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Treatment outcome in intra-articular distal end radius fracture by volar plate versus external fixator augmented with k wire

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Abstract

Introduction: Distal radius fractures happen more often than any other type of fracture and are still one of the most common bone injuries that orthopaedic or trauma surgeons fix. They are the most common type of injury in the upper limb. Percutaneous pin fixation, external fixation devices that allow distraction and palmar translation, low-profile internal fixation plates and implants, arthroscopically assisted reduction, grafting techniques, and bone-graft substitutes have all helped improve fracture stability and outcome.

Aims and objectives: The present study was conducted to compare treatment outcome in intra-articular distal end radius fracture by volar plate versus external fixator augmented with k wire

Material and method: This is a prospective study consisting of 40 patients, who were treated with volar plate and external fixator augmented with k wire for intra-articular comminuted distal radius fractures (AO type C) during one year study period. The 20 patients were treated with open reduction using the volar approach and locking plate were used while 20 patients were treated with external fixator augmented with k wire.

Results: The volar plate showed better functional outcomes in Green and O'Brien compared to external fixator augmented with k wire group. The radiographic results in the volar plate group were more favorable than in the external fixator augmented with k wire group.

Conclusions: We found that both volar plate with plating and external fixator augmented with k wire represent treatment choices for distal radius fractures. Volar plate had better functional and radiological outcomes according to Green and O'Brien and Sarmiento scoring systems when compared to external fixator augmented with k wire. Volar plate had less incidence of complications compared with external fixator augmented with k wire.

Keywords: Volar plate, external fixator augmented with k wire, intra-articular comminuted distal radius fractures

Introduction

Distal radius fractures are common injuries going on more frequently than some other fracture, and remain one of the most common skeletal injuries treated via orthopaedic or trauma surgeons [1-3]. They're taken into consideration the maximum common fracture of the upper extremity [4, 5]. The articular surface of the radius is triangular, with the apex of the triangle at the radial styloid. It slopes in a volar and ulnar direction with a radial inclination of 23° (range 13-30°), a radial length of 12 mm (range 8-18 mm), and an average volar tilt of 12° (1-21°) [6]. Anderson and O Neil have been first to maintain fracture reduction with an external fixator using the principle of ligamentotaxis.

Treatments vary from simple splinting to surgical reduction [7] with combined internal and external fixation [8]. Restoration of normal alignment and articular congruity after a displaced fracture can be difficult but is crucial for a very good functional result [9, 10]. The use of percutaneous pin fixation, external fixation devices that permit distraction and palmar translation, low profile internal fixation plates and implants, arthroscopically assisted reduction, and grafting techniques including bone-graft substitutes all have contributed to improving fracture stability and outcome [11]. External fixation, currently extensively used to treat these fractures, is minimally invasive. It makes use of traction to maintain fracture-fragment reduction so that additional trauma from dissection of the soft tissues around the fracture during open reduction and plate fixation is avoided [12, 13]. But many authors have reported significant losses of reduction, from pin loosening, infection and fixation failure [14-17]. The stability of distal radius fracture fixation can be more depending on the method to

