

Approaches for the Upper Extremity

from AO Surgery Reference

Jonas Andermahr | Michael McKee | Diane Nam

2 Clavicle

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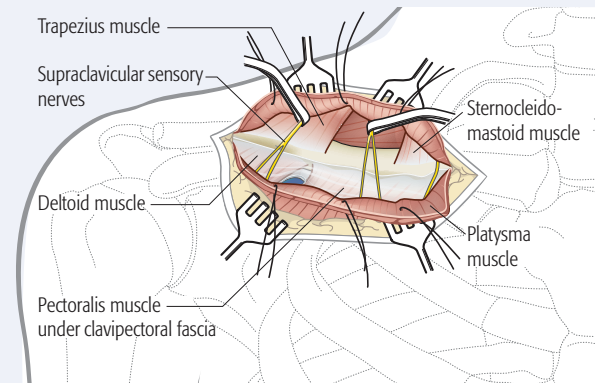
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2.1 Anterior approach

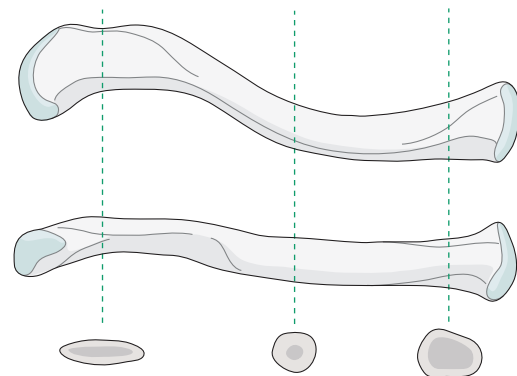
Surgical approach

The anterior approach to the diaphyseal clavicle can be used for nearly any clavicular shaft fractures, for both anterior and superior plating.



Anatomy

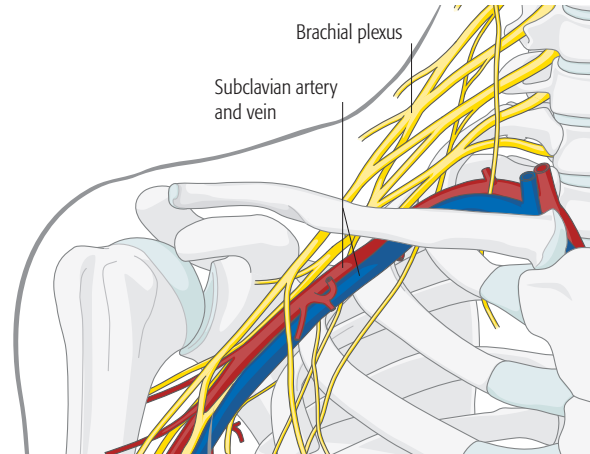
The clavicle is an S-shaped bone, anteriorly concave laterally and anteriorly convex medially. The cross sectional anatomy along its lateral to medial course changes from flat to tubular to prismatic. The junction from the flat region to the tubular region is a stress riser and this explains the higher incidence of midshaft fractures. Commonly, plates are applied to the superior and/or anterior surface of the clavicle.





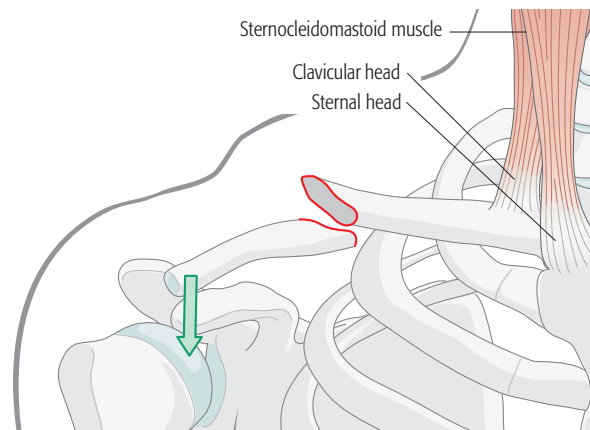
Neurovascular structures

The neurovascular structures, namely, the subclavian artery and vein and the brachial plexus, pass from a posterosuperior to antero inferior direction, between the first rib and the clavicle at the junction of its medial and middle thirds and are thus vulnerable during surgery and instrumentation in this region. In the middle third or the tubular portion, the subclavius muscle and fascia protect the neurovascular structures from the fracture. However, to avoid injury to the neurovascular structures, care should be exercised when sharp instruments are used in this area.



