th postoperative day. Patient was advised to use arm sling pouch during night times. Patient was instructed elbow ROM active and passive exercises as tolerated within the safe prescribed arc for 3 to 4 times daily. Forearm and wrist ROM active and passive stretching exercises were performed. Later patients were discharged with the forearm in an arm pouch and advised to perform shoulder, elbow, wrist and finger movements. Patients were advised not to lift heavyweight or exert the affected upper limb. After discharge, patients were advised to report for follow up after 6 weeks and 12 weeks and thereafter every 3 months up to 1 year. At follow up a detailed clinical examination was done and patients were assessed subjectively for the symptoms like pain, swelling and restriction of joint motion. Patients were instructed to carry out physiotherapy in the form of active flexion, extension, gravity assisted and against gravity exercises. Muscle strengthening exercises were advised after union of the fracture. Pronation and supination exercises were also advised. The functional assessment of the patient was done according to Riseborough and Radin grading system [5].

RESULTS

The present study consists of 20 cases of supracondylar fracture humerus with Intercondylar extension treated by open reduction and internal

fixation with Dual plating (3.5mm reconstruction plate and 1/3rd tubular plate or locking plate), Y-plate, AO cancellous screw and Kirschner wire in Narayana Medical College and Hospital, S.P.S.R.Nellore, A.P. between November 2012 to October 2014.

In age distribution, 6(30%) patients were between 21-30 years, 5 (25%) patients were between 31-40 years, 2 (10%) patients were between 41-50 years and patients between 51-60 years were 7(35%). The range of age was between 21-58 years, with mean age of 43.4years. The maximum incidence was between 51 to 60 years i.e. 7 cases (35%). In sex distribution, there were 11 (55%) males and 9(45%) females with male: female ratio of 11:9. Right upper limb was involved in 9 (45%) cases and left upper limb in 11 (55%) cases. In mode of injury, 10 cases (50%) were due to direct fall injury and 10 cases (50%) were due to road traffic accident. In fracture series, there were no cases of type I fractures. There were 5 (25%) cases of type II fractures, 12 (60%) and 3 (15%) cases of type IV fractures (Table 1). No case was operated as a surgical emergency. All the cases were operated on regular operation theatre days, at the earliest possible time. 9 (45%) patients were operated between 2 to 4 days, 8 (40%) patients were operated between 5 to 7 days and 3 (15%) patients were operated between 7 to 10 days. None of the cases had any associated fracture of other bones. All the patients had an isolated supracondylar humerus fracture with intercondylar extension. In the fixation series, 11 (55%) patients were fixed with double reconstruction plates of which supplementary Kirschner wires were used in 2 cases and 9 (45%) patients were fixed with Y-plate and screws. Three cases of comminuted intercondylar fractures of humerus wherein it was difficult to obtain rigid fixation were immobilized with above elbow posterior plaster of paris slab for a period of 3 weeks. All the other cases were encouraged active elbow motion from the 3rd postoperative day. There were no cases of Postoperative complications. Superficial infection: Two patients developed superficial infection; infection was controlled with appropriate antibiotics after culture and sensitivity report. Ulnar neuropathy: Two patients developed ulnar neuropathy which recovered spontaneously after 3 weeks. Non-union: One patient had non union in which Y plate was removed and internal fixation with two 3.5mm reconstruction plate with bone grafting was done. Implant failure: Y plate breakage occurred in two patients where resurgery was done, broken Y plate was removed and two 3.5mm reconstruction plates were applied with bone grafting. In our study, radiological union was seen at 6 months to 9 months follow up except for one case which showed non union. In the present study there were no type I fractures, 5 cases were of type II out of which 3 good and 2 fair results had. There were 12 cases of type III fractures out of which 5 had well, 5 fair and 2 poor results. There were 3 cases of type IV fractures out of which 1 had good and 2 had poor results.

