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ABOVE AND BELOW-THE-ELBOW PLASTER CASTS FOR DISTAL FOREARM FRACTURES IN CHILDREN

A RANDOMIZED CONTROLLED TRIAL

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Background: Closed fractures of the distal third of the forearm are the most common fractures of childhood, but the method of immobilization after closed reduction is controversial. This study was undertaken to determine whether below-the-elbow casts are as effective as above-the-elbow casts in immobilizing these types of fractures and to identify patient and treatment considerations that are related to loss of reduction.

Methods: We designed a blinded, randomized, controlled trial. The criteria for reduction and remanipulation were set a priori. The primary outcome measure was fracture immobilization as reflected by reangulation in the cast and by the need for remanipulation. Exploratory analysis with use of stepwise logistic regression analysis was undertaken to search for factors predictive of loss of reduction.

Results: A total of 102 children were enrolled in the study and were allocated to two groups: the above-the-elbow cast group (fifty-six children) and the below-the-elbow cast group (forty-six children). The mean age was 8.6 years, and sixty-one patients were boys. The groups did not differ with respect to the initial fracture angulation, postreduction angulation, reangulation during cast immobilization, and angulation of the fracture at the time of cast removal. In the above-the-elbow cast group, twenty-three (42%) of fifty-five children with adequate radiographs met the criteria for remanipulation compared with fourteen (31%) of forty-five children with adequate radiographs in the below-the-elbow cast group ($p = 0.27$); only four of these thirty-seven children actually underwent remanipulation. Children with fractures of both the radius and ulna ($p = 0.01$) and those with residual angulation after reduction ($p = 0.0001$) were at the highest risk of meeting the criteria for remanipulation. The rates of complications related to the cast did not differ between the groups.

Conclusions: Below-the-elbow casts perform as well as above-the-elbow casts in maintaining reduction of fractures in the distal third of the forearm in children, and the complication rates are similar. Factors that are associated with a higher risk of loss of reduction include combined radial and ulnar fractures and residual angulation of the fracture after the initial reduction.

Level of Evidence: Therapeutic Level I. See Instructions to Authors for a complete description of levels of evidence.

Fractures of the distal third of the forearm are the most common fractures of childhood[1-3], but the method of immobilization after closed reduction is controversial. Some investigators have recommended an above-the-elbow cast[4], while others have proposed that a below-the-elbow cast is sufficient[5]. The benefits of below-the-elbow casts are thought to be easier application, greater comfort, better hand function for activities of daily living, and less elbow stiffness. Above-the-elbow casts are purported to achieve better stability of the fracture and to lessen the risk of redisplacement with the need for remanipulation[4].

In four case series describing treatment in above-the-elbow casts, ninety-three (14.6%) of the 638 fractures required remanipulation[6-9]. In a retrospective review of more than 700 fractures treated with below-the-elbow casts, Chess et al. reported a remanipulation rate of only 2.5%, although they did

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TABLE I Criteria for Acceptable Reduction
Isolated distal radial fractures
≤5° of angulation on lateral and posteroanterior radiographs
≥95% apposition of the fracture on lateral and posteroanterior radiographs
Combined distal radial and distal ulnar fractures
≤10° of angulation of either bone on lateral and posteroanterior radiographs
≥50% apposition of the fracture on lateral and posteroanterior radiographs
Isolated distal ulnar fractures
≤10° of angulation on lateral and posteroanterior radiographs
≥50% apposition of the fracture on lateral and posteroanterior radiographs

not state the criteria they used for undertaking remanipulation[5]. Those authors attributed the low rate of remanipulation to the use of a properly molded cast with a cast index of <0.70, defined as the ratio of the height of the cast in the sagittal plane to the width of the cast in the coronal plane at the level of the fracture. To our knowledge, no randomized trial has compared the results of above-the-elbow and below-the-elbow casts for the management of displaced fractures of the distal third of the forearm in children.

The primary purpose of our trial was to determine whether below-the-elbow casts are as effective as above-the-elbow casts in immobilizing displaced fractures of the distal third of the forearm in children. The secondary purpose was to identify patient and treatment considerations that are related to loss of reduction or remanipulation.

