Global Journal of Medical Research: H
Orthopedic and Musculoskeletal System
Volume 19 Issue 2 Version 1.0 Year 2019
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-4618 & Print ISSN: 0975-5888

Outcomes of Lateral Column Plating in Extra-Articular Distal Humerus Fracture

By Dr. Anuj Induprakash Gajbhiye, Dr. R Dorai Kumar & Dr. Mohan Choudhary

Abstract- *Background:* Distal humerus extra-articular fractures are rare injuries conventionally fixed with stable bi-columnar fixation. It requires extensive soft tissue stripping leading to delayed recovery, and Olecranon impingement as a frequent complication hampering elbow extension; without considering the damage caused by excessive soft tissue stripping, both intra-articular and extra-articular fractures are managed in the same way. In extra-articular distal humerus fractures it's not needed, and additional soft tissue stripping, olecranon impingement or need of olecranon osteotomy is eliminated by using single lateral column plate. The purpose of this study is to evaluate the clinical, functional and radiological outcome of lateral column plating in distal humerus extra-articular fractures in relation to patient benefits. With recent advances in the field of implant manufacturing, and their availability: single column plate with better strength, and designs are promising enough to provide equivalent fracture stabilization (7) (8), avoids olecranon impingement/osteotomy; with less surgical exposure, thereby helping in quicker recovery, and reduced rehabilitation time.

Keywords: *lateral column plate, distal humerus, extra-articular fractures, single column plate.*

GJMR-H Classification: *NLMC Code: WE 175*

Strictly as per the compliance and regulations of:

© 2019. Dr. Anuj Induprakash Gajbhiye, Dr. R Dorai Kumar & Dr. Mohan Choudhary. This is a research/review paper, distributed under the terms of the Creative Commons Attribution-Noncommercial 3.0 Unported License http://creativecommons.org/licenses/by-nc/3.0/), permitting all non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

Outcomes of Lateral Column Plating in Extra-Articular Distal Humerus Fracture

Dr. Anuj Induprakash Gajbhiye [α], Dr. R Dorai Kumar [σ] & Dr. Mohan Choudhary [ρ]

Abstract- *Background:* Distal humerus extra-articular fractures are rare injuries conventionally fixed with stable bi-columnar fixation. It requires extensive soft tissue stripping leading to delayed recovery, and Olecranon impingement as a frequent complication hampering elbow extension; without considering the damage caused by excessive soft tissue stripping, both intra-articular and extra-articular fractures are managed in the same way. In extra-articular distal humerus fractures it's not needed, and additional soft tissue stripping, olecranon impingement or need of olecranon osteotomy is eliminated by using single lateral column plate. The purpose of this study is to evaluate the clinical, functional and radiological outcome of lateral column plating in distal humerus extra-articular fractures in relation to patient benefits. With recent advances in the field of implant manufacturing, and their availability: single column plate with better strength, and designs are promising enough to provide equivalent fracture stabilization (7) (8), avoids olecranon impingement/osteotomy; with less surgical exposure, thereby helping in quicker recovery, and reduced rehabilitation time.

Materials and Methods: It's a prospective study conducted at Sri Ramachandra hospital during April 2015, and August 2017; and consisted of Twenty (20) patients of which one (1) was lost during follow-up, and thus nineteen (19) patients were available for final assessment. The Distal humerus extra-articular fractures were classified using the AO/ ASIF Classification. After the surgery, functional evaluation was done with DASH, MAYO, VAS score, and radiographic analysis at follow-up period starting from 6 weeks to 1year.

Result: Nineteen patients of distal humerus extra-articular fractures treated with distal humerus extra-articular plating were followed periodically from 6 weeks upto one year. Flexion movement was good throughout follow-up, and was statistically significant from 6 week to 3 months; 6 week to 6 months, 6 week to 1 year, 3 month to 6 months, 3 month, 1 year respectively, and was not significant at 6 month - 1 year. That means the patient had almost recovered by 6 weeks follow-up; little improvement was there up to 1 year from the initial time of the follow-up. When compared with the last 6 month of follow-up, there was no further improvement possible as the patient had already achieved there anatomical range of movement. The extension was significantly improved when the patient came for follow-up at 6 weeks, and mean extension was 3.68 ± 6 degrees. Later at 3, 6 months, and 1 year where an almost normal extension was possible in all cases except complicated cases; thus there was no scope of further extension at latter visits, and test were insignificant statistically. Supination was not statistically significant at any follow-ups. That means the patient had recovered to an anatomical range of movement by 6 weeks of follow-up, and there was no further improvement possible. Pronation was not statistically significant at any follow-ups. That means the patient had recovered to an anatomical range of movement by 6 week follow-up, and there was no further improvement possible. Dash score was decreasing over one year. The score was compared at 6 weeks to 3 month, 6 month, and 1 year respectively; at 3 month to 6 month, 1 year respectively, and at 6 month to 1 year. All intervals were statistically significant ($p < 0.05$) indicating improvement in patients daily activities to normal over 1 year. Mayo score was increasing over the period of one year. The score was compared; At 6 weeks to 3 month, 6 month, 1 year respectively; 3 month to1 year; and at 6 month to 1 year. All intervals were statistically significant ($p < 0.05$) except at 3 month - 6 month period where it was statistically insignificant due to one case of malunion, and implant failure. Otherwise, all patients recovered to almost normal over 1 year. VAS score was minimal at 6 weeks, and was decreasing at later follow-ups. It was found to be significant at 6 weeks i.e. patient were relived of pain by 6 weeks to 3 months. Later it was marginally significant at 6 months, but it was due to a case of implant failure that came up with aggrieved pain complaints. Otherwise; in other patient's it was insignificant after 3 months as patients were relived of pain, and there was no scope for any further pain relief. The mean metaphyseal-diaphyseal angle was 86.21° (SD3.441°, normal 82–84°), the mean humeral-ulnarangle was 14.63° (SD 2.338°, normal 17.8° valgus), and the mean shaft-condylar angle was 39.84° (SD 1.500°, normal 40°). The anterior humeral line passed through 50.00 % (SD 1.491 %) of the capitellar width (normal, middle third). One patient had implant failure, which was treated by implant exit, and revision lateral column distal humerus plating.

Conclusion: Extra-articular distal humerus fractures fixed with lateral column plate resulted in good immediate stability, and fracture union with quick recovery, and improved satisfaction to the patient.

Keywords: lateral column plate, distal humerus, extra-articular fractures, single column plate.

I. Introduction

Distal humerus extra-articular fractures comprise 16% of humerus fractures, and 10% of distal humerus fractures (1) (2). Conventionally all distal humerus fractures are stabilized with bi-columnar plating. It is a stable fixation but requires extensive soft tissue stripping leading to delayed recovery, and Olecranon impingement as a frequent complication hampering elbow extension; without considering the damage caused by excessive soft tissue stripping, both intra-articular and extra-articular fractures are managed

Author α σ ρ: MS Orthopaedics, MBBS, Department of orthopaedics, Sri Ramachandra Institute of higher education and research, Chennai. e-mail: andyursonly@gmail.com

© 2019 Global Journals

in the same way. In extra-articular distal humerus fractures it's not needed, and additional soft tissue stripping, olecranon impingement or need of olecranon osteotomy is eliminated by using single lateral column plate (1) (3) (4) (5) (6). With recent advances in the field of implant manufacturing, and their availability: single column plate with better strength and designs are promising enough to provide equivalent fracture stabilization (7) (8), avoids olecranon impingement/ osteotomy; with less surgical exposure, thereby helping in quicker recovery, and reduced rehabilitation time. Lateral column plating in extra-articular distal humerus fractures, is a surgical procedure in which fracture is reduced by open anatomical reduction, and fixed with single lateral plate to posterior surface of humerus to restore mechanical axis, stability of the bone and restore joint configuration (3) which will further enhance the function of the muscles, ligaments , and other soft tissue structures of the elbow joint with minimal soft tissue stripping, completely eliminating olecranon impingement, and thus aid in early mobilisation.