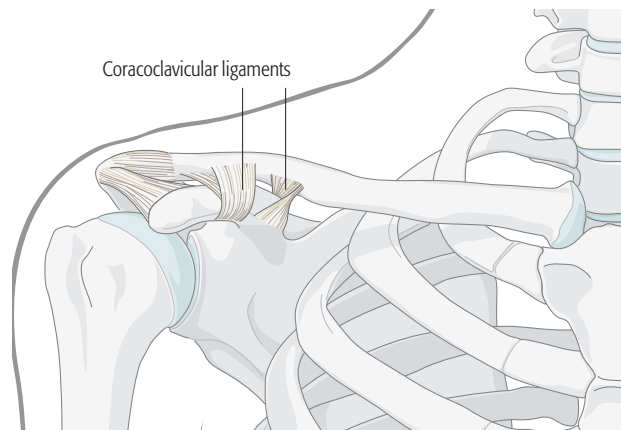
Sternocleidomastoid muscle

The sternocleidomastoid muscle, which inserts on the medial third of the clavicle, is not the main deforming force. The medial third of the clavicle stays in place, but the lateral 2/3 and the shoulder girdle displace downwards, inwards and forwards due to gravity. Pushing of the shoulder upward helps to reduce the lateral fragment to the medial fragment.



Ligaments

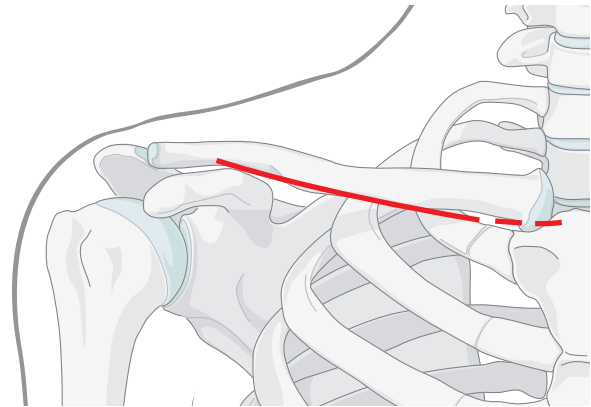
There are numerous ligamentous attachments to the clavicle. The coracoclavicular and acromioclavicular ligaments have a dominant role in maintaining the attachment of the clavicle to the upper extremity.





Skin incisions

An oblique 8-10 cm incision is made just inferiorly to the clavicle centered over the fracture site. In fractures of the medial third, the incision may be curved as required depending on chosen fixation.



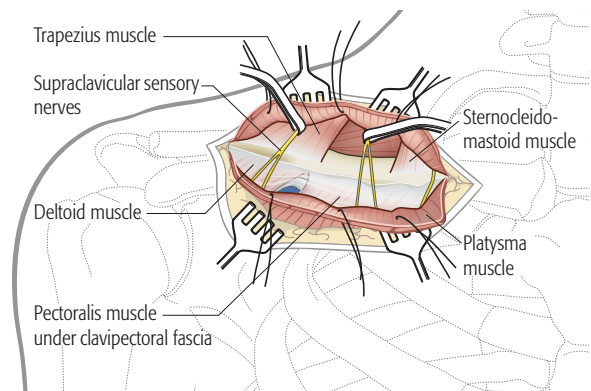
Deep dissection

The platysma is incised transversely and tagged with sutures.

Identify the supraclavicular nerves and make every effort to preserve them. Next incise the clavipectoral fascia. This will expose the underlying clavicle and the attached pectoralis major anteriorly, and trapezius posteriorly.

Minimal soft tissue dissection of underlying clavipectoral fascia is performed to expose the fracture. This can be performed bluntly with a periosteal elevator or sharply with a blade.

Care must be taken to preserve soft tissue attachments to all bone fragments to enable proper bone healing.





Wound closure

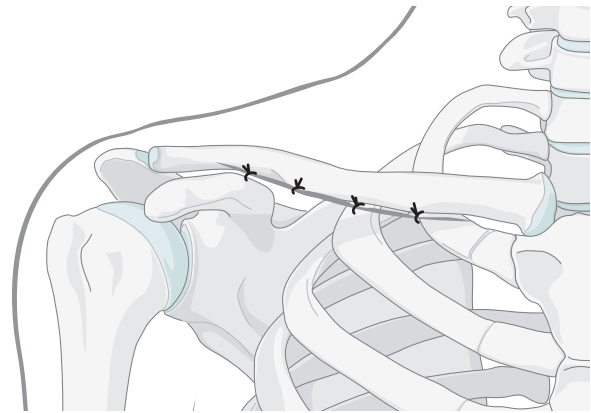
After copious irrigation of the wound the fascia and subcutaneous tissues are closed in layers.

Make sure that the clavipectoral fascia is closed so as to cover the underlying plate and optimize healing.