Materials and Methods

We designed a blinded, randomized, controlled trial to compare above-the-elbow casts with below-the-elbow casts for immobilization of displaced fractures of the distal third of the forearm in children after closed reduction. Each child between four and twelve years of age who was seen at our tertiary-care hospital with a closed fracture of the distal third of the forearm that required reduction was considered for the study. Most pediatric fractures that occur in this area and require reduction are treated at our institution. A lower age-limit of four years was set, as below-the-elbow casts can slip off the arms of the smallest children. An upper age-limit of twelve years was chosen, as residual deformity is less acceptable in older children because of their diminished remodeling potential. Children with open fractures or Salter-Harris type-III or IV fractures were not considered eligible, as these injuries are usually treated surgically. Informed consent was obtained from the child's caregiver, and the child provided assent when appropriate. Blinding of the patient and surgeon was maintained until the time of cast application; single blinding (of the outcome assessor) was maintained after cast application. Randomization was accomplished with use of a sealed envelope. The study received approval from our institutional ethics review board.

Once enrolled, the child's fracture was managed with closed reduction with the child under conscious sedation in the emergency department, usually within four hours after presentation, or under general anesthesia in the operating room, usually within twenty-four hours after presentation. Senior orthopaedic residents performed or supervised the reductions in the emergency department. Reductions performed in the operating room were undertaken by all levels of residents, supervised by an attending orthopaedic surgeon. A below-the-elbow plaster cast was applied with use of three-point molding. Once hard, the cast was extended above the elbow in the patients randomized to the above-the-elbow cast group. Final postreduction radiographs were made once the cast was dry. The child was observed for complications and then discharged from the hospital with a sling. Analgesia was provided with use of weight-appropriate doses of acetaminophen and codeine.

The criteria for acceptable postreduction alignment and apposition were developed with use of commonly accepted guidelines[10-17] and by consensus of the group of six orthopaedic surgeons participating in the study. These same criteria were also used to guide treatment at the initial presentation of the child at the emergency department. The fractures that fell within the criteria for acceptable position were not manipulated and were excluded from this study; the fractures that fell outside the criteria were manipulated and therefore were included in this study. The criteria are outlined in Table I.

The children had a follow-up visit at the fracture clinic every week for three weeks, and they returned to the clinic for removal of the cast six weeks after the injury. At each of the first three visits, lateral and posteroanterior radiographs were made through the cast to determine whether reduction had been lost, the cast was inspected and repaired as necessary, and any complications were noted. The radiographic criteria for determining whether remanipulation was required for loss of reduction were based on the indications for closed reduc-

TABLE II Criteria to Determine Whether Remanipulation Is Required for Loss of Reduction
Isolated distal radius fractures
>25° of angulation on the lateral radiograph
>10° of angulation on the posteroanterior radiograph
<50% apposition on either the posteroanterior or lateral radiograph
Shift of ≥15° in one week on the lateral radiograph
Combined distal radial and distal ulnar fractures
>10° of angulation of either bone on the lateral or posteroanterior radiograph
<25% apposition of the fracture on the lateral or posteroanterior radiograph
Isolated distal ulnar fractures
>10° of angulation on the lateral or posteroanterior radiograph
<25% apposition of the fracture on the lateral or posteroanterior radiograph

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TABLE III Age Distribution by Cast Group

	Above-the-Elbow Cast (N = 56)	Below-the-Elbow Cast (N = 46)	Both Groups (N = 102)
Mean age *(yr)*	8.6	8.6	8.6
No. (%) of boys	32 (57)	29 (63)	61 (60)
No. (%) of girls	24 (43)	17 (37)	41 (40)

TABLE IV Distribution of Fracture Type by Cast Group

Fracture Type	Above-the-Elbow Cast (N = 56)	Below-the-Elbow Cast (N = 46)	Both Groups (N = 102)
No. (%) of radial fractures only	14 (25)	19 (41)	33 (32)
No. (%) of combined radial and ulnar fractures	42 (75)	27 (59)	69 (68)
No. (%) of ulnar fractures only	0	0	0

tion at the time of the initial presentation (Table I) and the consensus of the participating orthopaedic surgeons; these criteria are outlined in Table II. If remanipulation was undertaken, the choice of cast type after remanipulation was left to the surgeon's discretion. The children were followed for a total of eighteen weeks.