II. Material & Methods

It was a Prospective study conducted at Sri Ramachandra Medical College & Research Institute, Chennai during April 2015 and August 2017. The study consisted patients of closed injury with distal humerus extra-articular fractures in skeletally mature patients, and excluded intra-articular fractures of elbow, paediatric age group, proximal humerus fractures, previously - treated or operated with other internal fixation methods/devices but failed, open injuries, and patients having a pre-operative neuro-vascular deficit. Preoperatively patients were evaluated clinically, radiologically and the diagnosis was established and classified using the AO/ASIF Classification. Twenty (20) patients of distal humerus extra-articular fractures were at hand of which Nineteen (19) were available for final assessment. Our follow-up period ranges from 6 weeks to 1 year. The Implant used was LCP Extra-articular Distal Humerus Plate, which is anatomically shaped, and angular stable fixation system for extra-articular fractures fixation of the distal humerus. The LCP head is tapered to minimize soft tissue irritation; five distal locking holes accept 3.5 mm locking screws, all head holes are angled medially to maximize screw purchase in bone, two most distal holes are angled toward the capitulum, and trochlea. whereas in the Plate shaft Combi holes combine a dynamic compression unit (DCU) hole with a locking screw hole, providing the flexibility of axial compression, and locking capability throughout the plate shaft, Limited-contact design, Available with 4, 6, 8, 10, 12 or 14 elongated Combi holes to accommodate distal humerus fractures with shaft involvement (figure 1)

Figure 1

a) Surgical Protocol

General anesthesia was used for all cases. The patient is then positioned right or left lateral with arm hanging by the side depending upon the side. In our study, all 19 distal humerus were operated through posterior Triceps-Splitting Approach. (Figure 2 A) Where; Distal one-third of triceps is split longitudinally to olecranon process. At olecranon process, split continues longitudinally, with the elevation of triceps insertion sharply off bone medially, and laterally. Triceps is essentially split into medial and lateral halves and retracted peripherally, allowing visualization of the underlying distal humerus, FCU, flexor carpi ulnaris (Figure 2 A B C).

© 2019 Global Journals

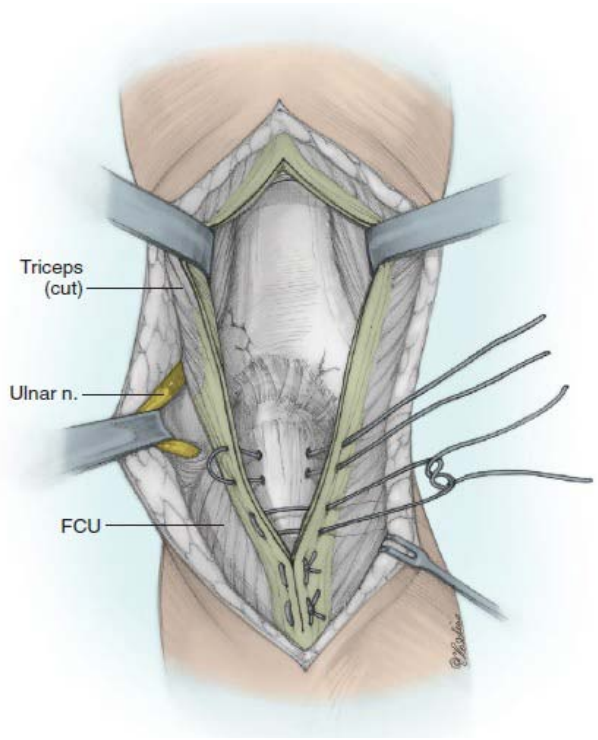

Figure 2 A

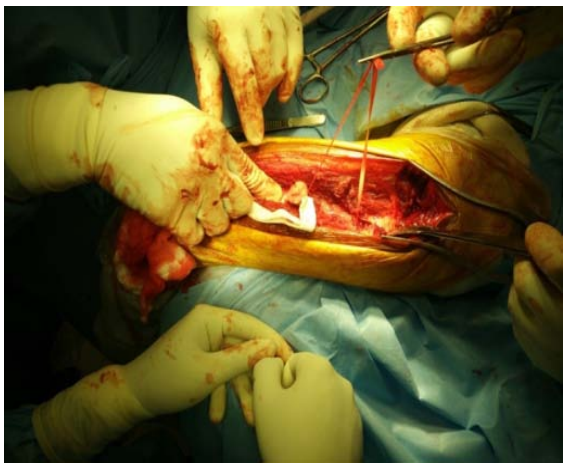

Figure 2 B

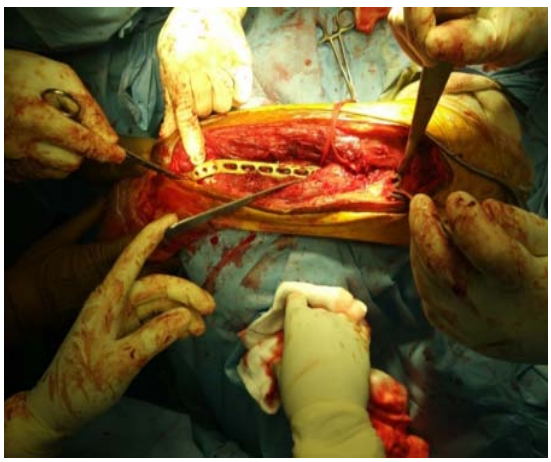

Figure 2 C

b) Postoperative Care, Rehabilitation, and Evaluation

The patient is nursed in absolute aseptic conditions in the postoperative ward with the limb in hanging position by pillow cover elevation. Parental antibiotics were continued for the first two days followed by oral antibiotics for the next three days. Pain management was done with intra-venous analgesic, and was removed on the 2nd post-operative day. There after oral analgesics were given. Drain is removed at the end of 48 hrs. As soon as pain subsides, Rehabilitation Protocol is started with physiotherapy. The Active elbow flexion-extension and supination-pronation exercises with the aim of maximum ranges of motion; as soon as possible but as tolerated by the patients. The patient was advised to continue exercises here or any other convenient centre. Sutures were removed during 12th to 14th post-operative day. After the surgery, functional evaluation was done with DASH, MAYO and VAS score (figure 3, 4, and 5) at six weeks, three months, six months, and one year.

Functional Evaluation of patients is done using the DASH and MAYO score and is categorized as:

MAYO: Excellent 100-90; Good 75-89; Fair 60-74; Poor below 60.

DASH: Excellent 0; Poor 100.

The Pain was assessed using VAS score: No pain 0; Worst pain10.

© 2019 Global Journals

www.orthopaedicscores.com

Date of completion
October 10, 2017

The Disabilities of the Arm, Shoulder and Hand (DASH) Score

Clinician's name (or ref) _____ Patient's name (or ref _____

INSTRUCTIONS: This questionnaire asks about your symptoms as well as your ability to perform certain activities. Please answer *every question* , based on your condition in the last week. If you did not have the opportunity to perform an activity in the past week, please make your *best estimate* on which response would be the most accurate. It doesn't matter which hand or arm you use to perform the activity; please answer based on you ability regardless of how you perform the task.

Please rate your ability to do the following activities in the last week.