augment fixation than at the strength of an external fixator itself [18]. The external fixation effectively can't protect comminuted distal-radius fractures from lack of the reduction originally attained; severe comminution is frequently associated with shortening and re-displacement [19]. The instant improvement in radial height, inclination, and volar tilt are significantly decreased by the time of fixator removal [20]. Traction does not correct the dorsal tilt of the distal fracture fragment. This is because the stout volar radiocarpal ligaments are shorter, and they pull out to length before the thinner dorsal radiocarpal ligaments exert any traction [21]. Excessive tractions can actually increase the dorsal tilt [22]. A dorsally directed vector is still necessary to restore the normal volar angulation. That is typically completed through making use of manual thumb pressure over the dorsum of the distal fragment. With intra-articular fractures, ligamentotaxis reduces the radial styloid fragment, however for the above reasons, it does not reduce a depressed lunate fragment [23]. Distraction additionally will increase the carpal canal pressure, which may predispose to acute carpal tunnel syndrome [24]. Many authors have stressed the significance of the usage of the external fixator as neutralization device rather than as a traction device. Ligamentotaxis is used to acquire a reduction of the fracture fragments, that is then captured with percutaneous k-wire fixation. The traction at the fixator can then be decreased, which allows positioning of the wrist in neutral or slight extension [25]. This serves to reduce extensor tendon tightness and facilitates finger motion. The efficacy of ligamentotaxis in neutralizing damaging compression forces, which are likely to cause displacement of unstable fracture with radial shortening, is a significant and increasingly appealing improve in the management of distal radius fractures [26]. Contraindications of bridging external fixation are: Ulnar translocation due to an unstable distal radioulnar joint; Intra-articular volar shear fractures (Bartons, reverse Bartons); Disrupted volar carpal ligaments/radiocarpal dislocations; Index finger metacarpal fractures preclude the usage of this technique because of the interference with distal pin site placement.

Modified Henry approach to the radius for volar plating: Its miles suitable for most distal radial fractures. This approach makes use of the plane between flexor carpi radialis (FCR) tendon and the radial artery, i.e., ulnar to the radial artery. The classical Henry approach uses the plane between brachioradialis and the radial artery, i.e., radial to the radial artery. During modified Henry approach, radial artery and the palmar branch of the median nerve are at risk of injury. Objective of study is to evaluate the functional and radiological outcomes according to green and O'Brien and Sarmiento scoring systems and compare them in ORIF and plating group vs external fixation group and also compare the occurrence of complications in every group. Post-op ranges of motion, grip strength have been also compared.

Methods

That is a prospective study such as 40 patients, who had been treated with volar locking plate or k-wire augmented external fixation for intra-articular comminuted distal radius fractures (AO type C). The 20 patients were treated with open reduction using the volar technique and locking plate had been used even as 20 patients have been treated with

closed reduction under fluoroscopy, distraction with the external fixator (Joshi type external fixator) together with k-wire fixation for additional balance have been used.

Inclusion criteria

Patients aged 18-60 years with recent intra-articular fracture of the distal radius with no clinical contraindications for anesthesia have been included and Fracture much less than 2 weeks old have been included.

Exclusion criteria

Patients with distal radius fracture treated with closed reduction and cast immobilisation; patient with extra injuries like head injuries, open fractures of distal radius, fracture older than 14 days, active infection or severe radiocarpal arthritis, pathological fractures, fracture with neurovascular complications were excluded.

Henry approach was used for the volar locking plate [27-29]. In the external fixation group, distraction with the Joshi type external fixator was performed following closed reduction under fluoroscopy. A simple method to determine the upper limit of distraction during surgery by using the observation that all fingers, in particular the second finger, can touch the palm of the hand with passive flexion (2nd finger reaching the distal palmar flexor fold with passive flexion). For extra stability, the fragments had been decreased and fixed with 1.5 to 2 mm k-wires, single k-wire were inserted through radial styloid. Following surgical procedure, a POP cast became applied in the volar locking plate group that did not go beyond the metacarpophalangeal joint and reached the bottom of the elbow. Active finger exercises had been started the day after surgical treatment. POP cast was removed at 4th week and wrist brace become prescribed. At the cease of 8 weeks, an workout program for muscle strengthening become started out depending on the level of union. Within the external fixation group, finger movements were started out the day after surgery. K-wires used for augmentation have been pulled out between week 4 and week 6. The external fixator became removed under sedation between 5 to 12 weeks and rehabilitation with active and passive exercises were started with the support of a wrist brace. Through the end of 12 weeks, muscle strengthening physical activities were started depending on the level of union. For functional assessment, range of motion of wrist joint become measured with a goniometer. Grip strength was measured using a dynamometer and as compared with the healthy side By comparison of radiographic measurements, losses in palmar angulation, radial length, and radial inclination, and ulnar variance have been determined for patients [30]. For both the groups follow-up period became one year. Fracture became classified according to AO classification [31].