All study charts and radiographs were reviewed on a regular basis by one of two of the authors (E.R.B. or V.B.). Measurements of the alignment were made on the radiographs with a marker, straight edge, and protractor. The radiographic measurement technique was standardized, and repeatability testing demonstrated a precision of ±5°. Complete blinding of the radiographic assessor was not always possible because the type of cast was sometimes identifiable on the radiograph.

Statistical Methods

The primary outcome measure was immobilization of the fracture as reflected by reangulation in the cast and by the need for remanipulation. The need for remanipulation was measured in two ways: (1) the proportion of children in each group who met the criteria for remanipulation, and (2) the proportion of children in each group who actually underwent remanipulation. The proportions were compared with use of both the standard 95% confidence interval and the 95% upper confidence limit. The 95% upper confidence limit provides a statistical upper limit below which one would expect the true difference in remanipulation proportions to lie. This method of statistical comparison is useful when attempting to determine the noninferiority of one treatment method to another; in this case, that below-the-elbow casts do not result in a higher requirement for remanipulation than do above-the-elbow casts. Exploratory analysis with use of stepwise logistic regression analysis with a significance level of 0.1 was undertaken to search for factors predictive of fracture reangulation and loss of reduction during treatment.

Before the statistical analysis was undertaken, all continuous variables were plotted to assess normalcy. Comparisons of age, prereduction and postreduction fracture alignment, loss of reduction during treatment, and the cast index were accomplished with use of the Student t test for normally distributed data or the Wilcoxon test if the data were not normally distributed. The remanipulation rates and cast complications were compared with use of the chi-square test or Fisher exact test if cell counts were less than five. All statistical analysis was by "intention to treat"; therefore, children who had their cast type changed partway through the study were included in the analysis according to their original randomization.

The sample size was set a priori at 100, with fifty children in each group. If the maximum clinically acceptable difference in loss of reduction of the radius on the lateral radiograph during treatment between the two cast types is set at 5°, and the standard deviation for this reangulation is assumed to be 7.5° (which is larger than the standard deviation found in our series), this sample size provides more than 90% power for detecting this difference. The power analysis was performed with the SAS statistical package (SAS Institute, Cary, North Carolina).

Results

From July 1999 to January 2003, a total of 117 children were enrolled in the study. Fifteen of the 117 children were excluded for one or more of several reasons: the fracture did not require reduction (nine patients); the wrong type of cast was applied after randomization (two patients); or the subject was too young, too old, had a Galeazzi fracture, or had fracture treatment with a flexible intramedullary nail (one patient each). Fifty-six patients were allocated to the above-the-elbow cast group and forty-six, to the below-the-elbow cast group. The groups were not different in terms of age (Wilcoxon test, $p = 0.98$) or gender (chi-square test, $p = 0.55$) (Table III). Age had a bimodal distribution, with peaks at 6.5 and 11.5 years. The above-the-elbow cast group contained a larger proportion of children with combined radial and ulnar fractures (Table IV); however, this difference did not reach significance (chi-square test, $p = 0.08$). Neither group had any patients with an isolated distal ulnar fracture.

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TABLE V Mean Postreduction Residual Angulation of Fracture According to Location Where Reduction Performed and Fracture Type*

	Emergency Department	Operating Room	Difference (95% Confidence Interval)
Mean postreduction radial angulation on posteroanterior radiograph			
Radius only	1.0°	0.3°	0.7° (–0.2° to 1.7°)
Both bones	1.6°	1.7°	–0.1° (–1.6° to 1.4°)
Mean postreduction radial angulation on lateral radiograph			
Radius only	4.4°	1.0°	3.4° (0.9° to 5.9°)
Both bones	5.0°	2.5°	2.5° (0.3° to 4.7°)
Mean postreduction ulnar angulation on posteroanterior radiograph			
Radius only	NA	NA	NA
Both bones	5.8°	4.4°	1.4° (–2.0° to 4.7°)
Mean postreduction ulnar angulation on lateral radiograph			
Radius only	NA	NA	NA
Both bones	5.8°	1.5°	4.2° (1.8° to 6.6°)

*NA = not applicable.

While the majority of fractures were reduced and immobilized in a cast in the operating room, fifteen (45%) of the thirty-three isolated radial fractures and thirteen (19%) of the sixty-nine combined radial and ulnar fractures were treated in the emergency department; the difference in proportions was significant (chi-square test, $p = 0.005$). No difference was seen in fracture angulation between the children who had reduction in the emergency department and those who had reduction in the operating room. However, fractures reduced in the operating room had slightly less postreduction residual angulation on the lateral radiograph than did those treated in the emergency department (Table V). The difference was likely due to the fact that fluoroscopy was available in the operating room but not in the emergency department.

