Clavicle Nonunion in a 10-year-old Boy

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Posttraumatic clavicle nonunion is rare, particularly in children. Four cases of clavicle fracture nonunion in patients aged 10 years and younger have been reported. A variety of techniques have been used to treat pediatric clavicle nonunions. A 10-year-old boy presented to our institution after a fall, sustaining a right closed midshaft clavicle fracture. No other injuries occurred, and neurovascular examination of the right upper extremity was normal. The fracture was initially treated with a sling for >4 months, and the fracture progressed to a hypertrophic nonunion. Serial radiographs failed to demonstrate progression to union. The patient continued to have pain with activity 4 months after his injury. Clavicle pseudarthrosis was considered; however, radiographs did not have the characteristic appearance of this condition. This fracture nonunion was treated with internal fixation and united with no complication. The patient was back to full activities of daily living 6 months postoperatively. He reported no tenderness at the fracture site or along the hardware. The treating surgeon (A.M.S.) prefers to remove hardware in young children, but the family declined removal. Pediatric post-traumatic nonunion of the clavicle is rare but can be safely treated with plate fixation, with excellent results.

Figure: Anteroposterior radiographs showing hypertrophic nonunion 4 months after injury (A) and union 6 weeks after plate fixation of the fracture (B).
Posttraumatic clavicle nonunion in children is rare. It occurs in approximately 1% of adult clavicle fractures. Four cases of clavicle fracture nonunion in patients aged 10 years and younger have been reported. All patients treated surgically for nonunion healed with no complication. Kirschner-wire intramedullary fixation, excision of the distal clavicle with coracoclavicular ligament reconstruction, and plate fixation with iliac crest autograft were performed.

In a 20-year review of clavicle fractures in children, Wilkins and Johnston found 33 nonunions. The majority were in adults, with 1 in a patient younger than 7 years, treated with screw fixation and bone graft.

Congenital clavicle pseudarthrosis should be included in the differential diagnosis of clavicle nonunion in children. Clavicle pseudarthrosis occurs due to failure of the medial and lateral ossification centers of the clavicle to unite. The right clavicle is most often involved, which is believed to be a consequence of pressure from the right subclavian, which is higher than the left subclavian in patients with no dextrocardia. These pseudarthroses typically have rounded ends with a lack of callus formation and cause mild discomfort. Other congenital causes of clavicular discontinuity must be excluded, such as cleidocranial dysplasia and neurofibromatosis.

Surgical treatment of clavicular fractures in children is rare. Kubiak and Slongo performed a retrospective review of 939 children over a 21-year period with clavicle fractures. Of these children, 1.6% required surgery. The most common indication was potential perforation of the skin. No surgically treated patients resulted in nonunion.

**Case Report**

A 10-year-old boy presented after a fall. He sustained a right closed midshaft clavicle fracture. No other injuries occurred, and neurovascular examination of the right upper extremity was normal. The injured clavicle was not compared with the noninjured side. At presentation, the clavicle demonstrated 1 cm of bayonette opposition, developing a hypertrophic nonunion after 4 months of sling immobilization. Therefore, 1 cm of shortening occurred as the nonunion was immobilized in situ. The nonunion was painful and limited the use of the right upper extremity.

To achieve fracture stability, we internally fixed the fracture with a plate. A hypertrophic nonunion was identified intraoperatively. The bony ends of the nonunion were freshened using a rongeur and osteotomes. Fibrous tissue in the nonunion was removed using a curette. The fracture was provisionally held using two 2.0-mm lag screws. Final fixation was achieved using a 2.7-mm LCDC plate (Synthes, West Chester, Pennsylvania) contoured intraoperatively. The fracture united with no complication.

Postoperatively, the patient was pain free and regained full shoulder range of motion (ROM). The patient was back to full activities of daily living at >18 months after the injury and nearly 6 months postoperatively. He reported no tenderness at the fracture site or along the hardware. The surgeon (A.M.S) prefers to remove hardware in young children, but the family declined removal.

**Discussion**

In this rare case of clavicle nonunion in a young boy, surgical intervention was elected due to pain and restricted ROM. Although the patient had a previous ipsilateral clavicle fracture that healed uneventfully, congenital pseudarthrosis was excluded after a review of the initial fracture and current fracture radiographs. Radiographs of the healed initial fracture were lost and could not be included in this report. Other congenital causes, such as neurofibromatosis and cleidocranial dysplasia, were also excluded. We elected plate fixation as the most immediate stable construct. Although pins and nails have been used in the past for clavicle fixation, these devices do not provide as rigid of fixation. Nail cutout and catastrophic pin migration have been reported. Pediatric posttraumatic clavicle nonunion is rare but can be safely treated with plate fixation, with excellent results.

**References**