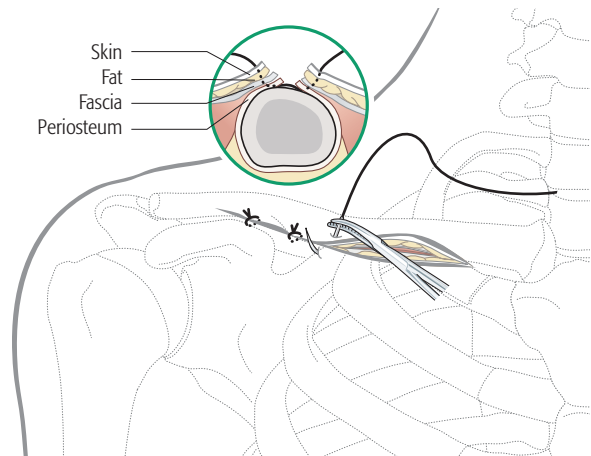
Take great care to oppose the layers of the platysma exactly as previously cut so that no deformity of the overlying skin occurs.

Pearl: Incorporating the cut and elevated underlying periosteum with the fascia repair will help to reduce dehiscence and strengthen closure of the fascia.

Oppose the skin with great care and avoid tension so as to end up with minimal scarring and deformity.



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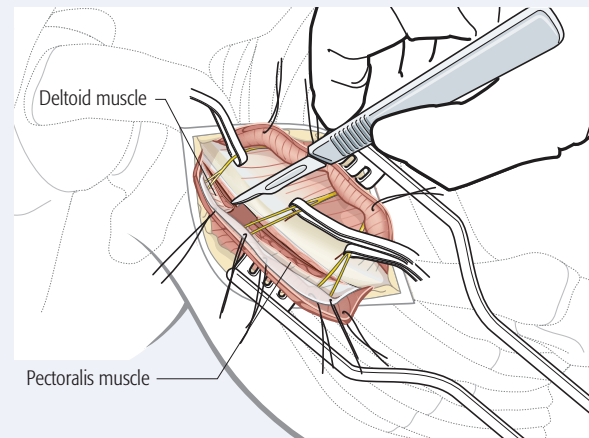




2.2 Superior approach

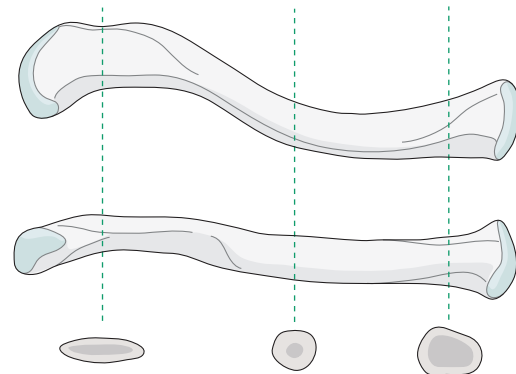
Surgical approach

The superior approach to the clavicle can be used for all lateral, medial, and diaphyseal clavicle fractures.



Anatomy

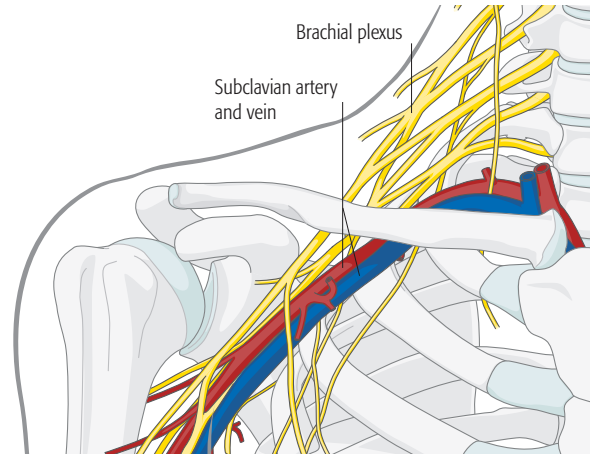
The clavicle is an S-shaped bone, anteriorly concave laterally and anteriorly convex medially. The cross sectional anatomy along its lateral to medial course changes from flat to tubular to prismatic. The junction from the flat region to the tubular region is a stress riser and this explains the higher incidence of midshaft fractures. Plates applied for lateral clavicular fractures are typically placed superiorly, while plates applied for diaphyseal or medial fractures can be placed anteriorly or superiorly.