The cast groups did not differ clinically with respect to the initial fracture angulation, postreduction fracture angulation, and fracture angulation at the time of cast removal (Table VI). In almost all cases, the 95% confidence interval for the difference in angulation between the cast types included zero. If it did not, the extreme limit of the confidence interval was 5°, the

TABLE VI Initial Fracture Alignment, Postreduction Fracture Alignment, and Fracture Alignment at Time of Cast Removal According to Cast Group*

	Above-the-Elbow Cast	Below-the-Elbow Cast	Difference (95% Confidence Interval)
Mean radial angulation on posteroanterior radiograph			
Initial	–6.8°	–5.3°	–1.5° (–6.8 to 3.7)
Postreduction	–1.2°	–0.3°	–0.9° (–1.9 to 0.1)
Cast removal	–3.8°	–0.7°	–3.1° (–5.4 to –0.8)
Mean radial angulation on lateral radiograph			
Initial	13.6°	16.8°	–3.2° (–10.2 to 4.1)
Postreduction	0.8°	1.3°	–0.5° (–2.3 to 1.4)
Cast removal	1.4°	1.0°	0.4° (–3.9 to 4.7)
Mean ulnar angulation on posteroanterior radiograph			
Initial	–8.8°	–8.8°	0.0° (–8.2 to 8.1)
Postreduction	–4.6°	–2.2°	–2.4° (–4 to 0.7)
Cast removal	–1.7°	0.8°	–2.5° (–5.6 to 0.7)
Mean ulnar angulation on lateral radiograph			
Initial	13.7°	18.6°	–4.9° (–13.4 to 3.5)
Postreduction	1.3°	0.4°	0.8° (–1.6 to 3.2)
Cast removal	–0.6°	–1.0°	0.4° (–3.0 to 3.8)

*The dorsal angulation (apex volar) or ulnar angulation (apex radial) was recorded as positive, while volar angulation (apex dorsal) or radial angulation (apex ulnar) was recorded as negative.

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TABLE VII Mean Fracture Reangulation During Immobilization in Cast According to Cast Group for Each Fracture Type*

	Above-the-Elbow Cast	Below-the-Elbow Cast	Difference (95% Confidence Interval)
Mean radial reangulation on posteroanterior radiograph			
All	3.8°	2.1°	1.7° (0 to 3.5)
Radius only	1.0°	1.5°	–0.5° (–2.5 to 1.4)
Both bones	4.7°	2.4°	2.3° (0 to 4.6)
Mean radial reangulation on lateral radiograph			
All	5.1°	5.6°	–0.5° (–3.1 to 2.2)
Radius only	5.3°	5.1°	0.2° (–5.2 to 5.8)
Both bones	5.1°	5.9°	–0.8° (–4.0 to 2.3)
Mean ulnar reangulation on posteroanterior radiograph			
All	5.0°	5.2°	–0.2° (–3.1 to 2.6)
Radius only	NA	NA	NA
Both bones	5.0°	5.2°	–0.2° (–3.1 to 2.6)
Mean ulnar reangulation on lateral radiograph			
All	2.9°	4.4°	–1.5° (–3.8 to 0.7)
Radius only	NA	NA	NA
Both bones	2.9°	4.4°	–1.5° (–3.8 to 0.7)

*NA = not applicable.

maximum clinically acceptable difference set a priori. Similarly, fracture reangulation during cast immobilization did not differ clinically between the cast types. Similar results were seen when the data were analyzed according to fracture type (Table VII).

While all 102 children were followed sufficiently to determine whether remanipulation was actually performed, adequate follow-up radiographs for assessing the need for remanipulation were available for 100 children. With use of the criteria for remanipulation established at the start of the trial, twenty-three (42%) of the fifty-five children in the above-the-elbow cast group met the criteria for remanipulation compared with fourteen (31%) of the forty-five children in the below-the-elbow cast group. While this reduction of 11% did not reach significance (chi-square test, $p = 0.27$), the 95% upper confidence limit of this difference was an increase of 5%, which is consistent with clinical equivalency between the two cast types (Table VIII).

