International Journal of Orthopaedics Sciences

E-ISSN: 2395-1958
P-ISSN: 2706-6630
IJOS 2020; 6(2): 10-14

www.orthopaper.com
Received: 07-02-2020
Accepted: 08-03-2020

Dr. AK Sipani
Professor & Head of Department of Orthopaedics, SMCH, Assam, India

Dr. Vikash Agarwala
Assistant Professor, Department of Orthopaedics, SMCH, Assam, India

Dr. Abhijeet Dhurwe
Junior Resident, Department of Orthopaedics, SMCH, Assam, India

Corresponding Author:
Dr. AK Sipani
Professor & Head of Department of Orthopaedics, SMCH, Assam, India

Cast index in predicting outcome of pediatric forearm fractures

Dr. AK Sipani, Dr. Vikash Agarwala and Dr. Abhijeet Dhurwe

DOI: https://doi.org/10.22271/ortho.2020.v6.i2a.2010

Abstract
Introduction: Prediction of Re-displacement of pediatric forearm fractures would be a boon for orthopaedic surgeons treating them conservatively. Cast index (CI), described by Chess *et al*. is calculated by measuring the internal antero-posterior (AP) diameter of the cast (excluding padding) at the level of the fracture and dividing it by the internal lateral diameter of the cast (excluding padding) which could be used as a tool to predict the re-displacement of fracture if it is maintao <0.8.
Aims: The aim of the present study is to evaluate the role of cast index in predicting the re-displacement in pediatric forearm fracture.
Materials and Methods: A hospital based prospective study was conducted in the Department of Orthopaedics, Silchar Medical College and Hospital, Assam. 83 paediatric patients ranging from 0 to 16 yrs with forearm fractures who met the inclusion criteria were recruited in our study. Patients with open fractures and with distal neurovascular deficit were excluded from our study. The fractures were treated with closed reduction with above elbow casts after manipulation. The cast index was measured immediately following casting on x-ray and patient was followed up weekly to check for re-displacement.
Results: Out of 83 patients, proximal and distal fractures were 14 (18.07%) and 69 (81.92%) respectively. Mean cast index in proximal fractures and distal fractures which were displaced was 0.85 and 0.75 respectively. Out of 69 distal forearm fractures 7 were re-displaced and were re-manipulated, on the other hand only 1 out of 14 proximal forearm fracture was re-displaced and re-manipulated.
Conclusion: Distal forearm fractures with cast index >0.8 were more likely toget re-displaced than with <0.8. It is difficult to achieve a cast index <0.8 in proximal forearm fractures, cast index < or > 0.8 does not predict the risk of re-displacement and re-manipulation in proximal forearm fractures. So, its use to predict the re-displacement should be discouraged in proximal fractures. It should be used to predict re-displacement in distal forearm fractures.

Keywords: Cast index, prediction of re-displacement, pediatric forearm fracture

Introduction
One of the most common childhood fractures are forearm fractures after clavicular fractures [1]. Among forearm fractures, distal radius fractures are the most common limb fractures in childhood. Of all pediatric forearm fractures 16–24% are proximal forearm fractures [2]. Despite of increasing trend in operative treatment for paediatric forearm fractures, closed fractures of the forearm in children are often treated with closed reduction and immobilization in a well fitting plaster cast and achieve a satisfactory outcome in a majority of patients [3]. The goal of the treatment is to restore appropriate length, alignment & rotation which will allow normal function after remodeling and healing is completed. Distal radius fractures in children heal quickly and mild to moderate degrees of displacement can be accepted as bone remodeling during early childhood has the potential to correct deformities. However, in children aged over 9 years a reduced potential for remodeling means that lesser degrees of deformity are acceptable [4].
The most important risk factor for re-displacement of a forearm fracture is the initial displacement of the fracture [5]. Modifiable risk factor that can prevent the redisplacement of fracture is the quality of casting, which can be measured objectively by casting indices. The first and simplest index to be described is the cast index (CI), described by Chess *et al*. [6] It is calculated by measuring the internal antero-posterior (AP) diameter of the cast

(excluding padding) at the level of the fracture and dividing it by the internal lateral diameter of the cast (excluding padding).

Materials and Methods

A hospital based prospective study was conducted in the Department of Orthopaedics, Silchar Medical College and Hospital, Assam from 01-06-2018 to 31-05-2019.

Data Collection

83 patients with forearm fractures of the pediatric age group attending the OPD and emergency of Department of Orthopaedics, Silchar Medical College and Hospital who met the inclusion criteria outlined below were recruited in the study. Inclusion criteria included all patients under the age of 16 years, fractures undergoing closed reduction of radius (with or without ulna) fractures, no other associated fractures eg. humerus fracture (only isolated forearm fractures), informed consent. Exclusion criteria included patient refusing informed consent,open fractures, distal neurovascular deficit positive, same limb with other fractures, pathological fractures, fractures undergoing crif or orif, incomplete follow up.

Consent: An informed written consent was obtained from each patient prior to participation in the study.

