ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 5.2
IJAR 2015; 1(10): 1081-1084
www.allresearchjournal.com
Received: 15-07-2015
Accepted: 16-08-2015

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Prospective study of treatment of extra articular fractures of distal end radius by cross k wire fixation and cast immobilisation and its comparison with kapandji's method of intrafocal pinning anatomically and functionally

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Abstract
Aim: the study of extra articular type of fractures of distal end radius in adults, their management with modalities of treatment involving closed reduction and cross K WIRE pinning and below elbow cast and its comparison with intrafocal pinning method of Kapandji and the relative complications.
Material and Method: All procedures were done in the operation theater under short general or i.v. regional anesthesia with monitoring of patient's pulse, blood pressure, SPO2 and ECG recording after aseptic preparation of the effected extremity. The patient was placed on a radiolucent table in supine position. Complete visualization of the fracture pattern of the involved bone was done with the help of C-Arm fluoroscopy in antero-posterior and lateral views.
Results: Dorsal tilt correction evaluation in cases by cross K wire method was Grade I (00-10,20-100) in 24 cases (96%) and Grade II (110-140,>150) in 1 case (4%) and that in Kapandji method was Grade I (00-10,20-100) in 18 cases (72%) and Grade II (110-140,>150) in 7 cases (28%). The cross K wire method is better than Kapandji method with respect to dorsal tilt correction with p=0.0243. Radial shortening evaluation in cases by cross K wire method was Grade I (<3, 3-6) in 24 cases (96%) and Grade II (7-11, >12) in 1 case (4%) and that in Kapandji method was Grade I (<3, 3-6) in 19 cases (76%) and Grade II (7-11, <12) in 6 cases (24%). The cross K wire method is better than Kapandji method with respect to radial shortening with p=0.042.
Conclusion: In cases with dorsal commination treated with Kapandji fixation dorsal tilt ecurrance was noted post reduction as orsoventral K wire had poor hold in near cortex. Despite of these results we suggest method of chaise in these fractures treatment should be made according to judgement of individual surgeon.

Keywords: closed reduction, distal end radius, elbow cast, K WIRE pinning

Introduction
Distal radius fractures account for 17% of all fractures in adults. Thousands of articles were published after Abraham Colles described a very common fracture of the distal end radius in 1814 in the Edinburgh Medical and Surgical Journal [1], have not yet created a consensus as a treatment programme 1. The fracture of the lower end of radius crush the mechanical foundation of man's most elegant tool, the hand [2]. No other fracture has a greater potential to devastate hand function [3]. A thorough understanding of the pathophysiology and treatment of distal end radius is important as high energy trauma to distal end radius in adults is becoming more common and long term functional results are unclear, these common injuries must be evaluated thoroughly and treated adequately. The causes of injury are fall on outstretched hand, work related accidents, car accidents, sport injuries [4].
The typical mechanism of a dorsally displaced distal radius fracture is a fall on outstretched hand. This type of injury results in tensile forces across the volar surface (compression side), compressive forces on the dorsal surface (tension side), and supination of the distal fracture fragment [5]. Compression and torsion across the articular surface can cause various patterns of intra-articular displacement [6].

This study is intended towards the study of extra articular type of fractures of distal end radius in adults, their management with modalities of treatment involving closed reduction and cross K WIRE pinning and below elbow cast and its comparison with intrafocal pinning method of Kapandji and the relative complications.AO classification for distal end radius fractures will be considered and the cases will be treated accordingly.

Material and Method

The cases including fractures of distal end radius AO OTA type A2.1, A2.2, A3.1, A3.2 and A3.3 in adults were considered in this study. Closed reduction and cast immobilisation, manual reduction, under short GA. Or i.v. regional anaesthesia with internal fixation by any of Kapandji's method of intrafocal K wires; cross K wire fixation First 25 cases were treated by Kapandji's method and next 25 cases were treated by cross K wire fixation and all cases were given below elbow cast after internal fixation.