1. Open a tight or new jar	○ No difficulty	○ Mild difficulty	◉ Moderate difficulty	○ Severe difficulty	○ Unable
2. Write	○ No difficulty	○ Mild difficulty	○ Moderate difficulty	◉ Severe difficulty	○ Unable
3. Turn a key	○ No difficulty	◉ Mild difficulty	○ Moderate difficulty	○ Severe difficulty	○ Unable
4. Prepare a meal	○ No difficulty	◉ Mild difficulty	○ Moderate difficulty	○ Severe difficulty	○ Unable
5. Push open a heavy door	○ No difficulty	◉ Mild difficulty	○ Moderate difficulty	○ Severe difficulty	○ Unable
6. Place an object on a shelf above your head	○ No difficulty	◉ Mild difficulty	○ Moderate difficulty	○ Severe difficulty	○ Unable
7. Do heavy household chores (eg wash walls, wash floors)	○ No difficulty	○ Mild difficulty	◉ Moderate difficulty	○ Severe difficulty	○ Unable
8. Garden or do yard work	○ No difficulty	○ Mild difficulty	◉ Moderate difficulty	○ Severe difficulty	○ Unable
9. Make a bed	○ No difficulty	○ Mild difficulty	○ Moderate difficulty	◉ Severe difficulty	○ Unable
10. Carry a shopping bag or briefcase	○ No difficulty	○ Mild difficulty	○ Moderate difficulty	◉ Severe difficulty	○ Unable
11. Carry a heavy object (over 10 lbs)	○ No difficulty	○ Mild difficulty	○ Moderate difficulty	◉ Severe difficulty	○ Unable
12. Change a lightbulb overhead	○ No difficulty	○ Mild difficulty	◉ Moderate difficulty	○ Severe difficulty	○ Unable
13. Wash or blow dry your hair	○ No difficulty	○ Mild difficulty	◉ Moderate difficulty	○ Severe difficulty	○ Unable
14. Wash your back	○ No difficulty	○ Mild difficulty	◉ Moderate difficulty	○ Severe difficulty	○ Unable

Figure 3A

15. Put on a pullover sweater	○ No difficulty	○ Mild difficulty	○ Moderate difficulty	◉ Severe difficulty	○ Unable
16. Use a knife to cut food	○ No difficulty	○ Mild difficulty	○ Moderate difficulty	○ Severe difficulty	◉ Unable
17. Recreational activities which require little effort (eg cardplaying, knitting, etc)	○ No difficulty	○ Mild difficulty	○ Moderate difficulty	◉ Severe difficulty	○ Unable
18. Recreational activities in which you take some force or impact through your arm, shoulder or hand (eg golf, hammering, tennis, etc)	○ No difficulty	○ Mild difficulty	○ Moderate difficulty	◉ Severe difficulty	○ Unable
19. Recreational activities in which you move your arm freely (eg playing frisbee, badminton, etc)	○ No difficulty	○ Mild difficulty	◉ Moderate difficulty	○ Severe difficulty	○ Unable
20. Manage transportation needs (getting from one place to another)	○ No difficulty	○ Mild difficulty	◉ Moderate difficulty	○ Severe difficulty	○ Unable
21. Sexual activities	○ No difficulty	○ Mild difficulty	○ Moderate difficulty	◉ Severe difficulty	○ Unable
22. During the past week, *to what extent* has your arm, shoulder or hand problem interfered with your normal social activities with family, friends, neighbours or groups?	○ Not at all	○ Slightly	○ Moderately	◉ Quite a bit	○ Extremely
23. During the past week, were you limited in your work or other regular daily activities as a result of your arm, shoulder or hand problem?	○ Not limited at all	○ Slightly limited	◉ Moderately limited	○ Very limited	○ Unable
Please rate the severity of the following symptoms in the last week					
24. Arm, shoulder or hand pain	○ None	○ Mild	◉ Moderate	○ Severe	○ Extreme
25. Arm, shoulder or hand pain when you performed any specific activity	○ None	○ Mild	○ Moderate	○ Severe	◉ Extreme
26. Tingling (pins and needles) in your arm, shoulder or hand	○ None	○ Mild	○ Moderate	◉ Severe	○ Extreme
27. Weakness in your arm, shoulder or hand	○ None	○ Mild	○ Moderate	◉ Severe	○ Extreme
28. Stiffness in your arm, shoulder or hand	○ None	○ Mild	○ Moderate	○ Severe	◉ Extreme
29. During the past week, how much difficulty have you had sleeping because of the pain in your arm, shoulder or hand?	○ No difficulty	○ Mild difficulty	○ Moderate difficulty	◉ Severe difficulty	○ So much I can't sleep
30. I feel less capable, less confident or less useful because of my arm, shoulder or hand problem	○ Strongly disagree	○ Disagree	○ Neither agree nor disagree	○ Agree	◉ Strongly agree

Thank you very much for completing all the questions in this questionnaire.

Figure 3B

© 2019 Global Journals

Mayo Elbow Performance Score

Clinician's name (or ref) ..... Patient's name (or ref) .....

Please answer the following questions.

Section 1 - Pain Intensity
○ None
○ Mild
○ Moderate
○ Severe

Section 2 - Motion
○ Arc of motion greater than 100 degrees
○ Arc of motion between 50 and 100 degrees
○ Arc of motion less than 50 degrees

Section 3 - Stability
○ Stable
○ Moderate instability
○ Grossly Unstable

Section 4 - Function (Tick as many as able)
○ Can comb hair
○ Can eat
○ Can perform hygiene
○ Can don shirt
○ Can don shoe

Figure 4

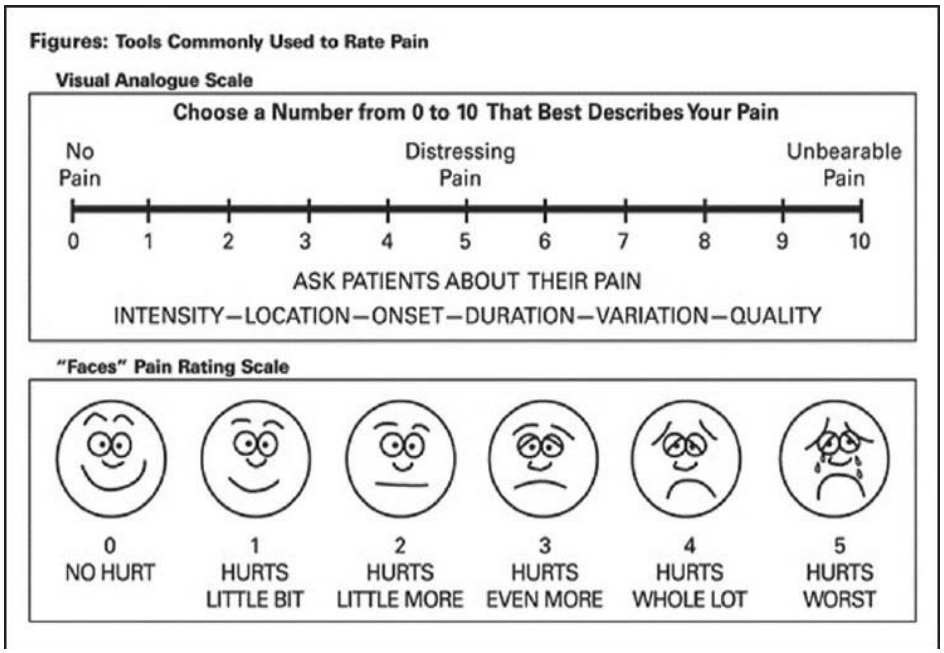

Figure 5

c) Radiographic Analysis

Antero-posterior and lateral radiographs were done at each visit, compared with previous radiographs, and analysed for Metaphyseal diaphysis angle, humeral ulnar angle, shaft condylar angles, anterior humeral line (Figure 6) , Plate location, Stability , and Sign of healing (post 6 weeks). Also, radiolucent lines, changes in bone density, cortical hypertrophy and heterotrophic ossification if any were noted. Healing of fracture was examined by observing cortical continuity,

© 2019 Global Journals

disappearance of fracture lines and appearance of bridging bone in all planes. Extensive reactive lines around bone contact surface of the implant were considered a major sign for the absence of Osseo-integration. Clinically healing was established by absence of pain, tenderness or abnormal mobility.

