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Comparative study of functional outcome in distal radius articular fractures treated by closed reduction using bridging external fixator augmented with k-wires and volar-locking plating

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Abstract

Background: Distal radius fractures are most common fractures of upper limb presenting at emergency rooms, compromising of more than 16% of all fractures. Close reduction and cast immobilization has been the principal mode of management of distal radius fractures but it often lead to fracture malunion and subluxation /dislocation of distal radioulnar joint, hence resulting in poor functional, radiographic and cosmetic results. Open reduction and volar plating was designed to ensure more consistent correction of displacement and maintenance of reduction.

Aims and objectives: To analyze and compare the functional outcome in distal radius articular fractures of 27 patients treated by closed reduction through bridging external fixator augmented with K-wires and volar-locking plating done in our Institute of Orthopaedics and Traumatology

Materials and methods: This study is conducted on 27 patients with unstable intra articular distal radius fractures of which 15 were treated with external fixator augmented with k-wire and 12 were treated with 2-column fixed-angle volar LC Pin department of radio-diagnosis in Alluri Sitarama Raju Academy of Medical Sciencesover a period of 12 months (1st October 2020 to 30th September 2021).

Results: Radial length and volar tilt were significantly greater for the ORIF group when compared with the radial length. There was significant difference in the radiological and functional outcome of AO Muller type C fractures treated by volar LCP with respect to the external fixator group (p value 0.009 and 0.026 respectively). There was no significant difference in the radiological and functional outcome of AO Muller type B fractures treated by volar LCP with respect to the external fixator group (p value 0.706 and 0.707 respectively)

Conclusion: The use of ORIF with a volar fixed-angle implant resulted in stable fixation of theunstable (dorsally or volarly displaced intraarticular) distal articular fragments, allowing early postsurgical wrist motion (functional outcome) and having excellent to good radiological outcome.

Keywords: Distal Radius, Articular Fractures, External Fixator, K-Wires, Volar LCP, 2- Column LCP, Lindstorm's Criteria, Functional Assessment, Mayo Wrist Score

Introduction

Distal radius fractures are most common fractures of upper limb presenting at emergency rooms, compromising of more than 16% of all fractures.Non-displaced or reducible but stable extra and intra-articular fractures can also be treated with casting. Unstable reducible extra-articular fractures are commonly treated with reduction and often supplemented with extra- or intra-focal pinning. Extra-articular fractures that are irreducible, intraarticular fractures and fractures for demanding patients who require early mobilization, are commonly treated with plating (more often with palmar plating), intramedullary fixation, external fixation or pinning [5;6;7;8].Close reduction and cast immobilization has been the principal mode of management of distal radius fractures but it often lead to fracture malunion and subluxation /dislocation of distal radioulnar joint, hence resulting in poor functional, radiographic and cosmetic results[9].Open reduction and volar plating was designed to ensure more consistent correction of displacement and maintenance of reduction.

Aims and objectives

To analyze and compare the functional outcome in distal radius articular fractures of 27 patients treated by closed reduction through bridging external fixator augmented with K-wires and volar-locking plating done in our Institute of Orthopaedics and Traumatology

Materials & Methods

This study is conducted on 27 patients with unstable intra articular distal radius fractures, of which 15 were treated with external fixator augmented with k-wire and 12 were treated with 2- column fixed-angle volar LCP in department of radio-diagnosis in Alluri Sitarama Raju Academy of Medical Sciences over a period of 12 months (1st October 2020 to 30th September 2021).

Inclusion criteria

- Age more than 18 years.
- Muller's type B (partial intra-articular) and type C (complete intraarticular)
- Intra-articular fractures extending less than 5 cm

from joint line

- Closed fractures.

Exclusion criteria

- Undisplaced fracture.
- All open fractures.
- Neglected fractures more than 4 weeks.
- Severe co-morbidities.

Results

The mean follow up was 8.9 months, ranging from 3 months to 24 months.All 27 patients had regular follow-up.

Union: All the patients had good union.The mean time of union was 14 weeks with a range of 10 to 18 weeks with a 16 cases healing by 12 weeks. Restof the 11cases took a longer duration. 1 case of delayed union was reported in the external fixator group when the external fixator was removed and a cast was applied for a further 2 months till union was complete Longer duration to union is noted in patients of older age withrelatively poor bone quality.

Malunion: 3 patients of the 15 treated with kirschner wire augmented External fixator had malunion with significant dorsal angulation with negative palmar tilt.

Radiological Outcome: Sarmiento's modification of **Lind storm's criteria:** External Fixator Group In Ao Type B Partial Intraarticular.

