The Role of Serial Radiographs in the Management of Pediatric Torus Fractures

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Objectives: To assess the utility of radiographs taken immediately after the application of a cast in the management of pediatric torus (or buckle) fractures and to determine the need for serial radiographs taken at follow-up visits.

Design: Retrospective medical record review; survey questionnaire of a panel of experts.

Setting: The pediatric emergency department (PED) and the pediatric orthopedic clinic at an urban, tertiary care hospital.


Main Outcome Measures: The number of patients whose postcast studies was obtained in the PED; number of follow-up visits and studies conducted at the pediatric orthopedic clinic; usual regional practices as extracted from a panel of experts by survey questionnaire.

Results: Of 70 patients, 46 (66%) were evaluated by a single, precast study in the PED, and 24 (34%) were evaluated by both precast and postcast studies in the PED. The time range of the first follow-up study was the first to fifth week after the patient’s injury. The range of the number of follow-up studies for each patient was 0 to 5. Our cohort’s total radiology charges for 70 patients were $27,251. Regional directors of pediatric orthopedic surgery unanimously agreed that postcast studies in the PED are unnecessary. The range of the number of follow-up studies they obtained is 0 to 3 per patient.

Conclusions: Postcast studies of torus fractures are unnecessary. Multiple radiographs taken during follow-up visits, especially early in the healing process, do not change fracture management. Relying on the clinical examination, perhaps combined with a single follow-up study, is a more appropriate regimen for the management of pediatric torus fractures and translates into a cost savings of over $10,000 for our 70 patients.


T he PEDIATRIC torus (or buckle) fracture is a common pediatric fracture, usually occurring in the distal radius. It is caused by the compression of one cortex; the opposite cortex is intact. It is the metaphysis of the bone that most commonly fractures in children, with peak incidence occurring between May and September.1 By definition, these fractures are nondisplaced. The fractures are treated with casts for 3 to 4 weeks and uniformly heal without problems. Although these fractures do not require any reduction during the immediate treatment, some physicians obtain multiple-view radiographs after the application of the short arm cast. Most patients will receive routine orthopedic follow-up, which may include taking additional radiographs. This investigation assesses the utility of serial radiographs and the variability in the number and timing of follow-up visits and studies.

RESULTS

Among patients who visited the PED during the investigation period, we identified 70 who were diagnosed with torus fractures of the radius or ulna. All fractures were at the distal metaphysis. Forty-six boys and 24 girls (mean age, 9.2 years) were identified. Forty-six patients (66%) underwent a single, precast study in the PED. The remaining 24 (34%) underwent both precast and postcast studies in the PED. Radiology reports confirmed no change in bony alignment at any fracture site after application of the cast. All 70 patients were followed up at least once in the orthopedic clinic. All but 5 were fol-
followed up in the orthopedic clinic for at least 4 weeks postinjury. The records of the 65 patients who were followed up for at least 4 weeks documented adequate healing either in the orthopedic record, the radiology report, or both.

Follow-up studies were obtained as early as week 1 (2 days after injury) and as late as week 7. Of these, the distribution among patients of the timing of first follow-up studies is shown in Figure 1. In no case was the cast removed before week 2. Twenty patients’ casts were removed before week 4. The distribution among patients of the number of follow-up studies is shown in Figure 2. Fifty-seven percent of patients were seen for more than 1 follow-up study.

We received a response from all 7 of the directors of the pediatric orthopedic surgery programs in New England. None said that they routinely advise residents to obtain a postcast study after casting a torus fracture in the PED, although one director noted that his academic institution has a standing policy in the PED to obtain postcast studies after every cast application. Another reported that postcast studies are sometimes ordered by the residents. When asked why a patient might undergo a postcast study in the PED, one director noted medico-legal reasons and documentation as the driving force in obtaining such studies. Another director noted that resident education may play a role in conducting a postcast study in the PED by looking at the length, thickness, and extremity position of the casts placed by newer residents on rotation in pediatric orthopedic surgery.

The mean number of follow-up visits the surveyed surgeons schedule for their patients with torus fractures is 2 (range, 1-4 visits). The mean number of follow-up studies they order is 1 (range, 0-3 studies). Those who obtain follow-up studies cite documentation of healing and diagnostic confirmation as reasons, eg, to make sure the fracture was actually a torus and not a greenstick fracture. One respondent used the follow-up study to check for progressive angulation. He also considered obtaining a study at 1 to 2 years after injury in those fractures with a high degree of trauma to check for growth arrest in a missed Salter fracture. Growth arrest would be clinically evident in these patients and not consistent with a torus fracture.

