One Brace: One Visit: Treatment of Pediatric Distal Radius Buckle Fractures With a Removable Wrist Brace and No Follow-up Visit

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Background: Previous studies have showed the efficacy of removable brace treatment for distal radius buckle fractures in children, whereas others have independently suggested that these injuries do not require additional radiographic imaging. However, no study has sought to collectively determine whether treating pediatric distal radius buckle fractures with a removable brace and no follow-up visit or imaging after the initial visit is a safe and satisfactory protocol.

Methods: In total, 42 consecutive patients with a distal forearm buckle fracture seen by a single fellowship trained pediatric orthopaedic surgeon were eligible to participate. Two patients refused participation, yielding 40 patients treated with a standard protocol of immobilization with a removable wrist brace for a prescribed period of time with no additional imaging or clinical follow-up. Two staggered telephone surveys were then conducted. The first survey was conducted within 1 week of the designated brace-removal date to determine the exact date the brace was discontinued. The second survey was conducted 5 to10 months postinjury to determine patient outcomes and parent satisfaction.

Results: In total, 100% of patients were reached for the initial survey and 90% (36/40) of patients were reached for the secondary survey. There were no complications, including refracture or residual pain, following treatment. In total, 100% of parents felt their child had returned to full and normal function and all said they would choose to have the same treatment again. In total, 67% of parents would have had to take time off from work and 77% of children would have missed school if they had hypothetically been required to attend a follow-up appointment.

Conclusion: Treatment of pediatric distal forearm buckle fractures with a removable wrist brace and no follow-up visit or radiographs results in both excellent patient outcomes and parental satisfaction.

Level of Evidence: Level IV—case series.

Key Words: pediatric distal radius buckle fracture, removable wrist brace, no follow-up visit, no follow-up x-ray, parental satisfaction

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Buckle fractures of the distal radius are a very common injury in the pediatric population, with 1 study of a pediatric orthopaedic practice showing that their surgeons each saw an average of 265 such injuries per year.[1] These injuries, which fail by compression at the transitional zone between metaphyseal and diaphyseal bone,[2] are inherently stable with minimal potential for displacement, yet management recommendations vary considerably.

Traditionally, distal radius buckle fractures have been treated with casting and follow-up for cast removal[3] and possible repeat imaging.[4] Recently, several randomized prospective studies have showed that immobilization with a splint, brace, and even a soft bandage result in outcomes similar to cast treatment.[1,5–7]

Furthermore, another study has shown that parental satisfaction is improved when a short-arm backslab is used and removed at home at a time specified by the treating physician.[8] Finally, 1 study has suggested that clinical and radiographic follow-up of buckle fractures may not be necessary.[1]

Our study is the first to examine these 3 components, previously studied independently of one another, as a single comprehensive treatment plan. The aim of our study was to evaluate the clinical effectiveness, parental satisfaction, and economic benefits of treating pediatric distal radius buckle fractures with a removable wrist brace without clinical or radiographic follow-up.

METHODS

Initial Data Collection

Institutional Review Board (IRB) approval was obtained for this study. Data were prospectively collected from May through October 2012 on consecutive patients seen by a fellowship trained pediatric orthopaedic surgeon

in solo private practice. Inclusion criteria included patients above 1 year and below 19 years of age with a diagnosis of a pure compression buckle fracture of the distal radius and/or distal ulna. Exclusion criteria included fractures with displacement (translation or angulation), evidence of cortical tension failure, or an ipsilateral upper extremity injury.

Demographic and clinical data obtained included date of injury, age, injured side, fractured bone(s), date of service, and mechanism of injury. All patients were seen in a non–hospital-based outpatient office setting and were treated with a removable wrist brace (Titan or Tiny Titan wrist brace; Hely & Weber, Santa Paula, CA) with instruction for it to be worn at all times, allowing it to be removed only for bathing and hand hygiene purposes.

Parents were instructed to have the child wear the wrist brace for a prescribed amount of time (typically for 3 to 4 wk) followed by a period of restricted activity after its removal (typically for 2 to 4 wk). Both factors were determined at the senior author's discretion.

No follow-up office visit or imaging was scheduled. A thorough discussion was held regarding the special nature of buckle fractures using an analogy of a crushed aluminum can. It was explained that this injury is stable and does not require rigid cast immobilization. Mention was made regarding the small risk for future growth abnormality as a result of this injury. A custom handout detailing all of the above, including the brace-removal date and the postbracing activity restrictions, was also given (Supplemental Digital Content 1, http://links.lww.com/BPO/A152). Parents were encouraged to contact the office with any questions or concerns and were specifically advised that they could bring their child back for reevaluation for any reason at any time.