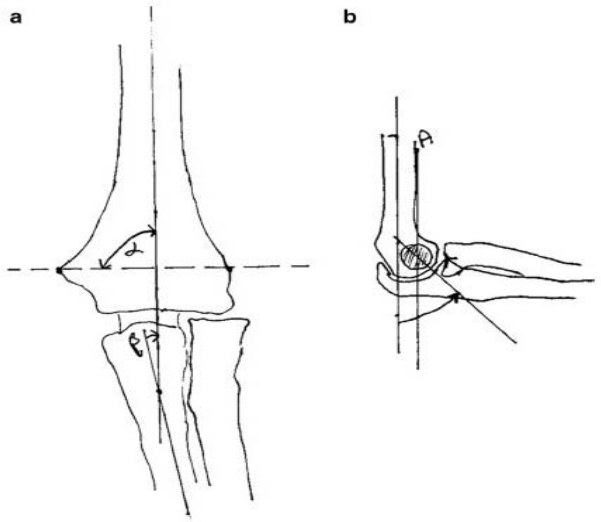

Figure 6: Elbow antero-posterior and lateral radiographs

On Ap View (Fig 6.A):
Metaphyseal-diaphyseal angle (α)
Humeral-ulnar angle (β)

On lateral view (Fig 6.B):
Anterior humeral line (A)
Shaft condyle angle (arrow)

III. Results

20 Cases were identified for this study, of which one (1) was lost during follow-up thus 19 cases (10 males, and 9 females) with bimodal distribution of age – where in 20-40 age group had most cases, most common cause being RTA followed by 60-80 as old age were available for final assessment. According to AO/ASIF classification 63.2% patients belong to AO type A2 type, and 36.8% belong to AO type A3 fracture.

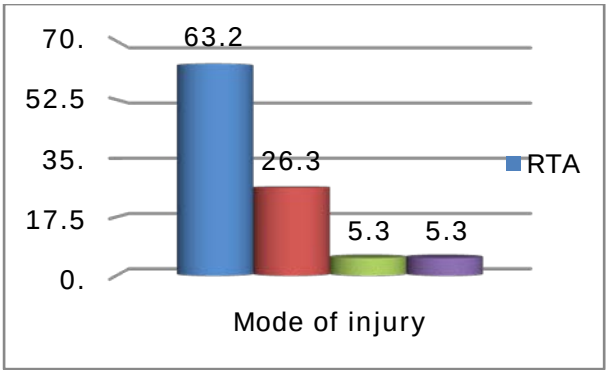

Figure 7

Road traffic accident was the major cause of injury 63.2%; followed by slip and fall 26.3%, one case of pathological (5.3%), and sports injury (5.3%) each.

Table 1: Radiological Analysis

	N	Minimum	Maximum	Mean	Std. Deviation
Metaphyseal diphyseal angle	19	82	91	86.21	3.441
Humeral ulnar angle	19	12	18	14.63	2.338
Shaft condylar angles	19	38	42	39.84	1.500
Anterior humeral line	19	48	52	50.00	1.491

The mean metaphyseal-diaphyseal angle was 86.21° (SD3.441°, normal 82–84°), the mean humeral-ulnar angle was 14.63° (SD 2.338°, normal 17.8° valgus), and the mean shaft-condylar angle was 39.84° (SD 1.500°, normal 40°). The anterior humeral line passed through 50.00 % (SD 1.491 %) of the capitellar width (normal, middle third).

