Original article
https://doi.org/10.18019/1028-4427-2024-30-5-627-635

Use of cast index and three-point index in paediatric both bone forearm fractures: a prospective study

K. Kumar[1], Ch. Katariya[1], M. Jindal[1]✉, P. Gupta[2]

[1] Kalpana Chawala Government Medical College, Karnal, India
[2] Guru Gobind Singh Medical College, Faridkot, India

Corresponding author: Mohit Jindal, drmohitjindalortho@gmail.com

Abstract

Introduction The majority of paediatric both bone forearm fractures are treated with manipulative reductions and casting; loss of reduction is one of the most commonly reported complications.

We **aimed** to assess the role of cast index and 3-point index as predictor of outcome of a successful closed reduction in distal both bones forearm fractures.

Materials and methods This prospective observational study was conducted at the Department of Orthopedics, Kalpana Chawala Government Medical College inKarnal to assess the role of cast index and 3-point index as predictor of outcome of a successful closed reduction in distal both bones forearm fractures. In the present study, patients under 16 years irrespective of sex with distal both bones forearm fractures, managed by closed reduction and casting were included.

Results In the present study, 55 patients were included. Fracture reduction failure was observed in 32.7 % of the patients. Both three-point index and cast index were found to be significantly higher in patients with reduction failure. It was observed that at 2 weeks Area under curve (ROC Curve) for Cast index and Three point index was 0.72 and 0.85 respectively. At 4 weeks, Area under curve for Cast index and Three point index was 0.77 and 0.84 respectively and at 6 weeks 0.74 and 0.86 respectively. Thus, in the present study, CI and 3PI had similar predictability for fracture reduction failure.

Conclusion The three-point index and cast index are clinically useful tools to assess the quality of cast molding following closed reduction of pediatric forearm fractures and to predict re-displacement in distal forearm fractures.

Keywords: forearm fracture, casting, cast index, three-point index, VAS score

For citation: Kumar K, Katariya Ch, Jindal M, Gupta P. Use of cast index and three-point index in paediatric both bone forearm fractures: a prospective study. *Genij Ortopedii*. 2024;30(5):627-635. doi: 10.18019/1028-4427-2024-30-5-627-635

INTRODUCTION

Forearm fractures account for 17.8 % of all fractures in pediatric age [1]. Joeris et al. found forearm fractures to be significantly more frequent in school age children (65 %) and adolescents (63 %) compared to infants (42 %) and preschool children (50 %) [2]. Both forearm bones were fractured in 50.1 % of cases of forearm injuries and there were significantly more males than females injured (63.6 % versus 36.4 %) [3]. The majority of the childhood diaphyseal forearm fractures are treated with manipulative reductions and loss of reduction was one of the most commonly reported complications [4]. Various indexing for assessment of reduction were described: cast index, padding index, Canterbury index, gap index and three-point index.The cast index (CI) is a simple and quick method of predicting the re-displacement after cast application in radius and ulna fractures in paediatric patients, particularly distal radius fractures [5]. Alemdaroglu et al. described the three-point index (TPI) in adult and paediatric radius distal end fractures and reported that the significance of the index in predicting the loss of reduction was higher than all other indices [6]. Therefore, in this study, we aimed to assess the role of cast index and three-point index as predictors of outcome of a successful closed reduction in distal both-bone forearm fractures.

