

Original Research Article

A comparative study of management of Colles fracture by closed reduction with cast versus closed reduction with internal fixation (K-wires/4 mm CC screws)

Vamshi Varenya Nimmagadda^{1*}, Bhanu Prabha T.¹, Johorul Islam Tapadar²

Department of Orthopaedics, ¹Kakatiya Medical College/Mahatma Gandhi Memorial Hospital, Warangal, Telangana, ²Al-Ameen Medical College and Hospital, Vijayapura, Karnataka, India

Received: 24 September 2017

Revised: 19 October 2017

Accepted: 23 October 2017

*Correspondence:

Dr. Vamshi Varenya Nimmagadda,
E-mail: vamsy_varenya@yahoo.co.in

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Background: Distal radius fracture is extremely common and represents 16% of fractures treated by orthopaedic surgeons. Near anatomical reduction with restoration of radial length, radial tilt and ulnar variances are important for good functional results. A variety of treatment options have been proposed for distal radius fracture closed reduction and immobilization in cast has been the main stay of treatment, but because it invariably results in malunion, poor functional outcome and cosmetic outcome, other modality of treatment were brought into practice like percutaneous intrafocal pinning, transulnar percutaneous pinning, external fixation, plating etc. This comparative study was to compare the clinical outcomes of closed reduction with cast and closed reduction with Percutaneous Kirschner wiring (PKW)/canulated cancellous screws (CC screws 4 mm) for the management of Colles fractures in patients between 20 and 70 years old. In this study we did an prospective study in 40 patients with extra articular distal radius fracture treated by both closed reduction with cast and closed reduction internal fixation (PKW/CC screws).

Methods: There were 20 patients with Colles fractures treated by closed reduction with cast and 20 patients treated with closed reduction internal fixation (PKW/CC screws). We compared both the managements together. All patients were followed up in the orthopaedic department prospectively for at least 12 months between June 2015-June 2016. The functional outcomes and radiological results were compared between the two groups.

Results: The study included 40 patients, aged between 20 to 69 yrs. Average follow up was 12 months. Using the demerit scoring system of Gartland and Werley we had excellent to good results of 60% in closed reduction internal fixation compared to closed reduction with casting excellent to good was 10%.

Conclusions: The percutaneous pinning/cc screws and immobilization in neutral position for 3 weeks followed by physiotherapy proved to be better and simple procedure for extra articular non comminuted distal radius fractures.

Keywords: Fracture radius distal 1/3rd, Cast, Pinning, CC screws, Immobilization

INTRODUCTION

Fracture of the distal end radius is one the most common injuries treated by the orthopaedic surgeons. Nearly 18% of all fractures treated by orthopaedic surgeons constitute distal end radius injuries. It was first described by

Pouteau in 1783 and later Abraham Colles in 1814.¹ During greek time the management of distal radius fracture includes manipulation of fractured arm until it is straight, then applying splints, which were subsequently hardened with grease and honey to maintain their position.² Restoration of the radial length, radial tilt and

ulnar variance are important for good functional results. Failure to achieve the anatomy may lead to degenerative arthritis, radio-ulnar instability, decreased mobility, strength and function.³ So in achieving the near anatomy of distal radius the surgical fixation have an increasing demand and better implants for distal end radius are developed.⁴ Lambotte in 1908, described the use of percutaneously placed wire through the radial styloid to maintain reduction. Closed reduction with percutaneous pin fixation is the most common method for unstable extra articular distal radius fracture.⁵ Since few years locking plates are being used to fixation which has better stability and good purchase of screws, but the negativity is of soft tissue dissection and fracture site haematoma destruction which can cause bad healing process.⁶ Percutaneous pinning/cc screws through closed reduction in different patterns was started. Various techniques of wire insertion through the fracture site and insertion across the fracture site, the former was described by Kapandji in 1976. Kapandji revolutionized intrafocal pinning in which K wires are introduced through the fracture to trap the fragment and are driven into the proximal opposite intact cortex.⁷ The Sauve Kapandji procedure became very popular but for the patients with poor bone quality the sauve kapandji procedure is difficult to perform without reducing the radio ulnar diameter of the wrist. Minimally invasive osteosynthesis techniques and approaches towards soft tissue have become more biological.⁸ There are different options available for the fixation of distal radius fractures. Cannulated cancellous screw technology is one of the options and is best suited to distal radius fractures.⁹ The purpose of this study is to evaluate functional, clinical and radiological effectiveness and drawbacks after closed reduction percutaneous fixation of acute, displaced extra articular and unstable fracture of the distal radius by using a standard 4.0 mm diameter long threaded cannulated screw in indian population. Percutaneous 4 mm cannulated cancellous screw, a new method of fracture fixation with 4 mm cannulated screw applied percutaneously after closed reduction. The screws/k wires gives good purchase to the bone and fixes the fragments. Early mobilization reduces the chance of joint stiffness. It is an inexpensive technique. Closed reduction and percutaneous application reduces the operative risk to the minimum level. With 4 mm diameter it is possible to put two screws instead of one. Hypothesis being the fixation with cannulated screw/K wire would allow immediate range of motion of the wrist while maintaining alignment, resulting in a rapid and comfortable functional recovery.