© 2019 Global Journals

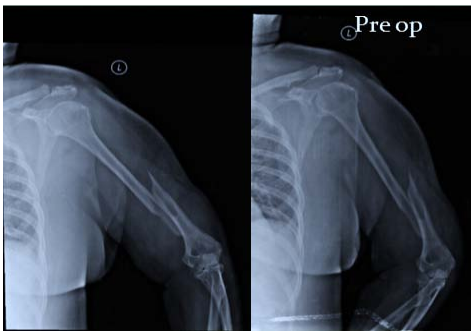

Figure 8 A

Figure 8 B

Figure 8 C

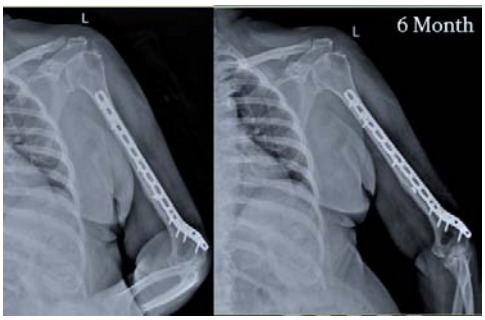

Figure 8 D

Figure 8 E

a) *Clinical illustration*

Figure 9: A/B Flexion and extension

© 2019 Global Journals

Figure 9: C/D Supination and pronation

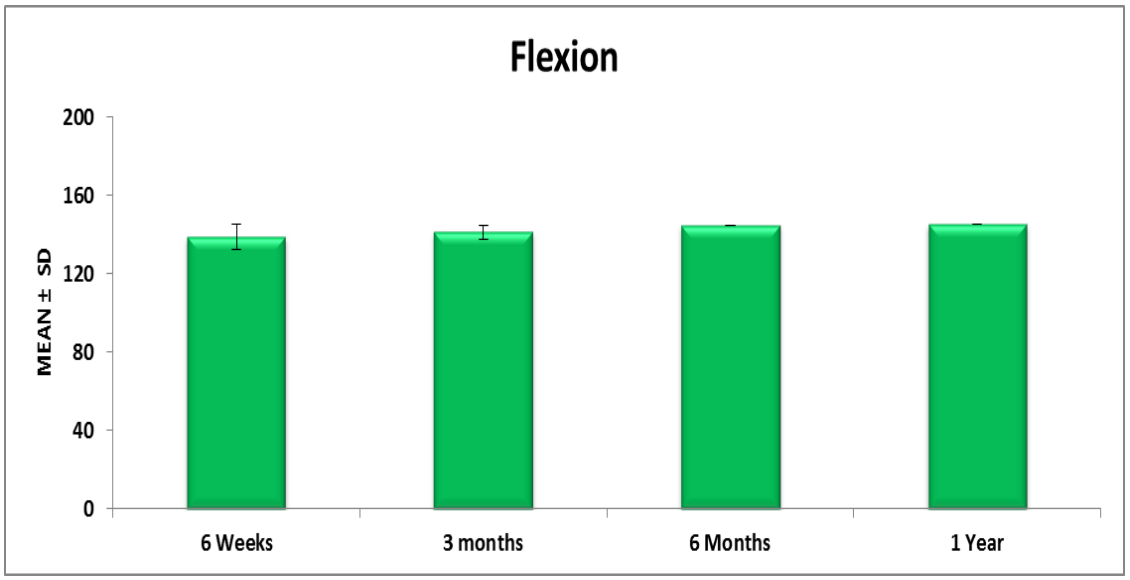

Figure 10

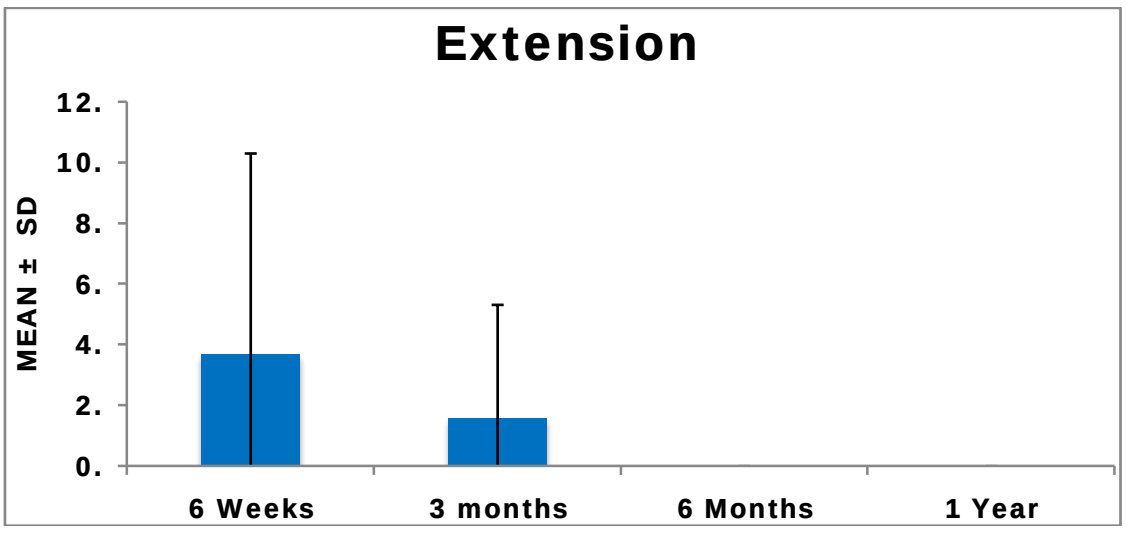

Figure 11

© 2019 Global Journals

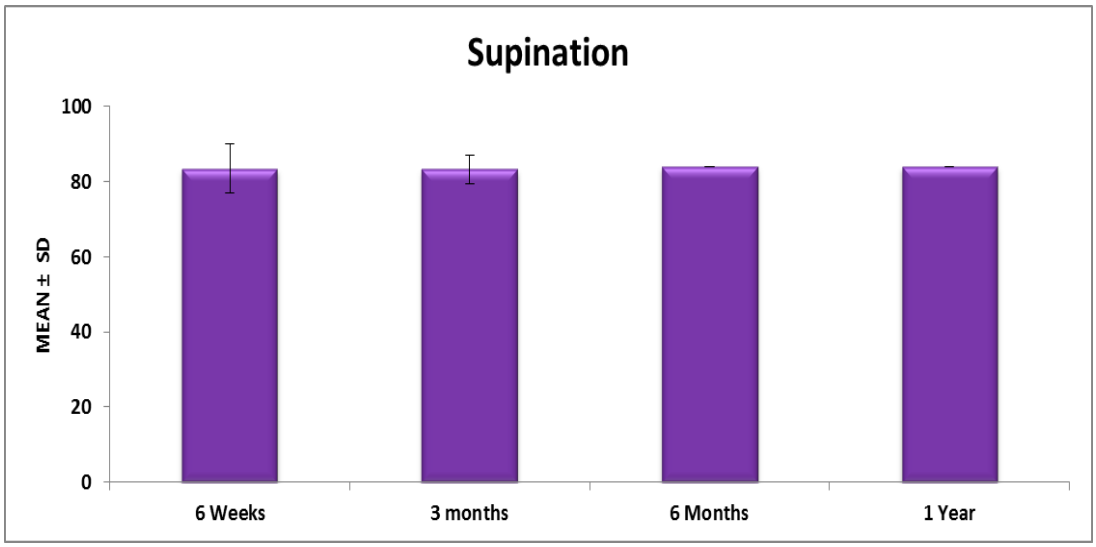

Figure 12

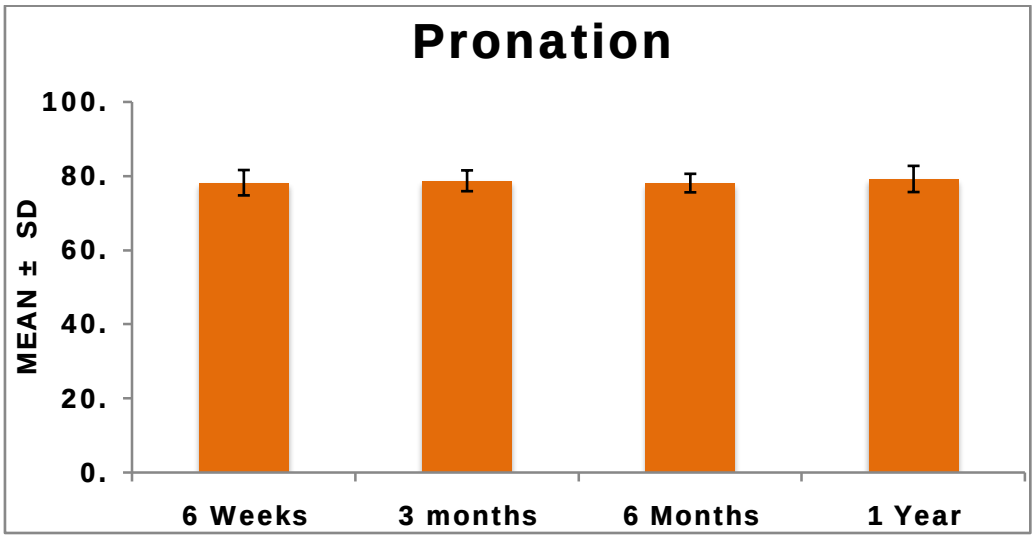

Figure 13

Flexion movement was good throughout follow-up, and was statistically significant from 6 weeks to 3 month; 6 week to 6 month, 6 week to 1 year, 3 month to 6 month, 3 month, 1 year respectively, and was not significant at 6 month - 1 year. That means patient had almost recovered by 6 week follow-up, little improvement was there up to 1 year from initial time of follow-up. When compared with last 6 month of follow-up there was no further improvement possible as patient had already achieved there anatomical range of movement (Figure 10). The extension was significantly improved when the patient came for follow-up at 6 weeks, and mean extension was 3.68 ± 6 degrees. Later at 3, 6 months and 1 year where almost normal extension was possible in all cases except complicated cases; thus there was no scope of further extension at latter visits, and test were insignificant statistically (Figure 11). Supination was not statistically significant at any follow-ups. That means the patient had recovered to an anatomical range of movement by 6 week of follow-up, and there was no further improvement possible (Figure 12). Pronation was not statistically significant at any follow-ups. That means the patient had recovered to the anatomical range of movement by 6 week follow-up, and there was no further improvement possible (Figure 13). Dash score was decreasing over one year. The Score was compared at 6 weeks to 3 month, 6 month, and 1 year respectively; at 3 month to 6 month, 1 year respectively, and at 6 month to 1 year. All intervals were statistically significant ($p<0.05$) indicating improvement in patients daily activities to normal over 1 year (Figure 14). Mayo score was increasing over a period of one year. The score was compared; At 6 weeks to 3 month, 6 month, 1 year respectively; 3 month to 1 year;, and at 6 month to 1 year. All interval were statistically significant ($p <0.05$) except at 3 month – 6 month period where it was statistically insignificant due to one case of malunion, and implant failure. Otherwise,

© 2019 Global Journals

all patients recovered to almost normal over 1 year (Figure 15). VAS score was minimal at 6 weeks, and was decreasing at later follow-ups. It was found to be significant at 6 weeks i.e. patient were relived of pain by 6 weeks to 3 months. Later it was marginally significant at 6 months but it was due to case of implant failure that came up with aggrieved pain complaints. Otherwise; in other patient's it was insignificant after 3 months as patients were relived of pain, and there was no scope for any further pain relief (Figure 16).