All procedures were done in the operation theater under short general or i.v. regional anesthesia with monitoring of patient's pulse, blood pressure, SPO2 and ECG recording after aseptic preparation of the effected extremity. The patient was placed on a radiolucent table in supine position. Complete visualization of the fracture pattern of the involved bone was done with the help of C-Arm fluoroscopy in antero-posterior and lateral views.

Various types of casts and positions 47 have been recommended but none have been uniformly accepted. The maximally flexed and ulnar deviated position of the wrist impairs function of the hand and increases pressure in carpal tunnel. Neuropathies, ischemia complications and stiffness are most often related to the type and position of cast immobilisation. In this study wrist was immobilized in neutral position with below elbow cast extending from the metacarpophalangeal joints of fingers to the proximal part of forearm just distal to elbow. In this position of wrist incidence of neuropathies, carpal tunnel syndrome and ischemia complications were not there.

Patients were started with physiotherapy for finger ROM, elbow and shoulder ROM exercises from 2ndpost operative day All the operated cases for distal end radius fractures are given below elbow immobilization in pronation for 6 weeks as a protocol. Passive and active range of motion exercises should commence the day of operation and on the 1st post-operative day, the patient should begin training in activities of daily living. Plaster should be checked for tightness, loosening, softening cracks and swelling, if its found it needs to be taken care of Oedema should be treated with limb elevation. The percutaneous K wires are removed at an average 4 weeks. At this point the internal fixation of K wires is removed with administration of sedation.6 weeks post-operatively, strengthening is begun and ultimately work and sports–hardening exercises are started at about 10 weeks post-operative.

Electrical modalities like TENS, Ultrasound, IFT are contraindicated when there is presence of an internal fixation at time of treatment.

1. For 1st six weeks no weight bearing, no wrist function.
2. Rom exercises for shoulder, elbow and joints of digits done regularly and wrist range of movement after cast removal.
3. At end of 6 weeks check for stability, tenderness and range of motion.
4. Physiotherapy exercises are a must in every postoperative case for good functional recovery of the wrist.

Observation and Discussion

Case selection was done in the criteria of history, clinical examination and radiological (X-ray) examination. Soon after the admission clinical data was recorded according to the proforma. The diagnosis was mainly based on clinical examination and was supported by radiological (X-ray) examination COMPARING WITH unaffected upper extremity. In all the cases routine investigations like complete blood count, urine routine and microscopic examination, X-ray examination, blood sugar level, serum creatinine and blood urea were carried out. Initial radiographs of the distal radius should consist of good postero-anterior and lateral views. For additional information later unaffected extremity radiographs were considered. On first post-operative day most of the patients were discharged. First follow up after 4 weeks for checking the cast condition and K wire removal through a window in the cast and closing the window back again. Second follow-upwas at total 6 weeks where in most of the patients immobilised were adviced for cast removal and physiotherapy was started. The next follow-up was after 3 months and then was followed up at 6 months. Results have been noted and filed-up.

The quality of recovery was determined by range of motion, grip strength, peri and post-operative complications, patient satisfaction and radiographic evaluation by the method of Gartland and Werleys wrist grading system [7] in which equal emphasis is placed for a maximum possible findings- each with 50 points for a maximum possible score of 100 points.

AP and lateral X-rays of the wrist were used for various measurements. The radiographs made at the time of the latest follow-up were evaluated for joint congruity comparing with unaffected extremity. The result for each fracture was graded as excellent, good, fair and poor with use of both these systems. Functional end results were assessed by the Lindstroms criteria [7]

Anatomical and radiological results were determined by the Lidstrom classification. This include an average flexion-extension arc of >120 degrees and an average supination-pronation of >150 degrees Dorsal tilt correction evaluation in cases by cross K wire method was Grade I (00-10,20-100) in 24 cases (96%) and Grade II (110-140,>150) in 1 case (4%) and that in Kapandji method was Grade I (00-10,20-100) in 18 cases (72%) and Grade II (110-140,>150) in 7 cases (28%). The cross K wire method is better than Kapandji method with respect to dorsal tilt correction with p=0.0243. Radial shortening evaluation in cases by cross K wire method was Grade I (<3, 3-6) in 24 cases (96%) and Grade II (7-11, >12) in 1 case (4%) and that in Kapandji method was Grade I (<3, 3-6) in 19 cases (76%) and Grade II (7-11, <12) in 6 cases (24%). The cross K wire method is better than Kapandji method with respect to radial shortening with p=0.042.

