

CLINICAL AND FUNCTIONAL OUTCOME OF DISTAL RADIUS FRACTURES MANAGED BY LIGAMENTOTAXIS AND/OR PERCUTANEOUS PINNING VERSUS OPEN REDUCTION & INTERNAL FIXATION BY BUTTRESS PLATES

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ABSTRACT: INTRODUCTION: We studied the clinical and functional outcome of distal radius fractures managed by ligamentotaxis and/or percutaneous pinning versus open reduction & internal fixation by buttress plates. **METHODS:** This prospective study was conducted during Aug 2012 to October 2014. All skeletally matured patients were having both Intra articular and extra articular Closed Distal Radius fractures were studied. Treatment was done either external fixator supplemented with k wires or internal fixation with plate and screws. The radiographic evaluation included radial length, palmar tilt, any evidence of joint incongruity and radio ulnar joint instability and arthritis. The assessments that were made includes Subjective assessment – pain, numbness, weakness of hand, stiffness, **OBJECTIVE:** Range of motion measured by hand held goniometer, Measurement of grip strength done by commercially available hand dynamometer. Unaffected hand served as control. **RESULTS:** Male patients (85.46%) outnumbered female patients (14.54%) in incidence. The incidence of distal radius fractures was common between the ages of 20 to 40 years. Left sided fractures were more common (52.73%). Type III was most common type of fracture (Frykman's Classification), accounting for 29% of all fractures. 25 cases were treated by external fixation and 30 cases were treated by open reduction and buttress plating. The results were evaluated by using STEWART ET AL anatomical and functional scoring system. The average range of movement at the knee joint was Dorsiflexion 70*, Palmar Flexion 65*, Ulnar Deviation 25*, Radial Deviation 15*, Supination 70*, Pronation 65*. Most common early complication was pin tract infection. Based on the Stewart et al scoring, 4(7.27%) had excellent, 43(78.18%) had good, 7(12.72%) had fair, 1(1.81%) had poor results. **CONCLUSION:** We observed that both fixations were equally same, there is no superiority with over the other. The incidence of complications in internal fixation (10%) is fewer compared to external fixation (24%) in this study.

KEYWORDS: Ligamentotaxis, Percutaneous pinning, Buttress plate.

INTRODUCTION: The fracture of the distal end of radius was first identified by Sir Abraham Colles in 1814,^(1,2) This was an extra articular fracture and occurred in elderly individuals with osteoporotic bones.⁽¹⁾ He described six classical deformities and advocated plaster cast as the treatment of choice. With the increase in high velocity trauma, there has been an observed increase in the incidence and fracture patterns of the distal radius. Younger individuals with good bone stock with intra-articular involvement have been more common. Plaster application in these

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fractures results in a lapse of functionality of the wrist and unsatisfactory cosmetic finish. Radial shortening, finger stiffness and wrist joint arthritis are common sequelae. Many methods of treatment have been tried to circumvent these problems. External fixation of the displaced fragment under radiological control, supplemented by percutaneous fixation with k-wires has given excellent results. Volar or dorsal rim fractures of distal radius demand the need for buttress plate fixation. The results of closed reduction followed by Immobilization in external fixation and buttress plating provide a viable and better alternative to physiologically young patients whose work schedule places a heavy load on the wrist. Thus the upcoming modality of treatment of unstable fractures of distal end of radius with intra-articular extension is either by external fixation or buttress plating. We assessed the clinical and functional outcome of distal radius fractures managed by ligamentotaxis and/or percutaneous pinning versus open reduction and internal fixation by buttress plates.

METHODS: This prospective study was conducted during Aug 2012 to October 2014. All study patients were having closed distal radius fractures, both intra articular and extra articular fracture's and were skeletally mature individuals were included. Patients with open fractures, fractures with vascular deficit, Ipsilateral long bone fractures of the same extremity, associated tendon and nerve injuries and associated fractures of hand skeleton (Metacarpal and Phalanges) were excluded. The assessments that were made includes subjective assessment – pain, numbness, weakness of hand, stiffness, Objective – range of motion measured by hand held goniometer, Measurement of grip strength done by commercially available hand dynamometer unaffected hand served as control. Treatment was done either external fixator supplemented with k wires or internal fixation with plate and screws. Post operatively, upper limb was elevated for 24 hours with monitoring of neurovascular status. Early motion of digits, elbow and shoulder was encouraged. Fixator was left in situ for 6-12 weeks. Fixator removal was considered only after clinical and radiological evidence of fracture healing. After fixator removal a splint was given for another 2 weeks that was to be removed during exercises. Range of motion exercises for fingers, wrist and elbow were advised. Patients were assessed subjectively and objectively. A detailed questionnaire was prepared for each patient to evaluate factors like pain, functional limitations and occupational hindrance. Objective examination included inspection of the wrist for deformity, tenderness, abnormal mobility of the distal radio ulnar joint, measurement of range of movements of wrist joint, grip strength, light touch and pin prick sensations. The radiographic evaluation included radial length, palmar tilt, any evidence of joint incongruity and radio ulnar joint instability and arthritis.

