



THE SHOULDER COMPLEX

Dhivakar Murugan
MPT - Neurology
Assistant Professor
SNSCOP



INTRODUCTION

- The shoulder complex, composed of the clavicle, scapula, and humerus, is an intricately designed combination of 3 joints that links the upper extremity (UE) to the thorax.
- The articular structures of the shoulder complex are designed primarily for mobility, allowing us to move and position the hand through a wide range of space.
- The Glenohumeral (GH) joint, which links the humerus and scapula, has greater mobility than any other joint in the body.

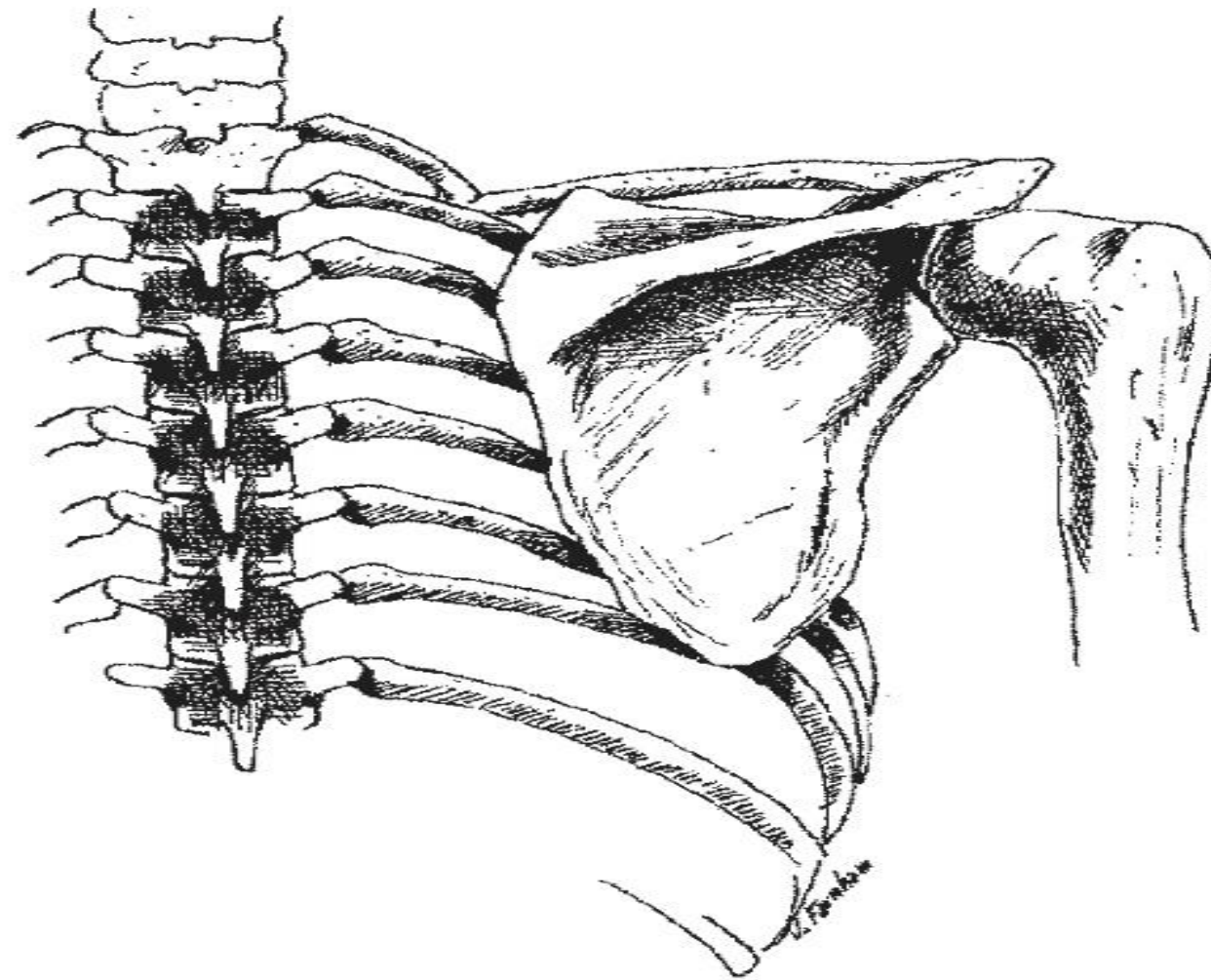


Figure 7-1 A posterior view of the three components of the shoulder complex: the humerus, the scapula, and the clavicle.



COMPONENTS OF THE SHOULDER COMPLEX

- The osseous segments of the shoulder complex are the clavicle, scapula, and humerus.
- These 3 segments are joined by **3 Interdependent linkages**:
 1. Sternoclavicular (SC) joint,
 2. Acromioclavicular (AC) joint,
 3. Glenohumeral (GH) joint.
- The articulation between the scapula and the thorax is often described as the “**Scapulothoracic (ST) joint**”, although it does not have the characteristics of a fibrous, cartilaginous, or synovial joint.