Retrospective Review

A retrospective review of the subjects' medical records was performed at the completion of the study time period. Patients who did not complete the treatment protocol were excluded from the final analysis.

Telephone Surveys

As there was no follow-up visit, outcomes were determined indirectly by 2 separate telephone surveys for which no previous notice was given.

Phase I was carried out within 7 days after the end date of the prescribed bracing time to minimize recall bias. The parents were called to confirm the exact date the brace was discontinued and to determine the patient's status at that time.

Phase II was carried out in February 2013. The parents were called to determine the posttreatment status of their child as well as their opinions about the treatment rendered. A maximum of 5 attempts were made for this phase.

Statistical Analyses

Descriptive statistics were calculated for study variables. For categorical variables frequencies and percentages were calculated. The Shapiro-Wilk test for normality of distribution was applied to all continuous variables. Variables that were not normally distributed are reported with median, 25%, and 75% quartile values. Normally distributed variables are reported with means and SD values. Wilcoxian-signed rank sum tests were performed to assess the differences in time the brace was prescribed and the time it was worn.

RESULTS

In total, 43 wrists in 42 patients were seen over 6 months with the diagnosis of a nondisplaced distal radius buckle fracture. These included 40 isolated distal radius buckle fractures and 3 combined distal radius and ulna buckle fractures. One patient was seen for a second buckle fracture of their contralateral distal radius during the study period and each injury was included as a separate incident in the analysis. Patient and injury demographics are shown in Table 1. Two patients (5%) were excluded from the study. One patient's treatment was converted to a short-arm cast at the request of their mother and the second child was later seen by a different provider. This left 40 patients (with 41 fractures) that comprised the cohort studied. For the telephone surveys, 100% of the patients (40/40) were contacted for phase I and 90% (36/40) were contacted for phase II.

The median time of prescribed brace wear was 21 days [interquartile range (IQR), 21 to 21 d]. The median time that patients' actually wore the brace was 21 days (IQR, 20 to 24.5 d). The difference between time prescribed and actual time worn was not statistically significantly different ($P = 0.30$).

Results of Patient Outcomes Survey

There were no complications, including refracture, noted in the 5 to 10-month period between the cessation of treatment and the phase II telephone survey. One child sustained another buckle fracture of their contralateral distal radius 3.5 months after completion of treatment for their first injury. None of the patients had any current complaints, including residual pain, in their injured wrist. In total, 94% (34/36) of the parents reported that the child wore the brace at all times (except for hand hygiene/bathing) for the entire prescribed duration. The majority of patients (31/36, 86%) were able to use their hand normally while wearing the brace. No patients required narcotic medication and only 4 children (11%) used

TABLE 1. Patient and Injury Demographics

Variables (n = 40)	Mean	SD	Range
Age (y)	8.65	3.38	1-15
Male	23		—
Female	17		—
Variables (n = 41)	N (%)		
Isolated distal radius buckle fracture	38 (93)		
Combined distal radius and ulna buckle fracture	3 (7)		
Right wrist injury	11 (27)		
Left wrist injury	30 (73)		

TABLE 2. Patient Outcome Results (n = 36)

Question Asked	N (%) Yes	N (%) No
Was the brace worn at all times (except to shower/bathe)?	34 (94)	2 (6)
Was your child able to use their hand normally while wearing the brace?	31 (86)	5 (14)
Did your child require pain medication?	4 (11)	32 (89)
Did your child complain of pain after the brace was removed?	2 (6)	34 (94)
Has your child required further follow-up with a physician regarding this injury?	4 (11)*	32 (89)
Has your child returned to full and normal function after the injury?	36 (100)	0
Has your child had a reinjury of their wrist since they were last seen?	0	36 (100)
Do you feel your child has any residual consequences of their injury?	0	36 (100)

*Parents mistakenly believed that they followed-up with the principal investigator though no such visit occurred.

over-the-counter ibuprofen or acetaminophen for their discomfort. The parents reported that it took a median of 7 days (IQR, 0 to 21 d) after discontinuation of the brace for their child to return to his/her normal state of function. Immediately after discontinuation of the brace 1 child complained of pain and 1 child reported "instability" but not pain and the symptoms in both children resolved by the time of the phase II survey (Table 2).

