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Comparison of U-Slab and Short Arm Casts for Fractures in the Distal Third of the Radius

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Abstract

Background: **Various methods of cast immobilization have been recommended for the treatment of distal radius fractures. This study was undertaken to determine whether U-slabs are as effective as short arm casts in immobilizing these types of fractures and to identify patient and treatment considerations related to loss of reduction.**

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

Results: **A total of 228 patients were enrolled in the study and were allocated to 2 groups: short arm cast group (116 patients) and U-slab group (112 patients). The 2 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 short arm cast group, 48 (42%) of 114 patients with adequate radiographs met the criteria for remanipulation compared with 34 (31%) of 110 patients with adequate radiographs in the U-slab group ($p = 0.08$); only 20 of these 82 patients actually underwent remanipulation.**

Conclusions: **U-slab as well as short arm cast perform well in maintaining reduction of fractures in the distal third of the radius; complication rates are lesser, and they interfere less with daily activities. Factors 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.**

Introduction

Distal radius fracture is a very common injury. Application of plaster bandages to support fracture healing remains the single most common method of treatment.[1,2] Although cast does provide support, it will not completely maintain a reduction,[3,4] i.e. a satisfactory reduction is more likely to reangulate and/or displace when using only cast support. The benefits of U-slab include easier application, greater comfort, better hand function for daily activities, better stability of the fracture and lessening the risk of redisplacement with the need for remanipulation. Charnley[5] advocated "radial slabs" for distal radial fractures. To our knowledge, no randomized controlled trail has compared the results of U-slabs and short arm casts for the management of fracture in the distal third of the

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radius. This study was undertaken to determine whether U-slabs are as effective as short arm casts in immobilizing these types of fractures and to identify patient and treatment considerations related to loss of reduction.

MATERIALS AND METHODS

We designed a blinded, randomized, controlled trial to compare U-slabs and short arm casts for the management of fractures in the distal third of the radius after closed reduction. All displaced fractures of the distal third of the radius seen at the emergency department of the Sawangdandin Crown Prince Hospital between July 2006 and December 2007 were included in the study unless they met any of the exclusion criteria. The exclusion criteria included an open fracture, pathologic fracture, refracture through preexisting fracture lines and fracture with plan for surgery. Randomization was accomplished with the use of a sealed envelope. After closed reduction under hematoma block on fingertraps, a cast was applied with 3-point molding. Final postreduction radiographs were taken once the cast dries out. Patients were observed for complications and then discharged with a sling.

The criteria of acceptable postreduction alignment included 5-degree of dorsal tilt or shortening less than 2 mm. Follow-up visit was arranged every week for 3 weeks. U-slaps were then changed to short arm cast in 2-3 weeks and the patients returned for removal of the cast 6 weeks after the injury, depending on the radiographic and clinical evidence of healing. The criteria to determine whether remanipulation is required for loss of reduction included 10 degree of dorsal tilt or shortening less than 5 mm. Mean follow-up was 10 weeks.

The cast index was calculated by dividing the inner sagittal width of the cast by the inner coronal width of the cast on the initial postreduction radiagraph. The ideal cast index is 0.7.

The range of motion of the wrists and elbows on the injured and contralateral sides was measured with a goniometer and recorded when the cast was first removed for a baseline measurement. The patients were then instructed to perform range-of-motion exercises at home. Physical therapy was prescribed for patient who did not have a normal range of motion at this follow-up visit. Patients who had a normal range of motion at 8- or 10-week follow-up appointment were discharged from additional follow-up visit.

A questionnaire relating to the impact of the cast on daily activities was completed at the patient's final follow-up visit.

Statistical methods

Age, prereduction and postreduction fracture alignment, loss of reduction during treatment, and the cast index were accomplished with the use of 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 the use of Chi-square test or Fisher exact test if cell counts were less than 5. A p value of <0.05 was considered to be significant.