Although a variety of surgical treatments exist for treating distal radial fractures, closed reduction and the insertion of percutaneous Kirschner wires/CC screws to help maintain fracture reduction is still the popular method.

The specific aim of this prospective study was to compare the clinical and radiological outcomes of closed reduction with cast and closed reduction internal fixation

(PKW/CC screws) for the management of Colles fractures in patients between 20 and 70 years old.

METHODS

Design: Prospective clinical study.

Setting: Tertiary care center.

Patients and methods

Between a period of one year June 2015- June 2016, 20 patients were surgically treated and 20 patients were conservatively treated with cast in orthopaedic department for acute displaced distal radial fractures and regular follow up was made. Patients were assessed using Demerit-point system of Gartland and Werley.

Inclusion criteria

- a) Acute and displaced fractures,
- b) All patients between 20 and 70 years,
- c) Dorsal-angulated fractures (Colles' fractures).
- d) Good bone quality,
- e) Extra articular fractures requiring surgical fixation

Exclusion criteria

- a. Previous fractures or nonunions of the wrist,
- b. Bilateral fractures,
- c. Open fractures,
- d. Severe systemic disease with the American society of anaesthesiologists (ASA) physical status grade 3 or more,
- e. Volar-angulated fractures (smith fractures),
- f. Ipsilateral limb injuries, and
- g. Patients who needed help with daily living activities or who were living in nursing homes,
- b) Late injury more than a week,
- c) Associated nerve injury.

There were 40 patients who met the inclusion criteria and were treated by closed reduction with cast and closed reduction (PKW/CC screws). We compared outcomes of both management. The type of fracture was classified according to the AO and Frykman classification. All patients were followed-up for at least 12 months after discharge from the hospital.

Statistical methods

Descriptive and inferential statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean±SD (Min-Max) and results on categorical measurements are presented in number (%). Significance is assessed at 5% level of significance. The following assumptions on data is made, assumptions: 1- Dependent variables should be normally distributed, 2- Samples drawn from the population should be random, cases of the samples should be independent.

Student t test (two tailed, independent) has been used to find the significance of study parameters on continuous scale between two groups (inter group analysis) on metric parameters.

Chi-square/Fisher exact test has been used to find the significance of study parameters on categorical scale between two or more groups.

Significant figures

- *Suggestive significance (P value: 0.05<p<0.10)
- *Moderately significant (P value: 0.01<p≤0.05)
- **Strongly significant (P value: p≤0.01)

Statistical software

The Statistical software namely SAS 9.2, SPSS 15.0, Stata 10.1, MedCalc 9.0.1, Systat 12.0 and R environment ver.2.11.1 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc.

PKW procedure

The fracture was reduced with traction and direct manipulation under anaesthesia. A series of K-wires were then used to maintain the reduction. First K wire is introduced from the radial styloid across the fracture line into the proximal segment with an angle of 45° and the second is introduced from proximal fragment to distal. Typically, at least two, if necessary three 1-1.5 mm K-wires were used to secure the fracture in anatomical alignment. A below-elbow slab was applied for four to six weeks. Postoperatively, finger ROM was encouraged immediately. At six to seven weeks after surgery, all the K-wires were removed. Early physiotherapy was advised. Strengthening was initiated as ROM improved and symptoms returned to normal. At the last follow-up, we evaluated the subjective and objective data by using the modified Green and O'Brien score. An overall score of 90–100 points ranked as excellent, 80–89 points as good, 65–79 points as fair, and <65 points as poor results.¹⁰ We defined excellent and good results as a satisfactory outcome. Fair and poor results were considered an unsatisfactory outcome.



