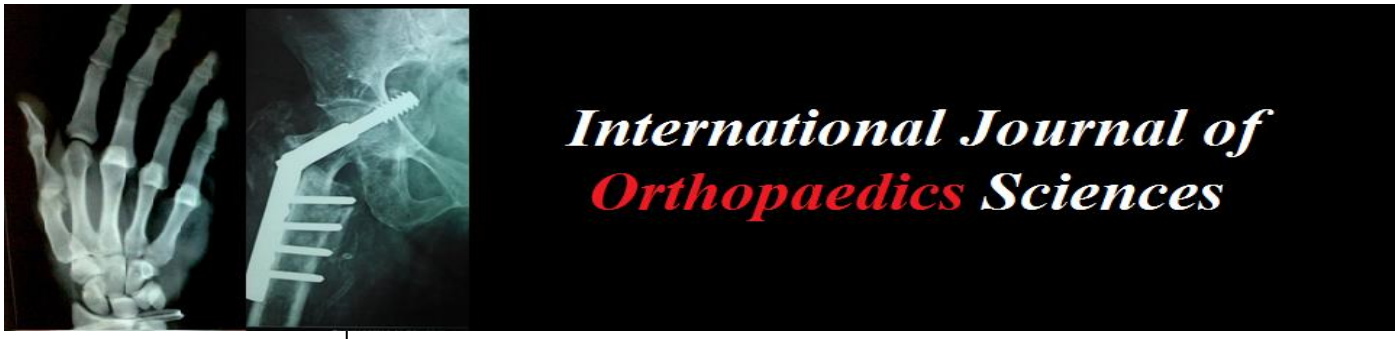

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Dr. Dayanand BB
Department of Orthopaedics, Shri B M Patil Medical College and Research Centre, BLDE (DU), Vijayapura, Karnataka, India

Dr. Ezhil Vikrama Vell G
Department of Orthopaedics, Shri B M Patil Medical College and Research Centre, BLDE (DU), Vijayapura, Karnataka, India

Corresponding Author:
Dr. Dayanand BB
Department of Orthopaedics, Shri B M Patil Medical College and Research Centre, BLDE (DU), Vijayapura, Karnataka, India

Functional outcome of surgical management of distal end humerus fractures in adults: A prospective study

Dr. Dayanand BB and Dr. Ezhil Vikrama Vell G

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Abstract
Introduction: Distal humerus fractures are uncommon injuries that account for fewer than 2%of all adult fractures. The aim of the study is to evaluate the functional outcome of the surgical management of distal humerus fractures in adults treated by various methods using the postoperative functional criteria by Riseborough and Radin.
Materials and Methods: A Prospective clinical study was conducted over a period of 2 years which included 20 patients in tertiary care centre. The patients were treated with primary open reduction and internal fixation.
Results: The average age of the patients in our study was 35.8 years with a range of 23-53 years. In our series, according the Riseborough and Radin criteria, the results were good in 50% patients, Fair in 35% and Poor in 15% patients.
Conclusion: Operative treatment with rigid anatomical internal fixation should be the first line of treatment for all grades of Riseborough Radin intercondylar fractures, more so in young adults as it gives best chance to achieve good elbow function. Vigorous, active physiotherapy is a must for good results. Stable fixation allows early, active and aggressive post-operative mobilization.

Keywords: Distal humerus, plate osteosynthesis

1. Introduction
Distal humerus fractures are uncommon injuries that account for fewer than 2% of all adult fractures. The complex shape of the elbow joint, the adjacent neurovascular architecture 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].
Restoration of painless and satisfactory elbow function after a fracture of the distal humerus requires anatomic reconstruction of the articular surface, restitution of the overall geometry of the distal humerus and stable fixation of the fractured fragments to allow early and full rehabilitation [2].
These fractures remain a challenge to effective treatment and are best managed by the surgeon's interest and experience in skeletal trauma involving the upper extremity. However even the most experienced surgeons may be intimidated with certain fracture characteristics including poor bone quality, fracture involving the distal most aspects of the bone columns and fragmentation of the articular surface in sagittal and coronal planes. A surgeon treating a healthy, active patient with a fracture of the distal humerus should make every attempt to reconstruct and preserve the bone [3].
The final X-ray does not always coincide with the functional result (Keon-Cohen). Those with Excellent function of theelbow may demonstrate a distorted radiographic appearance and vice versa. On final X-ray, there may be nearly perfect anatomical restoration but poor functional capacity, usuallydue to joint stiffness (Riseborough) [4]. Hence the surgeon may have to compromise appearance (both clinically andradiographically) for function [5].
The aim of the present studyis to evaluate the functional outcome of surgical management of distal humerus fractures in adults treated by various methods using the post-operative functional criteria by Riseborough and Radin [4]

