

Posttraumatic Nonunion of the Clavicle in a 13-Year-Old Boy Causing an Arteriovenous Fistula

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Abstract

Context: Fractures of the clavicle are one of the most common injuries to the bone in childhood, but posttraumatic nonunion of pediatric clavicle fractures are extremely rare, with only isolated reports in literature. **Case Report:** We report a case of a posttraumatic painful nonunion of a clavicle fracture in a 13-year-old boy that caused symptomatic compression of the external jugular vein (EJV) and the formation of an arteriovenous fistula. The fracture was treated successfully with open reduction and internal fixation with a contoured recon plate 6 months following the injury. The fistula was treated by ligation and closure. **Conclusion:** The patient made a full recovery 6 months following surgery and was asymptomatic with full range of shoulder movement. Fracture union was confirmed by computed tomography (CT) scanning and no residual fistula was found.

Keywords: Arteriovenous fistula, Arteriovenous fistula surgery, Clavicle fixation, Clavicle fracture, Clavicle nonunion, Clavicle surgery, Pediatric clavicle fracture, Pediatric nonunion

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Introduction

Fractures of the clavicle are one of the most common bony injuries of childhood, accounting for 15% of the fractures in this population.^[1] The majority of these occur in the midshaft region and approximately half are displaced fractures.^[1] Nonunion of the clavicle is a recognized complication in the adult population, with reported rates of between 1% overall and 15% in displaced fractures.^[2] It is an extremely rare complication in children, with seven published cases in the English literature. We describe a case of a posttraumatic clavicle nonunion in a 13-year-old boy which caused significant dilatation of the external jugular vein (EJV) as a result of a traumatic arteriovenous fistula.

Case Presentation

A 13-year-old boy was referred to clinic with a prominent

dilatation on the right side of his neck that had been gradually enlarging since he sustained a displaced fracture of the middle third of his right clavicle 6 months previously. This was treated conservatively by the referring hospital [Figure 1a]. The patient was uninhibited in daily activities, but complained of ongoing pain at the fracture site and was concerned about his cosmetic appearance. His past medical history consisted of a congenital atrial septal defect with partial anomalous pulmonary venous drainage, which was surgically corrected at the age of 18 months. On examination, there was a nonpulsatile dilation in the right anterior triangle of his neck overlying the clavicle which was tender on palpation. There was no other visible deformity and he had full range of motion of the ipsilateral shoulder.

An ultrasound and computed tomography (CT) scan were arranged, which revealed a hypertrophic angulated nonunion of the clavicle fracture. The surrounding callus formation was shown to be compressing the EJV, impeding its drainage, and causing the striking distension measuring 2 cm in diameter. The anatomy of the carotid and subclavian arteries appeared normal.

Following multidisciplinary discussion, a decision was made to operatively reduce and fix the clavicle nonunion. Intraoperatively, gross callus formation was found at the

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fracture site. However, an arteriovenous fistula was also discovered in a vascular cavity in the callus between a branch of the subclavian artery and the EJV. The fistula

was excised and adjacent veins ligated and closed by vascular surgeon before the clavicle fracture was reduced and fixed with a six-hole contoured plate without the use of bone graft.

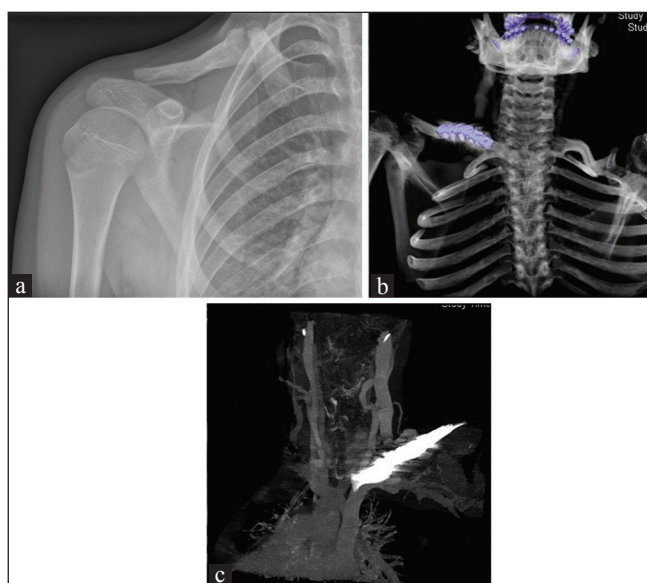


Figure 1: (a) Preoperative radiograph of right clavicle nonunion. (b) Computed tomography (CT) three-dimensional (3D) reconstruction demonstrating fracture union. (c) CT venogram showing enlarged right external jugular vein with no residual fistula present

