

Appendix

Ovid MEDLINE In-Process & Other Non-Indexed Citations and Ovid MEDLINE and Embase databases were searched with the following criteria (last date of search: May 17, 2017):

1. Sternoclavicular.mp
2. Luxation.mp
3. Instability.mp
4. Dislocation.mp
5. Retrosternal.mp
6. Posterior.mp
7. 5 OR 6
8. 2 OR 3 OR 4 OR 7
9. 1 AND 8
10. Limit 9 to: English language and yr = "1970-Current"

TABLE E-1 Sternoclavicular Joint Fixation Techniques from the Included Studies*

Surgical Technique and Study	Procedure Details
Ligament reconstruction using autograft or allograft tendon	
Brophy (2005) ⁴⁷	Approximately 1 cm of the medial clavicle was resected with an oscillating saw; one 5-mm anterior-to-posterior drill-hole (i.e., bicortical) created 1 cm from the articular surface of the manubrium and within the medial clavicle; the anterior tibialis tendon (allograft) was shuttled through drill-holes, pulled taut, and sutured side to side using no.-2 FiberWire (Arthrex) sutures.
Aure (2012) ⁴⁸	Two 3.5-mm anteroposterior holes were created within sternum through anterior cortex (i.e., unicortical); one 3.5-mm drill-hole was placed in the medial clavicle (craniocaudally), perpendicular to the first holes; plantaris tendon (autograft) was passed through drill-holes in a circumferential fashion and was sutured back to itself with Ti-Cron 2.0 nonabsorbable suture; the free end of the graft was then led posteriorly around the clavicle and was sutured to itself anteriorly. The joint capsule was closed.
Singer (2013) ⁴¹	Gracilis or semitendinosus autograft was harvested from the ipsilateral knee; two 4.5-mm anteroposterior drill-holes were created 1 cm away from the sternoclavicular joint and 1 cm away from each other within the manubrium and medial clavicle (i.e., bicortical); the figure-of-8 graft weave with guiding suture was reinforced with nonabsorbable sutures.
Gaines (2014) ³⁴	The medullary canal of the medial clavicle was entered with a 3.5-mm drill through the anteroinferior articular margin; a 2.5-mm drill-hole was made at the superior margin of the clavicle to connect to the intramedullary tunnel; two 3-mm tunnels were formed within the manubrium with a burr (unicortical): 1 tunnel 1 cm from the superior margin and 1 tunnel 1 cm from the lateral border; then 2 corresponding tunnels were formed on the articular side of the manubrium and were connected with the previously made outer 2 tunnels; the doubled gracilis graft (autograft or allograft) was passed through transosseous tunnels and was secured with a button over the posterosuperior border of the clavicle.
Sabatini (2015) ³⁹	A 4.5-mm × 25-cm semitendinosus allograft with no.-2 polyethylene suture on each end was created; two 4.5-mm anteroposterior drill-holes (i.e., bicortical) were created within the manubrium and clavicle; the graft was shuttled from the inferior manubrium to the inferior clavicle to the superior manubrium to the superior clavicle; the graft was tensioned, with two 4.75-mm (diameter) × 15-mm (length) polyetheretherketone (PEEK) tenodesis screws (Arthrex) placed in the inferior manubrium and superior clavicle drill-holes; two figure-of-8 no.-2 polyethylene sutures were placed to secure the graft.
Kusnezov (2016) ⁴²	Two 4-mm drill-holes in both the clavicle and manubrium (anterior to posterior), approximately 1 cm from the sternoclavicular joint, were made; the gracilis tendon graft (autograft or allograft) was passed in a figure-of-8 fashion; the graft was tensioned and the tails were approximated and were secured to each other with nonabsorbable, high-tensile suture.
Local soft-tissue repair or augmentation or reconstruction with synthetic materials	
Thomas (2000) ⁴⁹	Two 2.5-mm drill-holes in the clavicle 5 mm from the medial end breached the outer cortex (sagittal plane); 2 holes were drilled through the medial joint surface to connect with the previously drilled holes; the process was repeated, 5 mm from the articular margin, on the manubrium; a polydioxanone suture was double-looped and then was passed through drill-holes and was tied under tension.
O'Connor (2003) ⁵⁰	Two drill-holes were made in the sagittal plane in both the manubrium and the medial end of the clavicle; fixation was then achieved with "heavy absorbable anchor sutures."
Waters (2003) ⁵¹	Primary repair of the costoclavicular and sternoclavicular ligaments using no.-1 Ethibond suture in a figure-of-8 fashion through 1 to 2-mm drill-holes in anterior sternum and anterior clavicular epiphysis was performed.
Mirza (2005) ³⁸	The sternoclavicular joint was stabilized using intra-osseous Ethibond fixation and a staple to hold the suture in the clavicle.
Abiddin (2006) ³¹	Mitek Super Anchors (Johnson & Johnson) were placed near the edge of the manubrium; transosseous sutures were placed through 2 drill-holes in the medial clavicle (avoiding the articular surface); sutures were fastened after reduction, with capsular reinforcement with nonabsorbable sutures.
Bennett (2006) ⁴⁵	No.-5 Ti-Cron transarticular sutures were combined with soft-tissue repair of the ligamentous structures.
Hoekzema (2008) ⁵²	A high-speed burr was used to create drill-holes in the medial clavicle and manubrium; local ligamentous (sternoclavicular, costoclavicular, and capsule) "reconstruction" was performed using a no.-2 polydioxanone suture.

