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A COMPARITIVE STUDY BETWEEN CLOSED REDUCTION WITH EXTERNAL FIXATOR & KWIRES VERSUS ORIF WITH BUTTRESS PLATING IN INTRA-ARTICULAR DISTAL END RADIUS FRACTURE (AO CLASSIFICATION TYPE B & C)

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ABSTRACT Study of intrarticular fractures of distal end of radius and its management with various methods.

KEYWORDS : Fractures of Distal end of radius, K-wires, External fixation

INTRODUCTION

Fractures of lower end radius are the most common fractures of the upper extremity, encountered in practice and constitute 17% of all fractures and 75% of all forearm fractures[1].

Three column theory[2]- The distal radius has been conceptualized as a three column model. The wrist is divided into medial, intermediate and lateral columns. This theory emphasizes that the lateral or radial column is an osseous buttress for the carpus and is an attachment point for the intra capsular ligaments. The primary function of the intermediate column is load transmission and the medial or the ulnar column serves as an axis for forearm and wrist rotation as well as a post for secondary load transmission. Close reduction and cast immobilization has been the mainstay of treatment of these fractures but malunion of fracture and subluxation /dislocation of distal radioulnar joint & radiocarpal joint resulting in poor functional and cosmetic results is the usual outcome[3]. The residual deformity of wrist adversely affects wrist motion and hand function by interfering with the mechanical advantage of the extrinsic hand musculature[4]. It may cause pain, limitation of forearm motion, especially supination and decreased grip strength as a result of arthrosis of the radiocarpal and distal radioulnar joints.

Recently surgical management has been widely recommended and performed to prevent disability. Several studies has shown convincingly that functional outcome is good when the anatomy is restored by obtaining good reduction of fracture fragments, maintaining the angulations of the articular surface of radius and radial Length. This study evaluates the surgical and functional outcomes of Intra-Articular Fracture of Distal End Radius in a comparative study between Closed Reduction with External Fixator & K-wires versus ORIF with Buttress Plating.

AIM:

Study of Intra article fracture of distal end of radius and its management with various method (external fixator multiple k-wires vs ORIF with buttersss plating.

MATERIALS & METHODS

This was a prospective randomized controlled observational study with a dsample size of 50 patients.

Population included all patients with Intra-articular Fracture of Distal End Radius (AO Classification Type B&C / Frykman Classification Type III to VIII) 6, 72 presenting to the Orthopaedic Department of RIMS Medical College & Hospital, Adilabad (Telangana) during the study period from December 2012 to May 2016.

Patients were treated by one of the two surgical methods –

- Closed Reduction with External Fixator & K-wiring
- Open Reduction Internal Fixation with Buttress Plating.

Treatment modality was decided randomly by chit system.
All surgical procedures were done in the operation theatre under strict aseptic precautions and under suitable anesthesia.

Minimum follow up after treatment upto 6 months was ensured for all patients included in the study. They were followed up and assessed at every 2, 6, 8,10 and 14 weeks for fracture union, status of implant, finger and wrist movements and complications. Final assessment of functional outcome was done at 6 months.

INCLUSION & EXCLUSION CRITERIA

INCLUSIONS

- Patients with Intra-articular fracture Distal end Radius (AO Type B & C / Frykman Type III-VIII). 6, 72
- Skeletally mature age group between 18 – 70 years.
- Patients of both genders.
- Closed fractures.
- Patients willing to give written informed consent for participation in the study.

EXCLUSIONS

- Patients having Extra-articular fracture Distal end Radius & Segmental Radius fracture.
- Open fractures.
- Patients having fracture Ulna Shaft.
- Patients having fracture of any carpal bones.
- Patients with Neurovascular compromise/injury.

TREATMENT OPTIONS

When first described, before even the advent of X-rays, distal radial fractures were considered rather uncomplicated. Abraham Colles in his 1814 paper famously stated, "The limb will at some remote period again enjoy perfect freedom in all its motions, and be completely exempt from pain."1 The understanding of these fractures, techniques of radiographic evaluation, as well as the options for intervention have since progressed. The goals of treatment, however, have remained constant: restoration of function, cosmesis and prevention of associated complications.

