Original Article

Functional analysis of patients with fracture of distal end radius managed using volar locking plate

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Abstract

Introduction: Distal radius fractures crush the mechanical foundation of man's most elegant tool, the hand. No other fracture has the potential to devastate hand function and no metaphysis is embraced by more precious soft tissue as the distal radius. Fractures of distal radius are amongst the most common fractures encountered by orthopedic surgeons and at times the most challenging. These fractures account for one sixth of all fractures treated in emergency and the incidence of this injury appears to be both age and gender specific. **Aims and Objectives:** To study Functional Analysis of Patients with Fracture of Distal End Radius managed using volar locking plate **Methodology:** This was a prospective study conducted on 30 patients of either sex, in the age group of 18 years and above, with displaced, unstable, intra-articular fractures of distal end of radius admitted in G. M. C. Jammu from May, 2010 onwards. The criteria of case selection for this study were in consonance with the Fernandez classification of the fractures of distal end of radius. All patients above 18 years of age with unstable distal radius fractures were selected. **Result:** 50% of our patients reported no pain during follow-up period while 27% reported occasional pain and 23% reported mild paid which restricted them in doing heavy work. 87% of our patients achieved a mean range of motion which was >60% of that of the normal side. In 93% of the patients, fracture united within 8 weeks post-operatively. In 77% of the patients, fracture united clinically (i. e. no tenderness at fracture site) within 10 weeks post-operatively. 63% of the patients were graded as excellent according to Frykman Criteria. , 27% of the patients had good outcome and 10% had fair outcome. **Conclusion:** Union at fracture site was achieved within an average of 6. 7 weeks radiologically and 7. 9 weeks clinically(no tenderness at fracture site). Majority of our patients (50%) were pain free with relatively better range of motion and grip strength without restriction of any daily activity. Final functional and radiological outcome of our study revealed 90% of the patients had excellent and good results, 10% had fair results.

Key Words: Fracture of Distal End Radius, Colles's fracture.

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INTRODUCTION

Distal radius fractures crush the mechanical foundation of man's most elegant tool, the hand. No other fracture has the potential to devastate hand function and no metaphysis is embraced by more precious soft tissue as the distal radius. Fractures of distal radius are amongst the most common fractures encountered by orthopedic surgeons and at times the most challenging. These fractures account for one sixth of all fractures treated in emergency and the incidence of this injury appears to be both age and gender specific[1].

MATERIAL AND METHODS

This was a prospective study conducted on 30 patients of either sex, in the age group of 18 years and above, with displaced, unstable, intra-articular fractures of distal end of radius admitted in G. M. C. Jammu from May, 2010 onwards. The criteria of case selection for this study were

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in consonance with the Fernandez classification of the fractures of distal end of radius. All patients above 18 years of age with: - Unstable distal radius fractures (intra-articular or extra-articular) i. e. dorsal communition of more than 50% of the width laterally, palmar metaphyseal communition, loss of palmar tilt more than 5 degrees, radial shortening of more than 5 mm, intra – articular disruption of more than 2 mm, associated fractures of ulna or ulnar styloid. Failure of conservative treatment. Bilateral fractures of distal radius along with associated fractures of the carpals. Fractures with radiocarpal instability. , Open fractures, patients below 18 year, . patients with gross osteoporosis, patients with neurovascular compromise, patients with pathological fractures were excluded from study. The operative procedure was undertaken after taking informed consent of the patient, under general anesthesia/regional block (axillary block) and under tourniquet control. If there was metaphyseal instability due to communition, we used ligamentotaxis via manual traction to maintain length of the radius. Volar approach was used for fixation of all distal end radius fractures (Henry's modified palmar approach to distal radius between flexor carpi radialislongusand radial artery). Also, post-operatively, broad spectrum antibiotics were infused and hydration and analgesia was taken care off. The patients were discharged on 10th day post-operatively. Physiotherapy was started on first post-operative day and constituted of Codman's six pack system.

RESULT

Table 1: Distribution of the Patients as Per the Pain Reported

Types	No. of Patients	Percentage (%)
No Pain	15	50
Occasional pain	8	27
Mild pain	7	23
Severe pain	0	0

It is evident from the table above that 50% of our patients reported no pain during follow-up period while 27% reported occasional pain and 23% reported mild paid which restricted them in doing heavy work.