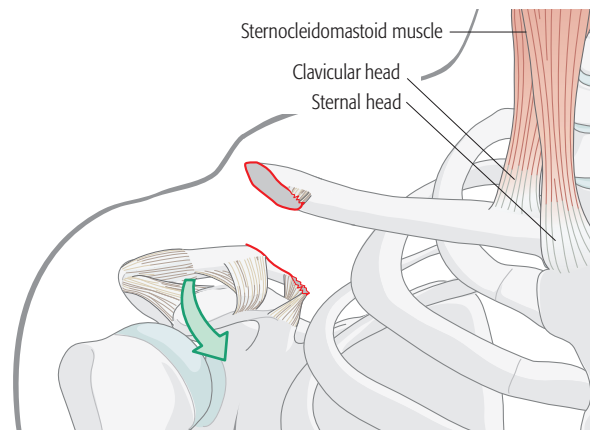
Neurovascular structures

The neurovascular structures, namely, the subclavian artery and vein and the brachial plexus, pass from a posterosuperior to antero inferior direction, between the first rib and the clavicle at the junction of its medial and middle thirds and are thus vulnerable during surgery and instrumentation in this region. In the middle third or the tubular portion, the subclavius muscle and fascia protect the neurovascular structures from the fracture. However, to avoid injury to the neurovascular structures, care should be exercised when sharp instruments are used in this area.



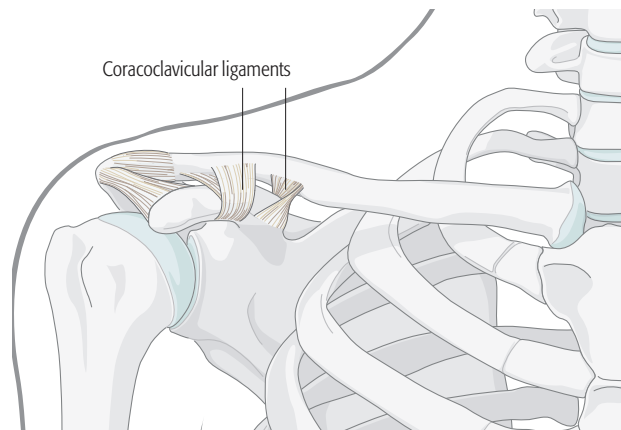
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Ligaments

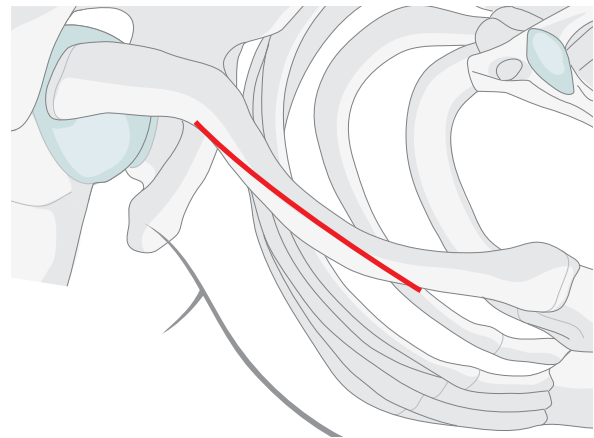
There are numerous ligamentous attachments to the clavicle. The coracoclavicular and acromioclavicular ligaments have a dominant role in maintaining the attachment of the clavicle to the upper extremity.





Skin incisions

An oblique 8-10 cm incision is made just superiorly over the clavicle centered over the fracture site. This incision will work for fractures of the medial 1/3.

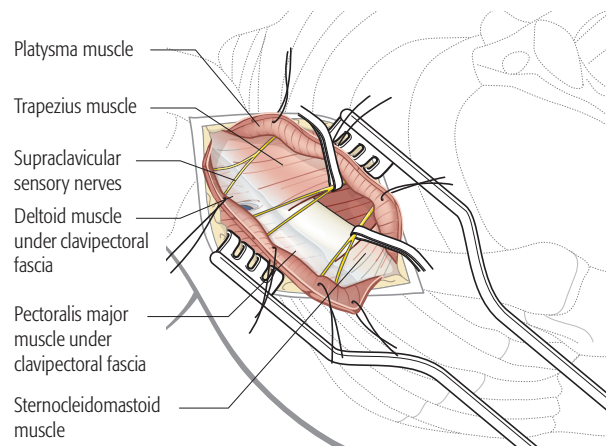


Deep dissection

Subcutaneous flaps are created anteriorly and posteriorly.