Figure 1: A) Pre-operative X-ray before PKW; B) Post-operative X-ray after PKW.

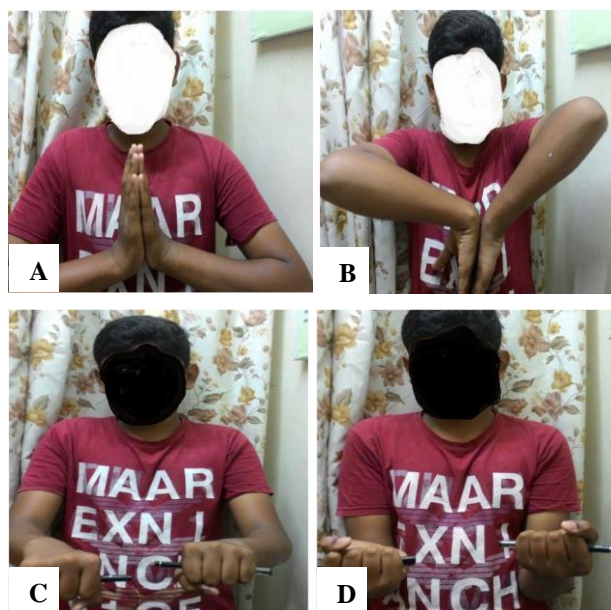


Figure 2 (A-D): Follow up after PKW.

CC screws procedure

Closed reduction under C arm ligamentotaxis is performed. Once anatomical reduction is achieved guide wire placement is done with continuous traction is performed. The wire is inserted through the radial styloid, the wire is then advanced through the ulnar cortex in a distal to proximal and radial to ulnar direction, a second guide wire is inserted crossing the first guide wire in a proximal to distal direction and radial to ulnar direction from proximal radial side of the radius. incision of 1 cm is made around the pin and care is taken to avoid injury to the cutaneous branch of radial nerve. After the measurement of the screw length the near cortex is drilled with a drill bit and a 4 mm CC screw is inserted through the guide wire. Compression obtained, the screws are slightly buried into the bone to prevent tendon irritation. The wrist is immobilized in a short arm cast post operatively. Active and passive finger movements are encouraged in immediate and post-operative period. The cast was removed on an average of 10-16 days (average 2 weeks). Then patient is referred to physiotherapy.

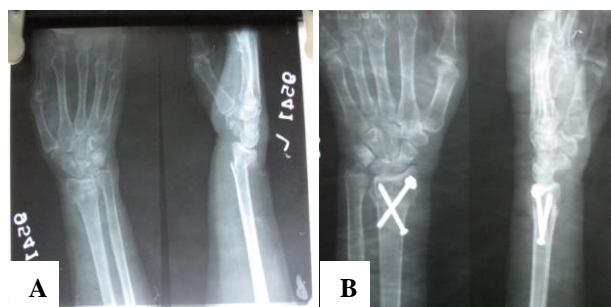


Figure 3: A) Pre-operative X-ray before CC screws fixation; B) Post-operative X-ray after CC screws fixation.



Figure 4 (A and B): Follow up after CC screws fixation.

Cast procedure

The fracture was reduced with traction and counter traction, reduction of fracture is obtained. Then cast immobilization is done with slight palmar flexion and ulnar deviation of the hand.

The cast immobilization is done for a period of 6 weeks, with active finger movements, and the patient is followed with radiograph after 1 week, and then at three weeks, and then at 6 weeks before cast removal and followed upto 12 months. Then the patient is advised to go for physiotherapy and the patient is assessed functionally according to extension, supination, pronation.