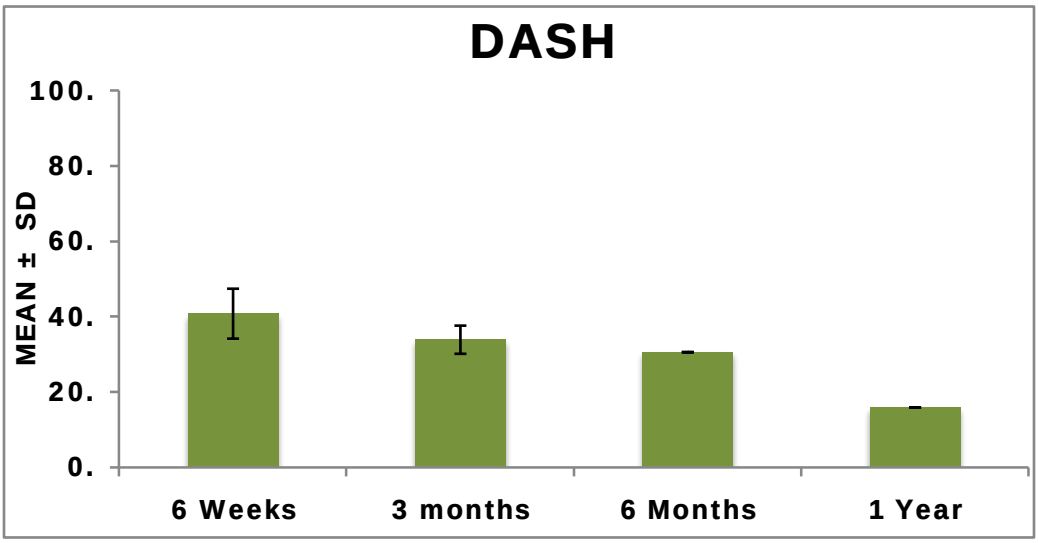

Figure 14

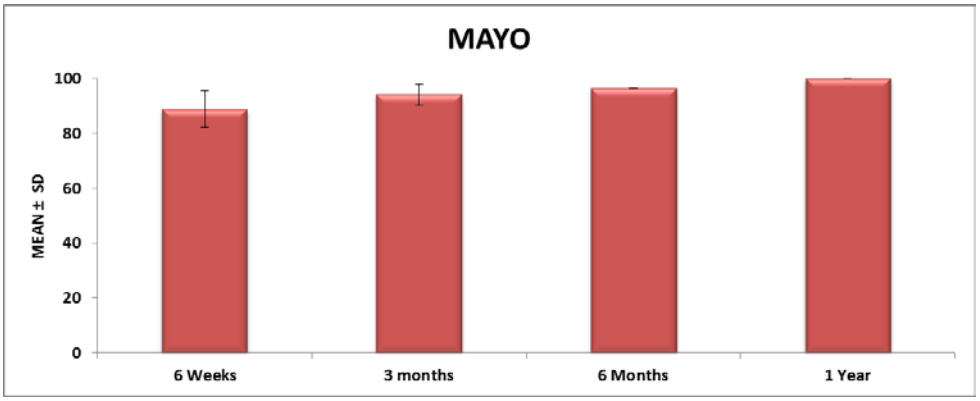

Figure 15

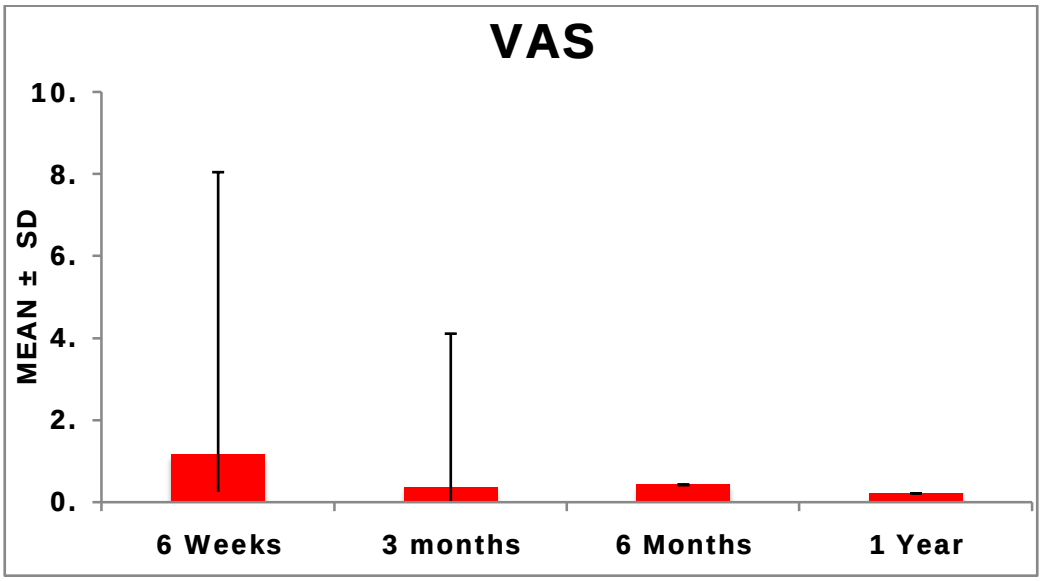

Figure 16

© 2019 Global Journals

b) Complications

Malunion (Cubitus varus) was seen as the most frequent complication 15.8% of the study group. Infection (CDC Superficial) and Elbow stiffness were seen in 10.5% which was second most frequent complication noticed. Delayed union and implant failure was seen in 1 case (5.3%) each. One infected patient, after getting completely treated for infection, had implant pulled out at 6 months review also she had associated varus deformity , and elbow stiffness. The patient was not willing for deformity correction. She was managed with bursa excision, wound debridement and implant exit followed by antibiotics and regular dressing. One patient had delayed union and associated elbow stiffness; post 6 months fracture healed well. No intervention was done as the patient was unwilling. Only calcium, multi-vitamin supplementation, and supervised exercises were given. One patient with varus malunion had a postoperative superficial infection which was managed with regular dressing and antibiotics. Another varus malunion had no associated complication. Both malunion did not require any intervention as it did not deteriorate any function, and patients were satisfied without come.

Fractures: None of the patients had peri-prosthetic fracture during the follow-up.

Heterotrophic ossification: None of the patients had heterotrophic ossification during the follow-up. *Neurovascular Injury:* None of our patients had a neurovascular injury (Figure 17).

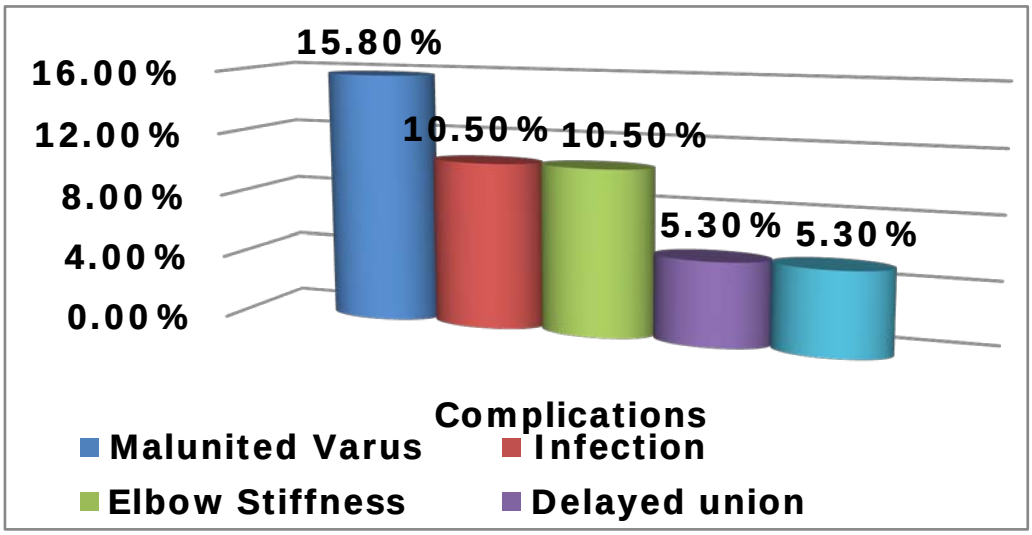

Figure 17

IV. Discussion

These fractures are closely associated with elbow function and its stability (7) (9), the elbow range of movement is essential for most daily activities indicating its earliest surgical fixation to restore the anatomical and functional integrity, and prevent both structural as well as neurovascular complications (3) (10) (11). But both intra-articular and extra-articular distal humerus fractures should not be put in the same mold of treatment. Damage caused by excessive soft tissue stripping should not be overlooked. John T Capo et al. (1) did a retrospective study where in his study at final follow-up; mean flexion was of 126±16 °, and extension was 7±7° at final follow-up. In Yatinder kharbanda et al. (12) study mean flexion was 125 °, and only one patient had flexion deformity of 5 ° at the end of one year after surgery. Rajendraprasad bhutala et al. (13) at 6 months of the study showed flexion of 128 °, and full extension in 17 cases and +10 in other 3 cases, and had concluded as excellent functional outcomes. In 2013 Gregory M. Meloy (14) did a multi-centered retrospective comparative study: A paradigm shift in the surgical reconstruction of extra-articular distal humeral fractures: single-column plating. Group 1 consisted of 53 extra-articular distal humeral fractures treated with dual column plating. Group 2 comprised 51 patients who were managed with a single pre-contoured poster lateral locking plate. In Group 1 (dual plating), the mean elbow flexion achieved was 127.09 ± 14.968 °, and the mean elbow extension was – 12.44 ± 10.848 °. In Group 2, the mean elbow flexion achieved was 136.1 ± 7.78 °, and the mean elbow extension was – 3.62 ± 4.968 °, they concluded Group 2 (single plating) had a better overall range of motion than Group 1. Group 2 in this study was compared to our study where mean flexion is 141.67 ± 4.201 °, and mean extension is 1.11 ± 3.234°. Our discussion with other studies comes to a conclusion that reduced soft tissue stripping, elimination of olecranon impingement or need of olecranon osteotomy has resulted in faster recovery, reduced rehabilitation time in flexion extension movement at elbow joint and thus the patients returned to their day to day activities earlier (Table 2).