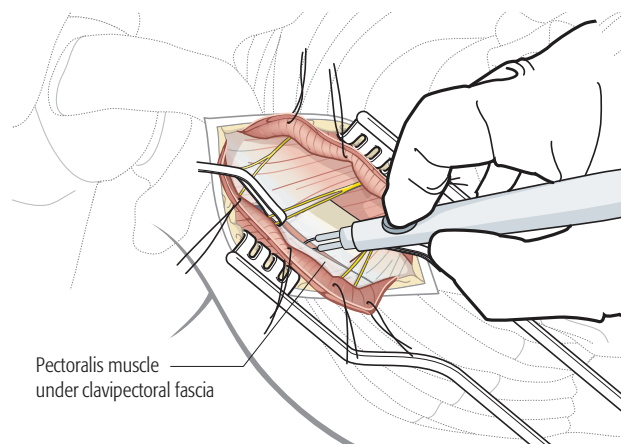
At the medial end of the incision, the sensory branches of the suprascapular nerve may be encountered. If so they should be identified and protected. If damaged or sacrificed, this leaves a small area of numbness inferior to the incision which patients will typically tolerate well if they are warned of this preoperatively.

However, the upper end of the cut cutaneous nerve can form a painful irritating neuroma. For this reason the supraclavicular nerve should not be sacrificed.



Pectoralis major muscle

The clavipectoral fascia is incised to expose the fracture. Laterally a small area of pectoralis major muscle attachment may require reflection at the fracture site, most of the attachment of this muscle is left undisturbed. This can be performed bluntly with periosteal elevators or sharply with a blade.

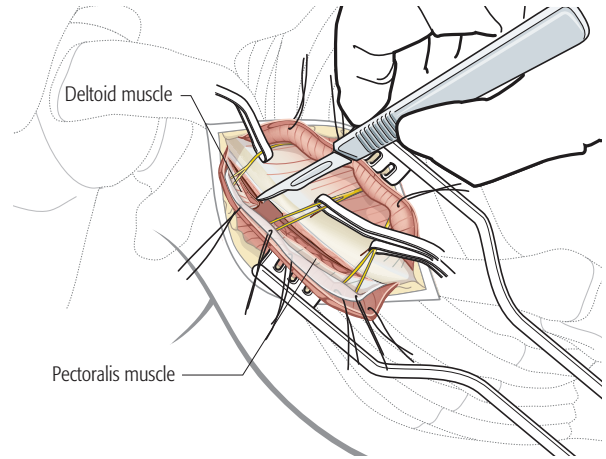




Deltoid muscle

Laterally, the deltoid muscle must be reflected from the lateral clavicle anteriorly and posteriorly in a contiguous sheet.

Care must be taken to preserve soft tissue attachments to all bone fragments to enable proper bone healing. Comminution of the fracture site is common. While accurate reduction of these fragments is important, it should not be at the expense of complete stripping of soft tissue. It is preferable to maintain viability of these fragments at the expense of some malreduction.



Closure

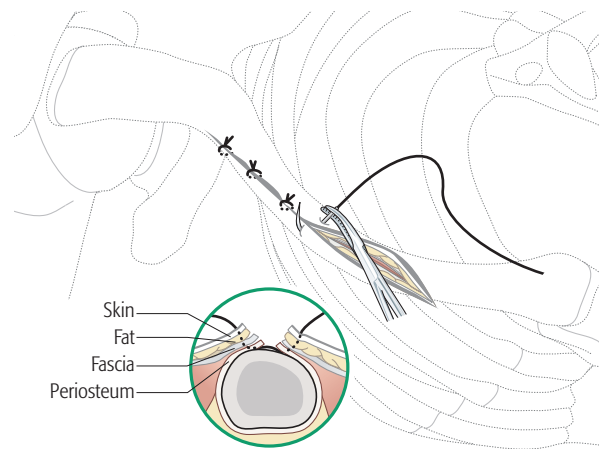
After copious irrigation of the wound the fascia and subcutaneous tissues are closed in layers.

Take great care to oppose the layers of the platysma exactly as previously cut so that no deformity of the overlying skin occurs.

Make sure that the clavipectoral fascia is closed so as to cover the underlying plate and optimize healing.

Pearl: Incorporating the cut and elevated underlying periosteum with the fascia repair will help to reduce dehiscence and strengthen closure of the fascia.

Oppose the skin with great care and avoid tension so as to end up with minimal scarring and deformity.





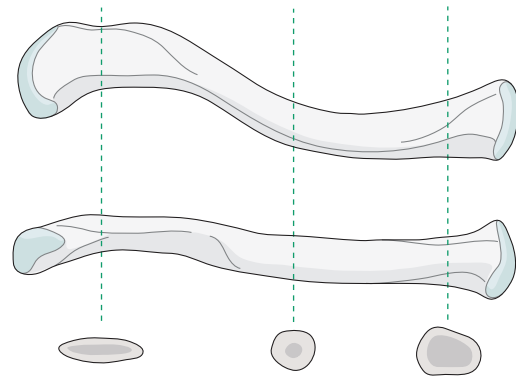
2.3 MIPO anterior approach

Surgical approach

MIPO approaches to the diaphyseal clavicle can be utilized for many clavicular diaphysis fractures requiring anterior and superior plating.