Results

The fractures were on the right side in 22 patients, and on the left in 18 patients. Etiologies were fall (n=18), fall from height (n=13), and traffic accidents (n=9). The 20 patients have been managed by means of ORIF with plating and 20 patients have been managed through external fixator. In all patients of ORIF group, the amount of blood loss become less than 500 ml. The mean operation time was 45 minutes in the ORIF group, in comparison to 25 minutes in the Ex fix group.

Table 1: Age distribution

Age (years)	N	Percentages
18-20	05	12.5
21-40	10	25
41-60	25	62.5

Table 2: Sex incidence

Sex	N	Percentages
Male	31	77.5
Female	09	22.5

Table 3: Outcomes according to Green and O' Brien score

Variables	Plating group	Ex fix group
Score		
ROM	25	20
Pain	25	25
Grip strength	25	25
Activity	25	25
Classification, N (%)		
Poor	00	1 (4.6)
Fair	01(5.7)	3 (17)
Good	4 (20.5)	1 (4.6)
Excellent	15 (73.8)	15 (73.8)

Table 4: Outcome according to Sarmiento radiological score

Variables	Plating group	Ex fix group
Palmer tilt	4.5	5.5
Radial height	10	11.5
Radial inclination	19.5	21
Classification, N (%)		
Fair	2 (7.7)	3 (15.3)
Good	2 (7.7)	3 (15.3)
Excellent	16 (84.6)	14 (69.4)

Table 5: Complications

Variables	ORIF, n (%)	Ex fix, n (%)
Nerve injury	0	0
Stiffness	2 (13.3)	3 (20)
Malunion	1 (6.6)	3 (20)
Complex regional pain syndrome	0	2 (13.3)
Pin tract infection	0	1 (6.6)

The ORIF with plating group showed better functional outcomes in Green and O'Brien compared to Ex fix group. The 94.3% of the ORIF group had accepted functional outcomes (15 Patient is excellent, 4 patient is good), while 78.4 % of the ex-fix group had accepted functional outcomes (15 patient is excellent, 1 patient is good). The radiographic results within the ORIF group had been more favourable than in the EF group, in which 92.3% of the ORIF group had acceptable radiological parameters (16 patient is got excellent in Sarmiento score), the percentage become 84.7% within the ex-fix group (14 patient is excellent and 3 patient is good in Sarmiento score). The radiographic outcomes in the ORIF with plating group were more favorable than in the external fixator group. The percentage of patients with acceptable volar tilt, radial length and radial inclination within the ORIF group became 92.3%, while in the external fixator group it was 84.7%. This is mostly because of plating which allows direct visualization and manipulation of the fracture and consequently provides better recovery of radial height, radial inclination, volar tilt and articular congruity. In the

current study, ORIF had an overall decreased incidence of complications compared with external fixation, complex regional pain syndrome became found in 2 patients (13.3%) in the EF group however was now not encountered in ORIF group. This may be associated with the severity of injury or excessive distraction and reduction related to external fixation and this may be avoided by means of early wrist rehabilitation, avoidance of over distraction during external fixator application and postoperative vitamin C supplementation. Stiffness became observed in 2 patients (13.3%) of the ORIF group, in comparison to 3 patients (20%) in the EF group. Within the ORIF group, the power and balance of the construct allows early wrist motion, and this has been shown to decrease the incidence of stiffness and enhance hand and finger feature. Infection was observed only in 1 patient (6.6%) of the external fixator group (pin tract infection) but was absent in ORIF group. Malunion was found in 3 patients (20%) of the external fixation group compared to only 1 patient (6.6%) within the ORIF group. On this study, ORIF restored volar tilt and radial inclination better than external fixation.