| Dorsal angle | Loss of radial length(mm) | Loss of radial angle (degrees) | Score |
|--------------|---------------------------|--------------------------------|-------|
| neutral | 0-2 | 0-4 | 0 |
| 1-10 | 3-6 | 5-9 | 1 |
| 11-14 | 7-11 | 10-14 | 2 |
| >15 | >12 | >15 | 4 |

Excellent =0, Good=1-3, Fair =4-6 and Poor =>7

Table 1: Criteria for evaluation of end result of distal radius fractures- (Stewart et al)

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| FUNCTIONAL (Demerit Point System) | |
|---------------------------------------------------------------------------------------------------------------------------------------------|-----|
| Prominent ulnar styloid | 1 |
| Residual dorsal tilt | 2 |
| Radial deviation of hand | 2-3 |
| SUBJECTIVE EVALUATION | |
| Excellent: no pain, disability or limitation of motion | 0 |
| Good: occasional pain, light limitation of motion, no disability | 2 |
| Fair: occasional pain, some limitation of motion, feeling of weakness In wrist, no particular disability, slightly restricted activities | 4 |
| Poor: pain, limitation of motion, disability, activities markedly | 6 |
| OBJECTIVE EVALUATION | |
| Pain in distal radio ulnar joint | 1 |
| Grip strength <60% of normal side | 1 |
| Loss of circumduction | 1 |
| Loss of radial deviation <15% | 1 |
| Loss of palmar flexion <30* | 1 |
| Loss of pronation <50* | 2 |
| Loss of supination <50* | 2 |
| Loss of ulnar deviation <15* | 3 |
| Loss of dorsiflexion <45* | 5 |
| COMPLICATIONS | |
| Arthritic changes | |
| No changes | 0 |
| Minimum | 1 |
| Minimum with pain | 3 |
| Moderate | 2 |
| Moderate with pain | 4 |
| Severe | 3 |
| Severe with pain | 5 |
| nerve complications | 1-3 |
| poor finger function due to cast | 1-2 |
| The overall scoring was graded as follows: excellent= 0 – 2, good= 3 – 8, fair= 9 – 20 and poor=21 & above | |
| Table 2 | |

RESULTS: 55 cases admitted in Narayana General Hospital were considered for the study. The following observations were made from the data collected during the study and the data was tabulated as follows. Out of 55 cases, 47 were males and 8 were females. In our series, left sided fractures were commoner than the right sided fractures. Road traffic accidents were the main

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cause of injury. Frykman type III was the commonest fracture pattern in our study. Two patients had associated injuries like subtrochanteric fractures.

The results were correlated using chi square method. The chi square value was found to be 1.97 and p value 0.578 which shows that sex of the patient did not influence the outcome of the treatment. The youngest patient in the series was 18 years old and the oldest was 70 years old in this case study. The chi square value was found to be 3.99 and p value 0.2629 which shows that age of the patient did not influence the outcome of treatment. Majority of the cases were left sided. Largest number of cases was of Frykman type III.⁽³⁾ The chi square value was found to be 21.62 and p value 0.0001 which shows that method of fixation determined the outcome of treatment.

| | Internal fixation (n=30) | External fixation (n=25) |
|-----------------------|-------------------------------------|-------------------------------------|
| Gender | | |
| Males | 24 | 23 |
| Female | 6 | 2 |
| Age (yrs) | | |
| 18-20 | 4 | 2 |
| 20-30 | 7 | 6 |
| 30-40 | 8 | 5 |
| 40-50 | 3 | 3 |
| 50-60 | 6 | 7 |
| 60-70 | 2 | 2 |
| Side | | |
| Right | 14 | 10 |
| Left | 16 | 15 |
| Mode of injury | | |
| RTA | 24 | 15 |
| Fall | 6 | 10 |

