

Excision of Symptomatic Spinous Process Nonunion in Adolescent Athletes

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Abstract

While clay-shoveler's fractures in athletes are usually treated conservatively with rest, activity modification, and return to activities when symptoms abate, nonunion of these fractures can occur, given the ligamentous attachments and muscular forces acting on the fracture fragment. Surgical treatment for recalcitrant symptomatic nonunions in adolescent athletes has not been described in the literature.

We examined the medical records and radiographs of adolescent athletes who presented with persistent symptoms related to a T1 spinous process nonunion at our institution. Three adolescent athletes were identified who underwent surgical excision of a nonunited ossicle after a T1 spinous process fracture and failure of conservative treatment. All patients had complete pain relief and were able to return to sports after surgical excision. There were no surgical complications.

Persistent pain after a clay-shoveler's fracture in athletes has been described in the literature. This is the first case series describing surgical excision of the nonunited ossicle in athletes unable to return to play because of persistent disabling pain at the nonunion site. Excision should be considered if patients experience persistent pain after this injury, with expectation of complete resolution of symptoms after surgery.

Fractures of the spinous process of the lower cervical spine or upper thoracic spine are frequently referred to as *clay-shoveler's fractures*. Originally reported by Hall¹ in 1940, these fractures were described in workers in Australia who dug drains in clay soil and threw the clay overhead with long shovels. Occasionally, the mud would not release from the shovel, causing excess force to be transmitted to the supraspinous ligaments and resulting in a forceful avulsion fracture of one or multiple spinous processes. The few reports following the earliest description in the literature frequently describe the mechanism of injury as being athletic in nature.²⁻⁴ The forceful contraction of the paraspinal and trapezius muscles on the supraspinous ligaments and the resultant attachment

to the spinous processes make this a not uncommon injury during athletics, especially with a flexed position of the neck and shoulders. The resultant fracture or apophyseal avulsion is painful and often necessitates a visit to the physician, with plain films, computed tomography (CT) scans, or magnetic resonance imaging (MRI) confirming the diagnosis.⁵

Treatment of these fractures has not been well described, but frequently a period of rest followed by physical therapy will allow a return to activity. We present a series of adolescent athletes who developed nonunion of the fracture of the T1 spinous process with continued symptoms, despite rest and conservative therapy, and who underwent surgical excision of the ununited fragment.

Materials and Methods

We obtained institutional review board permission for this study and searched the surgical database between 2006 and 2013 for patients who had undergone resection of a spinous process nonunion. We collected demographic data on the patients, evaluated the radiographic studies, and reviewed operative reports and follow-up patient data.

Results

Dr. Hedequist operated on 3 patients with a spinous process nonunion over the study time period. The average age of the patients was 14 years; the location of the spinous process fracture was the T1 vertebra in all patients. Two patients sustained the injury while playing hockey and 1 during wrestling. The average duration of symptoms prior to operation was 10 months; all patients had seen physicians without a diagnosis prior to evaluation at our institution. All patients had a trial of physical therapy before surgery, and all had been unable to return to sport after injury secondary to pain.

Examination of all patients revealed pain directly over the fracture site and accentuated by forward flexion of the neck and shoulders. Evaluation of injury plain films revealed a fracture fragment in 2 patients (**Figure 1**). All 3 patients underwent MRI and CT scans confirming the diagnosis. MRI confirmed areas of increased signal at the tip of the T1 spinous process, with inflammation in the supraspinous ligament directly at that region (**Figure 2**). The CT scans confirmed the presence of a bony fragment correlating with the tip of the T1 spinous process (**Figure 3**).

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Surgery was performed under general endotracheal anesthesia via a midline incision over the affected area down to the spinous process. The supraspinous ligament was opened revealing an easily identified and definable ununited ossicle, which was removed without taking down the interspinous ligament. All 3 nonunions were noted to be atrophic with no evidence of surrounding inflammatory tissue or bursa. The residual end of the spinous process was smoothed down with a rongeur. Standard closure was performed. There were no surgical complications.

All patients had complete relief of pain at follow-up; 1 patient returned to full sports activity at 6 weeks and the other 2 returned to full sports activity at 3 months. There was no loss of

cervical motion or trapezial strength at follow-up. All patients voiced satisfaction with the decision for surgical intervention.