Ethical Clearance: Ethical clearance for this study was taken from the Ethical Committee of Silchar Medical College and Hospital, Assam.

Cast Index Measurement: With patient lying supine on the table traction and counter-traction was applied to correct the angulation. Putting the pressure between the two bones to maintain the interroseous membrane. Adequate soft cotton was applied. First the below elbow cast was applied and again interroseous membrane was maintained till the cast is set, then cast was converted to above elbow cast.

Repeat x-ray of forearm was done AP & lateral with a 4cm long radio-opaque scale as a reference to measure internal AP & lateral diameter and to rule out magnification error in the x-ray.The fracture fragment was also measured using the same method. Cast index was calculated by 2 post graduate trainees separately & then compared to detect any inter-observer error. The cast Index was calculated as a ratio of internal cast AP diameter and lateral diameter excluding the padding as described by Chess *et al*. 12 Both measurements were taken at the level of the radius fracture site.

All fractures were subsequently categorized as proximal or distal by dividing the length of the distal radial fragment with that of entire radius. The resultant values ranged from 0(distal) to 1(proximal). The fractures with a ratio of < 0.5 were grouped as distal and those with ratio of >0.5 were grouped as proximal. The measurements were made from proximal radio-ulnar joint proximally to wrist joint distally.

Statistical Analysis: Statistical analysis was performed using Graph Pad Prism software (trial version) and Microsoft Excel. The datas in each category were presented as numbers (percent) and were compared among groups using Chi square test. The means and standard deviations were compared by unpaired t test and for more than two groups, ANOVA was used to find out the most significant groups among all the groups. Probability value (p value) less than 0.05 was considered statistically significant.

Observations and results: The age ranged from 0 to 16 years with mean age of 8.5625 ±3.5424 years in our study. Maximum incidence of forearm fractures in pediatric age group was found in 8 to 12 years of age group. Out of 83 patients, 56 patients (67.46%) were male and 27 patients (32.53%) were female in our study. Left forearm was involved in 45 patients (54.21%) and right side was involved in 38 patients (45.78%). Out of 83 patients, proximal and distal fractures were 14(18.07%) and 69 (81.92%) respectively. Out of 68 distal forearm fractures, 48 (70.58%) were male and 20 (29.42%) were females. Out of 14 proximal forearm fractures, 8 (57.14%) were male and 6 (42.86%) were females. Out of 68 distal forearm fractures, 25 (36.76%) had associated ulna fractures. On the other hand, out of 15 proximal forearm fractures, 13 (86.67%) had associated ulna fractures. Mean initial displacement of fracture in distal forearm fractures was 21.40 ±5.2 degrees and that of proximal fractures was 25.3± 3.25 degrees. Time for union was 10.07± 0.97 weeks for distal forearm fractures and it was 10± 0.7 weeks for proximal forearm fractures. Mean cast index 0.753±0.001 for distal forearm fractures and for proximal forearm fractures it was 0.8415±0.3184. Mean cast index in proximal fractures and distal fractures which were displaced was 0.88 and 0.82 respectively. Mean cast index for un-displaced distal and proximal fracture was 0.7244±0.0602 and 0.8415±0.3184 respectively. Out of 69 distal forearm fractures 7 were re-displaced and were re-manipulated, on the other hand only 1 out of 14 proximal forearm fracture was re-displaced and re-manipulated. Only complication observed in our study was re-displacement following initial manipulation which was treated with remanipulation.

