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Radiological evaluation of distal radio-ulnar joint congruency in distal radius fractures

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Abstract
Distal Radius fractures (DRFs) are recognized as complex injuries with prognosis depending on several variables which include the fracture type and the method of treatment. Some mal-alignment of the distal Radio-Ulnar and Radio-Carpal joint has been estimated to occur in up to 71% of patients following a DRF. The Lidstrom scoring system is utilized to radiologically evaluate the DRFs in comparison to the normal side in the same individual. In this study we have assessed the Lidstrom score of DRFs at pre-reduction i.e. at the time presentation, at immediate post reduction and at follow-up at 7-10 days after reduction and after 6 weeks of reduction. The effect of various methods of reduction and stabilization in distal radius fractures was assessed, and we found that the conservative method of treatment of DRFs is most commonly opted for and gives good results. The most common AO fracture pattern in younger individual was 23B2 in the elderly was 23A2. The incidence of displacement for individual parameters was found to vary with age and severity of fracture pattern. We found there is a high propensity of post reduction re-displacement if wrist mobilization is not restricted till the time of union, even in operatively fixed pts. The most common cause of DRFs in young Males is road traffic accident, while in females is due to fall on outstretched hand.

Keywords: Distal Radius fractures, radiological evaluation of DRF's, Lidstrom score, radial inclination, ulnar variance, dorsal tilt

Introduction
These fractures are often the result of a fall onto an outstretched hand (FOOSH); and are often known by eponyms e.g. Colle's fracture, Smith's fracture, Barton's fracture, Chauffeur's fracture [1]. Distal Radius fracture is the most common type of fracture, accounting for one-sixth of all fractures seen in an emergency room [2]. Distal Radius fractures (DRFs) are recognized as complex injuries with prognosis depending on several variables which include the fracture type and the method of treatment. The failure to reduce these fractures is associated with more subtle, later problems such as midcarpal instability, incongruity or instability of the distal Radio-Ulnar joint, the Ulnar impaction syndrome, post traumatic arthritis and pain syndromes around the wrist joint, which are secondary to small degrees of Radial malalignment or inter-Carpal or Radio-Carpal ligament disruption. The radiological parameters used to assess bone and joint configuration and congruency are Ulnar variance, Radial inclination, Dorsal tilt, Radial height, Radial shift. But the most commonly used radiological parameters are Ulnar variance, Radial inclination, Dorsal/Palmar tilt, since they provide an adequate assessment [3].

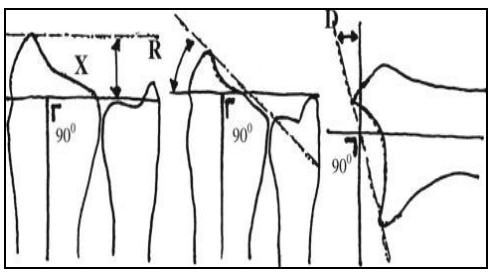


Fig 1: Image showing measurement technique for Radial inclination, Radial shortening, Volar tilt [4].

We have taken the parameters to access reduction as given in Rockwood and Green's Fractures in Adults (eighth edition volume 1st). The mean Radial inclination is 21degree (19-23degree), Ulnar variance is 0mm and palmar tilt is 11 degree (9-14 degree).
Lidstrom scoring is pure radiological scoring for distal Radius fractures reduction. The parameters used for scoring the reduction are Radial inclination, Ulnar variance and Palmar tilt and the results are based on comparing the fractured limb with the normal side. It is a demerit score with an excellent result being 0 points, good 1 to 3 points, fair 4 to 6 points, and poor greater than 7 points.

Lidstrom Scoring
0–Excellent(Insignificant deformity)
Dorsal angle <0 degree
Radial Shortening <3 mm
Loss of Radial tilt < 4 degree
1-3: Good (Small deformity)
Dorsal angle 1-10 degree
Radial Shortening 3-6 mm
Loss of Radial tilt 5-9 degree
4-6: Fair (Moderate deformity)
Dorsal angle 11-14 degree
Radial Shortening 7-11 mm
Loss of Radial tilt 10-14 degree
7-12: Poor (Severe deformity)
Dorsal angle > 15 degree
Radial Shortening >11 mm
Loss of Radial tilt >15 degree
This study was undertaken to compare the radiological status of reduction achieved immediately at the time of injury and final result at the time of union in distal Radius fractures.