As with any orthopaedic injury, decisions on management should not be based solely on radiographic appearance and fracture pattern. Factors such as handedness (dominance), patient age and bone quality, functional demands, comorbidity and other injuries are also taken into account. Fractures of the distal radius can be associated with open wounds, tendon rupture, neurological or vascular injury and the multiply injured patient. Treatment of those injuries must coincide with fracture care (Kreder et al. 2005). 25

EXTERNAL FIXATOR & K-WIRES

The use of joint bridging external fixation to treat fractures of the distal radius is widely accepted. It is based on the principle of ligamentotaxis. By distracting the joint area, the fragments are reduced by traction on the capsulo-ligamentous attachments. Sometimes an additional reduction is achieved by creating a vacuum in the joint. The latter may explain how successful reduction of fragments without capsular attachment can be achieved in some cases. By maintaining the traction throughout the healing process, the fragments are kept aligned. The negative effects of the maintained traction can be the creation of extrinsic extensor tightness and a loss of radiocarpal and intercarpal

motion. Furthermore extensive traction can be associated with an increased risk of algoneurodystrophy. When excessive traction is needed to maintain reduction, additional fixation by K-wires should be used in order to allow for lower distraction forces.

Furthermore the external fixator can be used as a device to neutralize forces acting on an unstable osteosynthesis or in anatomically reduced extra-articular bending fractures. In case of high-energy fractures with meta-diaphyseal comminution and/or bone loss, the fixator can be used to bridge the defect and to act as a buttress

INSTRUMENTATION

2mm and 2.7mm Drill Bits
2.5mm and 3.5mm Schanz Pins
Distractor/Connecting Rod
Clamps – Rod-Pin
Spanner
T-Handle
K-wires
Power Drill
K-wire Bender
K-wire Cutter

POSITION

Position the patient supine and place the forearm on a hand table.

Abduct the shoulder so it is possible for the surgeon and assistant to sit on either side of the hand table.

In order to expose the extensor aspect of the forearm, the elbow should be slightly flexed and the arm internally rotated at the shoulder. The position of the limb should allow complete imaging in the frontal and sagittal plane of the distal radius.

Prophylactic antibiotics are given 30 minutes prior to skin incision.
The hand may be supported with a rolled towel.

PROCEDURE

Insertion of distal Schanz pins.

The skin incision is made over the second metacarpal for the insertion of the most distal Schanz pin.

Expose the bone with blunt dissection and insert the long shaft of the parallel drill guide in direct contact with the bone.

Pin insertion plane
In the frontal plane, the pins should be inserted at an angle of 30º-40º in relation to the sagittal plane to avoid transfixing the extensor tendon/hood.

The first self-drilling, self-tapping Schanz pin is inserted through the long drill sleeve shaft, using a power drill.

The tip should be embedded in the far cortex to resist cantilever forces. Correct position should be checked under image intensification.

Remove the parallel drill guide, place the short shaft over the Schanz pin.

Make a skin incision for the insertion of the second Schanz pin, expose the bone with blunt dissection and insert the long shaft again in direct contact with the bone.

Insert the second Schanz pin through the long shaft of the parallel drill guide.

The proximal two Schanz pins should be inserted proximal to the muscle bellies of Abductor Pollicis Longus (APL) and Extensor Pollicis Brevis (EPB), and should not penetrate them.

These muscles are usually easy to identify. Proximal to these muscles, the radial shaft can be palpated through the skin between the bellies of the Extensor Digitorum Communis (EDC) and Extensor Carpi Radialis Longus/Brevis (ECRL/ ECRB) over a distance of 3-4 cm. This is the preferred area for proximal Schanz pins insertion in the radial shaft.

The screws are inserted through the parallel drill guide, as described above for the metacarpal perpendicular to the transverse section of the radius.

If standard Schanz pins are used, predrilling through a drill sleeve to protect the soft tissues is recommended. Schanz pins are then inserted by hand with a Thandle.

Place clamps on the Schanz pins and insert a connecting rod/distractor of appropriate length through the clamps and tighten the distal clamps with the distractor.

The two remaining clamps are kept open, which allows free play of the external fixator construct.