Table 3: Demographic characteristics of patients

| Frykman's Fracture classification | Internal fixation (n=30) | External fixation (n=25) |
|------------------------------------------|-------------------------------------|-------------------------------------|
| Type I | 2 | 0 |
| Type II | 0 | 0 |
| Type III | 10 | 6 |
| Type IV | 5 | 4 |
| Type V | 5 | 4 |

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| | | |
|----------------------|----|----|
| Type VI | 4 | 3 |
| Type VII | 2 | 4 |
| Type VIII | 2 | 4 |
| Results | | |
| Excellent | 3 | 1 |
| Good | 25 | 18 |
| Fair | 2 | 5 |
| Poor | 0 | 1 |
| Complications | | |
| Wrist stiffness | 2 | 2 |
| Pin site loosening | 0 | 1 |
| Pin site infection | 0 | 2 |
| Finger stiffness | 1 | 1 |

Table 4: Characteristics of fractures, outcomes and complications

| Wrist | Normal ROM | Result (average) |
|------------------|-------------------|-------------------------|
| Dorsiflexion | 70 | 70 |
| Palmar flexion | 75 | 65 |
| Ulnar deviation | 30 | 2 |
| Radial deviation | 20 | 14 |
| Forearm | | |
| Supination | 80 | 70 |
| Pronation | 75 | 65 |

Table 5: Movements after surgery compared with normal side

DISCUSSION: Increased awareness of the complexity of Colles fracture has stimulated a growing interest and prompted new ideas regarding their optimal management. Although closed reduction with cast immobilization remains a reliable standard of treatment for stable extra-articular fractures and minimally displaced articular injuries, similar management for unstable articular disruption is prone to failure.

Ever since Bohler ⁽¹⁾ advocated the use of fixed pin traction to maintain the reduction for comminuted fracture of the distal end of radius, this method has been recommended and modified by many surgeons. Then, came the external fixator in the treatment of these fractures, growing in popularity because of their sound mechanical stability and fixed traction which prevents shortening due to initial bone loss and later resorption of the cancellous bone in the metaphysis of the distal radius. The management of distal radius fractures has changed considerably since Cassebaum (1950) supported Abraham Colles ⁽⁴⁾ statement that a patient with a colles fracture will not have pain or serious functional disability despite considerable deformity. This is no longer acceptable. Mc Queen and Caspers (1988)⁽¹⁾ have shown a clear correlation between anatomical reduction and functional results. Secondary reconstruction is difficult and

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repeated manipulations appear to increase the risk of oligodystrophy. It therefore seems that fractures of the distal radius should be treated by principles usually applied to other articular fractures.

Intra-articular fractures with a step of over 2mm in the radiocarpal joint inevitably result in osteoarthritis and functional impairment. It is therefore important to reconstruct the joint surface and make it congruent. Plating (T plate) enables both the radiocarpal and radioulnar joints to be perfectly restored. Distal radius fractures account for 20% of all fractures and are only second to hip fractures in terms of incidence in the elderly population.⁽⁵⁾ The present lifetime risk of sustaining fracture is 15% for women and 2% for men.⁽⁵⁾ In our study there were 47 males and 8 female patients indicating that the incidence of distal radius fractures is no longer limited to females. Fragility fracture of the distal part of the radius is a major source of patient morbidity. In the study of 240 patients 181 were women and 59 were men with the mean age of 76 years.⁽³⁾ Of the 65 patients of unstable Colles fracture studied at Mayo's clinic, 53 were women and 7 men.⁽⁶⁾ The mean age was 63 years.⁽⁷⁾ This indicates that Distal radius fractures was more common in the geriatric age group.