Laffosse (2010) ¹⁷	A repair of the costoclavicular ligament with or without costoclavicular cerclage with a polydioxanone suture was performed.
Laffosse (2010) ⁵³	A costoclavicular polydioxanone suture cerclage was performed, with costoclavicular ligament and anterior capsular sutures.
Gardeniers (2013) ³⁵	A polydioxanone suture “envelope plasty” (modification of the figure-of-8 technique) was performed using a polydioxanone suture ligament (Ethicon); 3.2-mm and then 4.5-mm (widened) drill-holes were made through the clavicle (inferior to superior) and a 4.5-mm tunnel was made in the manubrium; 2-0 Vicryl was passed through and was used to pass the 5-mm polydioxanone suture “ligament” through the bone tunnels.
Janson (2013) ³⁷	Local ligamentous repair and sternal cable passage through medial clavicle and manubrium in a figure-of-8 configuration (fastened under tension) were performed.
O’Reilly-Harbridge (2013) ³²	Suture anchors were placed in the sternal notch of the manubrium (anterior to posterior direction) and into the medial clavicle (craniocaudal direction); sutures were tied together to form a triangular shape.
Lee (2014) ⁵⁴	Horizontal mattress transphyseal suture fixation using no.-1 Ethibond was performed; unicortical drill-holes were made in the clavicle and manubrium with a 1.6-mm Kirschner wire approximately 8 mm lateral to the edge of the physis; 2 double-looped sutures were then passed by a needle.
Quayle (2014) ⁴⁴	The LARS 30 (Ligament Augmentation and Reconstruction System, Arc Sur Till) allograft was used to reconstruct costoclavicular and sternoclavicular ligaments; 2 vertical tunnels were made in the clavicle and a V-shaped tunnel was made in the manubrium using a 4.5-mm drill; LARS was weaved around the first rib and through tunnels and was secured with interference screws in the lateral clavicular tunnel.
Tepolt (2014) ¹⁸	Two holes were drilled in medial clavicular metaphysis; the shaft of the clavicle was secured to the manubrium with FiberWire in a figure-of-8 configuration.
Aydin (2015) ⁵⁵	Two 3.2-mm holes were drilled in the sternum (1 cm away from sternoclavicular joint), and two 3.2-mm drill-holes were drilled in the medial clavicle (in vertical plane); a 6-mm polyamide nonabsorbable suture was passed through and was secured using a tension-band technique.
Kirby (2015) ¹⁹	2.5-mm drill-holes were made in both the clavicle and manubrium (starting anterior, exiting the sternoclavicular joint); Mersilene tape or suture material was passed transosseously and was tied in a figure-of-8 fashion or as 2 individual loops.
Kusnezov (2016) ⁴²	A figure-of-8 reconstruction using no.-5 Ethibond was performed.
Adamcik (2017) ³⁶	A modified figure-of-8 suture with a doubled FiberWire sling through a bicortical 2.5-mm drill-hole (anterior to posterior) in the medial end of the clavicle and sternum was used.
Open reduction and internal fixation	
Brinker (1997) ⁵⁶	Open reduction and internal fixation with two 75-mm × 7.0-mm cannulated screws directed from the most superior aspect of the medial clavicle into the body of the sternum was performed.
Franck (2003) ⁵⁷	A Balsa plate was contoured to the clavicle, a hook was shortened to reduced prominence; a central opening was created in the lateral cortical bone of the sternal joint surface, enlarged bluntly; the hook of the plate was inserted into the opening, and the plate was attached to the clavicle; torn ligaments were reapproximated with absorbable suture.
Shuler (2008) ⁵⁸	Open reduction and internal fixation using 2 precontoured locking plates placed at 90° to each other was performed.
Hecox (2010) ⁴³	A standard 3.5-mm limited contact dynamic compression 6-hole plate was fixed to the clavicle; the plate was positioned to leave 2 holes to serve as a ledge over the manubrium (“ledge plating”).
Stahel (2013) ⁵⁹	Bridge plate fixation with a 3.5-mm one-third tubular locking plate (unicortical) was performed on the anterosuperior border of the clavicle, spanning the midline of the manubrium (note: revision in 1 patient to resection arthroplasty with allograft tendon figure-of-8 reconstruction for pain over sternoclavicular joint after implant removal).
Kirby (2015) ¹⁹	One case was performed with initial treatment with the Ti-Cron tension band and dynamic compression buttress plating (note: 1 revision case from Mersilene tape fixation to fixation with two 2.7-mm Synthes plates).
Boesmueller (2016) ³³	Open reduction and internal fixation with plate fixation between the sternum and clavicle was performed.
Quispe (2016) ⁶⁰	Open reduction and internal fixation using locking compression plating along the superior border of the medial clavicle spanning across the body of the manubrium (unicortical locking and nonlocking screws) was performed.
Medial clavicular resection with or without ligament repair	
Gangahar (1978) ⁶²	Resection of the “medial half of the clavicle” after failed closed and open reduction was performed.
Acus (1995) ⁶³	1 cm of the medial clavicle was resected.