Table 2: Distribution of the Patients as Per the Daily Activity

Type of Work	No. of Patients	Percentage (%)
Return to normal work	27	90
Routine daily work only	3	10
Unable to work	0	0

It can be seen that 90% of the patients returned to normal work and 10% ended up with slight limitation of activity.

Table 3: Distribution of the Patients as Per the Range of Motion

Percentage of normal side	No. of Patients	Percentage (%)
30 – 40	1	3
41 – 50	1	3
51 – 60	2	7
61 – 70	4	13
71 – 80	6	20
81 – 90	10	34
91 – 100	6	20

87% of our patients achieved a mean range of motion which was >60% of that of the normal side after removing the underlying screw and giving appropriate rest to the thumb.

Table 4: Distribution of the Patients as Per the Radiographic Union of Fracture

Weeks	No. of Patients	Percentage (%)
4-8	28	93
8. 1-12	2	7

From the table above, it can be seen that in most of the patients (93%) fracture united within 8 weeks post-operatively as seen on radiographs.

Table 5: Distribution of the Patients as Per the Clinical Union of Fracture

Weeks	No. of Patients	Percentage (%)
6-9	23	77
9. 1-12	7	23

From the table above, it can be seen that in most of the patients (77%) fracture united clinically (i. e. no tenderness at fracture site) within 10 weeks post-operatively.

Table 6: Distribution of the Patients as Per the Final Outcome

Grade	No. of Patients	Percentage (%)
Excellent	19	63
Good	8	27
Fair	3	10
Poor	0	0

Final outcome of the patients was done using Frykman Criteria. It is evident from the table above that most of our patients (63%) were graded as excellent according to Frykman Criteria. 27% of the patients had good outcome and 10% had fair outcome.

DISCUSSION

Parameters	Hove 1997	Carter 1997	Jorge L Orbay 2002	Re Ankawe 2010	Present study 2012
No pain	16 (51%)	57 (80%)	26 (92%)	10 (47%)	15 (50%)
Occasional pain	9 (29%)	13 (19%)	1 (3%)	7 (30%)	8 (27%)
Mild pain	3 (10%)	0	2 (5%)	4 (23%)	7 (23%)
Severe pain	3 (10%)	1 (1%)	0	0	0

Our results are comparable to other studies, as seen in the table above. In our study 50% of patients were pain free, 27% of patients had occasional pain and 23% of patients had mild pain and no patient had severe pain.

Parameters	Jupiter 1993	Carter 1997	Kenichi Murakami 2007	Hanae Minegishi 2011	Present study 2012
Mean extension	60^0	58^0	61^0	55.5^0	66^0
Mean flexion	60^0	52^0	55^0	59.3^0	52^0
Mean radial deviation	20^0	20^0	23^0	20.5^0	26^0
Mean ulnar deviation	25^0	31^0	35^0	31.2^0	30^0
Mean pronation	71^0	82^0	87^0	86.3^0	76^0
Mean supination	80^0	82^0	87^0	90.4^0	75^0

The results of range of motion are comparable with other studies done elsewhere. The range of motion results manifested in such a way that 90% of our patients had no restriction of daily activity and 10% had slight limitation of daily activities.

Parameters	Jorge L Orbay 2002	Re Ankawe 2010	Minos E Tyllianakis 2011	Present study 2012
Time to Union in Weeks	5. 6	12	5. 3	6. 7

The results of our study is comparable with that of Jorge L Orbay[52] and Minos E Tyllianakis[22]. Re Ankawe[23] showed that the fractures united completely (no fracture line visible) by 12 wks as shown on x-rays.

Parameters	Nienstedt 1999	Jorge L Orbay 2002	Kenichi Murakami 2007	Hanae Minegishi 2011	Present study 2012
Excellent	18 (85%)	19 (61%)	20 (83%)	14 (93%)	19 (63%)
Good	2 (9%)	12 (39%)	4 (17%)	1 (7%)	8 (27%)
Fair	0	0	0	0	3 (10%)
Poor	1 (6%)	0	0	0	0

Using Frykman criteria, our results were compared with results of other studies. 63% of the patients had an unrestricted wrist function, no subjective complaint and no visible deformity. 27% of the patients had an unrestricted wrist function but minor subjective complaint. 10% of the patients had less satisfactory wrist function when working with a tool or upon extreme of movements but function otherwise was retained. There was moderate loss of strength of wrist. The result of our study were not comparable to most of the studies, which may be due to the fact that these studies had a post-operative patient follow-up of 2 years where as our study had a follow up of 6 months. Amongst 3 of our patients who had fair outcomes, 2 of them had suffered a fracture of distal end radius for the second time involving the same extremity.