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**METHODS**

One of us (K.S.F.) performed a retrospective review of x-ray logs to identify patients referred to the pediatric orthopedic clinic between February 1995 and February 1997 at Boston Medical Center in Massachusetts, an urban, tertiary care, academic teaching hospital with an accredited training residency program in orthopedic surgery. The pediatric orthopedic clinic primarily serves an urban population. An attending pediatric orthopedic surgeon staffs the clinic and sees every patient along with orthopedic surgical residents. The medical records were retrieved of all patients who had forearm or wrist studies ordered at the pediatric orthopedic clinic. The radiology reports were then reviewed to determine which patients had a torus fracture diagnosis. Radiology reports and orthopedic charts were reviewed together to assure diagnostic agreement.

There were no discrepancies between radiologist and surgeon. Demographic and clinical data extracted included the age and sex of each patient, fracture site, number of studies obtained in the pediatric emergency department (PED), dates of follow-up visits, clinical condition at follow-up, and whether radiographs were obtained at that clinic visit (a follow-up study). There was no clinical pathway in place regarding radiography at the time of this investigation. To compare regional management trends with our own, we sent a survey to the directors of pediatric orthopedic surgery at all 7 other accredited programs for residency training in orthopedic surgery (as listed in the 1996-1997 Graduate Medical Education Directory) in New England (Connecticut, Massachusetts, Rhode Island, and Vermont). The survey asked the directors of pediatric orthopedic surgery to describe their facility’s management regimen for torus fractures.

![Figure 1. Number of patients undergoing first follow-up studies (radiography performed) on a given week after injury.](image1)

![Figure 2. Number of patients undergoing a given number of total follow-up studies.](image2)

**COMMENT**

There are no national guidelines that support any medical indications for a postcast study in the PED after a cast is administered for a pediatric torus fracture. Still, we
found that one third of patients with torus fractures at our institution underwent postcast studies in the PED. When radiology or senior level orthopedic staff is available to confirm the diagnosis of a nondisplaced, unicortical fracture, there should be no concern that the application of the cast itself may cause displacement—a medical indication for the postcast study.

In an era of managed care and renewed emphasis on quality, the broad range of the number of follow-up visits and studies is surprising. A limitation of this retrospective review is that we cannot identify why each follow-up study was ordered. There was no consistent documentation of management decisions based on these studies. It was not noted whether the patient was sent directly to radiology by the registrar or nurse prior to physician evaluation, or whether prior studies or past visit notes were available to the orthopedic surgeon at that visit. A review of the English-language literature concerning fractures of the distal third of the radius found that only those patients with dorsal angulation who have a bicortical fracture, or a unicortical fracture with a cortical breach (fracture evident across the entire bone just to the opposite cortex), should have further studies taken within 1 week to check for displacement.2 The torus fracture fits neither of these categories.

The possible cost savings of limiting serial studies in the management of the pediatric torus fracture is significant. The charge at our institution for processing and interpreting each forearm radiography series is $119. Our 70 patients accrued a total cost of $27,251 in radiology charges for their average of 3.3 studies per patient. Undergoing a single study in the PED and a single follow-up study would cost $238 per patient. This would have reduced the total charges for our cohort to $16,660, a savings of over $10,000. In a study by Michelson et al3 of serial radiographs used in the management of stable, adult ankle fractures, an average of 4.5 radiographs per patient were obtained, none of which showed any change in fibular alignment. They calculated a cost savings in the United States of over $35 million annually by doing away with multiple, routine follow-up studies.

CONCLUSIONS

Unlike the “postreduction” study used to assess the position of displaced or angulated fractures after manipulation, the postcast study in the PED of true torus fractures appears to be medically unnecessary as suggested by unanimous agreement of the 7 New England regional directors of pediatric orthopedic surgery programs. These studies are still obtained at some centers. Anecdotally, newer orthopedic residents will often assume that the attending surgeon expects to see the postcast result on every patient in the PED and will often fail to differentiate between casts for fractures at risk for displacement or progressive angulation and those not at risk.

In addition, obtaining multiple follow-up studies of the torus fracture, especially early in the healing process, does not appear to change fracture management by the orthopedic surgeon. Relying on the clinical examination at follow-up, perhaps combined with a single study conducted at least 4 weeks after an injury to document healing, is a more appropriate regimen for the management of pediatric torus fractures.

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REFERENCES