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The effectiveness and complications of distal end radius fractures treated with locking compression plate

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Abstract

Open reduction and internal fixation is indicated to address the unstable distal radius fractures and those with articular incongruity that cannot be anatomically reduced and maintained through external manipulation and ligamentotaxis, provided sufficient bone stock is present to permit early range of motion. Following admission to the hospital, a careful history was elicited from the patients and / or attendants to reveal the mechanism of injury and the severity of trauma. All patients were thoroughly examined. Their general condition associated systemic diseases and associated injuries were noted. All the findings were duly recorded in the patient proforma. Of the 20 cases, 4(20%) of the fractures were of Type I Frykman's classification, 2(10%) of Type II, 7(35%) of Type III, 3(15%) of Type IV, 1(5%) of Type V and 3(15%) of Type VIII. There were no cases of Type VI and VII fractures. We had excellent results, 9(45%) good results, 2(10%) fair results and no poor results.

Keywords: complications, distal end radius fractures, locking compression plate

Introduction

Fractures of distal end of radius continue to pose a therapeutic challenge. Intra articular and extra articular malalignment can lead to various complications like post traumatic osteoarthritis, decreased grip strength and endurance, as well as limited motion and carpal instability^[1].

Open reduction and internal fixation is indicated to address the unstable distal radius fractures and those with articular incongruity that cannot be anatomically reduced and maintained through external manipulation and ligamentotaxis, provided sufficient bone stock is present to permit early range of motion^[2].

Internal fixation of metaphyseal bending fractures has become increasingly popular due primarily to (a) directly control and maintain physiologic palmar tilt, (b) prevent collapse with external fixation, and (c) avoid bridging the radiocarpal joint. The distal fragment typically has sufficient size and integrity to provide adequate purchase and may be approached from either a dorsal or a volar approach. Palmar plating is preferred, as the screws directly buttress against collapse and loss of palmar tilt. With smaller and more distal fragments, a dorsal plate has to be positioned distally on the dorsum of the radius making extensor tendon injury more likely^[3]. There are two types of plates for fractures of distal radius (a) Conventional plates and (b) Fixed angle locking compression plates. When using conventional plates comminution must be less, they poorly hold the cancellous bone fragments, toggle of screws in the distal holes of the plate leads to settling and loss of reduction.

With conventional plates and screws stability is achieved by compression of plate to bone by bicortical screws. With fixed angle locking plates the locking screws support subchondral bone and resist axial forces. Compression of locking compression plate to bone is unnecessary and preserves periosteal blood supply^[4].

Fixed angle construct provides additional strength to fixation by constructing a scaffold under the distal radial articular surface^[5].

Volar fixed angle locking plates are an effective treatment for unstable extra articular distal radius fractures allowing early post operative rehabilitation^[6].

Because of angular stability of locking compression plates reduction can be maintained over times so that secondary displacement is no longer a problem^[7].

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Primary stability achieved with locking screw in a plate prevents secondary displacement irrespective of the bone enabling good results in osteoporotic bones and young patients [8].

Under 100N axial load, the palmar locking compression T-plate restores stability comparable to that of an intact radius, and is superior to conventional palmar or dorsal T-plate [4].

The development of fixed angular stable fixation techniques theoretically improves stability to maintain the reduction of fractures in osteoporotic bones and fractures considered to be unstable [1].

When the wrist is in extension the carpal bones are in contact with the surface of the impact. At the same time, the radial head is in compression against the humerus. This force is then automatically transmitted to the distal end of the radius. It is at this moment that the fracture occurs.

It is therefore a mechanism of compression impaction and crush; the wrist is an anvil on which the radius is crushed.

This theory is based on the very important fact that all distal radial fractures are compression fractures and the fall occurs on a wrist in extension-pronation. Tensile forces act on the anterior part and compression forces on the posterior part. The posterior constraint forces are very high.