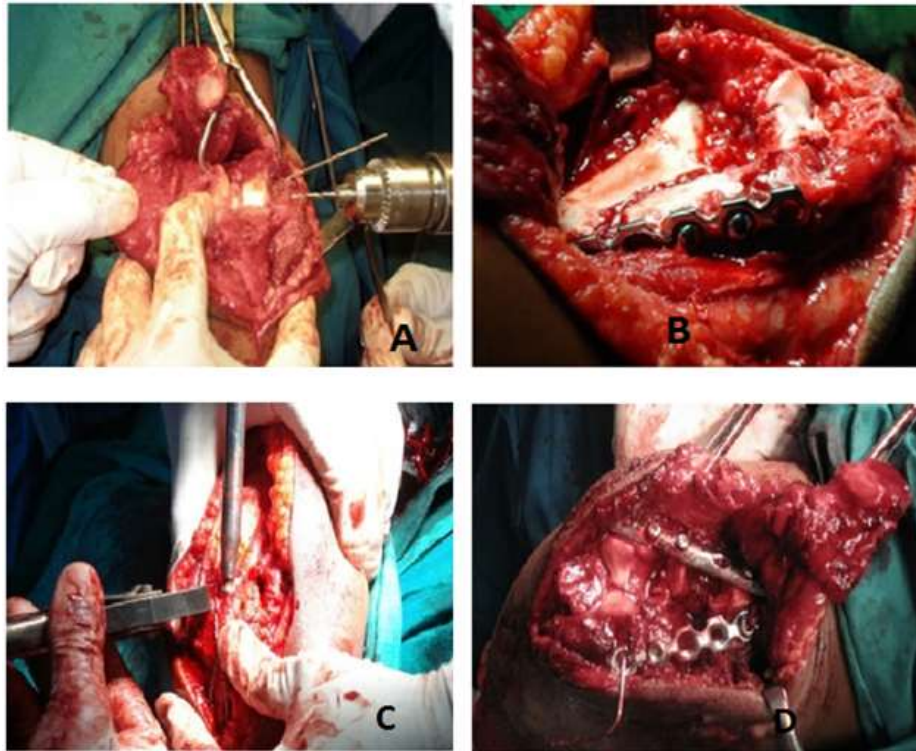


Fig. 1: A. Reduced condyles fixed with inter fragmentary screw; B. Medial pillar reconstructed using contoured 3.5 mm reconstruction plate and screws; C. Lateral pillar reconstructed in same fashion; D. Olecranon osteotomy site was fixed with BW and 6.5 mm cancellous screw

Table 1: Type of fracture: (Riseborough Radin Classification)

Type of fractures	No. of cases	Percentage
I	-	-
II	5	25
III	12	60
IV	3	15

Table 2: The comparison of present study with the Riseborough Radin series

RiseboroughRadin Series			RR types	Present study		
Good	Fair	Poor		Good	Fair	Poor
-	-	-	I	-	-	-
3	1	1	II	3	2	-
4	5	3	III	5	5	2
3	4	4	IV	1	-	2

DISCUSSION

It is a prospective study in which 11 cases of supracondylar humerus fracture with intercondylar extension were treated with dual plating and 9 cases of supracondylar humerus fracture with intercondylar extension were treated with Y plate. Our experience with these methods of fixation has given favorable results. The findings, the end results and various other data have been analyzed and compared in the following discussion.

Age incidence

In our study fractures were commoner in the third and fifth decade with average age being 43.4 years (21-60). Our findings are comparable to the study made by