DISCUSSION

Historically, the accurate description of these fractures is first ascribed to Petit, Pouteau (1780)[2] and Abraham Colles (1804)[3]. Colles article named "On the fracture of the carpal extremity of radius" is considered a milestone in the history of the radius fractures, wherein he gave a clear description of what today is commonly known as the Colles's fracture[4]. With time further facts and description of the distal radius fractures was credited to Barton (1838)[5], Dupeytren (1847)[6] and Smith(1854)[7]. Today, it is more important to determine the exact nature and anatomy of the fracture and describe the pathology involved, rather than linking the diagnosis and treatment to a single name. Fractures of distal radius are amongst the most common fractures encountered by orthopedic surgeons and at times the most challenging to treat. These fractures account for one sixth of all fractures treated in emergency and the incidence of this injury appears to be both age and gender specific[8]. Ellis (1965)[10]was the first person to describe open reduction and internal fixation for fractures of distal end radius using a t-shaped buttress plate for volar barton and smith fracture. Subsequently Knirk and Jupiter(1986)[32], Fernandez and Geissler(1991)[12], Cooney(1992)[13]and Carter, Frederick and Laster (1998)[14] have shown that restoration of articular congruency is more important than restoring palmar tilt and radial length. Advancement in the design and biomechanics of volar plates have taken place to allow a more snug fit on the palmar surface, to effectively withstand the immediate post-operative demand, including axial loading, bending and distal fragment rotation. The usual mechanism of injury in case of distal radius fractures is fall on the outstretched hand. Various theories have been put forth regarding the sequence of

events leading to distal radius fractures. The theories which have stood the test of time are: Blow and Counterblow theory: This concept was initially put forth by Dupuytren in 1834 and supported by several succeeding investigators. This theory suggested that it is the force of the body weight which is transmitted through the carpus directly to the distal radius specifically at the distal metaphysis where the cortex is thinnest.[15] Ligament avulsion theory: This concept was first suggested by several investigators including Lecomte (1861). The basis of this theory centered on the fact that the close anatomic relationship between the olecrenon and distal humerus resulted in the ulna rather than the radius absorbing more of the impact of the fall. Lecomte suggested that the force of injury was transmitted to the radius and volar radiocarpal ligaments, which then produced traction force sufficient to create a fracture of distal radius[16]. Bending fracture theory: Mayer in 1925 suggested that the characteristics of the distal radius fractures were influenced by three factors: - the position of the hand, the surface upon which the impact occurred and the velocity of the force[17]. Lewis in 1950 expanded this approach by suggesting that at the moment of impact, the hand remain in place while the kinetic energy of the fall manifests itself as continued forward movement of the body. The hyper-extended position of the hand and wrist places an increased load on the volar radiocarpal ligaments while the proximal carpal row is pressed against the end of the distal radius. Using the analogy of a cantilever beam loaded beyond its limit of elasticity, Lewis considered failure of the beam (or distal radius) to have occurred as a result of a bending moment[18]. Failure of non-operative treatment is common and is the largest risk of an adverse outcome. Only 27% - 32% of fractures are in acceptable alignment 5 weeks after closed reduction[19]. The locking head screws of internal fixator are actually more like threaded bolts. These bolts maintain the relative position between the body of fixator and the bone. These screws get locked into the plates on tightening. This gives the screw axial and angular stability relative to the plate which serves as an internal fixator[20]. S Matschke, A Wentzensen, D Ring, L Audige, M Maret-Huber, JB Jupiter(2010)[21] performed a study to compare radiological and functional outcomes between volar and dorsal surgical fixation of distal radius fractures using low-profile, fixed-angle implants in 305 patients. They found volar internal fixation of distal radius fractures with LCP implants can result in earlier and better functional outcome compared with the dorsal approach, yet is associated with a higher incidence of complications. After 2 years, these differences are no longer observed between the two surgical methods.

CONCLUSION

Union at fracture site was achieved within an average of 6. 7 weeks radiologically and 7. 9 weeks clinically(no tenderness at fracture site) Majority of our patients (50%) were pain free with relatively better range of motion and grip strength without restriction of any daily activity. Final functional and radiological outcome of our study revealed 90% of the patients had excellent and good results, 10% had fair results.

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