Outcomes of Operative Versus Nonoperative Treatment of Displaced Pediatric Clavicle Fractures

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abstract

Current literature proposes relative and absolute indications for surgical treatment of clavicle fractures in adults. However, few studies have evaluated these fractures in children. The current study examined short- and long-term outcomes of pediatric patients with displaced clavicle fractures. Outcomes assessed included radiographic healing, full active range of motion, and return to activity. The authors’ hypothesis was that open reduction and internal fixation of displaced clavicle fractures would lead to better outcomes than nonoperative treatment. The authors retrospectively reviewed the charts of pediatric patients treated for clavicle fractures between January 2001 and October 2011. The nonoperative group included 32 patients, and the operative group included 46 patients. Mean time to return to activity was 12.24 weeks in the nonoperative group and 12.70 weeks in the operative group ($P=.67$). Mean time to full active range of motion was 7.85 weeks in the nonoperative group and 8.74 weeks in the operative group ($P=.24$). Mean time to radiographic evidence of healing was 12.02 weeks in the nonoperative group and 11.90 weeks in the operative group ($P=.90$). Average Disabilities of the Arm, Shoulder and Hand (DASH) score was 0.04 in the nonoperative group (range, 0-0.08) and 1.17 in the operative group (range, 0-8.3), with no significant difference between groups. No significant difference between operative treatment and nonoperative treatment was found in any of the authors’ outcome measures. Thus, the authors propose that unless the patient’s injury is an absolute indication for surgery, conservative management provides equivalent immediate and long-term clinical results. [Orthopedics. 2015; 38(2):e135-e138.]
Treatment of displaced clavicle fractures in both the adult and pediatric populations has been a topic of debate in recent literature. Clavicle fractures account for approximately 10% to 15% of pediatric fractures, and the clavicle is the most commonly fractured bone in the shoulder region. Specifically, fractures of the midshaft account for approximately 85% of clavicle fractures. This is attributed to the change in shape of the clavicle in the midshaft region, from concave to convex in the coronal plane and from round to flat on cross-section. Absolute indications for surgical fixation of midshaft clavicle fractures include open fracture, neurovascular compromise, and tenting of the skin over the clavicle. Fractures that do not meet these criteria may have a relative indication for surgical fixation. As proposed by the Canadian Orthopaedic Trauma Society, relative indications for surgical fixation in the adult population are 100% or greater displacement and more than 1.5 to 2 cm shortening of the fracture fragments.

Few studies have examined relative indications for treatment of displaced pediatric clavicle fractures. To the authors’ knowledge, no published data have compared clinical outcome measures in operatively treated and nonoperatively treated displaced pediatric clavicle fractures. The goal of this study was to compare clinical and radiographic outcomes in operatively treated vs nonoperatively treated displaced pediatric clavicle fractures both immediately after injury and at long-term follow-up. The authors’ hypothesis was that patients treated with open reduction and internal fixation (ORIF) of displaced clavicle fracture would have a statistically significant shorter time to return to activities, achieve full active range of motion of the shoulder, and show evidence of radiographic healing. For long-term outcomes, the authors anticipated that Disabilities of the Arm, Shoulder and Hand (DASH) scores in patients treated with ORIF would be lower than scores in those treated conservatively.

**Materials and Methods**

A children and youth institutional review board approval was obtained before initiation of the study. A retrospective review of patient charts from January 2001 to October 2011 was performed using the Code for Procedural Treatment code for clavicle fracture. Patients were treated by 1 of 3 fellowship-trained pediatric orthopedic surgeons at the authors’ pediatric tertiary care facility. Patients who were lost to follow-up after initial injury films, those younger than 5 years, and those whose radiographs were unavailable were excluded from the study. Between January 2001 and October 2011, 339 patients with clavicle fractures were seen by the 3 surgeons noted earlier and treated nonoperatively. All 50 patients treated operatively by the surgeons noted earlier were initially included in the study. Outcomes were measured in weeks and included evidence of full radiographic healing, as determined by the attending surgeon; full active range of motion of the affected upper extremity, as documented by the attending surgeon; and time to return to unrestricted activity. Radiographic inclusion criteria to define a displaced fracture in the nonoperative group were 100% or greater displacement and 1.5 cm or greater shortening.

Ultimately, 32 patients who met the radiographic and clinical criteria were included in the nonoperative group. The 307 patients who were not included were generally younger patients who had a lower-energy mechanism of injury, such as birth trauma, and therefore had nondisplaced or minimally displaced fractures. The operative group ultimately included 46 patients because 4 patients were lost to follow-up. The operative group included all patients who had an absolute indication for operative fixation, more than 100% displacement of fracture fragments, 1.5 cm or greater shortening, and any refracture through a previously nondisplaced clavicle fracture. Patients were contacted and asked to complete a DASH questionnaire to determine long-term clinical function. Mean patient age in the operative group was 13.6 years (range, 8-18 years). Mean patient age in the nonoperative group was 10.3 years (range, 10 months-18 years).

**Surgical Technique**

Patients were placed supine on a radiolucent table with a rolled towel placed longitudinally between the scapulae. All patients received a weight-based dose of intravenous antibiotics before incision. A longitudinal incision was made over the fracture fragments. The platysma was sharply dissected off the clavicle. Fracture fragments were identified, hematoma was debrided, and the fracture fragments were reduced. If anatomically possible, a lag screw was placed perpendicular to the fracture line. A small fragment plate or one-third tubular plate was used in neutral mode. The wound was copiously irrigated, and the platysma was repaired. The fascia and subcutaneous layers were closed with interrupted absorbable suture, and the skin was closed with a running monofilament suture. A dry sterile dressing was placed, and the patient was discharged home on the day of surgery.