The injuries to the lower end of radius are not only encountered in the emergency department setting, but the mobility and delicate functional requirements of the hand make accurate diagnosis and treatment crucial to avoiding long-term loss of function and disability47.Because multiple variables influence the results of treatment of injuries such as fractures of distal end of radius, definitive conclusions about

such treatment and factors affecting the outcome are difficult to reach.

Heightened awareness of the complexity of the collies fracture has stimulated a growing interest and promoted new ideas regarding their optional management. Perhaps no fracture in the body is as ubiquitous and fraught with potential complications as the distal radius fracture. Urgent reduction of fractures may be necessary when neurovascular status has been compromised 47.

The importance of anatomic reduction has been demonstrated by clinical studies as well as by laboratory assessment of force and stress studies. In fractures with articular displacement greater than 2 mm, radial shortening greater than 5 mm or dorsal angulation greater than 20°, suboptimal results have been reported in previously published studies.

Accurate reduction of the fracture is the first step in the treatment of distal radial fractures. Many options are available to maintain this initial reduction. The most common traditional method is closed reduction and cast immobilization, but this often fails to prevent early radial collapse and is associated with a high risk of malunion, joint stiffness and painful wrist. Hence, this method is for low-demand elderly patients [8].

Several studies clearly showed that restoration of the radial length is the most important factor in achieving a good end result. However, shortening of the radius is associated with poor results only in cases of severe shortening deformities after conservative treatments. The results of one study indicated that most of the elderly patients with moderate radial shortening and dorsal angulation obtained satisfactory functional outcome and did not show a significant correlation between functional outcome and anatomical outcome [9].

External fixators can maintain radial length and radial inclination by ligamentotaxis, but cannot effectively maintain palmar tilt. Also complication rates as high as 60% have been reported with the use of external fixators. These mainly include pin loosening, pin tract infection, reflex sympathetic dystrophy, radial sensory neuritis and delayed union [10].

Thus, external fixators are better avoided in noncomminuted extraarticular distal radial fractures.

Open reduction and internal fixation and arthroscopic reduction techniques should be reserved for partial and complex intra-articular [11].

Distal radius fractures. Percutaneous pinning with K-wires was first recommended by Green as a simple and inexpensive procedure. Various techniques of percutaneous pinning are available. Most studies attribute poor results of this technique to radial shortening, wrist stiffness and reflex sympathetic dystrophy. The authors are of the view that wrist stiffness and reflex sympathetic dystrophy occur because of the palmarflexed position of the wrist in which postoperative immobilization of the fracture is done. Prolonged immobilization of the wrist increases the magnitude of the problem [12].

On the radiographs when evaluating a fracture of the distal radius anatomic alignments should be checked for, Radial height, ulnar variance, ulnar tilt with respect to normal parameters should be considered. Studies of radiographic outcome have varied: some studies, concluded measurement of only residual dorsal angulation. Some men noted dorsal angulation and either radial inclinationor shortening, and some used all three of these standard measurements. In a prospective study, van der Linden and Ericson evaluated the applicability of these three measurements, as well as that of radialshift. They observed that only radial shift and dorsal angulation were independent of each other and concluded that residual displacement could be measured accurately with these two criteria alone [12].