2. Materials and Methods

This study was conducted over a period of 2 years and included 20 patients. Patients admitted to the hospital with adiagnosis of distal end humerus fracture, willing to undergo surgical treatment and participate in the study were included. Patients with compound fractures of the distal humerus, patients less than 18 years of age and patients medically unfit for surgery were excluded from the study. Written informed consent was obtained from every patient regarding the surgery and inclusion in the study. The patients were evaluated using a standardized pre-anaesthetic work-up and other associated injuries were treated using the appropriate treatment for that particular disease. Surgery was performed either under general anaesthesia (8 patients) or under brachial block (12 patients). The patients were treated with primary open reduction and internal fixation. None of the patients underwent primary elbow replacement. No patient had a history of inflammatory arthritis or other arthritis of the injured elbow.

Fragments of the humerus were assembled in 3 steps

1. Reduction and fixation of condyles together
2. If fractured, the medial or lateral epicondylar ridge was fixed to the humeral metaphysis
3. Reassembled condyles were fixed to the humeral metaphysis.

Post-operatively, patients were instructaed to keep the limb elevated and move their fingers a actively. Suction drain was removed after 24-48 hours. Wound was inspected after 3-4days. IV Antibiotics were given to the patient for 3-5 days, later converted to oral antibiotics until suture removal. Sutures were removed on the 12th postoperative day and check X-ray in antero-posterior and lateral views were obtained. Patients were later discharged with the above elbow posterior POP slab and advised to perform active shoulder and finger movements. Patients were advised not to lift heavy weight or exert the affected upper limb. Upon discharge, patients were advised to report for follow up after 3 weeks. The posterior POP slab was then removed and an arm pouch was given and the patient was advised to do active range of elbow movements as the pain permits. Patients were asked to return at 6 weeks, 12 weeks and thereafter every 6 months. The results were assessed at 3 months, 6 months and 1 year after the procedure. 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 perform physiotherapy in the form of active flexion-extension and pronation-supination without loading. The functional assessment of the patient was done according to the rise borough and rad in grading system.

3. Results

Study consists of 20 cases of distal humeral fractures treated by open reduction and internal fixation with anatomical locking plates. Cases were followed up periodically. The following were the observations made and the available data are analyzed as follows.

A) Age Incidence

Table I: Age incidence

Age years	21-30	31-40	41-50	51-60
No. of Cases	6	8	4	2
Percentage.	30	40	20	10

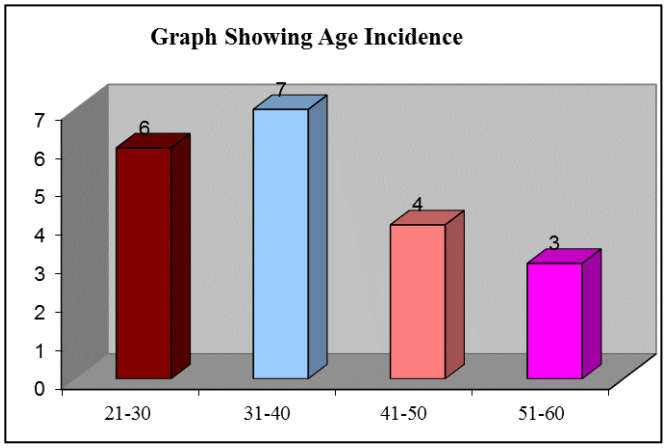

Chart 1: Age Incidence

In this series, 6(30%) patients were between 21-30 years, 8 (40%) patients were between 31-40 years, 4(20%) patients were between 41-50 years and 2(10%) patients were between 51-60 years. The range of age was between 23-53 years, with mean age of 35.8 years. The maximum incidence was between 31 to 40 years i.e. 8 cases (40%).