Anatomy

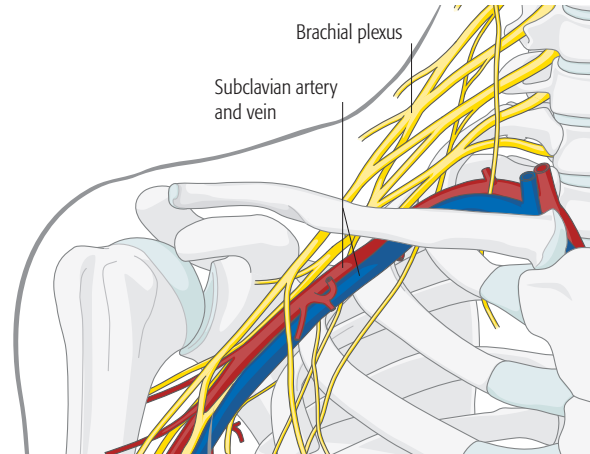
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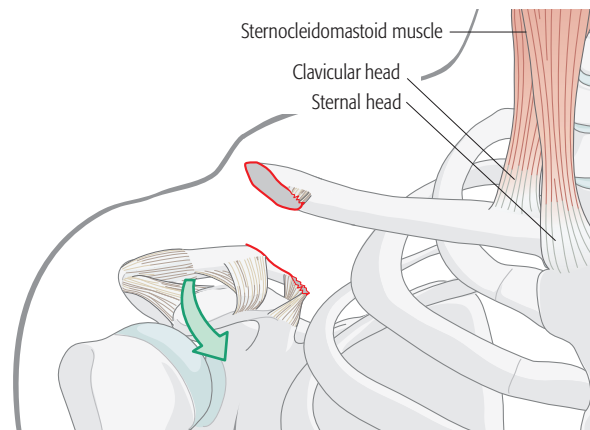
Neurovascular structures

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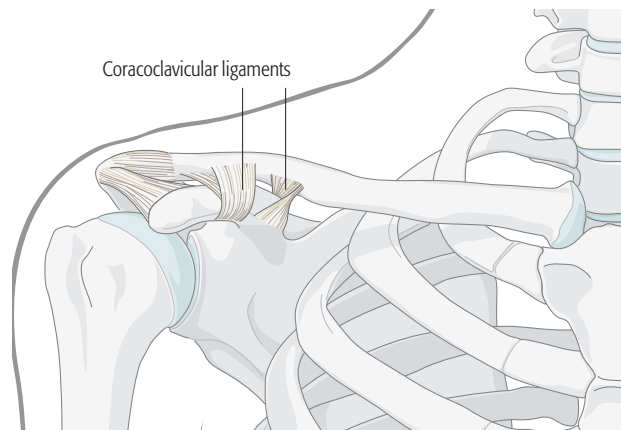
Sternocleidomastoid muscle

The sternocleidomastoid muscle, which inserts on the medial third of the clavicle, acts as a deforming force, pulling the medial fragment superiorly, following a fracture. The weight of the arm acts as a deforming force pulling the lateral fragment inferiorly and anteriorly. Pushing of the shoulder upward helps to reduce the lateral fragment to the medial fragment.



Ligaments

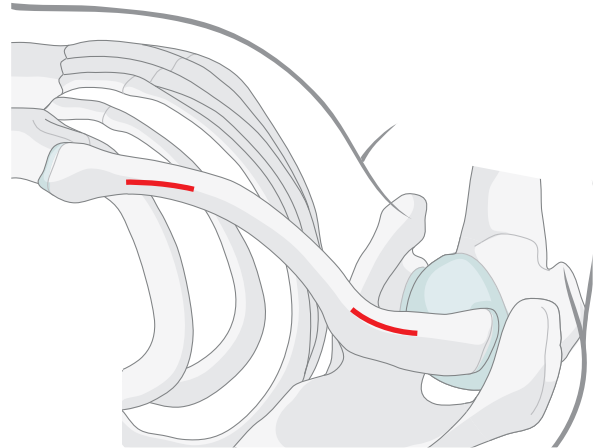
There are numerous ligamentous attachments to the clavicle in which the coracoclavicular and acromioclavicular ligaments have a dominant role in stabilizing the clavicle laterally.