Results of Parent Satisfaction Survey

Ninety percent (36/40) of parents were reached for phase II of our telephone survey and 100% of them felt that their child received satisfactory medical care and indicated that they would choose the same treatment option again. No parent felt their child had any residual problems from their injury. In total, 100% of parents also reported feeling comfortable with removing the brace at home at the designated time. Only 6% (2/36) of parents would have wanted a follow-up office-visit and 14% (5/36) would have wanted the option of additional imaging after treatment was performed. If, hypothetically, the patients were scheduled to return for an additional follow-up visit, 67% (24/36) of the parents would have had to take time off from work and 77% (27/35) of the children would have had missed school to do so. One child, who was not in school, was excluded from this part of the assessment (Table 3).

TABLE 3. Parent Satisfaction Results (n = 36)

Question Asked	N (%) Yes	N (%) No
Do you believe your child received satisfactory medical care for this injury?	36 (100)	0
Were you comfortable with not having an in-office follow-up visit after the initial visit?	34 (94)	2 (6)
If your child suffered the same injury, would you choose the same treatment?	36 (100)	0
Did you feel comfortable removing the brace at the designated time?	36 (100)	0
Were you comfortable with not having x-rays done after you removed the brace?	31 (86)	5 (14)
If you were asked to bring your child back for a follow-up visit, would you have had to miss work?	24 (67)	12 (33)
If you were asked to bring your child back for a follow-up visit, would your child have had to miss school? (n = 35*)	27 (77)	8 (23)

*One child was not of school age and was therefore excluded from this question.

Interestingly, 4 parents indicated that they returned to the senior author for additional follow-up of their child's injury. A review of our medical records confirmed that these patients were not seen back in our clinic for their injury, thus illustrating the limitation of recall bias.

DISCUSSION

The current standard of care for distal radius buckle fractures is 2 to 4 weeks of immobilization in a short-arm or long-arm cast[9,10] with return to require for cast removal, clinical assessment, and often for follow-up radiographic imaging.[4] Our study is the first to our knowledge to implement a clinical protocol that utilized a removable brace without additional follow-up visits or imaging.

Safety of Treatment With a Removable Brace

Several randomized trials have examined the safety and efficacy of alternatives to casting such as the use of Futura-type wrist braces,[1] soft bandages,[7] soft casts,[11] or removable splints.[3,5,6] These studies have shown that, compared with casting, removable immobilization methods have equal or superior clinical outcomes. Further, in a 2010 Cochrane review, Abraham et al[12] reported that the available evidence supports the use of a removable splint for the treatment of distal radius buckle fractures. Although the nature of our protocol does not allow the safety of our approach to be assessed directly, we feel that similarity to these studies allows for a reasonable extrapolation in this regard.

Clinical Follow-up

After splinting/bracing was established as safe and effective, researchers began to question the need for follow-up visits for reevaluation, splint/brace removal, and repeat imaging. On the basis of their study, comparing a plaster-of-Paris cast versus a wrist brace, Davidson et al[1] suggested that additional follow-up after the fracture clinic visit was not necessary.

A United Kingdom study in 2013 comparing rigid versus soft cast immobilization[11] showed results similar to ours in terms of positive parental satisfaction, citing long wait times and difficulty with missing work as primary difficulties associated with a follow-up visit. In their study, however, complications in the soft casting group resulted in unscheduled cast changes for 6.8% of patients due to cast deterioration, rubbing at the thumb or ulna, denting of the cast, and paresthesias. They also excluded patients with a skin condition, including lacerations, abrasions, psoriasis, or eczema—theses exclusions were not necessary with the brace utilized in our study. Finally, they reported

that 2.6% of parents had difficulty removing the soft cast material at home. In our study there were no return visits for problems with the brace and no parents reported difficulty with its removal at home.

A best evidence topic report by May and Grayson[13] concluded "a child diagnosed with a buckle fracture of the wrist can be safely discharged from the emergency department in a removable splint with no follow-up from the orthopaedic department." We disagree with this approach and believe that an accurate diagnosis is requisite to obtaining a good result with our approach and further feel an experienced orthopaedic surgeon is best qualified to make this determination. Plint[6] showed that unstable distal radius fractures were misidentified as stable buckle fractures by emergency room physicians 14% of the time.

Hamilton et al[14] editorial to the review by May and Grayson[13] also pointed out that the lack of follow-up with an orthopaedic surgeon eliminates an opportunity for the patient and parents to ask more detailed questions, such as when they may return to sports or other activities. A comprehensive discussion with the treating orthopaedist addresses these concerns in an efficient manner.