© 2019 Global Journals

Table 2

Elbow ROM		John T. Capo *et al* (post op)	Yatinder Kharbanda *et al*	Gregory M. Meloy (At 4 month)	Rajendraprasad bhutala *et al*	Our Study
6 week	Flexion (mean)					138.74 ± 8.685 °
	Extension (mean)					3.68 ±6.634 °
3 months	Flexion (mean)			136.1 ±7.78 °		141.67 ± 4.201°
	Extension (mean)			3.62±4.96 °		1.11 ± 3.234 °
6 months	Flexion (mean)				128 °	144.44 ± 1.617 °
	Extension (mean)				0 °; 3 cases ffd of 10 °	.00 °
1 year	Flexion (mean)	126±16°	125 °			145.00 ± .000 °
	Extension (mean)	-7 ± 7 °	0 °			.00 °

Similarly Supination/pronation was evaluated at 6 weeks and at later follow-up, and it was found that complete anatomical restoration of movement was achieved by 6 week itself, and no further benefit was possible at later follow-ups. Other researchers also had observed similar values in their observation. John T capo et al. (1) observed supination 83 ± 22 ° at 3 months where as it was 82 in Rajendraprasad Butala et al. (13) 6 months, and Yatinder kharbanda (12) got value of 84.5 ° at the end of 1 year which is within normal range of movement. In our study Supination was 83.42±1.539 ° at 6 week, 83.61±2.304 ° at 3 month, 84.00±1.455 ° at 6 month, and 84.00±1.455 ° at 1 year, and was statistically insignificant. I.e. Range of movement was recovered to full before 6 weeks, and no further improvement was possible beyond it. Pronation 82 ± 23 ° was reported by john T capo et al. (1) at 3 month where as it was 85 ° in Rajendraprasad Butala et al. (13) study, and Yatinder kharbanda (12) 83.75 ° at one year. In our study it was 78.16 ± 3.420 ° at 6 weeks, 78.68 ± 2.810 ° at 3 months, 78.06 ± 2.508 ° at 6 months, and 79.17± 3.536 ° at 1 year. Statistically, it was insignificant indicating it was functionally recovered before 6 weeks, and there was no further scope of improvement. Thus indicating supination and pronation movement were not affected primarily due to these fractures. Difficulty in supination pronation was due to surrounding soft tissue pain. Once the patient was pain free this movement had come back to normal (Table 3).

Table 3

Supination	John T. Capo *et al*	Yatinder Kharbanda *et al*	Rajendraprasad butala *et al*	Our Study
6 week	-			83.42 ± 1.539 °
3 months	83±22°			83.61 ± 2.304 °
6 months			82 °	84.00 ± 1.455 °
1 year		84.5 °		84.00 ± 1.455 °
Pronation	John T. Capo *et al*	Rajendraprasad butala *et al*	Yatinder Kharbanda *et al*	Our Study
6 week	-			78.16 ± 3.420 °
3 months	82±23°			78.68 ± 2.810 °
6 months		85 °		78.06 ± 2.508 °
1 year			83.75 °	79.17 ± 3.536 °

Hassan Fawi et al. (11) conducted a study on distal third humerus fractures treated using the Synthes 3.5-mmextra-articular distal humeral locking compression plate where the mean VAS score was 8.5. In the study conducted by John T Capo (1) there were 47% patients who had VAS score of 0 i.e. no pain,17% patients had score of 1-3 i.e. Mild pain,17% patients had score of 4-6 i.e. moderate pain, , and score of 7-10 in 0% patients i.e. severe pain. In our study VAS score was minimal by six weeks, and was further decreasing;

© 2019 Global Journals

At 6 week mean VAS was 1.16±2.062, at 3 month. 37±1.012, 1 year. 21±.918, except at 6 months where it was increased (.42±1.017) due to implant failure that came up with aggrieved pain complaints. The score was compared from 6 weeks to 3 months (and later); At 6 weeks- 3 month it was statistically significant (p =0.05); marginally significant (p=0.58) at 6 weeks- 1 year due to a case of implant failure. Otherwise, in other patient's it was insignificant at 6 weeks- 6 month; 3 month -6 months, 1 year; at 6 months to 1 year. Indicating patients were relived of pain by 6 weeks, and there was no further scope of pain relief (Table 4).

Table 4

	Hassan Fawi *et al*	John T Capo *et al*	Our Study
VAS (mean)	8.5	0 None 47% 1-3 Mild 17% 4-6 Moderate 17% 7-10 severe 0%	6 week 1.16 ±2.062 3 month .37±1.012 6 month .42±1.017 1 year .21±.918

John T. Capo et al. (1) conducted a retrospective study consisting of 21 cases of distal humerus extra-articular fracture treated with single column lateral plate where DASH score was 25.8±17.7 at 3 months follow-up. In our study DASH at 6 weeks was 40.72 ±5.498, where as compared to john T Capo et al. (1) study at 3 month DASH score is 33.81 ± 5.522. Further it showed significant decrease in DASH score at every follow-up, indicating significant recovery over one year. Yatinder Kharbanda et al. (12) did a retrospective analysis of extra-articular distal humerus shaft fractures treated with the use of pre-contoured lateral column metaphyseal LCP by triceps-sparing poster lateral approach. At final follow-up the mean DASH score at 1 year was 17.6 ranging from 13.3 to 38.3 points. The normal DASH score in the general population has been reported to be around 10 with a standard deviation of 14.68. In our study, DASH score was decreasing over one year; at 6 weeks it was 40.72 ± 5.498 at 3 months 33.81 ± 5.522 at 6 months 30.51± 4.447, and at 1 year it was 15.82± 4.450. The score was compared 6 weeks to 3 months (and later); At 6 weeks- 3 month, 6 month, 1 year; at 3 month -6 month, 1 year; at 6 month to 1 year. All intervals were statistically significant (p <0.05) indicating improvement in patients daily activities throughout follow-up. That means the patients recovered to almost normal over 1 year (Table 5).