MATERIALS AND METHODS

This prospective observational study was conducted at the Department of Orthopedics of Kalpana Chawla Government Medical College, Karnal, India from December 2022 to June 2024. Ethical committee clearance was taken. Informed written consent was taken from all the parents/care providers of patients included in the study. The inclusion criteria were patients under 16 years of age irrespective of sex with distal both-bone forearm fractures, managed by closed reduction and casting with acceptable reduction, pediatric patients presenting within a week of fracture. The exclusion criteria were patients with open fractures, polytrauma, vascular compromise, poor skin condition, allergy to POP, isolated radial or ulnar fractures, systemic disease (Bone metabolic disease). A total of 55 patients fulfilling the inclusion criteria were studied. All fractures were manipulated to anatomical position for close reduction under X-ray image intensification before the application of an above elbow plaster cast using Plaster of Paris with forearm in neutral position and elbow kept at 90 degrees flexion. A uniform layer of padding was applied throughout with a 50 % overlap between successive wraps. The manipulation and casting was done by orthopaedic surgeons; patients were followed up at the Kalpana Chawla Government Medical College. The principles of good forearm casting technique, i.e. interosseous molding, supracondylar molding, appropriate padding (ensuring at least two layers of padding material, with extra padding over bony prominences), evenly distributed cast material, straight ulnar border and flat posterior humeral borders, and three-point molding, were ensured. Reduction was assessed on check radiographs in standard AP and lateral views. Quality of reduction was assessed and casting indices (cast index and three-point index) of the patient were calculated at this stage. The cast index (CI) was calculated on the basis of the cast geometry at the fracture site: cast index = inner diameter of the cast at fracture site in the lateral view/ inner diameter of the fracture cast at fracture site in the AP view as shown in Figure 1. An ideal CI will be taken to be 0.8 or less.

Fig. 1 X-ray of the forearm capturing the wrist joint, lateral and anteroposterior views showing CI calculation. CI = A / B, A — internal anteroposterior diameter of cast excluding padding, B — internal mediolateral diameter of cast excluding padding

The three-point index was assessed as shown below in Figure 2. The three-point index considered the gap at the fracture site as well as the gaps that are proximal and distal to the fracture itself. It was calculated with a complex formula. The narrowest distal radial gap at radiocarpal or proximal carpal joint + the narrowest ulnar gap within 1 cm of the fracture site + the narrowest radial gap within the area between 3 and 7 cm proximal to the fracture line) / transverse width of bone contact between proximal and distal fragments on AP + (the narrowest distal dorsal gap at radiocarpal or proximal carpal joint + the narrowest volar gap within 1 cm of the fracture site + the narrowest dorsal gap within the area between 3 and 7 cm proximal to the fracture line)/transverse width of contact between proximal and distal fragments on lateral radiograph and the cut-off was < 0.8.

Fig. 2 Three-point index:
(1) Anteroposterior (AP) radiograph, showing measurement of distal radial gap (A), fracture site ulnar gap (B) and proximal radial gap (padding thickness) (C), sum of which was divided by sum of coronal reduced distance of radius (x1) and ulna (x2). (2) Lateral radiograph, showing measurement of distal dorsal gap (P), fracture site volar gap (Q) and proximal radial gap (R), sum of which was divided by sum of sagittal reduced distance of radius (y1) and ulna (y2). Results of calculations of AP and lateral radiographs are added to find the three-point index
(A + B + C) / (x1 + x2) + (P + Q + R) / (y1 + y2)

The reduction was deemed satisfactory by the surgeon when there was no evidence of displacement (< 5 mm) on both planes and angulation was corrected to near anatomical position (< 5°). The decision to re-manipulate was based on standard guidelines [7] (re-angulation of more than 20°). Fractures that re-displaced significantly were re-manipulated or fixed internally. All patients were followed up at 2 weeks, 4 weeks and 6 weeks.

Statistical analysis

The Statistical analysis included profiling of patients on different demographic, laboratory and clinical parameters. Descriptive analysis of quantitative parameters was expressed as mean and standard deviation. Ordinal data were expressed as absolute number and percentage. Comparison was done between patients with and without failure of fracture reduction. Cross tables were generated and chi square test was used for testing of associations and student t-test was used for comparison of quantitative parameters. A *p*-value < 0.05 is considered statistically significant. All analysis was done using SPSS software, version 24.0.

RESULTS

Fifty-five patients were included in the study. Fracture reduction failure was observed in 32.7 % of the patients (Table 1).