Jesse B. Jupiter *et al.* [17], Gabel *et al.* [18], M. Bradford Henley *et al.* [19], Kun-Chuang Wang *et al.* [6]. In 1985 Jesse B. Jupiter *et al.* [17] found 57 years as the average age in their series. In 1987 Gabel *et al.* [18] found 45 years as the average in their series. In 1987 M. Bradford Henley *et al.* [19] found 32 years as the average age in their series. In 1994 Kun-Chuang Wang [6] found 47 years as the average age in their series. Our series has a male predominance with 55% and 45% female patient which were comparable to Kun-Chuang Wang [6] study. Jesse B. Jupiter *et al.* [17] in his study noted about 47% male and 53% female, sex distribution. M. Bradford Henley [19] in his study noted about 52% male and 48% female incidence. Kun-Chuang Wang [6] in his study noted 60% male and 40%

female incidence (Table 2). Male predominance is probable due to their increased involvement in outdoor activity level. In our series 50% of the cases were due to direct fall and 50% of cases had road traffic accident. Gabel *et al.* [18] accounted 100% of his cases to direct fall. M. Bradford Henley [19] accounted 61% of his cases to road traffic accident, 39% due to direct fall. Kun-Chuang Wang [6] accounted 30% of the cases to direct fall and 70% of the cases to road traffic accident. The results of the M. Bradford Henley [19] are comparable with our series. We accounted about 45% incidence of fractures in right side and 55% of the fracture in left side, which is also comparable to other studies. We accounted about 45 % of fractures in right side and 55 % in left side. Jesse B. Jupiter *et al.* [17] reported about 62% incidence of fractures in left distal end of humerus. M. Bradford Henley *et al.* [19] reported about 55% incidence of fractures in left distal end of humerus. Left sided predominance is probable due to direct fall injury, left sided predominance which is common in our series. In our series we accounted no cases of fractures of RR type I, 25% fractures of RR type II, 60% fractures of RR type III and 15% fractures of RR type IV. Gabel *et al.* [18] in his series noted about 23% of fractures of RR type I, 15% fractures of RR type II, 31% fractures of RR type III and 23% fractures of RR type IV. M. Bradford *et al.* [19] in his series noted about 9% of fractures of RR type I, 12% fractures of RR type II, 43% fractures of RR type III and 36% fractures of RR type IV. The comparison of present study with the Riseborough Radin series [5] is as follows: In RR series, there were 5 type- II cases of which 3 had good, 1 fair, 1 poor results. In our series 5 type – II Cases were present out of which 3 had good and 2 fair results. There were 12 cases of type – III fractures in RR series of which 4 had good, 5 fair and 3 poor results. In our series there were 12 cases of type – III cases of which 5 had good, 5 fair, 2 poor results. There were 11 cases of type – IV fractures in RR series of which 3 good, 4 fair and 4 poor results were obtained. Our series had 3 type – IV cases of which 1 good and 2 poor results were obtained. M. Bradford Henley *et al.* [19] reported 4% superficial infection 7% of ulnar neuropathy, 5% of implant failure, 2% of non union and 4% incidence of heterotrophic ossification.

Superficial Infection

In our series we had two cases of superficial infection which resolved with appropriate antibiotics. Studies have shown that patients who have increased level of haemoglobinA1c and glucose levels greater than 200 mg/dl. In the immediate postoperative period are associated with an increased risk for surgical site infections. The use of nicotine before surgery has been demonstrated to increase the risk of surgical site infections possible because of delayed wound healing.

Ulnar Neuropathy

Two cases of ulnar neuropathy was seen which resolved spontaneously after conservative treatment.

Ulnar Neuropathy can be prevented by anterior transposition of ulnar nerve to prevent possible impingement of the hardware in and around the sulcus [6]. Preoperative nerve function and routine intraoperative exposure and determination of any visible injuries of the ulnar nerve should be documented. In a study conducted during 1983 to 1993, our of 99 cases 21 cases had ulnar nerve lesion [7].

Non Union

In our study, one patient had a non union, in which Y-plate was removed and internal fixation with two 3.5mm reconstruction plate with bone grafting was done. Olecranon non union may occur after olecranon osteotomy. A non union case requires revision surgery of ORIF with bone grafting. In a study conducted during 1983 – 1993, out of 99 cases, 10 non unions developed with 6 involving the radial condyle and 4 the osteotomized olecranon [7].