Kiroff (1996) ⁶⁴	“The clavicle was transected 5 cm from its medial end and the medial fragment was removed” after failed closed and open reduction.
Nakayama (2007) ⁶⁵	A 3-cm resection of the medial head of the clavicle was performed.
Groh (2011) ¹³	The medial 1.5 to 2.0 cm of the clavicle was resected; 1-mm Cottony Dacron suture (Deknatel) was then passed around the remaining medial end of the clavicle and periosteal tube and through the residual costoclavicular ligament and first rib periosteum.
Ting (2014) ²⁰	A medial clavicular resection (1 to 2 cm) with an osteotome and saw in patients with damage or degeneration of the articular surface was performed; the Ethibond suture passed through transosseous tunnels in a figure-of-8 configuration; the periosteal sleeve was repaired with attached sternoclavicular and costoclavicular ligaments.
Kusnezov (2016) ⁴²	Medial clavicular resection, costoclavicular ligament transfer, and capsular repair were performed (note: revision medial clavicular resection and ligament reconstruction using a figure-of-8 semitendinosus allograft was performed).
Saltzman (2016) ⁴⁰	Medial clavicular excision just medial to the costoclavicular ligament with local ligamentous repair was performed.
Tendon transfer techniques	
Noda (1997) ⁶⁷	Articular disc excision was performed; a modified Burrows technique using palmaris longus tendon graft was used (could not locate the subclavius tendon) (note: revision procedure including an interpositional arthroplasty using allograft tissue [iliotibial band and costoclavicular ligament reconstruction] using a “tendinoperiosteal strip of the sternoclavicular muscle”).
Camara (2009) ⁶⁸	A Burrows subclavius tenodesis was performed; a vertical 4-mm diameter tunnel was created on the anterior aspect of the clavicle.
Laffosse (2010) ¹⁷	Costoclavicular tenodesis was performed using the subclavius muscle or the sternal head of the sternocleidomastoid muscle.
Ting (2014) ²⁰	Two drill-holes were made in the medial clavicle and sternum approximately 1.5 cm from the sternoclavicular joint; an Ethibond suture was passed in a figure-of-8 manner; local soft-tissue structures were repaired and a sternocleidomastoid tendon weave and fixation were performed.

*Details were obtained directly from the studies with or without supplementation via e-mail correspondence.