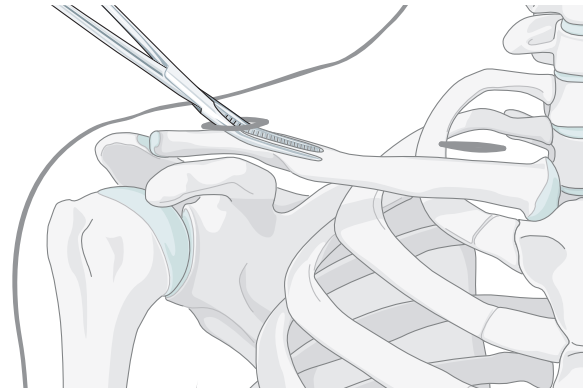
Skin incisions

Two skin incisions, each 2–3 cm in length, are made over the lateral and medial ends of the clavicle corresponding in position to the ends of the preselected plate.



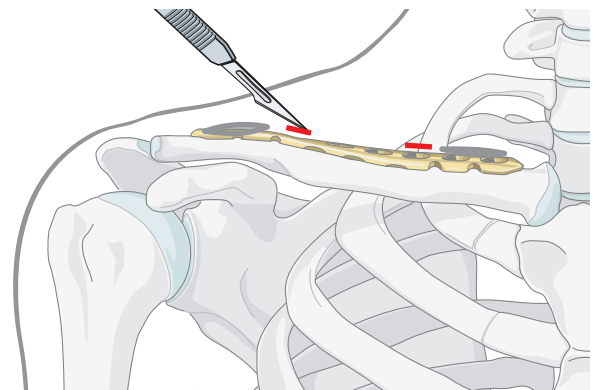
Dissection

A subcutaneous tunnel is created using blunt dissection connecting the medial and lateral incisions.



Stab incisions

Stab wounds are made for insertion of screws, as well as for pins and pointed reduction forceps. The stab wounds for the screws are made directly over the plate holes which can usually be palpated through the skin. A similar small incision can be made directly over the fracture if a limited open reduction has to be performed.

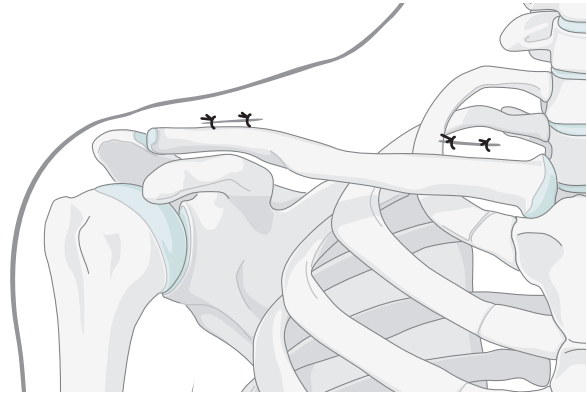




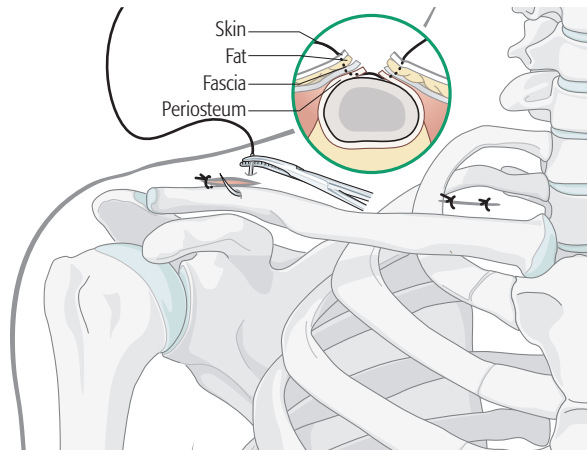
Closure

After copious irrigation of the wound the fascia and subcutaneous tissues are closed in layers.

It is important that the fascial closure is water tight and completely covering the underlying plate. This will optimize healing and prevent deep infections in this area, which has a limited soft tissue envelope.



Pearl: Incorporating the cut and elevated underlying periosteum with the fascial repair will help to reduce dehiscence and strengthen closure of the fascia.