The indirect forces presented by the body weight are transmitted through the humerus, the ulna, the interosseous membrane, the distal radius and then the volar wrist ligaments to the point of impact of the hand. The distal radial fracture is then caused by an avulsion mechanism applied by the tensile forces transmitted by the volar wrist ligaments.

If tension increases at the level of the ulnar collateral ligament when the radial fracture occurs, an ulnar styloid process fracture will occur at the same time. The skin is usually not lacerated at the palm, implying that the hand has not slipped but was blocked on the floor. The body continues to go forward, moved by kinetic energy or inertia, and the volar wrist ligaments become tense because the wrist is placed in a hyperextended position.

If these ligaments resist, the forces are transmitted to the radiocarpal joint and the radius is in compression against the articular facets of the bones of the first carpal row. If the scaphoid and lunate are not crushed, the forces end at the level of the radius to produce a fracture at the weakest part of this bone. The dorsomedial fragment that separates due to this impact is called the 'die punch fragment'.

Methodology

Twenty adult patients with distal radial fractures treated were included in this study.

Inclusion Criteria

- Adults (aged over 18years), both male and female with unstable, comminuted or intra articular fractures of distal end radius.
- Patients willing for treatment and given-informed written consent.

Exclusion Criteria

- Patients aged below 18years.
- Patients medically unfit for surgery.
- Compound fractures associated with vascular injuries.
- Patients not willing for surgery.

Pre-Operative Evaluation

Following admission to the hospital, a careful history was elicited from the patients and / or attendants to reveal the

mechanism of injury and the severity of trauma. All patients were thoroughly examined. Their general condition associated systemic diseases and associated injuries were noted. All the findings were duly recorded in the patient proforma.

All patients presented with the involved elbow flexed and the wrist supported by the other hand. Careful inspection of the deformity, swelling and ecchymosis were done. Clinically tenderness, bony irregularity, crepitus and the relative position of radial and ulnar styloid process were elicited. Movements of the wrist and forearm were checked and found to be painful and limited. Distal vascularity was assessed by radial artery pulsations, capillary filling, pallor and paraesthesia over finger tips.

The involved forearm was immobilized in a below elbow POP slab and kept elevated. Pain and inflammation were managed using analgesics like diclofenac sodium 50mg twice daily.

Results

Table 1: Mode of Injury

Mechanism of Injury	No. of Cases	Percentage
Road traffic accident (RTA)	12	60
Fall on outstretched hand (FOOH)	8	40

In our study there were 12 (60%) patients with road traffic accidents and 8 (40%) patients fell on their outstretched hand.

Table 2: Type of Fracture According to Frykman's Classification

Type	No. of Cases	Percentage
I	4	20
II	2	10
III	7	35
IV	3	15
V	1	5
VI	0	0
VII	0	0
VIII	3	15

Of the 20 cases, 4(20%) of the fractures were of Type I Frykman's classification, 2 (10%) of Type II, 7 (35%) of Type III, 3(15%) of Type IV, 1(5%) of Type V and 3(15%) of Type VIII. There were no cases of Type VI and VII fractures.

Complications

Table 3: Complications

Complications	No. of Cases	Percentage
Extensor pollicis longus tendon irritation	1	5
Arthritis	1	5
Total	02	10

1 (5%) patient had extensor pollicis longus tendon irritation because of long volar to dorsal screw. 1 (5%) patient had developed arthritis of the wrist joint due to improper reduction and articular step and Werley based on objective and subjective criteria, residual deformity and complications.

Table 4: Results

Results	No. of Cases	Percentage
Excellent	9	45
Good	9	45
Fair	2	10
Poor	0	0

We had excellent results, 9(45%) good results, 2 (10%) fair results and no poor results.

Discussion

In our study 64% of the patients had road traffic accident and 36% had a fall on the out stretched hand.