In the present study, 16.4 % of patients were under 5 years of age, 47.3 % were aged between 5 to 10 years and 36.4 % were aged between 10 and 15 years. Mean age of the patients was 9.2 ± 2.6 years (range, 4 to 15 years). Age distribution was not significantly different between patients with and without fracture reduction failure (*p*-value = 0.76).

Boys were 81.8 % of the study population. Gender distribution was not significantly different between patients with and without fracture reduction failure (*p*-value = 0.34).

Mean three-point index immediately after reduction was 0.79 ± 0.01 and 0.80 ± 0.01 among those without and with reduction failure, *p*-value = 0.26. Further follow-up indices follow at 2 weeks among those without and with reduction failure were (0.81 ± 0.01 vs 0.79 ± 0.01, *p*-value < 0.05),

at 4 weeks among those without and with reduction failure (0.81 ± 0.02 vs 0.78 ± 0.02, *p*-value < 0.05), and at 6 weeks among those without and with reduction failure (0.82 ± 0.04 vs 0.77 ± 0.02, *p*-value < 0.05); mean TPI was significantly higher in those with reduction failure as compared to those without failure (Table 2).

It was observed that immediately after reduction among those without and with failure, 22.2 % and 45.9 % had three-point index < 0.8, and at subsequent follow-ups at 2 weeks (16.7 % vs 59.5 %, *p*-value < 0.05) at 4 weeks (27.8 % vs 89.2 %, *p*-value < 0.01) and 6 weeks (44.4 % vs 94.6 %, *p*-value < 0.01); there was a significantly lower proportion of patients who had three-point index < 0.8 among those with reduction failure as compared to those without reduction failure (Table 3).

Table 2

Comparison of mean three-point index between patients with and without fracture reduction failure

Three-point index	No Failure		Failure		*p*-value*
	Mean	SD	Mean	SD	
Immediately after reduction	0.79	0.01	0.80	0.01	0.26
2 weeks	0.79	0.01	0.81	0.01	< 0.05
4 weeks	0.78	0.02	0.81	0.02	< 0.05
6 weeks	0.77	0.02	0.82	0.04	< 0.05

* — analysed using independent t test.

Table 3

Comparison of three-point index between patients with and without fracture reduction failure

Follow-up	Three-Point Index	No Failure		Failure		Total		*p*-value*
		N	%	N	%	N	%	
Immediately after reduction	< 0.8	17	45.90	4	22.20	21	38.20	0.89
	> 0.8	20	54.10	14	77.80	34	61.80	
2 weeks	< 0.8	22	59.50	3	16.70	25	45.50	< 0.05
	> 0.8	15	40.50	15	83.30	30	54.50	
4 weeks	< 0.8	33	89.20	5	27.80	38	69.10	< 0.01
	> 0.8	4	10.80	13	72.20	17	30.90	
6 weeks	< 0.8	35	94.60	8	44.40	43	78.20	< 0.01
	> 0.8	2	5.40	10	55.60	12	21.80	
Total		37	100	18	100	55	100	

* — analysed using chi-square test.

Mean CI immediately after reduction was 0.80 ± 0.01 and 0.81 ± 0.01 among those with and without reduction failure, respectively (*p*-value = 0.07). Further follow-up indices were at 2 weeks (0.80 ± 0.01 vs 0.79 ± 0.01, *p*-value < 0.01), at 4 weeks (0.81 ± 0.02 vs 0.78 ± 0.01, *p*-value < 0.05), and at 6 weeks (0.82 ± 0.04 vs 0.78 ± 0.02, *p*-value < 0.05); mean CI was significantly higher in those with reduction failure as compared to those without failure (Table 4).

Table 4

Comparison of mean cast index between patients with and without fracture reduction failure

Cast Index	No Failure		Failure		*p*-value*
	Mean	SD	Mean	SD	
Immediately after reduction	0.80	0.01	0.81	0.01	0.07
2 weeks	0.79	0.01	0.80	0.01	< 0.01
4 weeks	0.78	0.01	0.81	0.02	< 0.05
6 weeks	0.78	0.02	0.82	0.04	< 0.05

* — analysed using independent t test.