Radiographs taken 1 week postoperatively confirmed satisfactory position of the clavicle fixation. At 1-month follow-up, the EJV was less prominent and there was no residual pain around the shoulder. At 6-months follow-up, the patient was asymptomatic with full range of movement of the ipsilateral shoulder. Radiographs and CT scans showed union of the fracture site with good alignment of the clavicle [Figure 1b]. A CT venogram revealed an enlarged right EJV with a stenosed lower end and tortuous collaterals to the right internal jugular vein and subclavian vein, but no residual arteriovenous fistula [Figure 1c].

Discussion

Complications associated with clavicle fractures include malunion, nonunion, thoracic outlet syndrome, vascular injury, and brachial plexus injury. Fracture displacement is associated with an increased risk of nonunion in adults,^[2] although this does not seem to be a risk factor in the pediatric population.^[1]

Table 1: Pediatric posttraumatic clavicle nonunions in literature							
Author	Age (years)	Sex	Mechanism	Fracture site	Time to diagnosis of nonunion	Treatment	Outcome
Nogi ^[7]	12	M	Fall from chair	Junction distal and middle third right clavicle	6 months	Excision of distal clavicle and stabilization of proximal clavicle	Asymptomatic with full activity at 12 months
Caterini ^[8]	7	F	Fall onto right shoulder	Middle third right clavicle	14 months	Kirschner wire stabilization with bone grafting from tibial metaphysis	Pain free, full range of movement at 12 months
Spapens ^[6]	8	F	Fall off bicycle	Midshaft right clavicle	12 months	Compression plate fixation with bone grafting from iliac crest	Asymptomatic with full activity at 10 months
Wilkins and Johnston ^[9]	7	M	Severe Fall	Not described	72 months	Screw with bone graft	Full unlimited movement
	13	M	Severe Fall	Not described	10 months	None	Nonunion, unlimited activity
Jain ^[10]	7	F	Fall	Refracture of junction middle and proximal third right clavicle	14 months	Compression plate fixation	Full range of movement at 6 months
	9	F	Not described	Midshaft right clavicle	23 months	Plate fixation	Full range of movement at 6 months

M = Male, F = Female

Vascular complications as a result of clavicle fractures are rare, but are recognized as either an immediate complication due to transection of the vessel by the displaced fracture or as a late complication, secondary to compression from abundant callus formation.^[3] These include subclavian artery or vein compression, thrombosis, or pseudoaneurysm.^[4] There are several reports of upper extremity deep venous thrombosis following clavicle fractures.^[5] We are not aware of any other reported case in English literature that describes the formation of a traumatic arteriovenous fistula and symptomatic compression of the EJV following clavicle fracture. There are no known associations between congenital cardiac anomalies and the later development of arteriovenous fistulas.

Complications following pediatric clavicle fractures are uncommon and healing usually occurs within 4-6 weeks.^[6] A study by Calder and colleagues recommended that children with isolated fractures of the clavicle with no complications at initial follow-up may be safely discharged from further follow-up.^[1] Posttraumatic nonunions of clavicle fractures in children are extremely rare, with only isolated reports in the literature [Table 1]. All cases presented with hypertrophic nonunion between 6 and 72 months following injury and all but one case were treated operatively. Compression plate fixation was the most common procedure, and half of the procedures also involved bone grafting of the fracture site. Union was only achieved through surgery, although the functional outcome was satisfactory in all cases.

This is the first reported case of nonunion of a clavicle fracture causing symptomatic EJV compression and a traumatic arteriovenous fistula formation. This required operative fixation of the fracture and ligation of the fistula to achieve a satisfactory functional outcome for the patient. Although current literature advises against routine follow-up for isolated pediatric fractures,^[1] the authors believe

that follow-up for displaced pediatric clavicle fractures is good practice. Open reduction and internal fixation reliably restores clavicle length and angulation, with low complication rates and good radiological and clinical outcomes for pediatric clavicle nonunions.

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