Table 5: RTA comparison

Series	Road traffic accident	Fall on the out stretched hand	Direct blow
Ayhan Kilic <i>et al.</i> , (2009) ^[9]	13	14	-
Kevin C. Chung <i>et al.</i> , (2006) ^[10]	42	45	-
R.E. Anakwe <i>et al.</i> , (2010) ^[11]	14	7	-
Arora Rohit <i>et al.</i> , (2007) ^[12]	40	60	14
Present study	12	8	-

Kevin C. Chung *et al.* (2006) ^[10] and Arora Rohit *et al.* (2007) ^[12] reported fall on the outstretched hand as the most common mode of injury. We reported road traffic accident as the more common mode of injury. Ayhan Kilic *et al.* (2009) ^[9] and R.E. Anakwe *et al.* (2010) ^[11] also reported similar findings in their series. Based on AO classification, we had 2 (10%) A2 type fractures, 4 (20%) A3, 1 (5%) B1, 4 (20%) B2, 4 (20%) B3, 4 (20%) C1, and 1 (5%) C2 fractures. Ayhan Kilic *et al.*, (2009) ^[9] reported maximum number of cases of AO C2 type of fractures. Kevin C. Chung *et al.*, (2006) ^[10] reported maximum number of cases of AO C1 and A3 type of fractures. R.E. Anakwe *et al.*, (2010) ^[11] reported maximum number of cases of AO C3 and C2 type of fractures. Arora Rohit *et al.*, (2007) ^[12] reported maximum number of cases of AO A3 and C2 type of fractures. Our series is has maximum number of cases of AO type A3, B2, B3 and C1 type of fractures.

We encountered a complication rate of 10%, out of which 1 (5%) was due to extensor pollicus longus tendon irritation, caused by long volar to dorsal screw, 1 (5%) developed arthritis of wrist joint secondary to improper reduction and articular step.

Ayhan Kilic *et al.*, (2009) ^[9] reported a complication rate of 11.1%, Kevin C. Chung *et al.*, (2006) ^[10] reported a complication rate of 9.1%, R.E. Anakwe *et al.*, (2010) ^[11] reported a complication rate of 4.8% and Arora Rohit *et al.*, (2007) ^[12] reported a complication rate of 57%.

In our series, we had 45% excellent, 45% good, 10%, fair and 0% poor result. Patients, who obtained excellent results, had no residual deformities or pain.

Range of motion was within the normal functional range. They had no arthritic changes or other complications. They were operated within 4 days after injury. Radial length, volar tilt and articular step-off were within acceptable limits. They were co-operative to physiotherapy. Patients with good results had minimal residual deformities, pain and slight limitation. Rest of their findings was within acceptable parameters.

Patients with fair results, along with residual deformity, pain and limitation also had pain in the distal radio-ulnar joint and minimal complications. Few of their movements were less than that required for normal function.

Our series is comparable to that of Ayhan Kilic *et al.*, (2009) ^[9] who had 44.4% excellent, 44.4% good, 11.2% fair.

Kevin C. Chung *et al.*, (2006) ^[10] out come measures included radiographic parameters grip strength, lateral pinch strength, the Jubsen Taylor test, wrist range of motion and Michigan hand questionnaire compared to normal side. In his series decrease in mean grip strength, ean pinch strength and mean

flexion of the wrist was 86% of normal side.

R.E. Anakwe *et al.*, (2010) ^[11] system outcome was assessed using clinical examination grip strength measures, radiographs and PRWE (patient related wrist evaluation) scoring. In his series 95% patient very high level of satisfaction, good functional outcome and increased grip strength.

Rohit Arora *et al.*, (2007) ^[12] used modified Green and Obrein score he had 31 excellent, 54 good, 23 fair and 6 poor results.

Conclusion

We encounterd two complications (10%) in our study. one being extensor tendon injury, which was because of long screws projecting dorsally. other complication being arthritis in one patient which was because of improper reduction and articular step. These complications can be prevented once the surgeon gets adapted to the procedure.

Use of locked compression plates in distal radius fractures provide good to excellent results and are effective in the correction and maintenance of distal radius anatomy. By using these plates, joint motions and daily functioning is recovered in a shorter time.

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