Under Image intensifier guidance longitudinal traction is applied on the thumb and index finger or the distal two Schanz pins to reduce the fracture. Additional maneuvers may be necessary depending on the specific fracture pattern. Pressure from the dorsal side of the carpus may be helpful to restore volar tilt of the distal radius joint surface.

Once satisfactory reduction is obtained, the remaining two screws on the clamps are tightened.

Pin sites are checked, and tension in the skin at the pin sites should be relieved by lengthening the incisions.

After application of external fixator K-wires are inserted.

The number of k-wires inserted depends on the type of fracture and its pattern.

First, a 1 cm incision is made over the tip of the radial styloid. The radial styloid is exposed by blunt dissection and great care is taken not to injure the superficial branch of the radial nerve or the tendons of the first and third extensor compartments.

The drill guide is introduced between the tips of the soft-tissue spreader. After checking reduction and anticipated direction of the K-wire using image intensification, the K-wire is introduced carefully with a power drill.

The K-wire should just penetrate the opposite cortex of the radial shaft. A second K-wire is introduced through the radial styloid in a similar manner, but in a divergent direction.

A second incision is made between the fourth and fifth extensor compartments.

Blunt dissection to the bone is carried out.

The fourth compartment is displaced radially by the pressure of the thumb, which enables precise K-wire positioning into the dorsoulnar corner of the lunate facet.

Under image intensifier control, the third K-wire is introduced from the dorsoulnar rim of the radius into the anterior cortex of the radial shaft.

Final reduction is then confirmed under image intensifier and in some cases of severe fracture communication, when required post-operative below elbow plaster of paris slab is given up to 4 weeks.

Excessive traction through the external fixator may promote complex regional pain syndrome (CRPS), and joint stiffness.

The insertion sites of the pins should be cleaned carefully every day in order to avoid pin-track infection.

Aftercare

IV antibiotics were given for 2 days post operatively after which they were shifted to oral antibiotics (3rd Generation Cephalosporins) for a further of 3 days.

Pin-tract dressings were done daily and patient was instructed in pin care.

All patients informed to visit the hospital immediately if they noticed

any discharge from the pin tract site or any loosening of the pins or increased pain.

Functional exercises
Immediately postoperatively, the patient should be encouraged to elevate the limb and mobilize the digits, elbow and shoulder.

The external fixator and K-wires are usually left in place for six weeks.

The timing of ExFix removal may be influenced by various factors. These include the specific details of the fracture and patient, and the radiological appearance of the healing fracture.

All External Fixators and K-wires were removed in OPD without anesthesia at the first evidence of callus formation and fracture union and non-tenderness at fracture site at around 6-8 weeks. Patients, in which complete fracture union was not yet achieved at ex-fix removal, were given removable splints for easy removal and allow for finger and wrist mobilization and commencement of physiotherapy.

DISCUSSION

AGE
In the current study the mean age at presentation for patients treated by External Fixator with K-wires was 39.44±12.26 (Range 21-60 years) and patients treated by ORIF with Buttress plating was 40.04±13.26 (Range 21-65). Shukla et al.31 reported similar observations. Rizzo et al.26 reported average age at presentation as 45 years in the external fixation group and 48 years in the ORIF group.

SEX DISTRIBUTION
In the current study 33(66%) patients were male and 17(34%) female with a Male:Female ratio of 1.9:1.

Fakoor et al.33 in a study reported 75.1% Male patients compared to 24.9% female patients suffered from Distal end Radius Intra-articular fractures.

MODE OF INJURY
In our study 33(66%) patients had a high velocity trauma mostly by Road Traffic Accidents and 17(34%) had a low velocity trauma predominantly by fall on outstretched hand, most of which were older osteoporotic patients. In a study done on 180 patients by Phadnis et al.99 it was suggested that increasing incidence of these injuries may be attributed to an ageing population (osteoporotic fractures) and the growing participation in outdoor pursuits (higher energy fractures)

DOMINANT EXTREMITY AFFECTION
In our study 20(40%) patients had their dominant extremity affected, out of which 11(22%) patients were in the External Fixator + K-wires group and 9(18%) patients were in the Buttress plating group.

In a study conducted by Rizzo et al26 30(54.5%) patients had their dominant extremity affected out of a total of 55 patients.