Material and Methods
This observational study on a sample size of 50 patients was carried out in the Department of Orthopedics at Himalayan Institute of Medical Sciences, Swami Ram Nagar, Dehradun, on cases of distal radius fracture in Orthopedics Department after taking written informed consent.
All the patients with distal radius fracture underwent X-ray of B/L wrist with forearm antero-posterior view and lateral view before reduction/ surgery.
Post reduction x-ray of wrist with forearm of affected limb, antero-posterior view and lateral views, is taken 3 times Firstly immediately after reduction and stabilization, secondly at 1st follow-up (at around 7-10 days after reduction and stabilization) and thirdly after 6 weeks of reduction and stabilization.
Pre-reduction measurement of angles (Radial inclination, Ulnar Variance and Volar tilt) using DIACOM software was done on digital x-ray on normal wrist, and affected wrist. This was followed by measuring the same angles immediate post-reduction and stabilization, 1st follow-up and after 6 weeks of reduction and stabilization.

The Inclusion Criteria were
- Patients with a mature skeleton i.e. of age 18 years and above with unilateral fractures of distal Radius.
- No previous history of distal Radius fracture or distal Radius operation on either side.

The exclusion criteria were
- B/L fractures of distal Radius.
- Non osteoporotic pathological fracture
- Fractures involving shafts of both Bones of forearm.
- Previous H/o Fracture of Distal Radius on either side, at any time.

This data on the normal and affected wrist was used to calculate Lidstrom score at each stage and was subjected to statistical analysis.

Results
A total of 50 patients met with inclusion criteria and taken for study.
Out of 50 cases 24 were male patients and 26 were female patients.
On the normal side the mean Radial Inclination was 22.03 ±4.69 degree, Ulnar Variance was 2.09 ± 1.98 mm and Palmar tilt was 12.99±3.03 degree in the 67 patients.
According to mode of injury, 34 patients had distal Radius fractures due to fall on outstretched hand and 16 patients had due to road traffic accident.

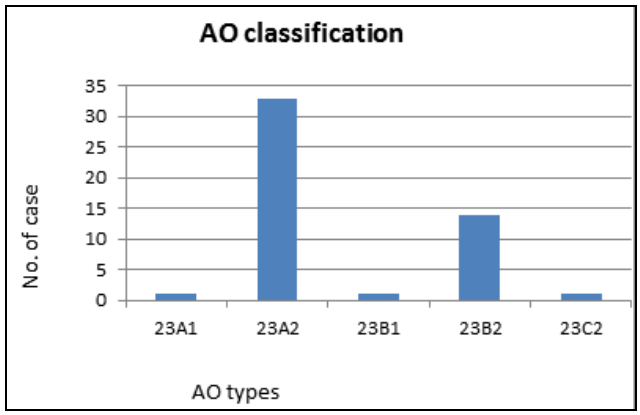


Fig 2: According to AO classification system of the 50 case, 1 case had 23A1type fracture, 33 case had 23A2 type fracture, 1 case had 23B1 type fracture, 14 case had 23B2 type fracture, 1 case had 23C2 type fracture. (Fig 2)

According to type of injury, 34 patients had extra articular distal Radius fractures, 16 patients had intra-articular distal Radius fractures.
Conservative treatment was used in 37 patients, operative method of reduction K-wiring was used in 9 patients and plating was used in 4 patients.
Lidstrom scoring in all 50 cases which reported till 2nd follow up was done on pre-reduction, immediate post reduction, 1st follow up and 2nd follow up x-rays.

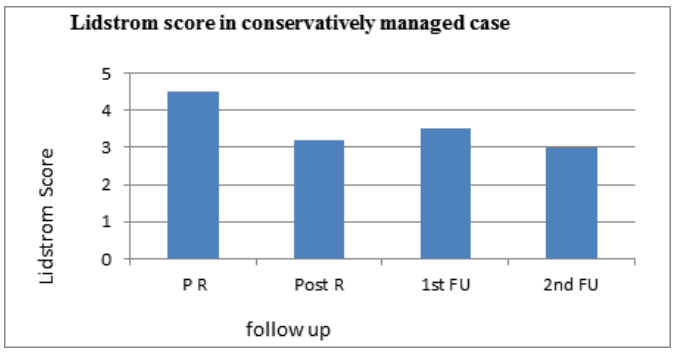


Fig 3: PR-Pre Reduction, Post R-Immediate post reduction, 1st FU-1st follow up, 2nd FU-2nd follow up.

For the 37 cases managed conservatively the mean Lidstrom scores were 4.50, 3.18, 3.54, 3 respectively (p value-0.0231).