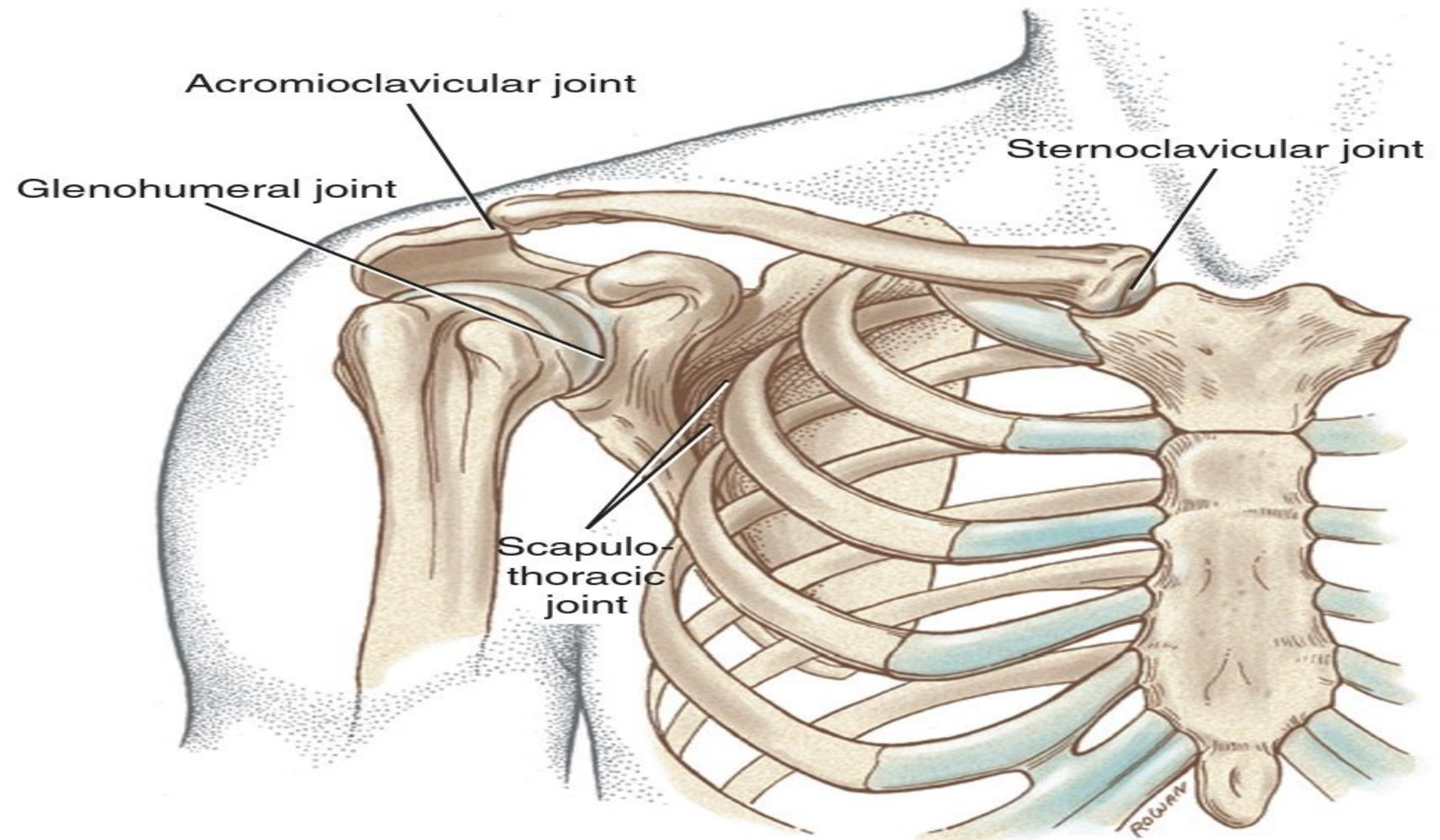


FIG. 5.1 The joints of the right shoulder complex.



- Elevation of the UE refers to the **combination of scapular, clavicular, and humeral motion** that occurs when the arm is raised either forward or to the side (including sagittal plane flexion, frontal plane abduction, and all the motions in between).
- Motion of the scapula on the thorax normally contributes about **1/3rd of the total shoulder complex motion** necessary for arm elevation, whereas the **GH joint contributes about 2/3rd of the total motion.**



STERNOCLAVICULAR JOINT



STERNOCLAVICULAR JOINT

- The SC joint serves as the only structural attachment of the shoulder complex and UE to the axial skeleton.
- The SC joint is a **plane synovial joint** with **3 rotary** and **3 translatory DOF**.
- The joint has a synovial capsule, a joint disc, and 3 major ligaments.
- Rotations at the SC joint produce movement of both the clavicle and the scapula under conditions of normal function, because the scapula is linked with the lateral end of the clavicle at the AC joint.
- Similarly, movement of the scapula results in movement of the clavicle at the SC joint.