B) Sex incidence

Table II: Sex Incidence

Sex	No. Of cases	Percentage
Males	17	85
Females	3	15

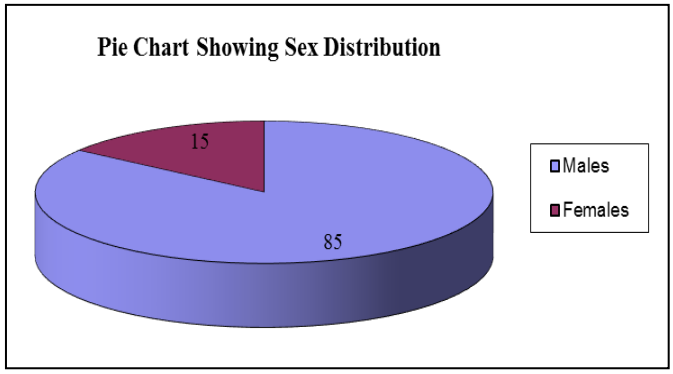

Chart 2: Sex Incidence

In the present series there were 17 (85%) were males and

3(15%) were females with M: F ratio of 5.6: 1

C) Side involvement

Table III: Side Involvement

Side Involved	NO. Of Cases	Percentage
Right	12	60
Left	8	40

Right upper limb was involved in 12 (60%) cases and left upper limb in 8 (40%) cases.

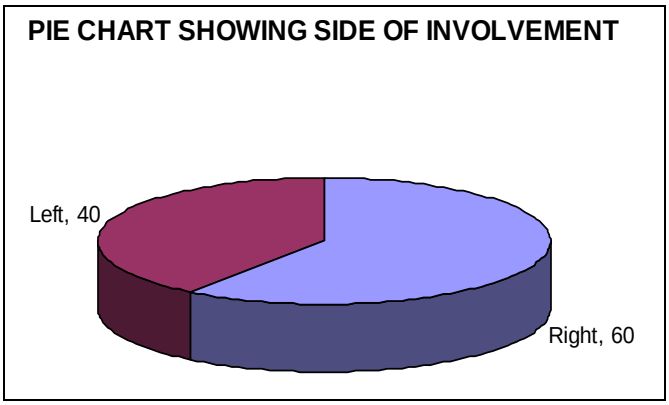

Chart 3: Side involvement

D) Mechanism of injury

Table IV: Mechanism of Injury

Mechanismof injury	No. Of cases	Percentage
Direct fall	9	45
Road traffic accident	9	45
Assault	2	10

In this series 9 cases (45%) were due to direct fall injury and 9 cases (45%) were due to Road traffic accident and 2 cases were due to assault.

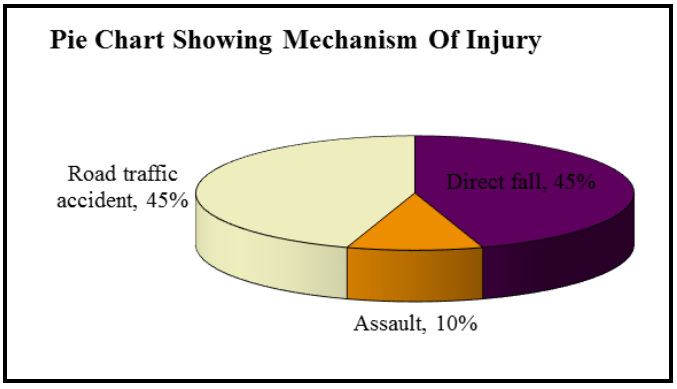

Chart 4. Mechanism of Injury

E) Type of Fractures: (Riseborough Radin Classification)

Table V. Type of Fractures

Type of fractures	No. Of cases	Percentage
I	2	10
II	6	30
III	10	50
IV	2	10

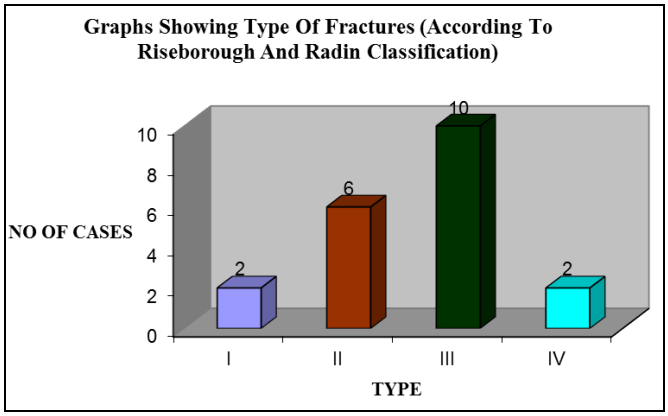

Chart 5: Type of fractures

In the present series there were 2 cases of type I fractures. There were 6 (30%) cases of type II fractures, 10 (50%) cases of type III fractures and 2 (10%) cases of type IV fractures.