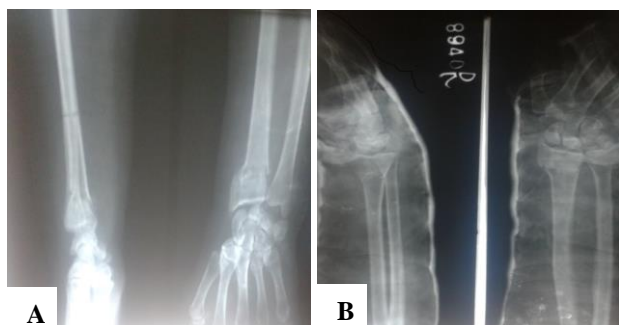


Figure 5: A) X-ray before Colles cast application; B) X-ray after Colles cast application.

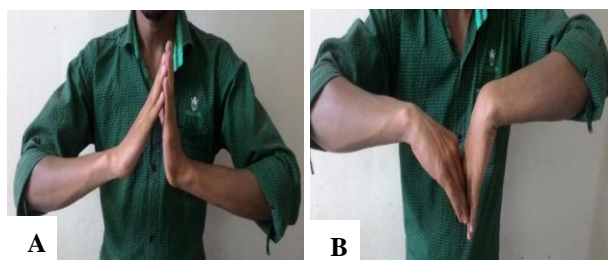


Figure 6 (A and B): Follow-up after cast application.

RESULTS

Results were evaluated clinically and radiologically at 6 months using Sarmiento's modification of Lindstrom criteria and by the Sarmiento et al, modification of the demerit point system of Gartland and Werley.^{11,12}

All fractures healed. Restoration of anatomy for CRIF was excellent in 8 patients (40%) and 4 patients (20%) had a good anatomical outcome while 6 (30%) had fair results, 2 (10%) patients had poor outcome.

Table 1: Age distribution of patients studied.

Age in years	CAST		CRIF	
	No	%	No	%
20-29	3	15.0	4	20.0
30-39	3	15.0	1	5.0
40-49	2	10.0	2	10.0
50-59	4	20.0	5	25.0
60-69	8	40.0	8	40.0
Total	20	100.0	20	100.0
Mean±SD	50.30±16.05		49.25±16.09	

Samples are age matched with p=0.83.

Table 2: Gender distribution of patients studied.

Gender	CAST		CRIF	
	No	%	No	%
Female	12	60.0	10	50.0
Male	8	40.0	10	50.0
Total	20	100.0	20	100.0

Samples are gender matched with p=0.525.

Table 3: Mode of injury in two groups of patients studied.

Mode of injury	CAST		CRIF	
	No	%	No	%
Fall on out stretched hand	8	40.0	8	40.0
Road traffic accident	6	30.0	6	30.0
Fall from height	4	20.0	4	20.0
Direct injury	2	10.0	2	10.0
Total	20	100.0	20	100.0

P=1.000, not significant, Fisher exact test

Table 4: Classification in two groups of patients studied.

Frykman classification	CAST		CRIF	
	No	%	No	%
Type 1	12	60.0	11	55.0
Type 2	8	40.0	9	45.0
Total	20	100.0	20	100.0

P=0.749, not significant, Chi-square test

Restoration of anatomy for cast immobilization 12 patients (40%) was poor, 6 (30%) patients had fair results, 2 (10%) patients had good outcome, nil patients had excellent results.

Functionally, for CRIF 8 patients (40%) had excellent hand function; 4 patients (20%) had good results; 6

patients (30%) had a fair outcome, and 2 patients (10%) had poor outcome.

Functionally, for cast immobilization patients 12 (40%) patients had poor outcome, 6 (30%) patients had fair outcome, 2 (10%) patients had good outcome, nil patients had excellent outcome.

Table 5: Complications in two groups of patients studied.

Complications	CAST (n=20)		CRIF (n=20)	
	No	%	No	%
Nil	0	0.0	12	60.0
Yes	20	100.0	8	40.0
• Impairment of joint mobility	8	40.0	3	15.0
• Residual pain	6	30.0	2	10.0
• Malunion	3	15.0	1	5.0
• Reflex osteodystrophy	3	15.0	1	5.0
• Tenosynovitis	0	0.0	1	5.0

P<0.001**, significant, Fisher exact test.

Table 6: Results in two groups of patients studied.