AO CLASSIFICATION
In this study 22(44%) patients suffered an AO classification Type B fracture with 11(22%) patients being treated by External Fixation + K-Wires and Plating each. In the Type B fracture patients all 11(22%) patients treated by External Fixator + K-wires had Excellent or Good results at the final 6 months assessment, whereas in the Plating group 9(18%) patients had Excellent or Good results and 2(4%) patients having Fair or Poor results.

A total of 28 (56%) patients suffered an AO Type C Fracture. The External Fixation + K-Wires and Plating groups had 14 (28%) patients each. 10(20%) patients treated by External Fixator + K-wires had Excellent or Good results and 4(8%) had Fair results, whereas in the Plating group 11(22%) patients had Excellent or Good results and 3(6%) had Fair results.

Chi-square test analysis showed no significant co-relation between type of fracture and final outcome (p=0.519).

DURATION OF SURGERY
In our study the average duration of surgery for Group 1 (External Fixator + Kwires) was 48.00±10.60 minutes, whereas in Group 2 (Plating) was 60.50±9.61 minutes with a t-value of 4.49 and a significant p-value of 0.000.

In a study conducted by Shukla et al, 31 mean surgery time was 35.1 ± 2.5 mins in the external fixation group and 56.5 ± 2.7 mins in the volar plate fixation group, which corresponds to our study.

DURATION OF HOSPITAL STAY
In our study 12(24%) patients were discharged after 3 days of hospital stay, 30(60%) were discharged in 4 days, 7(14%) in 5 days and 1(2%) in 6 days from the time of admission. Average duration of stay being 3.94 days. Average duration of stay for the External Fixator + K-wires group being 3.68 days, whereas with the plating group 4.24 days.

Duration of hospital stay proved to be significant with a t-value of 2.80 and a pvalue of 0.007.

TIME TO FRACTURE UNION
In our study the average time to fracture union for the External Fixator + K-wires group was 10.36±2.39 weeks, whereas for the Plating group it was 10.00±3.36 weeks, with a t-value of 0.433 and a p-value of 0.665, which was not significant.

This corresponds to a study done by Oliveira et al.100

COMPLICATIONS
Complications were seen in 11(22%) patients in the study conducted. 5(10%) were in Group A (External Fixator + K-wires) and 6(12%) belonged to Group B (Plating) Kreder et al. had similar results in a study conducted on 179 patients.
Following were the complications faced in our study:

- Implant loosening: 1(2%) case in Group A (External Fixator + K-wires) had loosening of a Schanz Pin which required revision under sedation. Rao et al.101 reported similar findings.
- Pin-tract infection : 2(4%) patients in Group A developed pin tract infection which was managed with oral antibiotics (3rd generation cephalosporins) and good pin-tract care.
- Stiffness of Metacarpo-phallangeal joints : 3(6%) patients developed stiffness of MCP joints (2 from Group A and 1 from Group B) which was treated with rigorous physiotherapy.
- Superficial Radial Nerve Neuropraxia : 2 (4%) patients in Group A developed Neuropraxia of the Radial Nerve and were treated with NSAIDs, short course steroids and physiotherapy. All patients recovered completely.
- Complex Regional Pain Syndrome (CRPS) : 4(8%) patients developed CRPS (1 from Group A and 3 from Group B) and were managed with physiotherapy, short course steroids and Amitriptyline.
- Superficial Infection: 2 (4%) patients from Group B developed superficial Infection at the suture site and were managed with Oral Antibiotics (3rd Generation cephalosporins). The superficial infections healed completely.
- Deep Infection : 1 (2%) patient in Group B developed deep infection which did not subside with oral antibiotics. Implant removal was done in this case with thorough debridement and was then managed with an external fixator and k-wires.
- Median Nerve Neuropraxia : 1 (2%) patient in Group B developed Median Nerve Neuropraxia and was managed with NSAIDs, short course steroids and physiotherapy (TENS). The patient recovered completely.