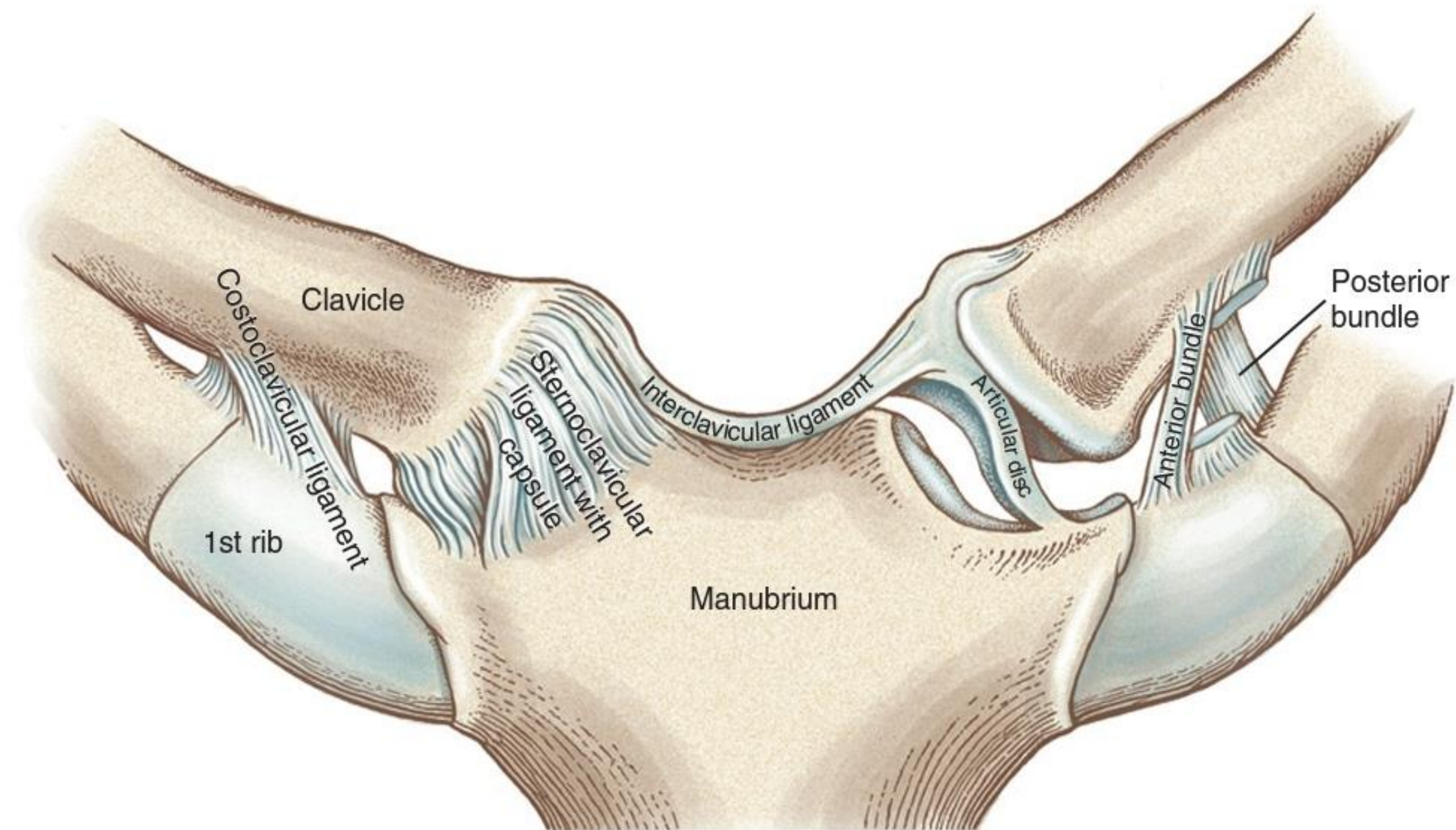


FIG. 5.11 The sternoclavicular joints. The capsule and lateral section of the anterior bundle of the costoclavicular ligament have been removed on the left side.



SC ARTICULATING SURFACES

- The SC articulation consists of 2 shallow, **saddle-shaped surfaces**, one at the medial end of the clavicle and one at the notch formed by the manubrium of the sternum and first costal cartilage.
- The SC joint is often classified as a **plane synovial joint** because the saddle shape of the articular surfaces is very subtle.
- The medial end of the clavicle and the manubrium are incongruent, with little direct contact between their articular surfaces.

