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Short Arm Plaster Cast for Distal Pediatric Forearm Fractures

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Summary: Ten years' clinical experience with below-elbow plaster cast treatment of distal one third pediatric forearm fractures was subjected to an independent retrospective radiographic review. In the study population of 761 fractures, no significant displacement occurred while the forearm remained in plaster. The average angulation change was 4.5° (SD ± 2.2°). In each angulation change >5°, poor cast molding was evident, as reflected by a high "cast index" ($p < 0.01$). Although this technique is technically demanding, excellent results are obtained in all distal pediatric forearm fractures if proper cast molding is used. **Key Words:** Cast—Forearm—Fracture—Radius—Ulna.

Childhood fractures of the forearm are a very common injury. In a review, Blount reported that 75% involve the distal one third of the forearm (2). Many different methods of cast fixation have been advocated to prevent reangulation (1–11). After closed reduction using the intact periosteal hinge principle, we at the Izaak Walton Killam Hospital (IWK), exclusively use a below-elbow cast, well molded to the normal contours of the forearm (Fig. 1). To analyze our results, we performed a retrospective radiographic review.

METHODS

All forearm injuries treated at the IWK from 1974 until 1984 were reviewed. Of these 1,585 consecutive cases, all distal one third fractures requiring reduction were included if the distal radial physis was open, a short arm cast was used, and prereduction, postreduction, and 3-week follow-up radiographs were available for review. Only true anteroposterior (AP) and lateral radiographs were considered acceptable. All open or pathologic fractures were excluded.

Fracture displacement and angulation were calculated on each radiograph. Displacement was expressed as a percentage of the proximal fragment's width. Angulation was measured along the long axis of each fragment and was expressed in degrees. Angulation from a "supination-extension" injury was termed positive, and that from a "flexion-pronation" injury was considered negative.

In each case, a "cast index" was also calculated, defined as the sagittal cast width measurement divided by the coronal cast width measurement at the fracture site (Fig. 2). A previous anthropometric study completed by the senior author (J.C.H.), has shown a normal ratio of 0.70 in the distal pediatric forearm. The cast index was therefore an indication of how well the cast was molded to the normal contours of the forearm.

RESULTS

Of the injuries reviewed, only 761 met all the inclusion criteria. Of these, 203 cases lacked complete 3-week follow-up radiographic documentation. Despite excellent clinical results, these were excluded, leaving 558 cases for analysis.

There were 443 distal radius and ulna shaft fractures, 45 isolated distal radial fractures, and 80 growth plate injuries (77 Salter-Harris II, two Salter-Harris I, and one Salter-Harris IV) (Fig. 3). Of these fractures, 466 (83.5%) were supination-extension and 92 (16.5%) were pronation-flexion injuries.

Displacement values on the pre- and postreduction radiographs averaged 43% (SD 6.5%) and 9.7% (SD 3.4%), respectively. The pre- and postreduction angulation values averaged 24.2° (SD 5.4°) and 3.9° (SD 1.3°) (Fig. 4). Cast index values averaged

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FIG. 1. Example of a well-molded forearm cast contoured to the natural curvatures of the distal forearm.

0.72° (SD 0.12°) (Fig. 5). Follow-up radiographs showed negligible changes in displacement. The average change in angulation while the forearm was in plaster was 4.5° (SD 2.2°). The change in angulation was <5° in 90% of cases, but the other 10% had significant changes.

Multiple analysis of variance was completed to analyze the cases of cast failure. Fracture type, pre- and postreduction displacement and angulation, the differences between these values, and the cast index were analyzed. For all supination-extension injuries, reangulation was related to poor cast molding, as reflected by a high cast index ($p < 0.01$). In cases of initially undisplaced but significantly angulated fracture, reangulation was also related to postreduction displacement ($p < 0.01$). No statistically significant factor explained reangulation of the pronation-flexion injuries.