Implant Failure

Y-plate breakage occurred in two patients where re-surgery was done, broken Y-plate was removed and two 3.5mm reconstruction plates were applied with bone grafting. Implant failure after distal humerus fracture fixation occurs usually by loosening of the bone – implant anchorage at distal fragment [8-10]. To prevent such failure two principles must be satisfied:

- i) Fixations in the distal fragment must be maximized and
- ii) All fixations in distal fragments should contribute to stability between the distal fragments and the shaft which is possible by placing as many screws as possible in the distal fragments.

In a study conducted by Lob G *et al.* [16], in which 412 cases distal humerus fractures were followed up for an average period of 33 months, the functional results were very good in 23.8% good in 36.0%, moderate in 22.3% and bad in 17.9%. They concluded that functional results depend on the anatomical reconstruction of the joint surfaces and on early kinesi therapy. In our study, out of 20 cases which were followed up, 4 (20%) cases had poor results. In our study conducted on 43 patients with distal humerus fractures, treated with locking plates the results obtained were grades as excellent or good results in 33 patients (82.5%). One patient had superficial infection, and 4 had myositis ossificans. There were no cases of primary malposition or secondary displacement, implant failure or ulnar neuropathy [11]. Mayo elbow performance score was used for grading the results. The authors attribute the low rate of implant failure in this study to the use of locking plates whereas markedly high failure rate has been reported in the literature for conventional plates especially loosening of distal screws [12]. In our study, Y Plate and dual plate (3.5 mm reconstruction plate and 1/3 Tubular plate) were used. Our study showed 2 (10%) cases of implant

failure and 2(10%) cases of ulnar neuropathy. The high failure rate is due to insufficient area for insertion of ample number of screws in a small sized distal fragment, resulting in poor stability at bone-plate interface [13]. Distal humerus locking plates (DHP) provide higher stability by permitting multiple screws in small distal fragment, thereby, addressing some of the limitations of conventional implants. A study of functional evaluation of comminuted intra – articular fractures of the distal humerus (AO type C) was conducted during 1999- 2001, where 26 patients were evaluated retrospectively after a mean follow up period of 70.2 months. The results were evaluated using the criteria of Morrey. The results were graded as excellent in 6 patients (23.1%), Very good in 15 (57.6%) and fair in 5 (19.3%) complications included postoperative ulnar nerve palsy (1), Wire migration(4), heterotopic ossification (3), infection(2) and material failure (2). The overall re-operation was 38.4%. The authors conclude that careful preoperative planning transolecranon approach for good visualization, routine ulnar nerve exploration and stable internal fixation facilitating early active rehabilitation; remain the gold standard for the treatment of intra – articular fractures of the distal humerus [14]. In a study comparing reconstruction of distal humerus with dual plating and single Y-plate, it was concluded that the dual plating was significantly stronger in rigidity and fatigue testing than the single Y-plate [15]. In our study there was one case of non-union and two cases of implant failure. In all three cases, Y-plate was used following which complication occurred. Later Y-plate was removed and fracture fixation was done using dual plating.

CONCLUSION

The present study was conducted to assess the outcome of surgical management of twenty cases of supracondylar humerus fracture with intercondylar extension. We conclude Supracondylar humerus fracture with intercondylar extension are common in fifth and sixth decade of life with male predominant in high incidence of fracture due to outdoor activity. The mode of injury was direct fall on elbow or RTA. Transolecranon approach provides best visualization of articular surface. Open reduction internal fixation should be done as early as possible. Delay in open reduction internal fixation with delayed soft tissue dissection leads to increased chances of elbow stiffness due to periarticular fibrosis. Operative treatment with rigid anatomical internal fixation should be the line of treatment for all grades of Riseborough Radinintercondylar fractures. During open reduction internal fixation, anatomic nature of articular surface should be given prime importance. Vigorous, active physiotherapy is a must for good results. Stable fixation allows early, active and aggressive postoperative mobilization.

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