Table 5

DASH	John T. Capo *et al*	Yatinder Kharbanda *et al*	Our Study
6 week	-		40.72±5.498
3 months	25.8±17.7		33.81±5.522
6 months			30.51±4.447
1 year		17.6 (13.3-38.3)	15.82±4.450

Vivek Trikha et al. (15) Functional outcome of extra-articular distal humerus fracture fixation using a single locking plate elbow function was assessed by Mayo score at final follow-up, and was 90.8 -9.9 they concluded Stable reconstruction, and early initiation of physiotherapy are utilitarian to envision optimal outcome; the use of pre-contoured extra-articular distal humerus locking plates has yielded satisfactory results which were comparable to our study where mayo elbow score was 100. It was progressively increasing at follows up suggesting significant improvement at each follow-up. Similarly, in Deepak Jain et al. (16) prospective study of 26 patients The MEPS (average: 96.1; range 80–100) was excellent in 81% cases (n = 21), and good in 19% cases (n =5). There were 2 cases followed up to 1 year average MEPS was 90. Rajendraprasad Butala (17) mentioned MEPS score of 95.5 at 6 month, which is excellent outcomes, and is comparable to our study. In our study Mayo score was found to be increasing over a period of one year; at 6 weeks it was 88.74 ± 11.464, at 3 months 94.11 ± 7.752, at 6 month 96.39 ± 5.893, and at 1 year it was 100.00 ±.000. The score was compared 6 weeks to 3 months (and later); At 6 weeks- 3 month, 6 month, 3 month – 1 year; 6 month- 1 year; , and at 6 month to 1 year. All interval were statistically significant (p <0.05) except at 3 month - 6 month period where it was statistically insignificant. This was due to one patient who came back during this period with malunion, and implant failure. That means the patient's recovered to almost normal over 1 year. Single column plate has proved promising enough to provide equivalent fracture stabilization, eliminates olecranon impingement/ osteotomy, with less surgical exposure due to good implant strength, and designs , and is thereby helping the patients to quick return to their normal lifestyle (Table 6).

© 2019 Global Journals

Table 6

Mayo	Vivek Trikha *et al*	Deepak jain *et al*	Rajendraprasad butala *et al*	Our Study
6 weeks	-			88.74 ± 11.464
3 months	-			94.11 ± 7.752
6 months	-	96.66	95.5	96.39 ± 5.893
1 year	90.8 ± 9.9	90		100.00 ± .000

Korner J et al. (9) conducted a retrospective study on distal humerus fractures in elderly patients: results after open reduction, and internal fixation consisting of 45 patients whose clinical, and radiological follow-up was obtained after a minimum of 24 months following surgery (median 87 months; range, 24-121 months). Functional results were evaluated according to the Mayo Elbow Score. Open reduction, and internal fixation of distal humerus fractures in elderly patients should be the main goal, since good elbow function can be achieved in the majority of patients. Elbow immobilization longer than 14 days should be avoided. Stable implant anchorage at the lateral column remains problematic, reflecting a general potential for further implant improvements.

V. Conclusion

Single- lateral column plating technique was a useful treatment option in the management of extra-articular distal humeral fracture. It addresses the difficulties encountered while managing these fractures, and provides predictable and satisfactory results. The plate matches the anatomic contour of the distal humerus, and does not impinge on the olecranon fossa, thus eliminates the need for olecranon osteotomy. It is low profile over the lateral column, and provides adequate stability leading to faster recovery. This technique can be safely performed using the Campbell's posterior triceps-splitting approach, which was associated with no iatrogenic radial or ulnar nerve palsies, and with less surgical exposure thus helping in quicker recovery, and reduced rehabilitation time. Early range of motion was probably the most important advantage of this technique. Full range of movements is observed by the first 6 weeks. But, patient's achieve a good functional score, recover to normal, and attain complete satisfaction over 1 year. The objective functional and radiological outcomes documented in our study were excellent, and impact of complications on the final functional outcomes was limited despite the minimal risk of postoperative varus deformity which primarily is a cosmetic deformity; as elbow had a full range of motion with no functional abnormality. Superficial infection was present in some patients, and we assume it was due to instant mobilization, and return into routine life, where wound care was neglected. Introduction of an early rehabilitation program along with the emphasis on the early use of the elbow and wound care, could improve the functional success of this technique.

Bibliography

1. John T C, Debkowska M P, Liporace F, Bryan G, Beutel, Elamed E. Outcomes of distal humerus diaphyseal injuries fixed with a single-column anatomic plate. Int Orthop. 2014 May; 38(5): 1037–1043.
2. Ekholm R, Adami J, Tidermark J, Hansson K, Törnkvist H, Ponzer S. Fractures of the shaft of the humerus. An epidemiological study of 401 fractures. J Bone Joint Surg Br. 2006 Nov; 88(11): 1469-73.
3. Scolaro J A, Pramod V, Makani A, Namdari S, Mirza A, Mehta S. Surgical fixation of extra-articular distal humerus fractures with a posterolateral plate through a triceps-reflecting technique. J Shoulder Elbow Surg. 2014 Feb; 23(2): 251-7 (https://doi.org/10.1016/j.jse.2013.09.020 Jour): p. 251-257.
4. Aggarwal S, Kumar V, Bhagwat K, Behera P. AO extraarticular distal humerus locking plate: extended spectrum of usage in intra-articular distal fractures with metaphyseal extension-our experience with 20 cases. Eur J Orthop Surg Traumatol. 2014 May; 24(4): 505-11.
5. Tejwani N, Murthy A, Park J, McLaurin T, Egol K, Kummer F. Fixation of extra-articular distal humerus fractures using one locking plate versus two reconstruction plates: a laboratory study. J Trauma. 2009 Mar; 66(3): 795-9.
6. Paris H, Tropiano P, ClouetD'orval B, Chaudet H, Poitout D. Fractures of the shaft of the humerus: systematic plate fixation. Anatomic and functional results in 156 cases and a review of the literature. Rev Chir Orthop Reparatrice Appar Mot. 2000 Jun; 86(4): 346-59.
7. Levy J, Kalandiak S, Hutson J, Zych G. An alternative method of osteosynthesis for distal humeral shaft fractures. J Orthop Trauma. 2005 Jan; 19(1): 43-7.
8. Prasarn M, Ahn J, Paul O, Morris E, Kalandiak S, Helfet D. Dual plating for fractures of the distal third of the humeral shaft. J Orthop Trauma. 2011 Jan; 25(1): 57-63.
9. Korner J, Lill H, Müller L, Hessmann M, Kopf K, Goldhahn J, et al. Distal humerus fractures in elderly

© 2019 Global Journals

patients: results after open reduction and internal fixation. Osteoporos Int. 2005 Mar; 16 Suppl 2: S73-9.
10. Jawa A, McCarty P, Doornberg J, Harris M, Ring D. Extra articular distal-third diaphyseal fractures of the humerus. A comparison of functional bracing and plate fixation. J Bone Joint Surg Am. 2006 Nov; 88(11): 2343-7.
11. Fawi H, Lewis J, Rao P, Parfitt D, Mohanty K, Ghandour A. Distal third humeri fractures treated using the Synthes™ 3.5-mm extra-articular distal humeral locking compression plate: Clinical, radiographic and patient outcome scores. J Shoulder Elbow. 2015 Apr; 7(2): 104–109.
12. Kharbanda Y, Tanwar Y S, Srivastava V, Birla V, Rajput A, Pandit R. Retrospective analysis of extra-articular distal humerus shaft fractures treated with the use of pre-contoured lateral columnmetaphyseal LCP by triceps-sparing posterolateral approach. Strategies Trauma Limb Reconstr. 2017 Apr; 12(1): 1–9.
13. Jain D, Goyal G S, Garg R, Mahindra P, Yamin M, Selhi H S. Outcome of anatomic locking plate in extraarticular distal humeral shaft fractures. Indian J Orthop. 2017 Jan-Feb; 51(1): 86-92.
14. Trikha V, Agrawal P, Das S, Gaba S, Kumar A. Functional outcome of extra-articular distal humerus fracture fixation using a single locking plate: A retrospective study. J Orthop Surg (Hong Kong). 2017 Sep-Dec; 25(3): 2309499017727948.
15. Self J, Viegas S, Buford W J, Patterson R. A comparison of double-plate fixation methods for complex distal humerus fractures. J Shoulder Elbow Surg. 1995 Jan-Feb; 4(1 Pt 1): 10-6.
16. Meloy G, Mormino M, Siska P, Tarkin I. A paradigm shift in the surgical reconstruction of extra-articular distal humeral fractures: single-column plating. Injury. 2013 Nov; 44(11): 1620-4.
17. Butala R, Karn V V, Padmawar S. Evaluation of extra-articular distal humerus diaphyseal fractures treated with single pre-contoured locking lateral column plating. IJOS 2017 Jun; 3(3): 440-444.

© 2019 Global Journals