A Prospective Study of Unstable Comminuted Intraarticular Fracture Lower End of Radius Treated with Ligamentotaxis using Uniplanar External Fixator with Percutaneous Pinning

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Abstract: <u>Background</u>: In unstable comminuted intraarticular fracture lower end of radius it is difficult to maintain the achieved reduction until fracture union despite continued refinements of treatment methods. Clinical outcome of these types of fractures depends on method of fixation. Most of the studies recommended skeletal stabilization to maintain radial length and articular reduction to achieve good clinical outcome. We conducted a prospective clinical study using uniplanar external fixator for ligamentotaxis along with percutaneous pins for maintenance of articular reduction in the treatment of unstable intraarticular fracture lower end of radius with comminution. <u>Materials and Methods</u>: A prospective study of 40 patients of unstable comminuted intraarticular fracture lower end of radius were included in our study between january2014-january 2016. The average age of the patient was 45.5 years and all of them were between 20-70 years. All the patients were treated with uniplanar external fixator by ligamentotaxis with percutaneouspinning. Postoperative evaluation done at 3, 6, 12 weeks, 6 and 12months and were assessed using Gartland and Werley point system. <u>Results</u>: At the end of 1 year excellent to good results were seen in 70%, fair in 25%, poor in 5% cases according to the scoring system of Gartland and Werley point system. <u>Conclusion</u>: In our study of 40 patients withunstable comminuted intraarticular fracture lower end of radius, we had excellent and good outcome of 70% with uniplanar external fixator with percutaneous pinning and we conclude it is a good method of treatment for these type of fractures with low cost effectiveness.

Keywords: Ligamentotaxis, Unstable intra-articular fracture lower end of radius

1. Introduction

Unstable lower end of radius are very common and accounts for one sixth of all fractures which are treated in emergency room. Unstable intra-articular fracture remains one of the most challenging conditions that are treated non-operatively despite continued refinements in treatment. If these fractures are allowed to collapse, angulation, radius shortening, incongruity may cause loss of function and deformity¹.

Most studies recommended some type of skeletal stabilization to maintain radial height. A variety of methods have been designed including pinning the distal fragment, immobilizing the wrist and forearm in POP cast, using an external fixator to avoid loss of reduction. The basic principle of all these methods is to provide fixed traction, which prevents radial shortening. If satisfactory reduction is obtained by manipulation and distraction, but combination precludes maintainence of reduction by cast or pinning. So, uniplanar external fixation is usually the treatment of choice with percutaneous pinning. To be safe, an applied uniplanar external fixator should have very low rate of complications and be stiff enough to maintain fracture fragment under adverse loading conditions^{2, 3, 4, 5, 6}.

With the better understanding of principles that governs the safe and effective use, uniplanar external fixator with percutaneous pinning has become indispensable in the hands of experienced surgeons. There are very few complications with this technique such as loss of reduction, stiffness, radial sensory nerve problems and pin-tract infections. One of the main disadvantages of uniplanar external fixator may be a permanent loss of wrist motion^{7, 8, 9, 10}.

2. Materials and Methods

Forty patients with unstable comminuted intra-articular fracture lower end of radius were treated with uniplanar external fixator with percutaneous pinning in SSIMS & RC, Davanagere between January 2014 to January 2016; there were 24 males and 16 females of age group 20 to 70yrs with fall on outstretched hand being the commonest mode of injury. The dominant wrist (right) was affected in 24 patients. 10 patients had other associated fractures.

All fractures were classified using Frykman's classification. Pre-operative evaluation consisted of careful inspection of swelling and deformity of the fracture site. Tenderness was elicited and movements of the wrist were painful and restricted. There was no nerve injury or tendon injury recorded in our series.

Routine xrays of anterior and lateral views were taken and fracture fragments were analyzed for the involvement of distal radio-ulnar and radio-carpal joint and were classified according to Frykman's classification. Routine blood investigations were done, consent for surgery was taken. Thirty cases were done under regional anaesthesia, but only ten cases were done under general anaesthesia. Uniplanar external fixators were used in these series, consisted of (1) 3.5mm Shanz pins for radius -2no. (2) 2.5mm Shanz pins for II metacarpal -2no. (3) 4mm connecting rods- 2no. (4) aescular clamps- 4no.