F) Duration

No case was operated as a surgical emergency. All the cases were operated on regular operation theatre days, at the earliest possible time. The average duration between injury and operation was 7.6 days.

G) Associated Injuries

Table VI: Associated Injuries

Nature of injury	No. Of. Cases	Percentage (%)
Head injury	3	15
Ipsilateral femur	1	5
Ipsilateral radius and ulna	1	5
Ipsilateral colles' fracture	2	10

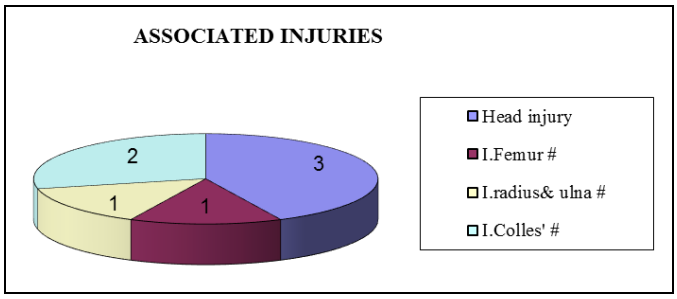

Chart 6: Associated Injuries

There were 7 cases of associated injuries, 3 cases of head injuries, 1 case of ipsilateral femur fracture, 1 case of ipsilateral radius and ulna fracture, and 2 cases of ipsilateral colles fracture.

H) Type of Anaesthesia

Table VII: Type of Anaesthesia

Type of anaesthesia	No. Of cases	Percentage
Brachial block	12	60
General anaesthesia	8	40

In our study 12 patients were operated under brachial block and 8 (40%) patients were operated under general anaesthesia.

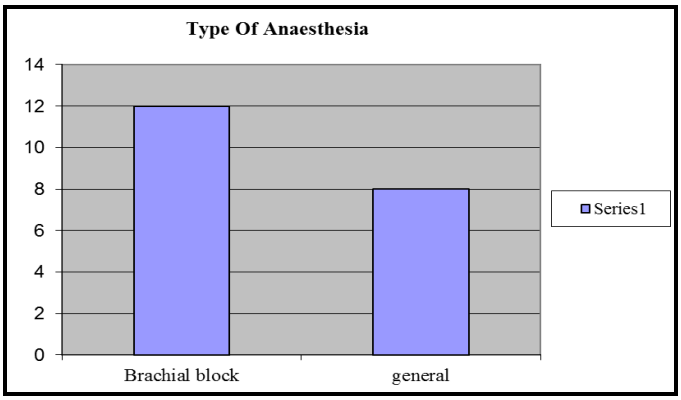

Chart 7: Type of Anaesthesia

I) Immobilization

All the cases were immobilized with A/E posterior P.O.P. slab for a period of 3 weeks. After 3 weeks active elbow mobilization was encouraged as pain permits.

J) Complications

Table VIII: Complications

Complications	No. Of cases	Percentage
Superficial infection	2	10
Deep infection	1	5
Non union	1	5
Implant failure	1	5

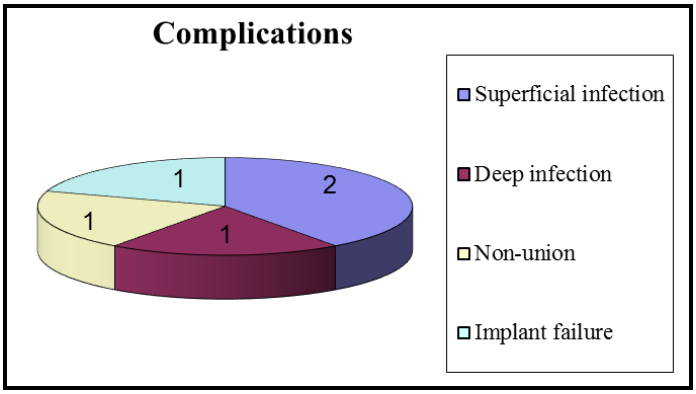

Chart 8: Complications

1. **Superficial infection:** 2 patients developed superficial infection. Infection was controlled with appropriate antibiotics after culture and sensitivity report.
2. **Deep infection:** One patient (5%) developed deep infection, which was taken for debridement, wound was kept open after subsiding infection secondary suturing done. It united at 4 months.
3. **Non-union:** One patient had non-union which was treated with internal fixation and bone grafting.
4. **Implant failure:** In one patient there was a implant failure. It was fixed with internal fixation and bone grafting.