RESULTS

From July 2006 to December 2007, a total of 253 patients were enrolled in the study. Twenty five patients were excluded for one or more of several reasons: the fracture did not require reduction (18 patients); the wrong type of cast was applied after randomization (4 patients), having a Galeazzi fracture (3 patients). One hundred and sixteen patients were allocated to short arm cast group, and 112 to U-slab group. The 2 groups were not different in term of age (chi-square test, $p = 0.68$) or gender (chi-square test, $p = 0.39$) (Table 1). The short arm cast group contained larger proportion of patients with combined radial and ulnar fractures (Table 2). However, this difference did not reach significance (chi-square test, $p = 0.28$). 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 3).

In most cases, the 95% confidence interval for the difference in angulation between the cast types included zero.

Similarly, fracture reangulation during cast immobilization did not differ clinically between the cast types (Table 4).

While all 228 patients were followed sufficiently to determine whether remanipulation was actually performed, adequate follow-up radiographs to assess the need of remanipulation were available in 224

Table 1 Age distribution by cast group

	Short arm cast (N = 116)	U-slab (N = 112)	Both groups (N = 228)
Mean age (yr)	65.8	66.5	66.1
No. (%) of man	50 (43)	42 (37)	92 (40)
No. (%) of woman	66 (57)	70 (63)	136 (60)

Table 2 Distribution of fracture type by cast group

	Short arm cast (N = 116)	U-slab (N = 112)	Both groups (N = 228)
No. (%) of radial fracture only	92 (79)	95 (85)	187 (82)
No. (%) of combined radial and ulnar fractures	24 (21)	17 (15)	41 (18)

Table 3 Initial fracture angulation, postreduction fracture angulation, and fracture angulation at the time of cast removal of the 2 groups

	Short arm cast	U-slab	Difference (95% confidence interval)
Initial	13.6°	16.8°	-3.2° (-10 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)

Table 4 Mean fracture reangulation during immobolization in cast according to cast group for each fracture type

	Short arm cast	U-slab	Difference (95% confidence interval)
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)

Table 5 Proportion of fractures that required ramanipulation according to the criteria

	Short arm cast	U-slab	Difference (95% upper confidence limit; 95% confidence interval)
All fracture types	42% (48/114)	31% (34/110)	-11% (+5%;-28% to +8%)
Radial fracture only	40% (36/91)	28% (26/94)	-12% (+9%;-35% to +13%)
Radial and ulnar fracture	52% (12/23)	50% (8/16)	-2% (+19%;-24% to +22%)

patients. With the use of the criteria for remanipulation established at the start of the trial 48 (42%) of 114 patients in short arm cast group met the criteria for remanipulation compared with 34 patients (31%) of 110 patients in U-slab group. However, this reduction of 11% was not significant (chi-square, p = 0.08) (Table 5).

Interestingly, of the 82 patients who met the requirements for remanipulation, only 20 (14 in short arm cast group and 6 in U-slab group) actually underwent remanipulation. This difference between cast groups with respect to remanipulation that was actually performed was not significant (chi-square test, p = 0.23). The patients had satisfactory maintenance of the repeated reduction.

The mean cast index in the short arm cast group (0.72) was not different from that in the U-slab group (0.70) (t test, p = 0.55). The mean cast index of 82 patients who met the criteria for remanipulation (0.79) was different from that of 142 patients who did not meet the requirements for remanipulation (0.71) (t test, p = 0.045).

Complications related to the cast were recorded for each group (Table 6). Fifty four (46%) of 116 patients with short arm cast had complications, while only 31 (28%) of 112 patients with U-slab had complications; this difference was significant (Chi-square test, p <0.003). At their requests, 11 patients had short arm cast converted to U-slab at the follow-up visit for reasons of comfort.