It was observed that immediately after reduction, those without and with failure, 27.8 % and 40.5 % respectively, had cast index < 0.8 and at subsequent follow-ups the rate was at 2 weeks (33.3 % vs 67.6 %, *p*-value < 0.05), at 4 weeks (44.4 % vs 94.6 %, *p*-value < 0.01) and at 6 weeks (44.4 % vs 94.6 %, *p*-value < 0.01); there was a significantly lower proportion of patients who had cast index < 0.8 among those with reduction failure as compared to those without reduction failure (Table 5).

Table 5

Comparison of cast index between patients with and without fracture reduction failure

Follow-up	Cast Index	No Failure		Failure		Total		*p*-value*
		N	%	N	%	N	%	
Immediately after reduction	< 0.8	15	40.50	5	27.80	20	36.40	0.35
	> 0.8	22	59.50	13	72.20	35	63.60	
2 weeks	< 0.8	25	67.60	6	33.30	31	56.40	< 0.05
	> 0.8	12	32.40	12	66.70	24	43.60	
4 weeks	< 0.8	35	94.60	8	44.40	43	78.20	< 0.01
	> 0.8	2	5.40	10	55.60	12	21.80	
6 weeks	< 0.8	35	94.60	8	44.40	43	78.20	< 0.01
	> 0.8	2	5.40	10	55.60	12	21.80	
Total		37	100	18	100	55	100	

* — analysed using chi-square test.

Mean pain score according to VAS (Visual Analog Scale) immediately after reduction was 6.7 ± 0.5 and 6.8 ± 0.6, *p*-value 0.31 among those with and without reduction failure, respectively. At further follow ups it was at 2 weeks (5.5 ± 0.9 vs 4.9 ± 0.5, *p*-value < 0.05), at 4 weeks (3.8 ± 1.3 vs 2.5 ± 0.7, *p*-value < 0.01), and at 6 weeks (2.5 ± 1.2 vs 1.4 ± 0.6, *p*-value < 0.05); mean VAS score was significantly higher in those with reduction failure as compared to those without failure (Table 6).

Table 6

Comparison of mean pain VAS score between patients with and without fracture reduction failure

VAS	No Failure		Failure		*p*-value*
	Mean	SD	Mean	SD	
Immediately after reduction	6.7	0.5	6.8	0.6	0.31
2 weeks	4.9	0.6	5.5	0.9	< 0.05
4 weeks	2.5	0.7	3.8	1.3	< 0.01
6 weeks	1.4	0.6	2.5	1.2	< 0.05

* — analysed using independent t test.

It was observed that at 2 weeks the area under curve (AUC) for cast index and three-point index was 0.72 and 0.85, respectively. At 4 weeks, the area under curve for cast index and three-point index was 0.77 and 0.84, respectively, and at 6 weeks it was 0.74 and 0.86, respectively (Table 7, Fig. 3).

Thus, in the present study, CI and TPI had similar predictability for fracture reduction failure.

Table 7

Prediction of fracture reduction failure based on three-point index and cast index

Test Result Variable	Area under curve	Std. Error	Asymptotic 95 % Confidence Interval	
			Lower Bound	Upper Bound
Cast index 2 WKS	0.72	0.084	0.561	0.888
Three-point index 2 WKS	0.85	0.054	0.743	0.956
Cast index 4 WKS	0.77	0.075	0.624	0.917
Three-point index 4 WKS	0.84	0.057	0.732	0.957
Cast index 6 WKS	0.84	0.057	0.734	0.96
Three-point index 6 WKS	0.86	0.051	0.76	0.959