**Statistical Analysis**

This study was a retrospective review of a prospective cohort of all patients presenting to Children’s Hospital of Buffalo with a clavicle fracture. Power analysis showed that with 48 patients per group, there was an 80% chance of detecting a mean difference of 1 week (±1.75 weeks). Student’s t test and descriptive statistics were used to analyze the data. Statistical significance was set at P<.05.

**Results**

Mean return to activity was 12.24 weeks in the nonoperative group and 12.70 weeks in the operative group (P=.67). Mean time to full active range of motion of the affected upper extremity...
was 7.85 weeks in the nonoperative group and 8.74 weeks in the operative group (P=0.24). Mean time to full radiographic healing was 12.02 weeks in the nonoperative group and 11.90 weeks in the operative group (P=0.90). Average DASH score was 0.04 in the nonoperative group (range, 0-0.08) and 1.17 in the operative group (range, 0-8.3). In the nonoperative group, 19 of 32 patients (59%) were available for study. In the operative group, 20 of 46 patients (43%) were available for study. Mean follow-up was 54 months (range, 14-115) in the nonoperative group and 41 months in the operative group (range, 15-102). No statistically significant difference in DASH scores was noted between groups.

In the operative group, 2 patients underwent subsequent surgery for removal of symptomatic hardware after full healing of the fracture. Three patients had a subsequent fracture adjacent to the plate; 2 were treated conservatively, and 1 underwent revision ORIF. No infections were reported. In the nonoperative group, 2 patients had repeat fracture several years after the initial clavicle fracture and were treated with ORIF. Two patients had delayed union, defined as longer than 7 months to radiographic healing. These patients ultimately went on to radiographic and clinical union. No nonunions occurred in the nonoperative group.

**DISCUSSION**

Management of clavicle fracture in the pediatric population has been debated in recent literature.6,7,8 Recent adult studies showed a clinical benefit of ORIF for displaced clavicle fractures.3,7,8 The relative lack of literature on the treatment of displaced pediatric clavicle fractures prompted the authors’ initial retrospective investigation of clinical and radiographic outcomes in their patient population. Based on the findings of studies in adults, the authors anticipated that operatively treated patients would have improved outcomes compared with nonoperatively treated patients; however, the study findings disproved their hypothesis.

McKee et al6 showed a mean DASH score of 24.6 in nonoperatively treated adults with displaced clavicle fractures compared with a score of 10.1 in normal adult patients without injury. The only statistically significant difference in objective outcomes in this study was a deficit in shoulder strength, including abduction, internal-external rotation, and flexion. The Canadian Orthopaedic Society7 study also showed improved functional outcomes, cosmesis, and rates of union in adult patients treated with plate fixation of displaced midshaft clavicle fractures. Throughout 1 year of follow-up, DASH scores of the nonoperatively treated group remained higher than the scores of the operatively treated group. A recent multicenter, randomized controlled trial by Robinson et al7 found that ORIF in adults with displaced clavicle fractures showed significant reduction in the rate of nonunion and cosmetic deformity. However, the cost of care in patients treated with ORIF was significantly greater than that in patients who were managed nonoperatively. Significantly higher DASH and Constant scores were noted in patients treated with ORIF only when nonoperatively treated patients with nonunion were included in the analysis. No difference between DASH and Constant scores was noted when nonunions were excluded.

The current study found no statistically significant difference in return to activity, time to radiographic healing, and full active range of motion. When patients were contacted an average of 41 months after the index procedure, DASH scores were elevated in the surgical group. The higher DASH scores reported in the adult literature may be caused by shortening in the coronal plane that may disrupt peri-clavicular musculotendinous tension and muscle balance in displaced clavicle fractures. Based on the current findings, the increased flexibility in pediatric musculotendinous units may avoid substantial objective functional limitations after injury.

Vander Have et al4 reported return to full activity at an average of 12 weeks in the operative group and an average of 16 weeks in the nonoperative group. In the current study, mean return to activity was 12.24 weeks in the nonoperative group and 12.70 weeks in the operative group. Furthermore, in the study by Vander Have et al.,4 5 of 25 patients treated nonoperatively had a symptomatic malunion. In contrast, in the current study, the nonoperative group did well overall, without malunion. In a study by Hosalkar et al.,6 adolescent patients with displaced clavicle fractures were treated with ORIF if the absolute indications for surgery were met or if the fracture pattern showed more than 15 mm shortening or greater than 100% displacement. Patients returned to full activity after 12 weeks, with serial evaluations of radiographic healing parameters.

**Limitations**

The limitations of the study are related to its retrospective nature. Many patients were lost to follow-up when the authors attempted to contact them for functional assessment. Only 59% of nonoperative patients and 43% of operative patients were available for assessment.

The current study had several strengths as well. The authors used a large sample. To their knowledge, no existing study has examined 32 nonoperatively treated and 46 operatively treated displaced pediatric clavicle fractures. Furthermore, the authors matched patients in each treatment group for displacement and age. In addition, although the long-term DASH scores were not strong, the authors obtained a limited quantity of data on functional outcomes in each treatment group.

**CONCLUSION**

The findings of this study contribute to the literature supporting nonoperative management of pediatric clavicle fractures. The authors acknowledge the limi-
tations of a retrospective study, but recognize that many patients who were treated operatively now request hardware removal. They hope that this study will further guide orthopedic surgeons who treat pediatric patients to consider nonoperative treatment in skeletally immature patients.

REFERENCES