Radiographic Follow-up

Special attention must be given to the pediatric patient undergoing radiographic imaging to minimize lifetime radiation exposure. Obtaining follow-up radiographs strictly because of protocol or to document healing lacks merit and we are not aware of any published study demonstrating a meaningful loss of alignment during treatment of a true distal radius buckle fracture. Routine imaging of this injury thus exposes children to unnecessary radiation and increases cost without improving outcomes.

When Davidson et al[1] surveyed members of the British Society for Children's Orthopaedic Surgery, they found that <17% routinely took posttreatment radiographs, an indication that this practice is already changing.

Financial and Value Impacts

The indirect costs associated with attending a clinic appointment are more difficult to assess and quantify. Although the difference was not significant, Symons and colleagues found that patients treated with a short-arm backslab removed in the clinic, versus those removed at home, had more problems related to the visit, including difficulty getting time off from work, issues with transportation to the hospital, and inadequate parking. One parent whose child had been randomized to backslab removal in the clinic instead removed it at home to avoid missing work and losing income. Anecdotally, we have encountered similar complaints and actions by our patients and their families when cast treatment has been used.

Health care reform efforts center primarily on improving outcomes or lowering cost. These concepts are encompassed in the equation "Value = Outcomes/Cost" as proposed by Porter.[15] This study shows outcomes that are comparable with traditional cast treatment while decreasing both direct and indirect financial costs, thus resulting in increased value for the health care system.

Study Strengths and Weaknesses

This study is a consecutive series of patients treated with a simple and consistent protocol by a single fellowship trained pediatric orthopaedic surgeon, thus minimizing the confounding factors of multiple and potentially differing physicians' assessments and treatment approaches seen with other studies. Only 5% (2/42) of eligible patients were excluded and our contact rates of 100% for phase I and 90% for phase II of our phone surveys minimized bias due to inadequate follow-up.

Our study also has several weaknesses. The short time frame resulted in a relatively small sample size and a larger study may have discovered problems not revealed by this effort. As our protocol intentionally lacked a follow-up visit, our telephone survey results served as surrogates for objective outcomes. However, given the known good outcomes of buckle fractures both with a traditional approach and in other studies of removable immobilization with radiographic follow-up, we believe this shortcoming is limited in nature. We also did not specifically define safety in our study and acknowledge that we cannot definitively prove that growth arrest or other long-term complications did not occur. However, we again feel that safety can be reasonably inferred from previous studies with similar protocols. In addition, within the time span of our study, we showed that no refracture, continued pain, or dysfunction occurred and offer these findings as some measure of the efficacy and safety of our approach.

Recall bias is also an inherent risk with delayed surveys. We minimized this by conducting phase I of our telephone survey immediately after treatment was completed but this error did occur in phase II of our telephone survey as 4 parents erroneously believed that they were seen by the senior author for a follow-up visit. Although we cannot exclude the possibility that these patients were seen by another physician, their survey results indicated no long-term complications of our treatment approach. We also chose to survey the parents rather than the patients themselves due to ease of communication (ie, being able to contact a parent at work or home while the child was at school). It is also unrealistic to directly question very young patients, as a standard outcome measure, such as the Activities Score for Kids, is only valid for children 5 to 15 years of age. For our study's youngest patients, whose parents decided when to provide the child with pain medications or noted changes in their function, we believe this is an acceptable alternative.

CONCLUSIONS

Our study is the first to show that treatment of pediatric distal radius buckle fractures with a removable wrist brace and without additional clinical or radiographic follow-up results in nearly universal good patient outcomes and parental satisfaction. For physicians experienced in treating these injuries, this simple approach requires no special training and can be immediately implemented on a wide-scale basis.

It also has several other significant benefits. First, by eliminating unnecessary follow-up office visits, access to

care for other patients in need of specialty care increases without the need for changes in practice scheduling. Second, by avoiding routine follow-up x-rays, radiation exposure for the growing child is decreased. Finally, this approach lowers the out-of-pocket cost for the individual family and the cost of health care for society as a whole. Although not easy to quantify, the indirect costs of missed time from work and school (lost income, job security, transportation issues, etc.) to attend a follow-up visit should not be underestimated in their importance, especially when many families with financial hardships may find these challenges difficult to overcome. We hope this report serves as the inspiration for a large academic center to conduct a more robust study of this topic in a prospective and randomized manner.

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