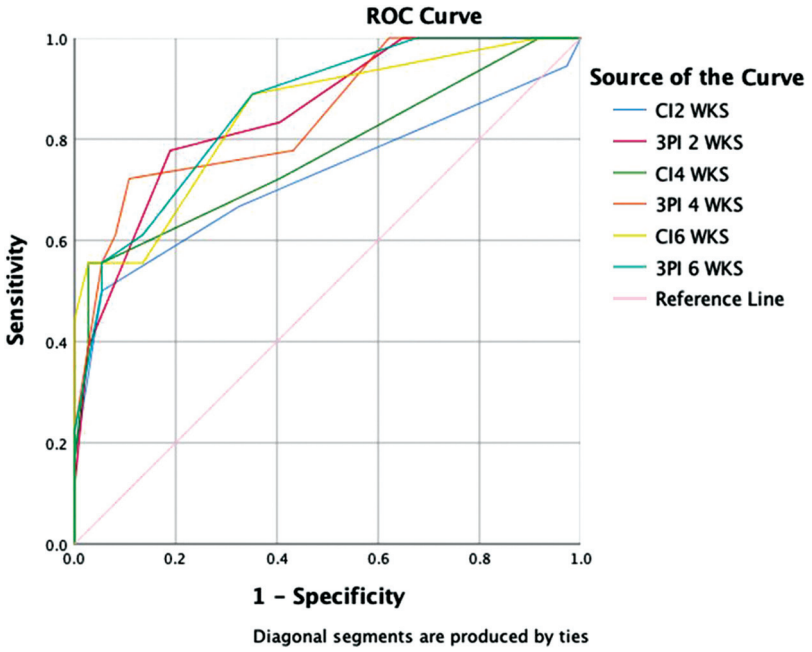

Fig. 3 Prediction of fracture reduction failure based on three-point index and cast index

DISCUSSION

Fracture reduction failure rate

In 55 patients of the study, fracture reduction failure was observed in 32.7 % which was similar to the finding observed in the study done by Alagöz et al. The study investigated the factors affecting the loss of reduction in pediatric diaphyseal forearm fractures and compared the three-point index (TPI) with the cast index, padding index, Canterbury index and gap index. In their study, 52 out of 159 patients (32.7 %) experienced loss of reduction during the follow-up [8]. Other studies showed different results in comparison to our study. Ajmera et al. assessed the rate of re-displacement in pediatric forearm fractures treated by cast by calculating the cast index. In their study, re-displacement was seen in 10 % of the cases [9]. In the study by Sipani et al., out of 69 distal forearm fractures 7 (10 %) were re-displaced and were re-manipulated [10]. Ravier et al. assessed which index is the most reliable in assessing cast adequacy in preventing re-displacements in a pediatric population. They reported loss of reduction in 54.8 % of the fractures [11].

The failure rates depend upon a number of factors which are beyond our scope of study. R. Arora et al. analyzed the role of risk factors and above casting indices in predicting significant re-displacement of pediatric forearm fractures treated by closed reduction and cast. In their study, thirteen (11.5 %) patients had significant re-displacement; all of them required re-manipulation [12].

Three-point index

It was observed that the mean three-point index immediately after reduction was 0.79 ± 0.01 and 0.80 ± 0.01 among those without and with reduction failure, respectively, p-value = 0.26 and at further follow ups at 2 weeks (0.81 ± 0.01 vs 0.79 ± 0.01, p-value < 0.05), 4 weeks (0.81 ± 0.02 vs 0.78 ± 0.02, p-value < 0.05), and 6 weeks (0.82 ± 0.04 vs 0.77 ± 0.02, p-value < 0.05); mean three-point index was significantly higher in those with reduction failure as compared to those without failure.

Our findings were similar to the studies done by Kharbamon et al., Alagöz et al., Iltar et al., Arora et al., which also concluded that if the three-point index is more than 0.8 than there was requirement of re-manipulation.

In the study by Kharbamon et al., the three-point index changed insignificantly from 0.81 ± 0.08 at first week post-operatively to 0.77 ± 0.18 six weeks post-operatively [13].