Results	CAST		CRIF	
	No	%	No	%
Excellent	0	0.0	8	40.0
Good	2	10.0	4	20.0
Fair	6	30.0	6	30.0
Poor	12	60.0	2	10.0
Total	20	100.0	20	100.0

P<0.001**, significant, Fisher exact test.

DISCUSSION

Distal radius fracture is one of the most common injury. Various clinical studies as well as laboratory assessment of force and stress have demonstrated the importance of anatomic reduction.^{13,14} In fractures with articular displacement greater than 2 mm, radial shortening greater than 5 mm or dorsal angulation greater than 20°, suboptimal results have been reported in previously published studies.¹²

First step in distal radius fracture is reduction and immobilization. The traditional method is closed reduction and cast immobilization, but this often fails to prevent early radial collapse and is associated with a high risk of malunion, joint stiffness and painful wrist. Hence, this mode of treatment is used for low-demand elderly patients.¹⁵

Radial length and radial inclination can be maintained by ligamentotaxis using external fixators, but palmar tilt is difficult to maintain.¹⁶ With the use of external fixators complication rates are high as 60%.¹⁷ These mainly

include pin tract infection, pin loosening, sympathetic dystrophy and delayed union. Thus, external fixators are not an option in noncomminuted extra-articular distal radial fractures.¹⁸

Open reduction and internal fixation techniques should be undertaken in cases of partial, complete and complex intra-articular distal radius fractures.^{19,20} Minimally invasive osteosynthesis has been growing worldwide. Patients who undergo minimally invasive procedure experience small incision scars, minimal blood loss, shorter hospital stay and quick rehabilitation.

To this end, K wires/cannulated screws have been used extensively and are well described in the upper extremity surgery and treatment of distal radial fractures. They are generally used for fixation or reinforcement of radial styloid fractures, but data on the treatment of completely displaced, extra articular metaphyseal fractures are limited. In UfukNalbantoglu, ArelGereli series of 20 patients analysed by Gartland and Werley scoring system, with a follow up of 12 months, 15 results were rated as excellent and 5 results as good with no fair or poor results.²¹ The high number of excellent to good results in comparison to our results may be due to, that they have not included elderly population in their study as maximum age of their subject was 60 years and poor bone quality (osteoporotic bone) was excluded in their study group. Where as in our series we had 8 patients with age more than 60 years with osteoporotic bone. We included elderly patients as we wanted to evaluate strength of this implant in osteoporotic bone.

Green first recommended percutaneous pinning with K-wire as a simple and inexpensive procedure.²² Various techniques of percutaneous pinning/CC screws are available. Radial shortening, wrist stiffness and reflex sympathetic dystrophy were the many drawbacks of this technique.^{23,24} Wrist stiffness and reflex sympathetic dystrophy occur because of the palmar-flexed position of the wrist in which postoperative immobilization of the fracture is more than 3 weeks. Longitudinal traction and direct pressure over the displaced fragment was given and reduction was achieved followed by percutaneous pinning/CC screws, slab was applied post operatively with wrist in neutral position. Active finger movements was advised.

In our opinion, percutaneous pinning/CC screws maintains radial length in extra-articular distal radial fractures.

CONCLUSION

Percutaneous K wire/CC screw is an effective means of treatment of extra articular distal radius fracture with early to immediate range of motion of the wrist, resulting in a fast early and comfortable functional recovery with anatomical alignment and bone healing. CC screws has good purchase when treating extra articular distal radius

with poor bone quality. Early physiotherapy with immobilization for nearly 3 weeks has good outcomes. Being minimally invasive with minimal soft tissue dissection, less operative time, cost effective. Cannulated screws/percutaneous K wire is a good option for both young and elderly patients with extra articular distal radius fracture.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the institutional ethics committee