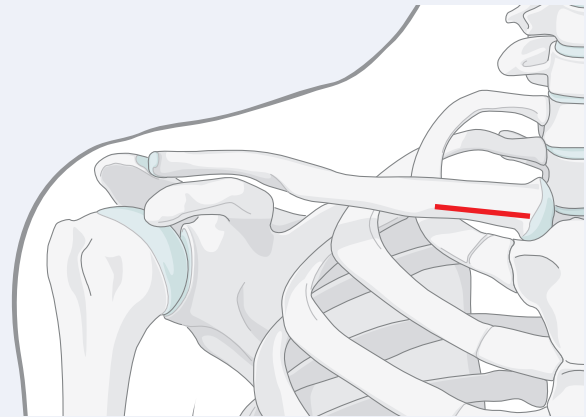




2.4 Nailing approach

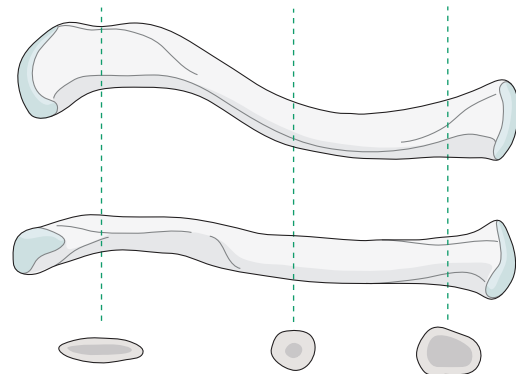
Surgical approach

This approach is used for intramedullary nailing of the clavicle.



Anatomy

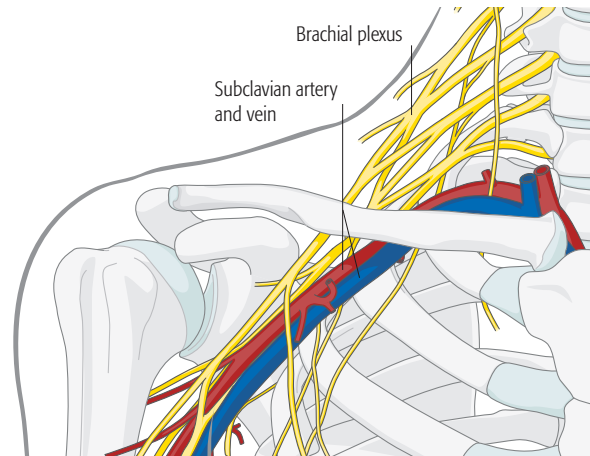
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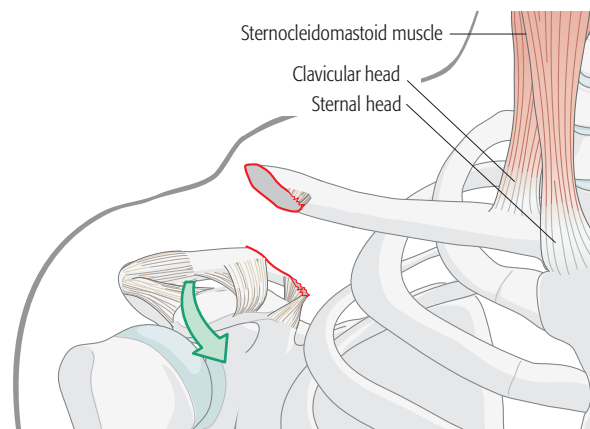
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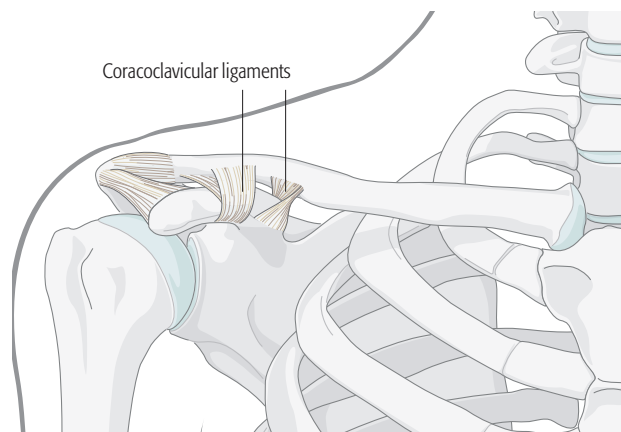
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Ligaments

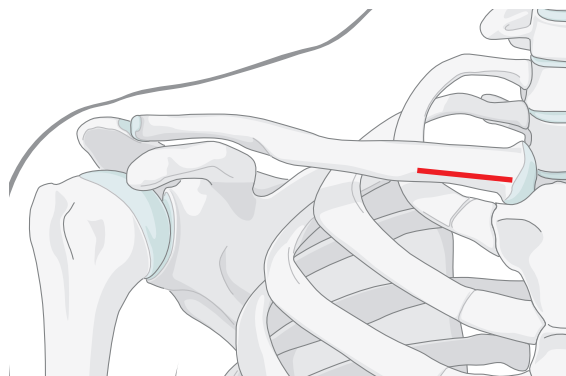
There are numerous ligamentous attachments to the clavicle in which the coracoclavicular and acromioclavicular ligaments have a dominant role in stabilizing the clavicle laterally.





Skin incisions

A small skin incision, 1-2 cm in length, is made just lateral to the sternoclavicular joint anteriorly. Blunt dissection to bone is performed to expose the entry point of the nail.



Closure

After irrigation of the wound, it is closed in layers.