Discussion

Goals of treatment are: Restoring the joint surface to protect the joint cartilage, achieving radial alignment and height to preserve normal kinematics of the joint, providing mobility for maintenance of finger-wrist and forearm functions, and making sure stability to protect length alignment-joint surface congruency till recovery [32]. Functional assessment confirmed that wrist flexion and supination had been better with palmar plate; however, the 2 groups were similar with respect to grip strength loss and time to return to work. Westphal and associates performed a retrospective comparative study of 166 of 237 patients who had surgery for AQ/ASIF A3 or C2 distal radius fractures. The fractures were treated with either external fixation or open reduction and internal fixation using palmar or dorsal plates. Open reduction and internal fixation, specifically palmar plate fixation, validated the great radiological and functional results [33]. Radiographically, it became shown that palmar plating was related to better correction of palmar angulation and protection of ulnar variance, this may be defined by using the reality that distraction generally occurs through palmar structures and that palmar locking plate gives a better support to the fracture. Traction alone in external fixation can't correct palmar angulation due to the fact that ligamentotaxis primarily functions through strong palmar links [27-30, 34]. As external fixation cannot repair a fracture as stable as seen through a locking plate and needs to be removed after some time, it cannot provide a firm basis towards compression in the fracture. In external fixation applications, losses in palmar angulation may additionally maintain within the long term (even after the removal of the fixation) [35]. On the other hand, palmar angulation can be better corrected because of direct intervention provided by open reduction and palmar plate fixation, while the subchondral distal screws of the palmar locking plate provide support against palmar angulation losses, they also prevent compression of the fracture in the long time [27]. The superior mobility achieved with the palmar locking plate can be attributed to the fact that those patients can start wrist movements earlier due to firm fixation. All external fixators used in our study went beyond the joint and have been not

dynamized. Thus, mobility of the wrist joint was not allowed till the fixator became removed. This will explain mobility losses in the external fixation group. Despite its advantages, there are still fracture types in which volar locking plate cannot be applied, especially in comminuted very distal fractures that do not permit screw insertion, k-wire augmented external fixation may yield successful effects. when Seitz and colleagues investigated the technique of "augmentation" of external fixation, in which percutaneous Kirschner wires are used as a lateral buttress to secure the radial styloid fragment, their reported rate of result that were fine overall was 92%.³⁶ The ORIF with plating group confirmed better functional results in green and O'Brien as compared to ex fix group. The 94.3% of ORIF group had common functional results (15 patient excellent, 4 patient is good), whilst 78.4% of the Ex fix group had accepted functional outcomes (15 patient excellent, 1 patient is good). Most of the prior studies are in agreement with these results as in Williksen et al, Abramo et al, Rozental et al, Wei et al and Egol et al.^[37-41] Recent biomechanical and clinical studies which have been undertaken for knowing the distal radius fixation revealed placement of locking screws in the metaphyseal bone with as close as 5mm close to the distal subchondral bone without violating its articular surface^[42]. It became evident that greater screw placement within the distal metaphyseal acts as reefing technique.

Limitation

Limitation of study are small number of patients in each treatment group, a short follow-up period and a failure to measure inter-observer errors in radiographic interpretation or functional evaluation.

Conclusion

From our study, we finish that patients with unstable, either a dorsally or volarly displaced intraarticular radius fracture or type C (complete intraarticular fractures) or in osteoporotic fractures had excellent to good radiological outcome when treated with fixed angle volar locking plate because it maintains the reduction until union and prevent the collapse of the fracture fragments. ORIF had higher functional and radiological outcomes according to green & O'Brien and Sarmiento scoring systems when compared to external fixation. ORIF had much less incidence of complications compared with external fixation. ORIF lets in for early postoperative range of motion exercises in comparison to external fixation. The grip strength became better in the ORIF group; but, it improved gradually in external fixation group after frame elimination and physiotherapy, thus became corresponding to the ORIF group. External fixation is a speedy and minimally-invasive method with comparable functional outcome with other methods of fixation.

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