In the study by Alagöz et al., 78.8 % of those with loss of reduction had three-point index ⩾ 0.8, while only 15.9 % among those without loss of reduction had the three-point index ⩾ 0.8. This association was statistically significant (*p*-value < 0.01). Although the accuracy of the three-point index was higher than the other parameters, the authors concluded that no parameter alone could provide a definite prediction [8].

In their study, Iltar et al. compared the three-point index with the cast, padding, and Canterbury indices and reported that three point index's sensitivity and specificity were higher than all other indices [14].

In a recent study, Asadollahi et al. found that cast, padding, gap and three-point indices all have a strong correlation with re-displacement [15].

Cast index

The cut-off level of cast index as given by Sheikh et al. [16] was 0.77 for re-displacement and 0.92 for second procedure by Debnath et al. [17], whereas in our study this level was 0.8. The probable reason for this difference may be the difference in padding material used by us compared to their study. Bohm et al. found no difference in re-displacement rates of below elbow versus above elbow casts based on cast index above or below 0.70 [18]. Sheikh et al. hypothesized that cast index of less than 0.8 is more difficult to achieve in the proximal forearm but that this does not necessarily adversely affect the risk of fracture re-displacement.

This is based on the fact that the proximal forearm has more soft tissue as compared with the distal forearm and therefore a cast that is more elliptical in cross section is less likely. However, a less elliptical proximal forearm cast (i.e., one with a higher cast index) may still provide adequate three-point fixation. Though not investigated in the present study, weight of the children also has an effect on the cast index. The study by Kamat et al. concluded that in addition to obesity, excessive padding and soft tissue swelling could allow re- displacement [19]. Similar observations were made by Malviya et al. who suggested that in young normally chubby children there is very little control over this otherwise useful tool [20].

In the present study, mean cast index immediately after reduction was 0.80 ± 0.01 and 0.81 ± 0.01 among those with and without reduction failure, *p*-value = 0.07. Further follow ups at 2 weeks (0.80 ± 0.01 vs 0.79 ± 0.01, *p*-value < 0.01), 4 weeks (0.81 ± 0.02 vs 0.78 ± 0.01, *p*-value < 0.05), and 6 weeks (0.82 ± 0.04 vs 0.78 ± 0.02, *p*-value < 0.05), showed that the mean cast index was significantly higher in those with reduction failure as compared to those without failure.

Shaw et al. reported that the mean cast index of the re-displacement group was 0.84, which significantly differs (p < 0.001) from the control group at 0.68 [21]. In another study by Agarwala et al., the mean cast index was 0.72 for distal forearm fractures. Mean cast index in displaced distal fractures was calculated to be 0.85. Mean cast index for un-displaced distal fractures was 0.7. Out of 83 distal forearm fractures 9 were re-displaced and were re-manipulated while 4 (out of 9) had to undergo operative treatment [22]. In the study by Ajmera et al., the mean cast index in the proximal, middle and distal forearm was 0.92, 0.86 and 0.80 respectively. Re-displacement was seen in only 3 (10 %) cases with cast index of 0.75, 0.97 and 1.004 and the mean cast index in these re-displacement cases was 0.908 (range 0.75 to 1.004). The change in cast index at 2, 4 and 6 weeks was not significantly different. Re-displacement was in one case of distal forearm fracture and two cases were of middle forearm fracture. This showed that the re-displacement rate is not associated with the level of fractures, but is directly proportional to cast index: the higher is the cast index, the higher is the chance of re-displacement [9].

VAS pain score

In the present study, mean VAS score immediately after reduction was 6.7 ± 0.5 and 6.8 ± 0.6, *p*-value 0.31 among those with and without reduction failure. Further follow ups at 2 weeks (5.5 ± 0.9 vs 4.9 ± 0.5, *p*-value < 0.05), 4 weeks (3.8 ± 1.3 vs 2.5 ± 0.7, *p*-value < 0.01), and 6 weeks (2.5 ± 1.2 vs 1.4 ± 0.6, *p*-value < 0.05) showed that the mean VAS score was significantly higher in those with reduction failure as compared to those without failure.