REFERENCES

1. Papyrus E. The book of medical knowledge of 16th century BC, egyptinshallamnokolajczak. *Archieve, History filooz med*. 2004;67(1):5-48.
2. Grammaticos PC, Diamantis A. Useful known and unknown views of the fracture of modern medicine. *Hell J Nucl Med*. 2008;11(1):2-4.
3. David L, Helfet MD, Norbert P. AO Philosopy and principles of Fracture Management, Its Evolution and Evaluation. *J Bone Joint Surgery*. 2003;85(6):1156-60.
4. Simic PM, Wieland AJ. Fractures of the distal aspect of the radius, Changes in treatment over the past two decades. *J Bone Joint Surg (Am)*. 2003;85:552-64.
5. Wayne M, Weil MD, Thomas E. Treatment of distal radius fractures with intrafocal (kapandji) pinning and supplemental skeletal stabilization. *Hand Clinic*, 2005;21:317-28.
6. Nana AD, Joshi A. Plating of the distal radius. *JAM Acad Orthop Surg*. 2005;13:159-71.
7. Norikar U, Ota MD, Thoshiyasu Nakamure MD. Radiographic parameter analysis on modified Saue Kapandji Procedure. *J Wrist Surg*. 2013;2(1):19-26.
8. Aita MA, Ferreira CHV, Ibanez DS, Marquez RS, Ikeuti DH, Mota RT. Randomized clinical trail of percutaneous osteosynthesis and Minimally invasive Surgery. Evaluation of the distal end of radius fractures. *Rev Bras Orthop*. 2014;49(3):218-22
9. Nalbantoglu U, Gereli A, Kocaoglu B, Turkmen M. Percutaneous Cannulated Screw Fixation in the treatment of distal radius fractures. *Arch Orthop Trauma Surg*. 2012;132:1335-41.
10. Green DP, O'Brien ET. Open reduction of carpal dislocations: indications and operative techniques. *J Hand Surg Am*. 1978;3:250-65.
11. Sarmiento A, Pratt GW, Berry NC, Sinclair WF. Colles' fractures, functional bracing in supination. *J Bone Joint Surg Am*. 1975;57:311-7.
12. Gartland JJ, Jr, Werley CW. Evaluation of healed Colles' fracture. *J Bone Joint Surg Am*. 1951;33:895-907.
13. Knirk JL, Jupiter JB. Intra-articular fractures of the distal end of the radius in young adults. *J Bone Joint Surg Am*. 1986;68:647-59.
14. Trumble TE, Schmitt SR, Vedder NB. Factors affecting functional outcome of displaced intra-articular distal radius fractures. *J Hand Surg Am*. 1994;19:325-40.
15. Jupiter JB, Ring D, Weitzel PP. Surgical treatment of redisplaced fracture of the distal radius in patients older than 60 years. *J Hand Surg Am*. 2002;27:714-23.
16. Chan BK, Leong LC, Low CO, See HF. The use of external fixators in treatment of intra articular fractures of the distal radius. *Singapore Med J*. 1999;40:420-4.
17. Gausepohl T, Pennig D, Mader K. Principles of external fixation and supplementary technique in distal radius fractures. *Injury*. 2000;31:56-70.
18. Sanders RA, Keppel FL, Waldrop JI. External fixation of distal radial fractures: Results and complications. *J Hand Surg Am*. 1991;16:385-91.
19. Ruch DS, Ginn TA. Open reduction and internal fixation of distal radius fractures. *Op Tech Orthop*. 2000;13:138-43.
20. Doi K, Hattori Y, Otsuka K, Abe Y, Yamamoto H. Intra-articular fractures of the distal aspect of the radius: Arthroscopically assisted reduction compared with open reduction and internal fixation. *J Bone Joint Surg Am*. 1999;81:1093-110.
21. Gereli A, Turkmen M, Kocaaglu B. Comparative study of closed reduction percutaneous cannulated screw fixation and open reduction palmar locking plate fixation in the treatment of AO Type 2 distal radius fractures. *Arch Orthop Trauma Surg*. 2013;134:121-9.
22. Green DP. Pins and plaster treatment of communited fractures of distal end radius. *J Bone Joint Surg Am*. 1975;57:304-10.
23. Field J, Atkins RM. Algodystrophy is an early feature after Colles' fracture. What are the implications? *J Hand Surg Br*. 1997;22:178-82.
24. Atkins RM, Duckworth T, Kanis JA. Features of Algodystrophy after Colles' fracture. *J Bone Joint Surg Br*. 1990;72:105-10.

Cite this article as: Nimmagadda VV, Bhanu PT, Tapadar JI. A comparative study of management of Colles fracture by closed reduction with cast versus closed reduction with internal fixation (K-wires/4 mm CC screws). *Int J Res Orthop* 2018;4:86-91.