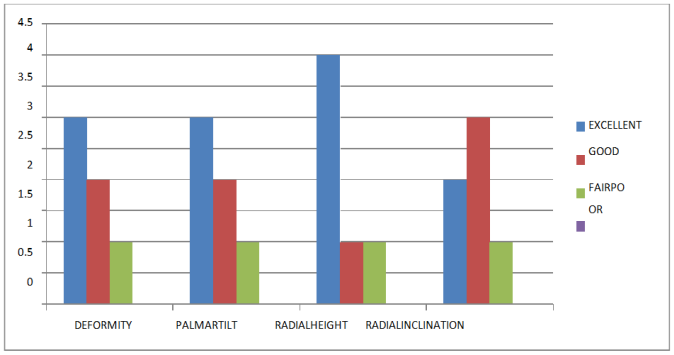
Table 1

EXTERNAL FIXATOR GROUP IN AO TYPE B (PARTIAL INTRAARTICULAR) FRACTURES

RESULT	DEFORMITY	PALMAR TILT	RADIAL SHORTENING	RADIAL INCLINATION	MEAN
EXCELLENT	3	3	4	2	3 (50%)
GOOD	2	2	1	3	2(34 %)
FAIR	1	1	1	1	1(17%)
POOR	0	0	0	0	0

External fixator group into type b (prtialintra articular) fractures

Graph 1



Graph 2

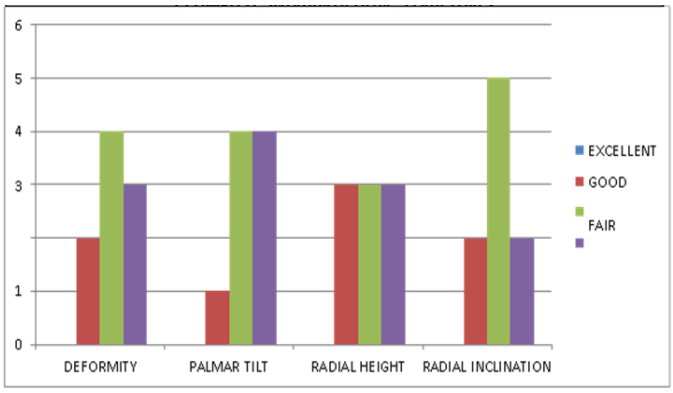


Table 2

VOLAR LCP GROUP IN AO TYPE B (PARTIAL INTRAARTICULAR) FRACTURES

RESULT	DEFORMITY	PALMAR TILT	RADIAL SHORTENING	RADIAL INCLINATION	MEAN
EXCELLENT	4	2	2	4	3(37.5%)
GOOD	3	4	2	3	3 (37.5%)
FAIR	1	2	4	1	2 (25%)
POOR	0	0	0	0	0

Graph 3

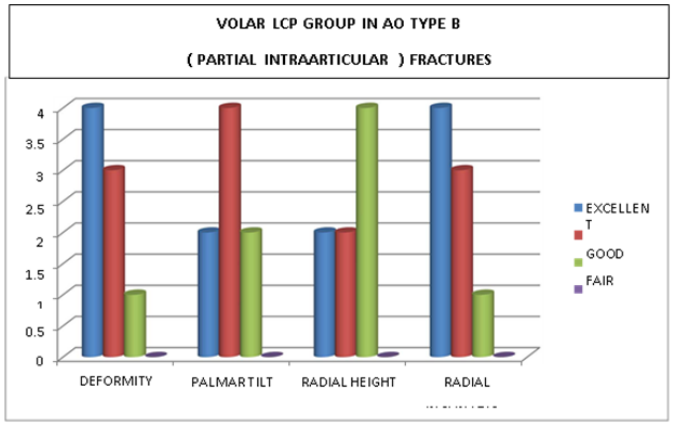
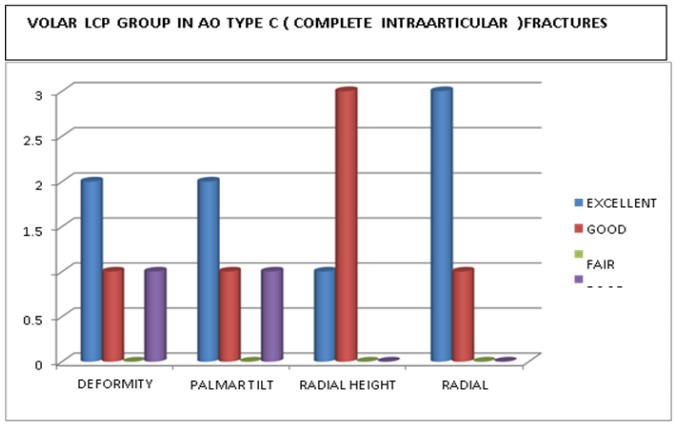


Table 3

VOLAR LCP GROUP IN AO TYPE C (COMPLETE INTRAARTICULAR) FRACTURES					
RESULT	DEFORMITY	PALMAR TILT	RADIAL SHORTENING	RADIAL INCLINATION	MEAN
EXCELLENT	2	2	1	3	2(50%)
GOOD	1	1	3	1	1.5 (37.5%)
FAIR	0	0	0	0	0
POOR	1	1	0	0	0.5 (12.5%)

Graph 4



This denotes that there is no significant difference in the radiological outcome of modality of fixation of distal radius partial intraarticular fractures by Volar LCP and External Fixator.