FRYKMAN (1967)

- Group 1 Extraarticular without fracture of the distal ulna
- Group 2 Extraarticular with fracture of the distal ulna
- Group 3 Intraarticular involving the radiocarpal joint without fracture of the distal ulna
- Group 4 Intraarticular involving the radiocarpal joint with fracture of the distal ulna
- Group 5 Intraarticular involving the distal radioulnar joint without fracture of the distal ulna
- Group 6 Intraarticular involving the distal radioulnar joint with fracture of the distal ulna
- Group 7 Intraarticular involving both radiocarpal and distal radioulnar joints without fracture of the distal ulna
- Group 8 Intraarticular involving both radiocarpal and distal radioulnar joints with fracture of the distal ulna

3. Surgical Technique

Patient was placed supine on operating table. Under regional anaesthesia or general anaesthesia, with strict aseptic precautions, two stab incisions were made over the lateral aspect of the lower end of radius about 2 to 4 cms apart, approximately 8 to 10 cm proximal to the radial styloid.

Through the incisions, care was taken not to injure nerve, vessel, tendon and the periosteum was displaced till the drill bit touched the bone. The radius was pre-drilled with 2.5mm drill bit and with T-handle, 3.5mm Shanz pins were fixed. Then, two more stab incisions were made over the lateral aspect of the index (second) metacarpal, one near the base and another over the shaft being an inch apart and then fixed with 2.5mm Shanz pins which were drilled with 1.5 mm drill bit. Uniplanar external fixator were fixed to the Shanz pins and 4mm connecting rod was inserted through the joints. The system was assembled but not fixed, keeping the joints loose. Closed reduction of the fracture was done till the fracture fragments got normally aligned. The closed reduction was confirmed with the help of C-arm, and after satisfactory reduction, the external fixation device was tightened and the reduction was re-assessed with the help of C-arm. At the end, sterile dressing was applied to the pins tract. No splint or cast was applied. But the limb was placed in elevation. Post-operatively, antibiotics were given along with analgesics and Serratiopeptidase. Average duration from the date of injury to the date of surgery was 1 to 3 days.

4. Post-Operative Care & Rehabilitation

Immediate post-operative check-xrays were taken in anterior and lateral views. Radial height, radial angulation, palmar angulation were assessed along with reduction of fracture fragments. Tension across the wrist generated by the uniplanar external fixation should provide enough ligamentotaxis, so that, on antero-posterior and lateral xrays, the radio-carpal articulation was seen to be 1mm wider than the mid-carpal joint. Active finger and thumb exercises were encouraged post-operatively, immediately from the day of operation, to avoid stiffness, oedema and to promote circulation. The pins were cleaned on every alternate day for two weeks and the patient was educated regarding the active movements of fingers, thumb, elbow, shoulder and cleaning of pins throughout the period of healing. The patient was assessed subjectively for pain, and clinically, for tenderness and loosening of pins. Second xray was taken on follow-up at sixth week and assessed radiologically for the bridging callus formation. The uniplanar external fixator was removed at 6th to 8th weeks under local/general anaesthesia. Additional splintage in the form of PoP slab was given for 1 to 2 weeks after the removal of external fixator in few cases. The patient was advised not to lift heavy weights for 4 to 6 weeks. Physiotherapy of wrist was started for six weeks along with hot water fomentation and under water exercises. All cases were followed at an interval of six weeks, three months, six months and twelve months with an average follow-up of eight months.

There were no cases of pin-tract infections, pin loosening, breakage or loss of fixation as long as they were followed till the external fixator removal. In our series, one of the patients insisted to remove the fixator and it was removed at five weeks, following this, there was collapse, redisplacement with radial shortening. The results were assessed according to Modified Gartland and Werley scoring system.

5. Results

The anatomical and functional assessment was done according to Modified Gartland and Werley scoring system as follows.

Gartland and Werley Scoring System (1951)

	Points	
Deformity	Prominent ulnar styloid	1
	Radial deviation	1-2
	Dinner fork deformity	1-3
	Maximum	6
Subjective	No pain, no limitation of motion	0
Evaluation	Occasional pain, some limitation of motion, weakness, pain, limitation of motion.	4
	Activities restricted	6
	Maximum	6
Range of	Limitation of motion<20%	0
Motion	Limitation of motion<50%	2
	Limitation of motion>50%	6
	Stiffness of wrist	6
	Maximum	6
Complications	None or minimal	0
	Slight crepitation	1-2
	Severe crepitation	3-4
	Median nerve compression	1-3
	Pulp-palm distance 1 cm	3
	Pulp-palm distance > 2cm	5
	Pain in distal radioulnar joint	1-3
	Maximum	15
Excellent		0-2
Good		3-7
Fair		8-18
Poor		19-33

Mode of Injury



Age Distribution



6 patients in our study were rated as excellent, 22 patients in our study were rated as good, since they had no deformity of the wrist, with occasional pain and some limitation of motion.

10 patients were rated as fair and 2 patients were rated as poor since they had dinner fork deformity, pain and limitation of motion more than 50%. Weakness and restricted activity around the wrist with slight crepitation and involvement of superficial branch of Radial nerve.