Discussion

Clay-shoveler's fracture is an injury well known to orthopedists. This fracture is thought to be caused by a forceful contraction of the thoracic paraspinous and trapezial muscles, causing an avulsion fracture with pain and frequently a "pop" experienced by the patient.¹ Usually considered self-limiting injuries, treatment involves a period of rest and activity modification with occasional physical therapy. Return to sports has been reported with occasional pain but with patient satisfaction.^{3,5,6}

Our series of patients represent a group of adolescent athletes who sustained spinous process fractures of the T1 vertebra and, despite a significant period of rest and activity modification, were unable to return to sports given their pain. The examination of these patients revealed focal tenderness at the tip of the spinous process. The diagnosis is made clinically, with radiographic studies confirming the diagnosis. In our series of patients, MRI was the original modality used to confirm injury to the area, with hyperintensity seen in the area of the supraspinous ligament and tip of the spinous process. CT confirmed the nonunion and presence of an ossicle in all patients. Surgical exposure of that area easily exposed the ununited ossicle, which was removed in all patients.

To our knowledge, this is the first report in the literature describing surgical excision of an ununited spinous process fracture in adolescent athletes. The original descriptive case series by Hall¹ states "in the minds of surgeons who have seen many of these cases that early operative removal of the fragments is the proper routine treatment." Since that original series, we have not found articles in the literature that support

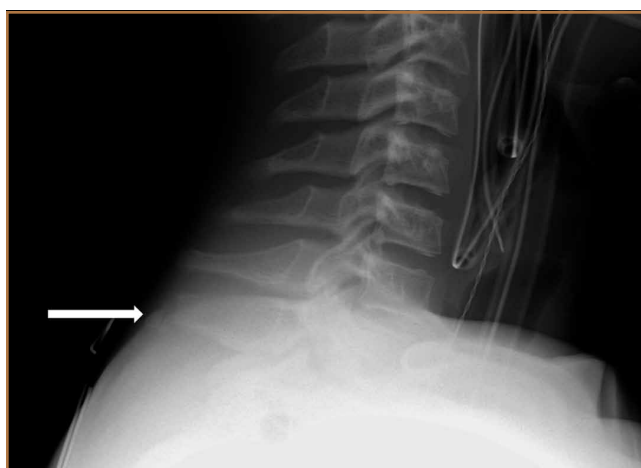


Figure 1. Intraoperative plain radiograph of a patient undergoing removal of a symptomatic spinous process nonunion. The arrow is pointing at the ununited ossicle.

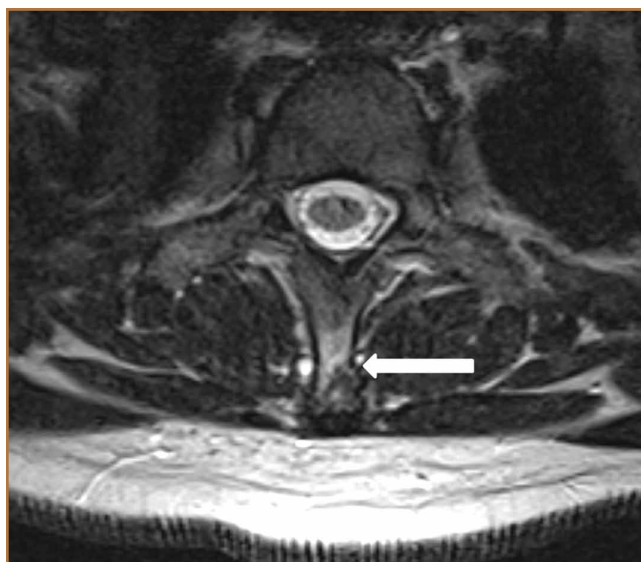


Figure 2. Axial-cut magnetic resonance imaging of a patient with symptomatic nonunion. Note the arrow pointing at the defined ossicle as well as the edema of the T1 spinous process.



Figure 3. Computed tomography sagittal image with arrow pointing at the well-demarcated nonunion of the T1 spinous process.

surgical removal; however, persistent symptoms after fracture are described.⁵ It is not surprising that these patients developed pain at the site of the fracture given the forces acting in that area. The trapezial and paraspinal muscles acting on that area are forceful and repetitive during activities, especially sports. All our patients had pain with attempts at activity and all had had a significant period of rest. In a recent article, this injury was described in adolescents without the patients having clear relief of symptoms despite a period of inactivity.⁵ While physical therapy is therapeutic in some patients experiencing pain, it can be a source of aggravation due to neck and shoulder motion and muscle contraction. It is not surprising that therapy would not help in most cases, as neck and shoulder motion and muscle contraction are the sources of continuing discomfort.

Clinical practice suggests that most patients with spinous process fractures will become pain-free; however, that is not universal. This series demonstrates that a small subset of patients with this injury will continue to have significant symptoms despite a period of rest. In those patients who desire a pain-free return to sports, we recommend consideration of surgical excision after confirmation of nonunion with radiographic studies. The inherent risks of surgical treatment are minimal with this procedure, and the benefits include return

to pain-free sports activity, with the resultant physical and psychosocial benefits for adolescent athletes.

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