Table 5

	E & G	F & P	*Marginal Row Totals*
EXFIX	5 (4.71) [0.02]	1 (1.29) [0.06]	6
VOLAR LCP	6 (6.29) [0.01]	2 (1.71) [0.05]	8
Marginal Column Totals	11	3	14 (Grand Total)

The Chi-square statistic is 0.1414. The P value is 0.706879. This result is *not* significant at p < 0.05.

Discussion

All in our study belong to either type B or type C of distalradius fractures and graded the severity accordingly. 14 of Our 27 cases had sustained a complete intraarticular(AO type C) fracture. That is Type C fractureaccounted for 52% in our study. The fixed angled 2.4mm locking plates is the relatively newer choice ofimplant was used in all our patients, with maximum number of screwsin the metaphyseal region in the desired direction of anchorage.Recent biomechanical and clinical studies whichwere undertakenfor 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 (59).or 52% in our study.The latest concept among the various researches in distal radiusfixation is the introduction of variable angle locking screwswhich as ply of 15 -20 degrees in all direction and also locks with the plate. The mean range of radiological evaluation of various studies was comparable with our study as below:

Table 6

COMPARISION OF RADIOLOGICAL EVALUATION			
	VA in degrees	RL in mm	RI in degrees
Jupiter et al	7	10	21
`Orbay J et al	13	10	21
F Fitoussi & SP Chow	3	9	20
Anakwe et al	10	11	20
Our study with VLCP	7.3	9.75	16.9
Our study with Exfix	2.9	5	14.2

Table 7

COMPARISION OF RANGE OF MOVEMENTS				
	Palmar flexion	Dorsiflexion	Supination	Pronation
Jupiter et al	66	58	78	72
Orbay J et al	47	44	76	77
F Fitoussi & SP Chow	52	52	88	68
Anakwe et al	64	62	78	62
Our study with VLCP	77	69	76	64
Our study with Exfix	67	55	58	46

Objective Functional Outcome: Low energy fractures in elderly are being associated with good functional results but has many confounding variables.

The key aspects of the treatment are distal radius articular surface's anatomical reduction and achieving gooddistal radio ulnar congruity with an early mobilization for early rehabilitation.

In our study we had 27% of external fixator and 42% of Volar LCP associated with very good results based on Mayowrist score and are comparable to other studies as tabulated below.

Table 8

COMPARISION OF FUNCTIONAL EVALUATION				
	Very good (%)	Good (%)	Satisfactory (%)	Bad (%)
Jupiter et al	63	20	17	-
Dennison et al	80	20	-	-
John K Bradway et al	44	12	44	-
Anakwe et al	24	60	16	-
Our study with VLCP	42	42	16	-
Our study with Exfix	26.6	26.6	26.6	20

Complications were at least and are comparable with standard studies. We had four patients with prominent wires, one case withsuperficial infection and 3 patients with wrist stiffness and 1 with finger stiffness.

In our study , among 15 external fixator cases, 3 had unstable distal fragments of distal radius , which needed to be augmented with additional K wirefixation and immobilization in above elbow slab for 4 weeks. Later it was removed and immediate methodical wrist mobilization started.

The results of the VLCP subgroup patients were comparable to studies like Bradway et al but a vast majority (84 %) had good to very good functional score and satisfactory movement.

Primary internal fixation of the distal radius fixed with variable angle screws of volar locking plate facilitates earlymobilization and hence earlier return to activities with good range ofmovements, especially rotations.

Conclusion

Conservative management or internal fixation with Kirschner wires alone for partial and complete intra-articular fractures of distal radiusis not sufficient.

Early Primary fixation of the distal radius fractures by volar LCP is essential for good functional outcome and to avoid complication of prolonged immobilization, which facilitates early return to regular activities

Patients with unstable, either a dorsally or volarly displaced intraarticular radius fracture had excellent to good radiological outcome when treated with fixed angle volar locking plate

With the above discussion, the fracture fixation with volar plate and screw system in the management of distal radius articular fractures, especially in type C (Complete intraarticular fractures) is a superiormethod to maintain the reduction till union and prevent the collapse of the fracture fragments, even in grossly comminuted , unstable and osteoporotic bones ; as compared with external fixator augmented with K – wires.

However in type B (partial intraarticular fractures) fractures, Volar LCP and K- wire augmented External fixator provide equivocal results and none is proved superior.

Ligamentotaxis by external fixation provided favourable results in younger age group and in partial intra- articular type of distal radius fractures and requires atleast 4 cortical purchases on each side for effective stability.

However long term follow-up is required to confirm our findings

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