



## Objective assessment of plaster cast quality in pediatric distal forearm fractures: Is there an optimal index?



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### ABSTRACT

**Background:** Several so-called casting indices are available for objective evaluation of plaster cast quality. The present study sought to investigate four of these indices (gap index, padding index, Canterbury index, and three-point index) as compared to a reference standard (cast index) for evaluation of plaster cast quality after closed reduction of pediatric displaced distal forearm fractures.

**Methods:** Forty-three radiographs from patients with displaced distal forearm fractures requiring manipulation were reviewed. Accuracy, sensitivity, specificity, false-positive probability, false-negative probability, positive predictive value, negative predictive value, positive likelihood ratio, and negative likelihood ratio were calculated for each of the tested indices.

**Results:** Comparison among indices revealed diagnostic agreement in only 4.7% of cases. The strongest correlation with the cast index was found for the gap index, with a Spearman correlation coefficient of 0.94. The gap index also displayed the best agreement with the cast index, with both indices yielding the same result in 79.1% of assessments.

**Conclusion:** When seeking to assess plaster cast quality, the cast index and gap index should be calculated; if both indices agree, a decision on quality can be made. If the cast and gap indices disagree, the padding index can be calculated as a tiebreaker, and the decision based on the most frequent of the three results. Calculation of the three-point index and Canterbury index appears unnecessary.

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### Introduction

Distal forearm fractures are one of the most common traumas in children [1–4]. These fractures usually heal rapidly, with excellent functional recovery, after closed reduction and plaster casting. [3,5,6] However, loss of reduction after treatment has been reported in 25 to 39% of cases. [7–10] Risk factors associated with loss of reduction include initial displacement, non-anatomical reduction, forearm position after manipulation, above-the-elbow casting, operator experience, inadequate molding, lack of support,

and excess padding. [2,11–17] but inadequate casting technique has been considered the major cause. [4,15,18,19]

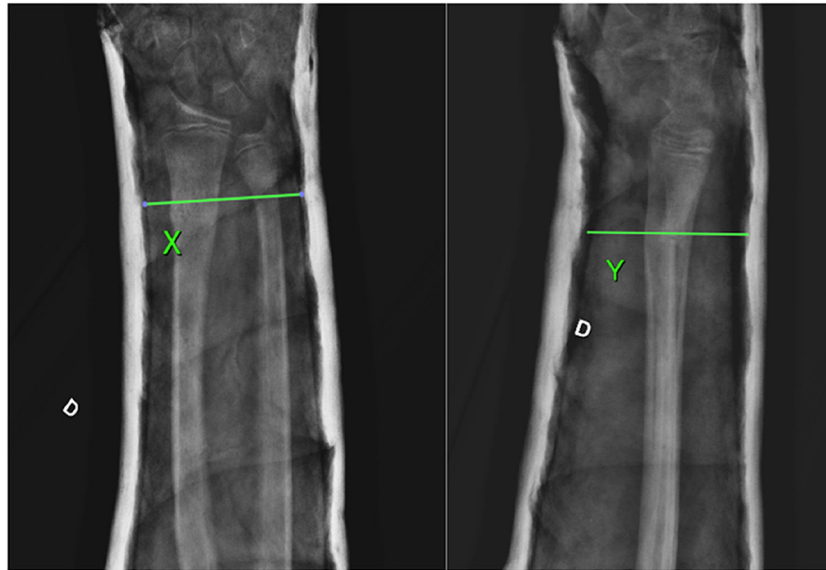
Although most of the aforementioned risk factors can be evaluated by objective parameters, plaster cast quality has historically been assessed in a subjective manner. Many authors have endeavored to develop indices that can provide an objective evaluation of the plaster cast. [20] These so-called cast indices are based on formulas that use measurements obtained from anteroposterior and lateral plain radiographs to estimate the quality of cast placement.

The objective of this study was to assess the relationship between the cast index and other indices available for evaluation of plaster cast quality and determine the optimal index for use in pediatric distal forearm fractures.

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**CAST INDEX: X/Y**



**Fig. 1.** AP and lateral radiograph demonstrating measurement of the cast index in a child.

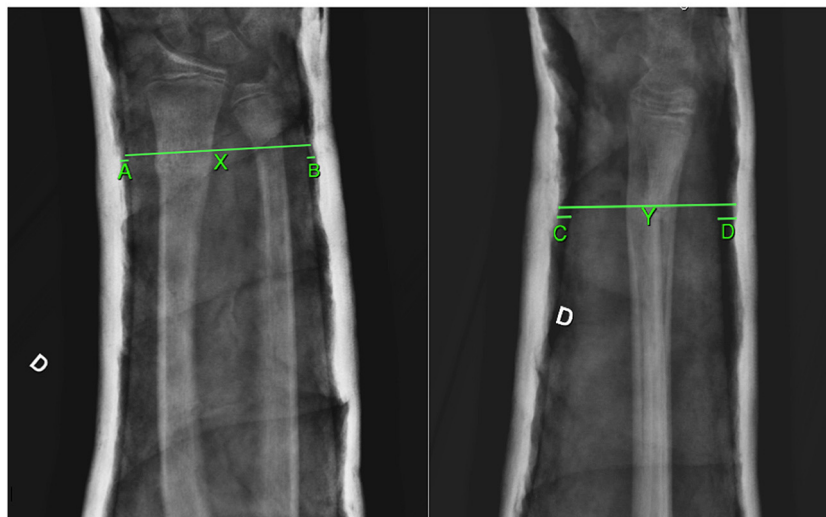
**Patients and methods**

Between September 2013 and June 2015, a retrospective analysis was conducted of all patients aged <16 years who underwent closed reduction and casting for distal forearm fractures in a general hospital. Forty-three cases of pediatric displaced forearm fracture were analyzed. Patients had a mean age of 10 years (range, 3–16); 34 (79%) were male and 9 (21%) were female. Children with compound fractures were excluded from the study, as were those treated with Kirschner wires, those with unacceptable initial reduction, fracture dislocations, and fractures with physeal separation. Children whose casts were split were also excluded.

Five indices were tested in the present study: the cast index, the gap index, the padding index, the Canterbury index, and the three-point index. The cast index, proposed by Chess et al., [15] is calculated as the inner diameter of the cast on lateral divided by the inner diameter of the cast on anteroposterior (at the fracture

site); the cutoff is <0.7. This was considered the reference-standard index (Fig. 1). The gap index, proposed by Malviya et al., [21] is based on the ratio of the gaps in the cast, at the level of the fracture, to the inner width of the cast in two planes; the cutoff is <0.15. (Fig. 2). The padding index and Canterbury index were proposed by Bathia and Housden respectively. [22] These indices were developed to help in the assessment of cast technique for treatment of both diaphyseal and distal metaphyseal forearm fractures in children. The padding index is calculated as the dorsal gap on lateral divided by the maximum interosseous distance on anteroposterior; the cutoff is <0.3. The Canterbury index is the sum of the cast and padding indices; the desirable value cutoff is <1.1. The three-point index, defined by Alemdaroglu et al. [9] differs from the other indices because it takes into account not only gaps at the fracture site, but also gaps in the region proximal and distal to the fracture, which play an important role in maintaining reduction against displacement forces; the cutoff is <0.8.

**GAP INDEX: (A+B)/ X + (C+D)/Y**



**Fig. 2.** AP and lateral radiograph demonstrating measurement of the gap index in a child.

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