When U-slab was changed to short arm cast in 2-3 weeks, the range of elbow motion was significantly less in the group treated with U-slab, but there was a minimal (if any statistically significant) difference in the final range of motion between the 2 groups. At the time of U-slab change, the difference in the arcs of elbow motion between the injured and contralateral side was 1.1° ± 3.6° in short arm cast group and 29.8° ± 15.9° in U-slab group (p <0.001). The mean final difference in the arcs of elbow motion between the injured and contralateral side was 0.4° ± 1.8° in the short arm cast and 2.1° ± 5.9° in U-slab group, no significant difference between cast-type groups (p = 0.162). The differences in the arcs of wrist motion between the injured and contralateral side at the time of cast removal averaged 47.1° ± 19.3° in short arm cast and 53.6° ± 22.6° in U-slab group, respectively, no significant difference between the cast-type groups (p = 0.193). The final differences between the injured and normal sides with regard to the arc of wrist motion averaged 6.3° ± 8.6° in short arm cast group and 10.7° ± 14.8° in U-slab group, respectively (p = 0.142). The results obtained by questionnaire are shown in Table 7.

Patients treated with short arm cast had significantly higher percentage of requiring help at meal, being unstable to write, and having difficulty with daily activities. When asked to subjectively rate the effect of the cast on daily activities, 86% of patients treated with U-slab either had no difficulty or had some difficulties that did not require assistance. In comparison, 28% of the patients treated with short arm cast found their daily activities to be difficult enough to require assistance.

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 patients with fracture of both radius and ulnar (p = 0.01) and those with residual angulation after

Table 6 Complications related to cast

Complications	Short arm cast	U-slab
Cast reinforced for breakdown	22	14
Cast change for loosening	8	15
Cast split for swelling	13	2
Converted to slab	11	0
Total	**54/116**	**31/112**

Table 7 Responses to questionnaire on daily activities, according to cast type

	U-slab (N = 110)	Short arm cast (N = 114)	P Value
Missing working days	0.56 ± 0.89	1.6 ± 1.3	0.001
Need help for dressing	33 (30%)	38 (33%)	0.592
Being able to shower	41 (37%)	44 (38%)	0.838
Need help at toilet	22 (20%)	28 (24%)	0.412
Need help at meals	12 (11%)	25 (22%)	0.026
Unable to write	23 (21%)	38 (33%)	0.037
Daily activity			0.028
No difficulties	52 (47%)	43 (38%)	
With difficulties but no help required	43 (39%)	39 (34%)	
With difficulties, help required	15 (14%)	32 (28%)	

reduction (p = 0.0001) were at the highest risk of meeting the criteria for remanipulation.

Discussion

The patients in U-slab and short arm cast groups were similar with respect to age, gender, fracture type, and initial fracture characteristics, which indicated that the randomization had been effective. The weaknesses and limitations in this study are recognized. There was an unequal distribution of patients in the 2 groups, with 116 patients in the short arm cast group and 112 in the U-slab group. This was because a block randomization process was not used and initially some patients with nondisplaced fractures were erroneously enrolled. These patients were excluded from the analysis presented here. 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. In a retrospective study of more than 700 patients, Chess et al. found the cast index to be useful.[6] However, like other authors[7], this study also demonstrated that the cast index of 0.7 was clinically important.

Contrary to the fracture-care principles of immobilizing the joint proximal and distal to a fracture, it appears that immobilization of the elbow by extending a short arm cast into a U-slab 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.

Fracture that lost reduction did so based on the fracture pattern; loss of reduction did not relate to the specific splint constructed.

This study supports the importance of weekly radiographic examination during the first 3 weeks. All fractures that lost their positions and met the criteria for remanipulation did so before 3 weeks. This is in consistence with guidelines that have been proposed elsewhere.[8,9] Logistic regression analysis confirmed that patients with fracture 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 in consistence with the observations reported by others.[10] After obtaining an acceptable initial closed reduction, patients aged over 58 years were found to be at 50% risk of secondary displacement.[11]

U-slabs as well as short arm casts perform well in maintaining reduction of fractures in the distal third of the radius, the complication rates are lesser, and they interfere less with daily activities. 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.

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