To the best of our knowledge, no previous study has assessed pain after successful closed reduction in distal both-bone forearm fractures.

Limitations

There are a few limitations of our study: We could not observe the patients for a longer period of time to know re-modelling in the long term. We did not take in to consideration the severity of fracture, type of anesthesia used (conscious sedation versus General Anesthesia) and the fracture configuration while assessing the outcomes. We also did not collect information about anthropometric parameters like child weight and diameter of the forearm.

CONCLUSION

Based on the results of our study, we conclude that both three-point index and cast index were found to be significantly higher in patients with reduction failure. Based on the area under curve, cast index and three-point index had similar predictability for fracture and reduction failure. Pain was significantly higher in patients with reduction failure. Thus, the three-point index and cast index are clinically useful tools to assess the quality of cast molding following closed reduction of pediatric forearm fractures and to predict re-displacement in distal forearm fractures.

Conflict of interest *Not declared.*
Funding *Not declared.*

REFERENCES

1. Naranje SM, Erali RA, Warner WC Jr, Sawyer JR, Kelly DM. Epidemiology of Pediatric Fractures Presenting to Emergency Departments in the United States. *J Pediatr Orthop*. 2016;36(4):e45-e48. doi: 10.1097/BPO.0000000000000595
2. Joeris A, Lutz N, Wicki B, Slongo T, Audigé L. An epidemiological evaluation of pediatric long bone fractures - a retrospective cohort study of 2716 patients from two Swiss tertiary pediatric hospitals. *BMC Pediatr*. 2014;14:314. doi: 10.1186/s12887-014-0314-3
3. Ryan LM, Teach SJ, Searcy K, Singer SA, Wood R, Wright JL, Chamberlain JM. Epidemiology of pediatric forearm fractures in Washington, DC. *J Trauma*. 2010;69(4 Suppl):S200-S205. doi: 10.1097/TA.0b013e3181f1e837
4. Bhatia M, Housden PH. Re-displacement of paediatric forearm fractures: role of plaster moulding and padding. *Injury*. 2006;37(3):259-268. doi: 10.1016/j.injury.2005.10.002
5. Mutimer J, Devane P, Horne J, Kamat A. The cast index: a simple radiological predictor of plaster cast failure in paediatric distal forearm fractures. *Orthop Procs*. 2010;92-B(SUPP_IV):598-598. doi: 10.1302/0301-620X.92BSUPP_IV.0920598a
6. Alemdaroğlu KB, Iltar S, Aydoğan NH, et al. Three-point index in predicting redisplacement of extra-articular distal radial fractures in adults. *Injury*. 2010;41(2):197-203. doi: 10.1016/j.injury.2009.08.021
7. Friberg KS. Remodelling after distal forearm fractures in children. III. Correction of residual angulation in fractures of the radius. *Acta Orthop Scand*. 1979;50(6 Pt 2):741-749. doi: 10.3109/17453677908991304
8. Alagöz E, Güleç MA. Factors affecting re-displacement in pediatric forearm fractures and the role of cast indices. *Jt Dis Relat Surg*. 2020;31(1):95-101. doi: 10.5606/ehc.2020.71523
9. Ajmera A, Jain S, Jain M. Evaluation of Cast Index in Predicting the Outcome of Pediatric Forearm Fractures. *Orthop JMPC*. 2020;26(1):30-33. doi: 10.5281/zenodo.3969791
10. Sipani AK, Agarwala V, Dhurwe A. Cast index in predicting outcome of pediatric forearm fractures. *Int J Orthop Sci*. 2020;6(2):10-14. doi: 10.22271/ortho.2020.v6.i2a.2010
11. Ravier D, Morelli I, Buscarino V, et al. Plaster cast treatment for distal forearm fractures in children: which index best predicts the loss of reduction? *J Pediatr Orthop B*. 2020;29(2):179-186. doi: 10.1097/BPB.0000000000000678
12. Arora R, Mishra P, Aggarwal AN, et al. Factors Responsible for Redisplacement of Pediatric Forearm Fractures Treated by Closed Reduction and Cast: Role of casting indices and three point index. *Indian J Orthop*. 2018;52(5):536-547. doi: 10.4103/ortho.IJOrtho_382_17
13. Kharbamon P, Sheth BA, Pawar P, et al. Importance of calculating various casting indices in predicting radiological outcomes of paediatric forearm fractures. *Int J Res Orthop*. 2020;6(5):1016-1021. doi: 10.18203/issn.2455-4510.IntJResOrthop20203724
14. Iltar S, Alemdaroğlu KB, Say F, Aydoğan NH. The value of the three-point index in predicting redisplacement of diaphyseal fractures of the forearm in children. *Bone Joint J*. 2013;95-B(4):563-567. doi: 10.1302/0301-620X.95B4.31143
15. Asadollahi S, Pourali M, Heidari K. Predictive factors for re-displacement in diaphyseal forearm fractures in children-role of radiographic indices. *Acta Orthop*. 2017;88(1):101-108. doi: 10.1080/17453674.2016.1255784
16. Sheikh HQ, Malhotra K, Wright P. Cast index in predicting outcome of proximal pediatric forearm fractures. *Indian J Orthop*. 2015;49(4):398-402. doi: 10.4103/0019-5413.159609
17. Debnath UK, Guha AR, Das S. Distal forearm fractures in children: Cast index as predictor of re-manipulation. *Indian J Orthop*. 2011;45(4):341-346. doi: 10.4103/0019-5413.80322
18. Bohm ER, Bubbar V, Yong Hing K, Dzus A. Above and below-the-elbow plaster casts for distal forearm fractures in children. A randomized controlled trial. *J Bone Joint Surg Am*. 2006;88(1):1-8. doi: 10.2106/JBJS.E.00320
19. Kamat AS, Pierse N, Devane P, et al. Redefining the cast index: the optimum technique to reduce redisplacement in pediatric distal forearm fractures. *J Pediatr Orthop*. 2012;32(8):787-91. doi: 10.1097/BPO.0b013e318272474d