K) Secondary procedures

Table IX: Secondary procedures

Procedure	No. of. cases
Wound debridement and secondary suturing	1
Revision surgery with bone grafting	2

In one patient who had deep infection was treated with wound debridement later after subsiding infection secondary suturing was done. In 2 patients revision surgery with bone grafting done, one in case of non-union, and another in case of implant failure.

L) Union

Table X: Union

Type of fracture	Average Time in weeks	Percentage of union (%)
Type I	12.50	100
Type II	15.33	100
Type III	17.80	90
Type VI	20.00	100
Total	16.40	97

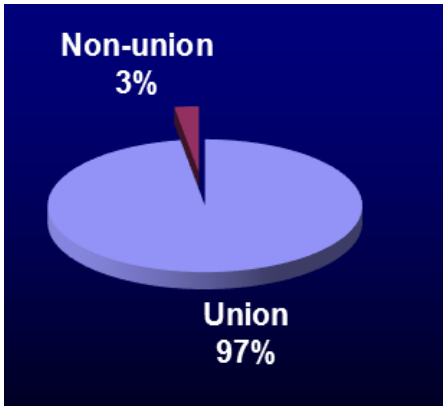

Chart 9: Union

The average time taken for union was 16.40 weeks. Type I fractures taken average time of 12.5 weeks, Type II fractures taken 15.33 weeks, Type fractures taken 17.8 weeks, and Type IV fractures taken 20 weeks for union.
97% of the fractures united with 3 fractures showing delayed union and 1(3%) fracture going for non-union.

M) Grading of results

Table XI: Grading of results

RR Types	Present Study		
	Good	Fair	Poor
I	2	-	-
II	4	2	-
III	4	4	2
IV	-	1	1

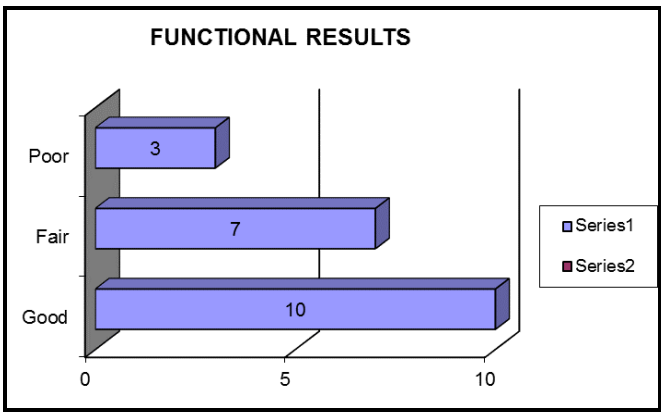

Chart 10: Grading of results

In the present study type I fractures had good results, type II fractures out of 6, 4 had good and 2 fair results. There were 10 cases of type III fractures out of winch 4 had good, 4 fair and 2 poor results. There were 2 cases of type IV fractures out of which 1 had fair and 1 had poor results.

Pre-Operative

Post-operative

Implant Failure

4. Conclusion

Fractures of the distal humerus often produce extensive soft tissue injury in addition to the bony injury. Preoperative roentgenograms should be carefully evaluated and appropriate treatment should be instituted as soon as possible. If open reduction is delayed by indecision or follows the failure of closed methods, the best time for surgery may be lost and soft tissue contractures, myositis ossificans and a more difficult reconstructive procedure are more likely. Regardless of the method of treatment, substantial damage to the distal humerus usually results in some limitation of motion, pain, weakness and possibly instability. Even minor irregularities of the joint surface of the elbow can cause some loss of function. This can usually be minimized by early, accurate open reduction with sufficiently rigid fixation to permit immediate motion.

Operative treatment with rigid anatomical internal fixation should be the line of treatment for all grades of Rise borough Radin intercondylar fractures, more so in young adults as it gives best chance to achieve good elbow function. Vigorous, active physiotherapy is a must for good results. Stable fixation allows early, active and aggressive postoperative mobilization.

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