Stratification by fracture type revealed that combined radial and ulnar fractures were more likely to meet the criteria for remanipulation than were fractures of the radius only (chi-square test, $p < 0.0001$). All patients who met the criteria for remanipulation did so because of fracture reangulation; no children met the criteria for remanipulation solely because of loss of fracture apposition. Whether analyzed together or stratified by type, fractures treated in below-the-elbow casts met the criteria for remanipulation less frequently than did those treated in above-the-elbow casts; however, the differences were not significant, as the 95% confidence intervals around the differences all contained zero (Table VIII).

Interestingly, of the thirty-seven children who met the requirements for remanipulation, only four (three in the above-the-elbow cast group and one in the below-the-elbow cast group) actually underwent remanipulation. This difference between cast groups with respect to remanipulations that were actually performed was not significant (Fisher exact test, $p = 0.38$). The four children who underwent remanipulation all had combined radial and ulnar fractures, received an above-the-elbow cast after remanipulation, and had satisfactory mainte-

TABLE VIII Proportion of Fractures That *Required* Remanipulation According to Criteria

	Above-the-Elbow Cast*	Below-the-Elbow Cast*	Difference (95% Upper Confidence Limit; 95% Confidence Interval)
All fracture types	42% (23/55)	31% (14/45)	–11% (+5%; –28% to +8%)
Radial fracture only	14% (2/14)	5% (1/19)	–9% (+9%; –35% to +13%)
Radial and ulnar fracture	51% (21/41)	50% (13/26)	–1% (+19%; –24% to +22%)

*The values are given as the percentage of fractures that met the criteria, with the number that met the criteria/total number in the group in parentheses.

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TABLE IX Complications Related to Cast*

Complication	Above-the-Elbow Cast *(No. of Patients)*	Below-the-Elbow Cast *(No. of Patients)*
Reinforced for breakdown	11	4
Changed for loosening or breakdown	4	10
Split for swelling	3	3
Converted to below-the-elbow cast at three weeks	5	NA
Converted to above-the-elbow cast	NA	1
Total with complication/total in group	23/56	18/46

*NA = not applicable.

nance of the repeat reduction. Children who met the criteria for remanipulation did so before three weeks, indicating that fracture position is stable between the third and sixth week.

The mean cast index in the above-the-elbow group (0.72) was not different from that in the below-the-elbow group (0.70) (t test, p = 0.55). The mean cast index of the thirty-seven children who met the criteria for remanipulation (0.73) was also not different from that of the sixty-three children who did not meet the requirements for remanipulation (0.70) (t test, p = 0.15). Both logistic regression analysis and receiver operating characteristic curve analysis failed to demonstrate the importance of having a cast index of 0.7.

Stepwise logistic regression analysis was used to examine the effect of cast type, fracture type, initial fracture angulation, location of fracture reduction, postreduction fracture angulation, gender, age, and cast index on meeting the criteria for remanipulation. At the significance level of 0.05, the model indicated that children with fractures of both the radius and ulna (p = 0.01) and those with residual angulation after reduction (p = 0.0001) were at the highest risk of meeting the criteria for remanipulation.

Complications related to the cast were recorded for each group (Table IX). Twenty-three (41%) of the fifty-six children with an above-the-elbow cast had complications, while eighteen (39%) of the forty-six children who had a below-the-elbow cast had complications; the difference was not significant (chi-square test, p = 0.84). At their request, five children had an above-the-elbow cast converted to a below-the-elbow cast at the three-week follow-up visit for reasons of comfort. A below-the-elbow cast fell off the arm of a child with Down syndrome, and the cast was converted to an above-the-elbow cast. No child had a compartment syndrome develop despite the acute application of a circumferential cast.

No formal functional assessment was undertaken. Further investigations incorporating long-term follow-up to assess strength and range of motion, as well as the amount of remodeling, is planned.

Discussion

When the two cast types were compared with respect to the amount of reangulation of the fracture while in the cast, the below-the-elbow casts were found to maintain the alignment of distal forearm fractures in children as well as above-the-elbow casts did. When the cast groups were compared with respect to the percentage of fractures that met the criteria for remanipulation, the below-the-elbow cast appeared to offer an absolute reduction of 11% compared with the above-the-elbow cast. While this improvement does not reach significance, the 95% upper confidence limit equal to an increase of 5% is consistent with at least clinical equivalency of the cast types. Because of the very low number of fractures that were actually remanipulated, the study had inadequate statistical power to compare the cast types by this measure.