DISCUSSION

Long-arm casts have been advocated for distal one third pediatric forearm injuries, with the forearm held in various positions based on fracture location (1–11). Our results show that short-arm casts are highly effective in maintaining reduction of all

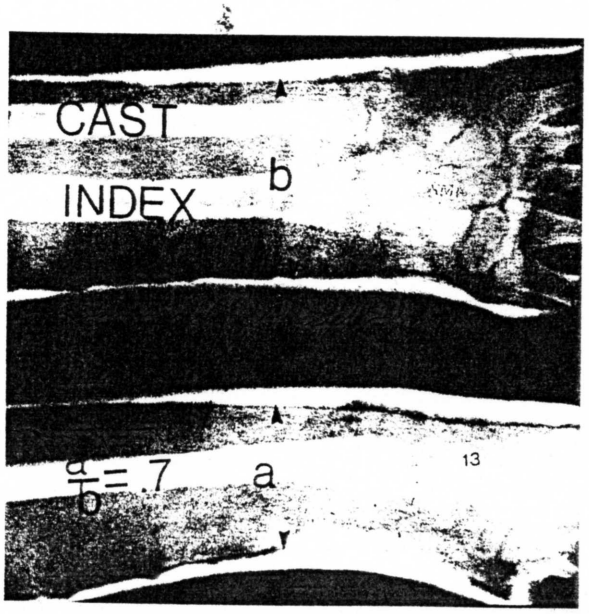

FIG. 2. Example of cast index calculation of a well-molded forearm cast.

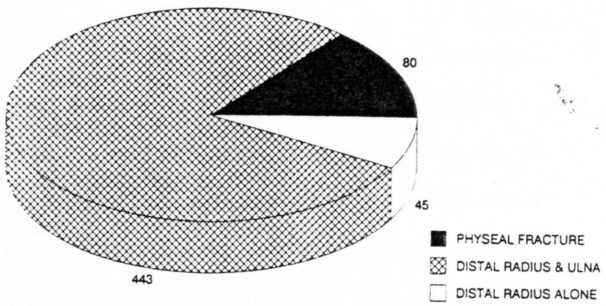

FIG. 3. Frequency of distal pediatric forearm fractures immobilized with below-elbow well-molded casts.

types of distal one third pediatric forearm fractures provided that the cast is well molded to the normal contours of the forearm. Of the 761 fractures reviewed clinically, not one with a well-molded cast required remanipulation. There were 19 cases with poor casting technique (high cast index $p < 0.01$), which required revision. These casts were most often fashioned by inexperienced junior housestaff, general practitioners, or our nonorthopaedic surgical colleagues. This implies a distinct learning curve in application of this technique. We have had excellent results in casting performed by experienced personnel, however, with all types and severity of fractures.

The practice of completion of a greenstick fracture to prevent reangulation is not supported by our results. Indeed, reangulation of an initially undisplaced fracture was directly related to any postreduction displacement ($p = 0.01$), which could only exist if the fracture was first completed. This practice therefore is unwarranted. We did not address the incidence of refracture but completion of the greenstick fracture theoretically has an advantage. Without completion, callus formation is minimal on the compression (concave) side of the fracture owing to the lack of periosteal elevation. If the fracture is completed and the periosteum is elevated, callus could form about the fracture and would therefore be of greater radius, resulting in greater torsional strength.

Our failure to detect a significant factor for rean-

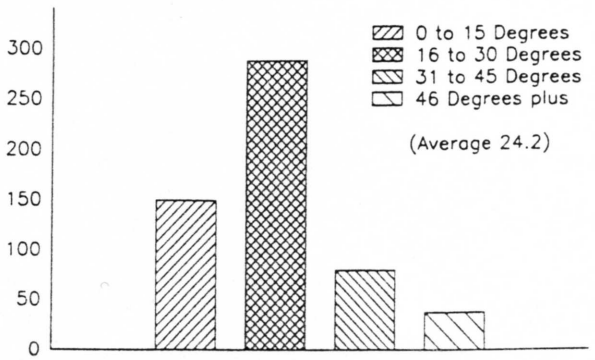

FIG. 4. Distribution of prereduction angulation values separated into 15° increments.

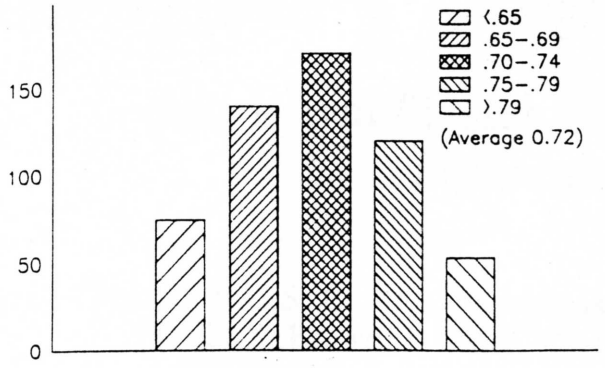

FIG. 5. Distribution of cast index measurements taken from postreduction radiographs.

gulation of the less common pronation-flexion group is probably a reflection of the smaller sampler size. We suspect that poor clinical plaster molding may again be the significant factor.

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