In our study 46% of the cases were in the age group of 20 to 40 years. This shows that distal radius fracture is not necessarily confined to geriatric age group.⁽⁶⁾ Thus the incidence of distal radius fractures is increasing in the younger age group too. W P Cooney, in his study of 65 patients of unstable Colles fracture found that 50 patients sustained injury due to fall on outstretched hand.⁽⁶⁾ 6 patients sustained a motor vehicle accident. No specific mechanism of injury was recorded in 4 patients.⁽⁶⁾ In our study, 80% of the patients sustained distal radius fracture following RTA. 20% of patients were injured following fall on out stretched hand. This leads us to conclude that high energy trauma has surpassed self-fall as the major cause for distal radius fractures. All patients were followed for a minimum period of 6 months. For each visit, patient was evaluated clinically and radiologically and the final results were analysed using New York Orthopaedic Hospital Wrist Scoring system. Despite wide spread enthusiasm for plating, current literature does not demonstrate the clear benefit of plating. When a fracture is well reduced either technique will provide similar good results. In this study 55% of the patients were treated by internal fixation (buttress plating) and 45% by external fixator. A number of studies have reported favourable results with external fixation, although most of the studies were retrospective and, thus are difficult to interpret due to the heterogeneous group of patients with a variety of skeletal and soft tissue injuries. In a study by Jesse B. Jupiter,⁽¹⁾ the incidence of complications was high ranging from 20 to 60%.⁽⁸⁾ The complications included infection of pin track, radial sensory neuritis, reflex sympathetic dystrophy, stiffness of the wrist and fracture through the pin sites. Although improved techniques of insertion of pins, pre-drilling have reduced the problems related to pins, the potential for wrist stiffness still remains a concern. In a landmark study in 1979, Cooney et al,⁽⁶⁾ reported only a slight loss of motion in patients who were followed for two years or more.⁽⁸⁾ The range of motion of the wrist that was reported by Clayburn⁽⁹⁾ in 1987, who used a mobile external fixator, showed little, if any, improvement compared with the series of Cooney et al.⁽⁶⁾ Westphal and colleagues performed a retrospective study of 166 out of 237 patients who underwent surgery for AO/ASIF A3 for C2 distal radius fractures. The fractures were treated with either external fixation, in particular palmar plate

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fixation, demonstrated the best radiological and functional results. External fixation falls short when used as the sole treatment for displaced intra articular fractures. In a study of 27 patients with comminuted, displaced intra articular fractures of distal radius fractures that were treated exclusively by external fixation, Arora and co-authors concluded that although the external fixation is reliable in maintaining the reduction in displaced comminuted intra articular fractures, it is inadequate in restoring articular congruity in many cases. Margaliot et al performed a meta-analysis of forty six articles (917 patients) external fixation studies and 18(603 patients) internal fixation studies. They did not detect a clinically or statistically significant difference in pooled grip strength, wrist range of motion, radiographic alignment, pain, and physician rated outcomes between the 2 treatment plans. There were higher rates of infection, hardware failure, and neuritis with external fixation and higher rates of tendon complications and early hardware removal with internal fixation. Considerable heterogeneity was present in all of the studies which adversely affected the precision of the meta analysis. The operative management of these fractures is difficult. Preoperative planning, antero-posterior and lateral X-rays are extremely helpful. The articular reconstruction should be supported by buttress plate. Although enthusiasm for operative approach for complex articular fractures of the distal end of radius is growing, serious complications including loss of fixation, neuritis of median nerve, reflex sympathetic dystrophy and infection of wound can occur even when surgeon is experienced.⁽⁶⁾ All the patients were followed for a minimum period of 16 weeks. For each visit, the patient was evaluated clinically and radiographically and the final results were analyzed with the help of Stewart et al anatomical and functional criteria. The measurements of wrist movements revealed mean dorsiflexion of 70° compared with 75° on the normal side. Mean palmar flexion was 65° as compared with 75° on uninjured side. The average supination and pronation was 70° and 65° respectively. The average ulnar and radial deviation at wrist were 25° and 14° respectively. We measured radial shortening as difference between post reduction and final roentgenogram made for each patient's. There was average loss of 2.8 mm length. One patient had a complaint of moderate wrist pain. For which implant removal was done after a period of 1 year. Postoperatively. Pain was relieved. The final loss of volar tilt was averaged 4° and average loss of radial angle was 5°. As studied by previous surgeons complications encountered in this study were in concurrence with the literature. The most common complications encountered in our series were wrist stiffness, pin tract infection, pin loosening and finger stiffness. In 2 patients infection was superficial and relieved by regular antiseptic dressings and antibiotics. Four patients had wrist stiffness which got relieved with analgesics and physiotherapy. Two patients had finger stiffness and two had pin loosening. The statistical figures show that anatomical and functional results were excellent in 7% of patients in both treated with external fixation and internal fixation. There were 83% patients having good functional outcome at the end of one year follow up with internal fixation. While 72% of patients treated by external fixation had good results. 6% of patients treated with internal fixation had fair results, while 20% of patients treated with external fixation had fair results under the category of poor results, there was 7% of external fixation and no cases of buttress plating were found. The poor results were due to pin tract infection in external fixation. Finally, we got in the series, that both fixations were equally same, there is no superiority with over the other.

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CONCLUSION: We observed that both fixations were equally same, there is no superiority with over the other. The incidence of complications in internal fixation (10%) is fewer compared to external fixation (24%) in this study.

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