Thus, contrary to the fracture-care principle of immobilizing the joint proximal to and distal to a fracture, it appears that the immobilization of the elbow obtained by extending a below-the-elbow cast into an above-the-elbow cast offers no benefit in maintaining the alignment of these fractures. This may be because the elbow joint is quite distant from the fracture, and the majority of immobilization is secured over the length of the forearm.

Fractures reduced in the operating room had slightly less postreduction residual angulation on the lateral radiograph compared with the fractures treated in the emergency department. This difference is likely due to the fact that fluoroscopy was available in the operating room and not in our emergency department. While residual angulation after reduction is associated with loss of reduction during cast immobilization, the slight improvement in alignment seen in the fractures reduced in the operating room does not seem to be clinically important, as logistic regression analysis did not confirm the location of the reduction as an independent risk factor for loss of reduction.

Our data support the importance of weekly radiographic examinations for each of the first three weeks. All of the fractures that lost position and met the criteria for remanipulation did so before three weeks. This is consistent with guidelines that have been proposed elsewhere[18,19].

In a retrospective study of more than 700 patients, Chess et al. found the cast index to be useful[5]. However, like other authors, we were unable to demonstrate that the cast in-

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dex of 0.7 was clinically important[20]. This may be due to our smaller sample size.

Logistic regression analysis confirmed that children with fractures of both bones and those with residual angulation after reduction were at highest risk of losing reduction. This finding probably recognizes the most unstable fracture pattern and is consistent with the observations reported by others[6].

An unexpected finding was the reluctance of the participating surgeons to remanipulate fractures that met the criteria for remanipulation—criteria that the same surgeons had participated in setting. In the above-the-elbow cast group, twenty-three (42%) of the fifty-five fractures with adequate radiographs met the criteria, yet only three (5%) of the fifty-six fractures in the group were actually remanipulated. In the below-the-elbow cast group, fourteen (31%) of the forty-five fractures with adequate radiographs met the criteria, yet only one (2%) of the forty-six fractures in the group was actually remanipulated. This stark difference between "armchair guidelines" set a priori and the reality of a busy fracture clinic has been reported elsewhere[21] and may be explained by a generally held optimism that forearm fractures in children have the ability to remodel with growth leading to a satisfactory outcome[13,22,23].

The weaknesses and limitations in this study are recognized. There was an unequal distribution of patients in the two groups, with fifty-six patients in the above-the-elbow group and forty-six in the below-the-elbow group. This was because we did not use a block randomization process and, initially, some children with nondisplaced fractures were erroneously enrolled. These children were excluded from the analysis presented here.

The above-the-elbow cast group contained a higher percentage of combined radial and ulnar fractures (75%) compared with the below-the-elbow cast group (59%). This fracture type is more unstable than isolated radial fractures, which could be the reason for the slightly higher remanipulation rate in the above-the-elbow cast group. However, even after stratification by fracture type, no difference could be detected between the cast types when they were compared with respect to the amount of fracture reangulation, remanipulation rate by criteria, and actual remanipulation rate. These findings were confirmed with the logistic regression analysis.

It was not possible to blind the patient or surgeon to the type of cast; however, the casts were applied in a standardized fashion. Efforts were made to blind the radiographic measurements; nonetheless, this was not always possible, as the type of cast was sometimes identifiable on the radiograph.

It is difficult to compare the results of the present study with those found in the literature because the criteria for remanipulation and the type of casts used in other studies have not been explicitly stated. There seems to be a large variation in the residual deformity that various authors have accepted before resorting to remanipulation, with reported rates of remanipulation ranging from 2.5%[5] to 63%[17]. Our actual remanipulation rate of 4% (four of 102 fractures) compares favorably. This low rate of remanipulation confirms that closed management of these types of fractures remains the standard of care, as has been suggested by other investigators[24].

Below-the-elbow casts perform as well as above-the-elbow casts for maintaining the reduction of fractures in the distal third of the forearm in children, and the complication rates are similar. Factors that are associated with a higher risk for loss of reduction include combined radial and ulnar fractures and residual angulation of the fracture after reduction. ■

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