Percutaneous pinning is simple, minimally invasive, and prevents redisplacement of fracture fragments adequately. Therefore this method is supposed to be an appropriate treatment for elderly patients with severely displaced and unstable fractures of distal end of radius. In this study we have brought together an observational report of 50 cases of extra articular distal end radius fractures treated with using these two modalities of treatment, closed reduction plaster cast immobilisation with cross K wire fixation for 25 cases and comparing their functional and anatomical outcome with 25 cases treated with closed reduction plaster cast immobilisation with k wire fixation by Kapandji's method of fixation in our hospital in 18 months of the study with an average follow-up of 1 year.

Regular follow-up has been kept to assess for adequate alignment and the need for operative intervention. Physical therapy to regain baseline range motion is a necessity. Colles' fracture patients who received physiotherapy immediately following cast removal were compared with patients who received no active therapy following cast removal in a prospective randomized study by Watt CF *et al*. Patients who attended physiotherapy achieved significantly greater increases in wrist extension and grip strength after 6 weeks compared to patients who received no active therapy [10]

In this study, number of male patients were more than the female patients. Right side involvement was more than the left side. Hand dominance is important to treatment for fractures of distal end of radius. Elderly patients might not need too much power with their non-dominant hand, nor do they use the nondominant hand frequently after trauma. Most of the patients with minor weakness did not complain about disabilities, but intensive physiotherapy seems to be necessary for physical laborers and sport lovers with the non-dominant hand injured [10].

In this study adult age group has been considered, in which patients between age group 51-60 were the commonest to have the fracture. Nesbitt *et al* determined that age was the only statistically significant predictor of secondary displacement. After obtaining an acceptable initial closed reduction, those patients who were more than 50 years of age had four times the risk for failure within the initial 4 weeks as compared with younger patients. The risk for displacement increased with each subsequent decade. It is apparent that late fracture displacement is common in elderly patients, which may be related to their lower bone density. Greater force is necessary to fracture the radius in younger patients because of their higher bone density, which can result in more comminution and a higher risk for subsequent fracture collapse61 A study of the bone mineral densitometry in women older than age 40 years who sustained a distal radius fracture demonstrated that the clinical results correlated better with bone mineral density than with the radiologic parameters [9].

Mechanism of injury, fall on outstretched hand was common, also commonest in series of Jerry Knirk48pechlaner demonstrated in cadaveric experiments, that all types of distal radial fracture patterns can be created by hyperextension of the wrist, including die punch injuries and palmar shear fractures. In our study Anatomical end results

were satisfactory in 24 and unsatisfactory in 1 of the subjects treated with closed reduction below elbow cast immobilisation and cross k wire fixation. Anatomical end results were satisfactory in 18 and unsatisfactory in 7 of the subjects treated with closed reduction below elbow cast immobilisation and k wire fixation by kapandji's method. Functional end results were excellent in 7 cases, good in 17 cases, fair in 1 case and poor in 0 cases treated with closed reduction below elbow cast immobilisation and cross k wire fixation. Functional end results were excellent in 3 cases, good in 15 cases, fair in 6 cases and poor in 1 case treated with closed reduction below elbow cast immobilisation and cross k wire fixation by kapandji's method.

Conclusion

Kapandjis method and our proposed method of cross K wire fixation were used to treat extra articular fractures of distal end radius in which cross K wire method proved to be better than Kapandji method of intrafocal K wire fixation both functionally and anatomically. In cases with higher communition (AA3.1 to AA3.3) cross k wire method had far better results than Kapandji's method but results were similar in cases with less communition. The probable cause behind these differences could be in Kapandji's method, presence of implant at fracture site hampering the healing and creation of a step at fracture site of the diameter of K wire. Higher degree of communition was seen in older age group probably due to osteoporosis in whom cross k wire method proves to be better modality of treatment. In cases with dorsal communition treated with Kapandji fixation dorsal tilt ecurrance was noted post reduction as orsoventral K wire had poor hold in near cortex. Despite of these results we suggest method of choise in these fractures treatment should be made according to judgement of individual surgeon.

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