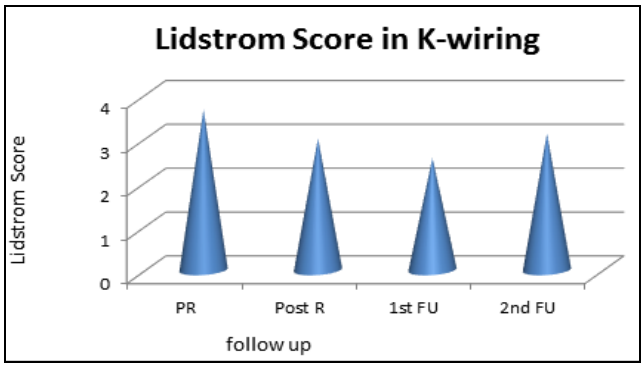


Fig 4: PR-Pre Reduction, Post R-Immediate post reduction, 1st FU-1st follow up, 2nd FU-2nd follow up.

For the 9 case managed with the K-wiring the mean Lidstrom scores were 3.66, 3, 2.55, 3.11 respectively (P-value 0.041).

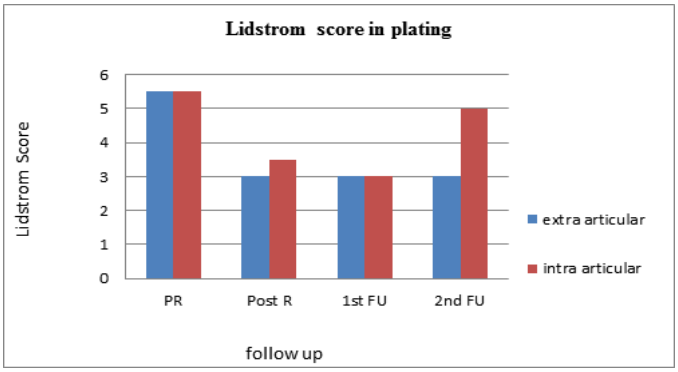
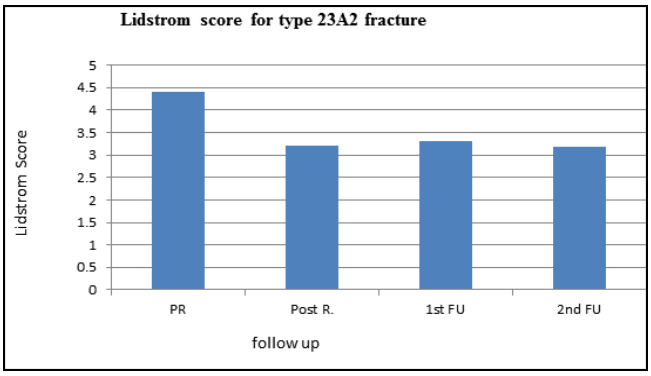


Fig 5: PR-Pre Reduction, Post R-Immediate post reduction, 1st FU-1st follow up, 2nd FU-2nd follow up.

For the 4 cases managed with plating the mean Lidstrom scores were 4.38, 3.3, 2.84, 3.61 respectively (p-value 0.019). The mean Lidstrom score for Intra-articular fractures were 4.62, 3.66, 3.43, 3 (p-value 0.046) and for extra-articular fractures are 4.44, 3.29, 3.32, 3.2 (p-value 0.0079).



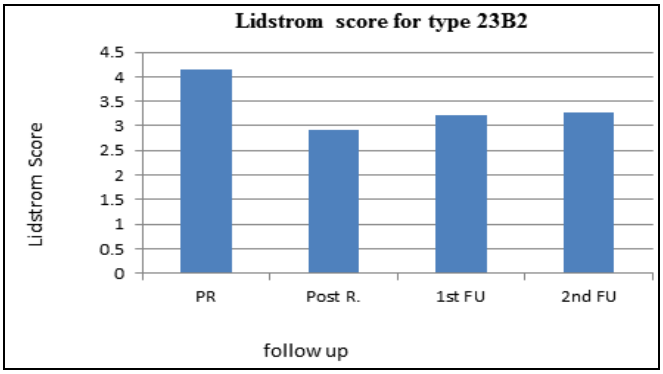


Fig 6: PR-Pre Reduction, Post R-Immediate post reduction, 1st FU-1st follow up, 2nd FU-2nd follow up.