FINAL OBSERVATION
In our study the final result was as follows :
In Group A (External Fixator + K-wires) 10 (40%) patients had Excellent, 11 (44%) Good, and 4(16%) had Fair results, with no patient having Poor results. In Group B (ORIF with Plating) 8 (32%) patients had Excellent, 12 (48%) Good, 4 (16%) Fair and 1 (4%) patient had Poor results at the final 6 month assessment according to the Modified Green O'Brien Scoring System.32 Chi-square test value came out to be 1.27 with a p-value of 0.737, which was not significant. Hence suggesting both surgical techniques predominantly provide excellent or good results as long as the radiological parameters are met and fixation achieved as early as possible along with rigorous physiotherapy.

These results were similar to a study conducted by Shukla et al.31 on 110 patients where he concluded that 85.5 % of patients treated with external fixation and 73.3 % of patients treated with volar plating had an excellent or good result. Kapoor et al.102 reported 80 and 63 % with good or excellent results in external fixation and volar plating groups, respectively and recommend that displaced severely comminuted

intra-articular fractures should be treated with an external fixator, while Gradl et al.103 reported 100 and 97.5 % with good or excellent results in these two groups, respectively.

SUMMARY

We conducted a prospective randomized controlled observational syudy in a group of 50 patients with Intra-articular Fracture of Distal End Radius (AO Classification Type B&C 31 / Frykman Classification Type III to VIII 32) presenting to the Orthopaedic Department of MGM Medical College & Hospital, Aurangabad (Maharashtra) during the study period of September 2013 to July 2015. The objective of the study was to compare the functional outcomes between treatment with external fixator and percutaneous k-wires versus ORIF with Buttress Plating of these fractures. We assessed ability of each technique to achieve articular alignment, radial height and inclination and to maintain fracture reduction, time taken to fracture union, complications encountered and to conclude the most effective treatment modality.

The final results were evaluated and compared after making observations for age, sex, mode of trauma, dominancy of affected hand, time interval between injury and admission, duration of hospital stay, duration of surgery, time to fracture union and complications.

In our study majority of patients had excellent or good results in both the study groups (Group A : n=21, 84%) (Group B : n=20, 80%), with only 4(16%) patients each in Group A and B with Fair results and just 1(4%) patient in Group B with a poor result.

CONCLUSION

Fracture of distal end of radius has a predominantly bimodal age distribution in our study, with young individuals between 21- 30yrs and older patients above the age of 40. The younger age group affected consisted more of male patients whereas the older age groups had a slight female predominance. Road traffic accidents were a major mode of trauma in the younger aged population while a fall on outstretched hand in the older. The affection of the dominant hand did not have an influence on the final outcome in either of the study groups. Duration of surgery was significantly lesser in the External Fixator + K-wires group with lesser surgical soft tissue trauma. There was a significant difference in the duration of hospital stay in the two study groups with the patients in the External Fixation and K-wiring group requiring a shorter hospital stay. Early post-operative mobilization is possible in the patients treated with ORIF and plating but does not affect the final outcome with rigorous physiotherapy initiated in the patients treated with external fixator and k-wires once implant is removed. Rigorous physiotherapy is key to avoiding post-operative arthritis and achieving good range of motion in the external fixator group. Not crossing the watershed line landmark is crucial during the placement of hardware (plate) during the ORIF and plating procedure with care taken to prevent damage to the neurovascular structures (radial artery and median nerve) around the operative field. Care should be taken not to damage the superficial radial nerve while drilling for and inserting schanz pins in the radius during the procedure of external fixation.Overdistraction should be prevented while using the external fixator and pin tract care is a must to avoid infection at pin-tract sites. Time to fracture union is similar in both study groups as long as the acceptable radiological criteria are met.

There was no significant difference in the final outcome in both the study groups, assessed using The Modified Green O'Brien System. However, we preferred the treatment of intra-articular fractures of the distal radius (AO Type B&C) using the External Fixator and K-wires. Although open reduction and internal fixation has advantages such as direct visualization and manipulation of the fracture fragments, stable rigid fixation, and the possibility of immediate postoperative motion we preferred the use of external fixator with k-wires since it provides continuity of reduction under fluoroscopic control, improved reduction by ligamentotaxis, and the ability to protect the reduction until healing occurs, with advantages such as the relative ease of application, minimal surgical exposure, reduced surgical trauma, and easy removal of hardware. External fixation neutralizes the axial load imparted by the physiologic load of the forearm musculature, while the use of a percutaneous kwires improves the stability of the external fixation and prevents loss of bone reduction.

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