20. Malviya A, Tsintzas D, Mahawar K, et al. Gap index: a good predictor of failure of plaster cast in distal third radius fractures. *J Pediatr Orthop B*. 2007;16(1):48-52. doi: 10.1097/01.bpb.0000236232.57269.ec
21. Shaw R, Dutta PK, Chandra M, et al. Is Gap Index Better Than Cast Index as a Predictor of Redisplacement of Paediatric Forearm and Extra-Articular Distal Radius Fracture Treated by Plaster Casting. *J Evolution Med Dent Sci*. 2021;10(5):258-264. doi: 10.14260/jemds/2021/58
22. Agarwala V, Newme K, Dhar A. Re-displacement and cast index in distal forearm fractures in children. *Int J Orthop Sci*. 2022;8(1):737-740. doi: 10.22271/ortho.2022.v8.i1j.3093

The article was submitted 20.07.2024; approved after reviewing 30.07.2024; accepted for publication 01.08.2024.

Information about the authors:

Kuljit Kumar — Professor, Department of Orthopedics, koolguy0062008@gmail.com, https://orcid.org/0009-0007-6462-4102;

Chetan Katariya — DNB Resident, Department of Orthopedics, katariyachetan96@gmail.com;

Mohit Jindal — Associate Professor, Department of Orthopedics, drmohitjindalortho@gmail.com, https://orcid.org/0000-0002-1699-456X;

Pranav Gupta — Assistant Professor, Department of Orthopedics, pranavchd88@gmail.com.