Radiographs demonstrated maintenance of radial length in all patients except one, who had a shortening of 5mm after removal of fixator.

Excellent- 06 (15%) Good- 22 (55%) Fair- 10 (25%) Poor- 02 (05%)

Results: Pie Representation







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POSTOP XRAY:



PREOP XRAY:



POSTOP XRAY:





PREOP XRAY:









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6. Discussion

Lower end of radius fractures are extremely common and a large majority is treated non-operatively. Lower end of radius fractures have recently become the focus of an intense interest regarding optimal management. Very commonly, these fractures are articular injuries leading to disruption of both radiocarpal and distal radioulnar joint.

Preservation of articular congruity is the principle prerequisite for successful recovery. The treatment in intraarticular fractures aims to allow early functional recovery of the limb, to improve long-term function of the wrist, and to prevent cosmetic deformity. Unstable comminuted fractures of distal radius pose a major problem in terms of stability and methods of immobilization. As proposed by Vidal et al, the simplest and most reliable means of treating an unstable intra-articular fracture of distal radius based on the concept of Ligamentotaxis and its principles, is an external fixator.

As stated by Green, a good functional result usually accompanies a good anatomical result. Poor long-term prognosis may result from failure to identify the unstable fracture by the degree of displacement, the severity of comminution, the involvement of radiocarpal and distal radioulnar joint and the loss of reduction after the application of a cast.

The external fixation of the wrist fractures have addressed themselves to either 'redisplaced' or 'unstable' fractures, the latter being defined by more severe Frykmann grades (1967). However, the potential of the fracture to slip is related to its initial displacement, i.e., any fracture that was displaced sufficiently to necessitate manipulative reduction, whether or not it was intra-articular or comminuted, is considered potentially unstable, as demonstrated by Stewart et al (1985).

The selection of patients plays a vital role for an optimal outcome, i.e., unreliable and poorly motivated patients make for poor candidates for external fixator.

Meticulous assessment of fracture patterns, appropriate patient selection, careful and systematic surgical approach, appropriate choice of fixation device and pins, early aggressive rehabilitation and post-operative monitoring are mandatory for successful use of external fixation of distal radial fractures. Frykmann type VII and VIII fractures, where dorsal comminution is present, are indications for external fixation. The basic principle of treatment is to obtain accurate fracture reduction and to maintain the reduction while protecting the wrist in the physiological position so as to facilitate the rehabilitation of the hand. As suggested in the literature (Grana and Kopta, 1979), the use of external fixator is only warranted in younger patients with strong bony cortices. Although, old age is not a contraindication for external fixation.

Based on these results, the following indications for the use of external fixator are suggested:

- 1) Intra-articular fractures of distal radius of young and active patients.
- 2) Open fractures of the distal radius.
- 3) Patients with distal radius fractures and other multiple injuries who need intensive care and nursing.
- 4) A failure to maintain reduction of such fractures in cast immobilization.

7. Conclusion

Of late, the treatment of choice for complex lower end radius fractures is external fixator with percutaneous pinning, especially when there is comminution and the fracture is unstable and intra-articular.

In our series 40 patients with comminuted intra articular fractures of lower end radius were treated with static external fixator with percutaneous pinning.

Most of the cases were of Frykman type VIII (25%). Mechanism of injury was fall in 26 and vehicular accidents in 14 cases. Four patients had other associated injuries.

Relatively large diameter pins (i.e. 3.5mm) for proximal radius were inserted by predrilling, pins engaged at least 2 cortices each, which enhanced the rigidity of the fixation and reduced the complications like pin loosening.

External fixation should be maintained for 6-8 weeks till the osseous union is complete, with further immobilization in plaster slab for additional 2 weeks if needed.

An optimal outcome requires the achievement of all the variables of the fracture, i.e., radial angle, radial length and volar tilt, though volar tilt has got least influence. It is difficult to regain volar tilt by ligamentotaxis and maintain it by external fixators with percutaneous pinning.

It is useful in intra articular fracture of lower end radius in young and active patients, open fractures, polytrauma patients and in fractures were anatomical reduction could not be maintained after closed reduction.

8. Summary

In our series, 40 intra articular fractures of distal radius were fixed using static external fixator with percutaneous pinning in a prospective study. Fixator was maintained for 6-8 weeks and duration of follow up ranged 4 months to 11 months. We had 6 excellent, 22 good, 10 fair, and 2 poor results. Complications were seen in 15%.

This series concludes that with meticulous assessment of fracture patterns, appropriate patient selection, careful and systematic surgical approach, appropriate choice of fixation device and pins, early aggressive rehabilitation and postoperative monitoring, Ligamentotaxis consistently results in a favorable outcome in the management of intra-articular fractures of lower end radius.

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