Lidstrom score on basis of fracture classification, for 23A1 (1 case) are 3,6,4,5 for 23A2 (33 case) are 4.40,3.21,3.31,3.18 (p-value 0.103) for 23B1(1 case) are 8,7,8, 5 for 23B2 (14 case) are 4.14, 2.92, 3.21, 3.28 (p-value 0.4261) and for 23C2 (1 case) are 6,3,2,2.

Lidstrom scoring on basis of gender, for males are 5.5, 4.41, 3.83, 3.29 (p-value 0.127) and in females are 4.92, 3.03, 2.92, 3.03 (p-value 0.032).

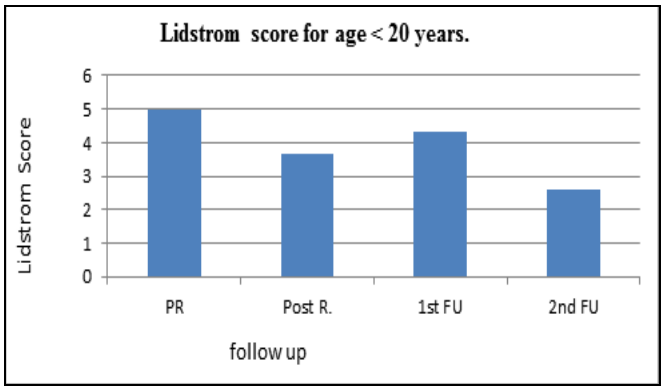


Fig 7: PR-Pre Reduction, Post R-Immediate post reduction, 1st FU-1st follow up, 2nd FU-2nd follow up.

Lidstrom scoring on the basis of age, <20 years (3 case) are 5, 3.66,4.33, 2.66 (p-value 0.127);

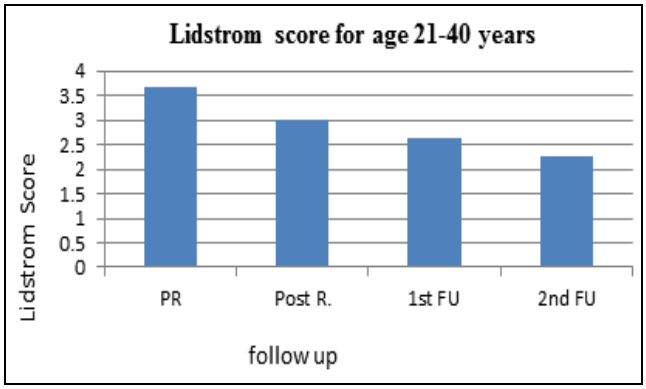


Fig 8: PR-Pre Reduction, Post R-Immediate post reduction, 1st FU-1st follow up, 2nd FU-2nd follow up.

21-40 years (11 case) are 3.36, 3, 2.63, 2.27 (p-value 0.395); 41-60 years (16 case) are 4.68, 3.06, 3.56, 3.75(p-value 0.227); and age >60 (20 case) are 4.9, 3.4, 3.45, 3.25 (p-value 0.1008).

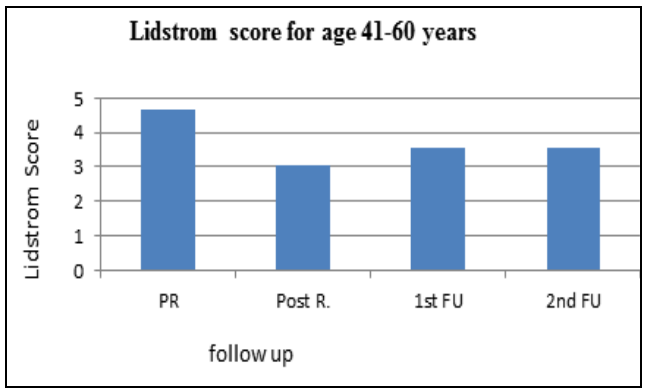


Fig 9: PR-Pre Reduction, Post R-Immediate post reduction, 1st FU-1st follow up, 2nd FU-2nd follow up.

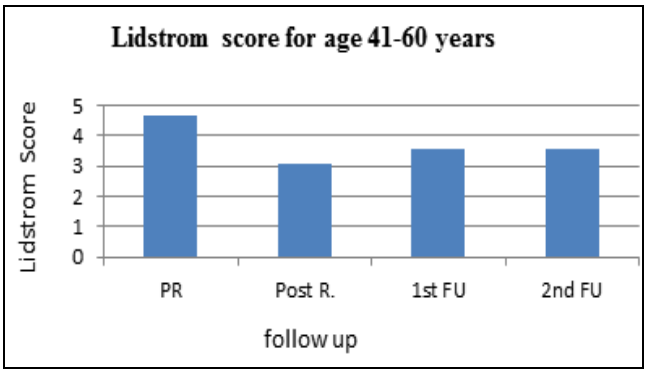


Fig 10: PR-Pre Reduction, Post R-Immediate post reduction, 1st FU-1st follow up, 2nd FU-2nd follow up.