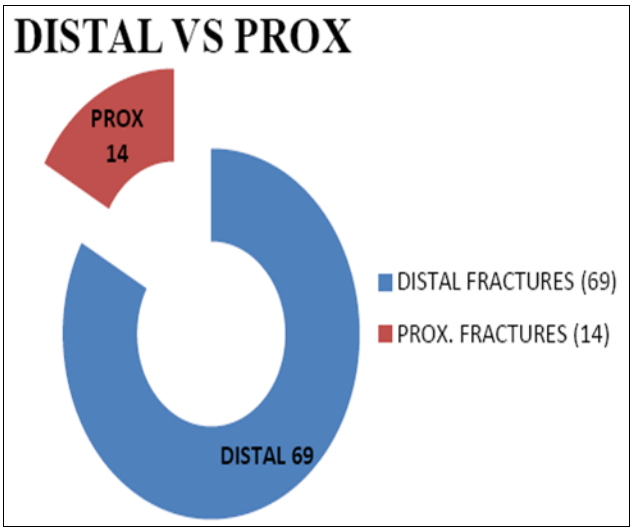

Fig 1: Distal vs Proximal forearm fractures

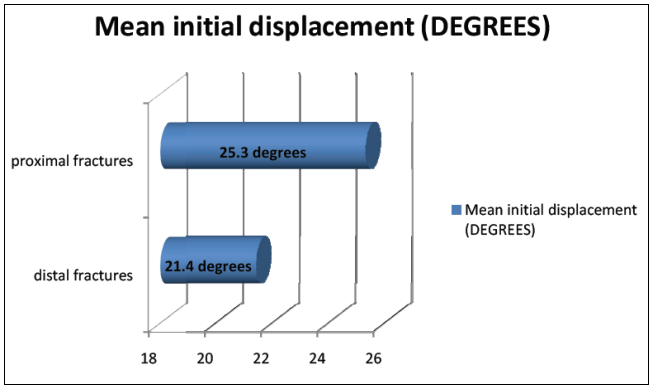

Fig 2: Initial Displacement of the fracture

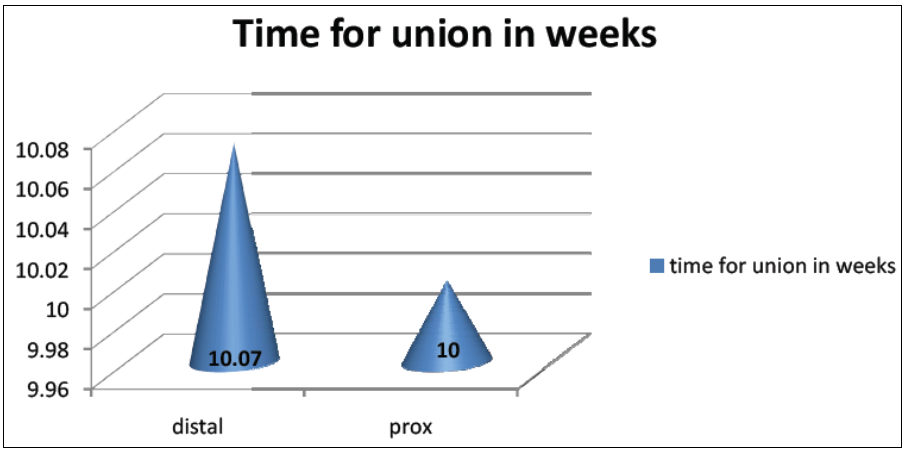

Fig 3: Times for union in weeks

Case 1: P. Mal, A 9 Yr Old Male Patient With Both Bone Left Forearm Fracture

Antero-posterior x-ray (DAY1) Lateral x-ray (DAY 1)


Antero-posterior x-ray (week 4) Lateral x-ray (week 4)

Case 2: R. Hoque, A 9 year old male child with both bone left forearm fracture


Antero-posterior x-ray (DAY 1) Lateral x-ray (DAY1)

Antero-posterior x-ray (Week4) Lateral x-ray (Week4)

Table 1: Baseline Data

	Distal Fracture		Proximal Fracture	
	Displaced	**Undisplaced**	**Displaced**	**Undisplaced**
Number of patients	7	62	1	13
Mean cast index	0.82±0.22	0.72±0.06	0.88	0.84±0.32
Re-manipulation on	7	-	1	-
p value	P<0.001		p>0.05	

Discussion

The outcome of our study is that the Distal forearm fractures with cast index >0.8 were more likely to get re-displaced than with <0.8. Though it is difficult to achieve a cast index <0.8 in proximal forearm fractures, cast index < or > 0.8 does not predict the risk of re-displacement and re-manipulation in this group. So the Cast index stays a clinically useful tool to assess cast moulding following closed reduction of pediatric forearm fractures and to predict re-displacement.

Conclusion

Though it was easy to achieve <0.8 cast index in distal forearm fractures and predict the re-displacement accordingly, but in proximal forearm fracture neither achieving <0.8 cast index was easy nor predicting the re-displacement based on it. Thus cast index can be used to predict the re-displacement distal forearm fractures, but its use in proximal forearm fractures should be discouraged.

Limitation of the study

Longer follow up should have been included to evaluate the remodeling potential. Possibility of re-fracture during the course of remodeling and its treatment should have been taken into account. Further studies should be conducted to find any other factors to predict the fate pediatric forearm fractures.

References

1. Xian CJ. The Biologic Aspects of Children's Fracture. Rockwood & Wilkins' fractures in children, 2006.
2. Cho KH, Lee SM, Lee YH, Suh KJ. Ultrasound diagnosis of either an occult or missed fracture of an extremity in pediatric-aged children. Korean Journal of Radiology. 2010; 11(1):84-94.
3. Herman MJ, Marshall ST. Forearm fractures in children and adolescents: a practical approach. Hand clinics. 2006; 22(1):55-67.
4. Cheng JC, Shen WY. Limb fracture pattern in different pediatric age groups: a study of 3,350 children. Journal of orthopaedic trauma. 1993; 7(1):15-22.
5. Proctor MT, Moore DJ, Paterson JM. Redisplacement after manipulation of distal radial fractures in children. The Journal of bone and joint surgery. British volume. 1993; 75(3):453-4.
6. Chess DG, Hyndman JC, Leahey JL, Brown DC, Sinclair AM. Short arm plaster cast for distal pediatric forearm fractures. Journal of Pediatric Orthopaedics. 1994; 14(2):211-3.