Discussion

In our study of 50 cases 34(68%) patients had distal Radius fractures due to fall on outstretched hand and 16(32%) patients had fractures due to road traffic accident, both of above are in co-relation with the study of Chavhan *et al.* having 71.4 % female cases and 28.6 % male cases, 57.1% cases had Fall on outstretched hand while 42.9% had road traffic accident as mode of trauma for distal Radius fractures. [5].

In our study of we found 34(68%) case to be of extra-articular of which 11(32.35%) were in males and 23(67.64%) were females, 16(32%) case to be of intra-articular type of 13(81.25%) were in males and 3(18.75%) were females.

In our study we found more re-displacement occurring in intra-articular fractures as compared to extra-articular distal Radius fractures which is in co-relation to the study of Adam [6].

Out of the 50 cases most of the distal Radius fractures were treated conservatively 37(74%) case because of the patient's decision on the treatment modality. Only 13 patients opted for operative management of which 9(18%) underwent K-wiring and 4(8%) underwent plating, which is in co-relation with the study conducted by Masood *et al.* [7]

The statistical analysis showed the mean radial inclination of normal side 22.03(±4.69) degree, mean ulnar variance of normal side 2.09(±1.98)mm and mean palmar tilt of normal side 12.99(±3.03)mm which is in accordance to the international literature. However the study on Indian population by P K Mishra *et al.* showed the mean radial inclination of 23.27(±7.42) degree, ulnar variance 0.66±2.46mm and Palmar tilt 10.07(±5.28) degree [8].

In the cases that were operatively fixed with K-wiring PoP support was continued for 6 weeks, hence displacement was minimal and Lidstrom score was maintained. But in cases where Plating had been done PoP support was taken off after suture removal and mobilization of the wrist was started. Of the 4 cases where plating had been done 2 were extra articular (23A2) and 2 were intra articular (23B2) these 2 intra-articular fractures showed a very significant deteriotion in Lidstrom score whereas in the extra-articular fracture the alteration in Lidstrom score was not very significant(GRAPH NO>). On enquiry it was found that despite instructions to the contrary these patients engaged in stress full use of the wrist early (i.e riding a 2 wheeler) and we found that the fracture had displaced in all 3 parameters. The displacement was maximum for dorsal tilt, followed by radial inclination then in ulnar variance. The collective effect of these altered parameters was worsening of Lidstrom score, compared to that was achieved at the time of surgery.

In Conservatively managed (80.59%) patients fracture displacement occurred in 34% patients analyzed on parameters of Radial inclination, ulnar variance and dorsal tilt, we found that in patients >60 years of age the most stable parameters in 23A2 type fractures is dorsal tilt and most prone to displace is radial inclination, while in age group (41-60 years) in 23B2 type fractures the parameter most prone to alter is ulnar variance followed by radial inclination, Similarly in intra-articular fracture radial inclination gets altered most commonly followed by palmar tilt and ulnar variance while in extra articular fracture palmar tilt is most commonly altered followed by ulnar variance and radial inclination.

Conclusion

In summary, the present study supports the notion that

The most common cause of distal Radius fractures in young Males is road traffic accident, while in females it is due to fall on outstretched hand.

The extra-articular fractures were most commonly seen in elderly female in fall patients. Extra-articular distal Radius 23A2 is most common fractures of distal Radius in females above 60 years of age, and intra-articular fractures most commonly seen due to road traffic accident in young males. The 23A2 fractures are most commonly occurring fractures in elder patients.

Conservative method of treatment of distal Radius fractures is most commonly opted and gives good results.

There is high chance of post reduction redisplacement if wrist mobilization is not restricted till the time of union, even in operatively fixed pts. It would be prudent to continue plaster support in operatively fixed fractures especially intra-articular fractures.

The Lidstrom score in extra-articular fractures remains fairly constant after reduction, while Lidstrom score in intra-articular fractures varies at different follow ups irrespective of the method of treatment used.

The most common treatment method of distal Radius fractures is Conservative and gives good radiological result.

We found Lidstrom score to be an effective method of radiologically evaluating the treatment's of distal Radius fractures.

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