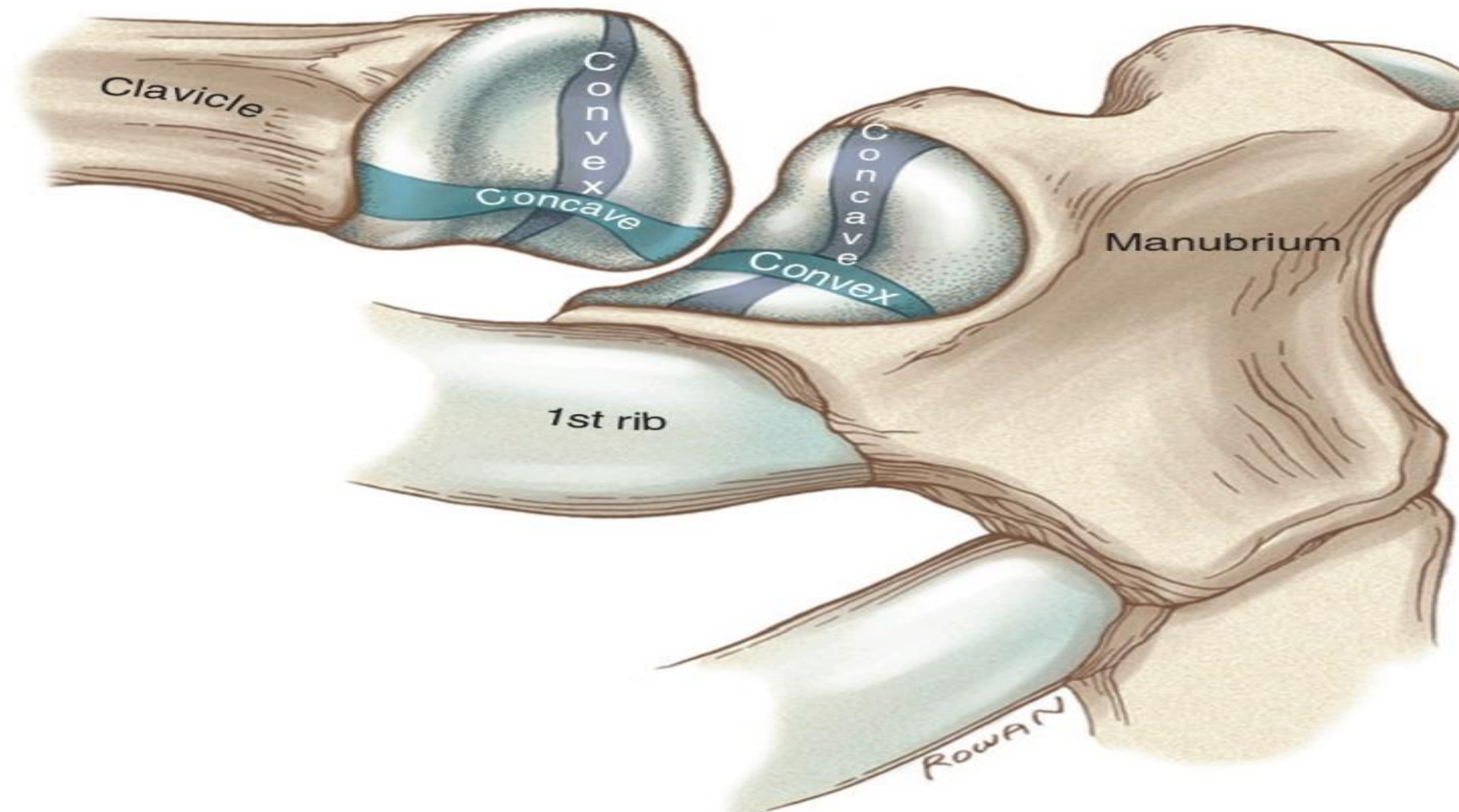


FIG. 5.12 An anterior-lateral view of the articular surfaces of the right sternoclavicular joint. The joint has been opened up to expose its articular surfaces. The longitudinal diameters (*purple*) extend roughly in the frontal plane between superior and inferior points of the articular surfaces. The transverse diameters (*blue*) extend roughly in the horizontal plane between anterior and posterior points of the articular surfaces.



- The superior portion of the medial clavicle does not contact the manubrium at all but serves as the attachment for the SC joint disc and the interclavicular ligament.
- At rest, the SC joint space is wedge-shaped and open superiorly.
- Movements of the clavicle in relation to the manubrium result in changes to the areas of contact between the clavicle, the SC joint disc, and the manubriocostal cartilage.



SC ARTICULAR DISC

- The SC joint has a **fibrocartilage disc**, or meniscus, **that increases congruence between the articulating surfaces.**
- The upper portion of the SC disc is attached to the posterosuperior clavicle, while the lower portion is attached to the manubrium and first costal cartilage, as well as to the anterior and posterior aspects to the fibrous SC capsule.
- The disc transects the SC joint space diagonally, dividing the joint into 2 separate cavities.

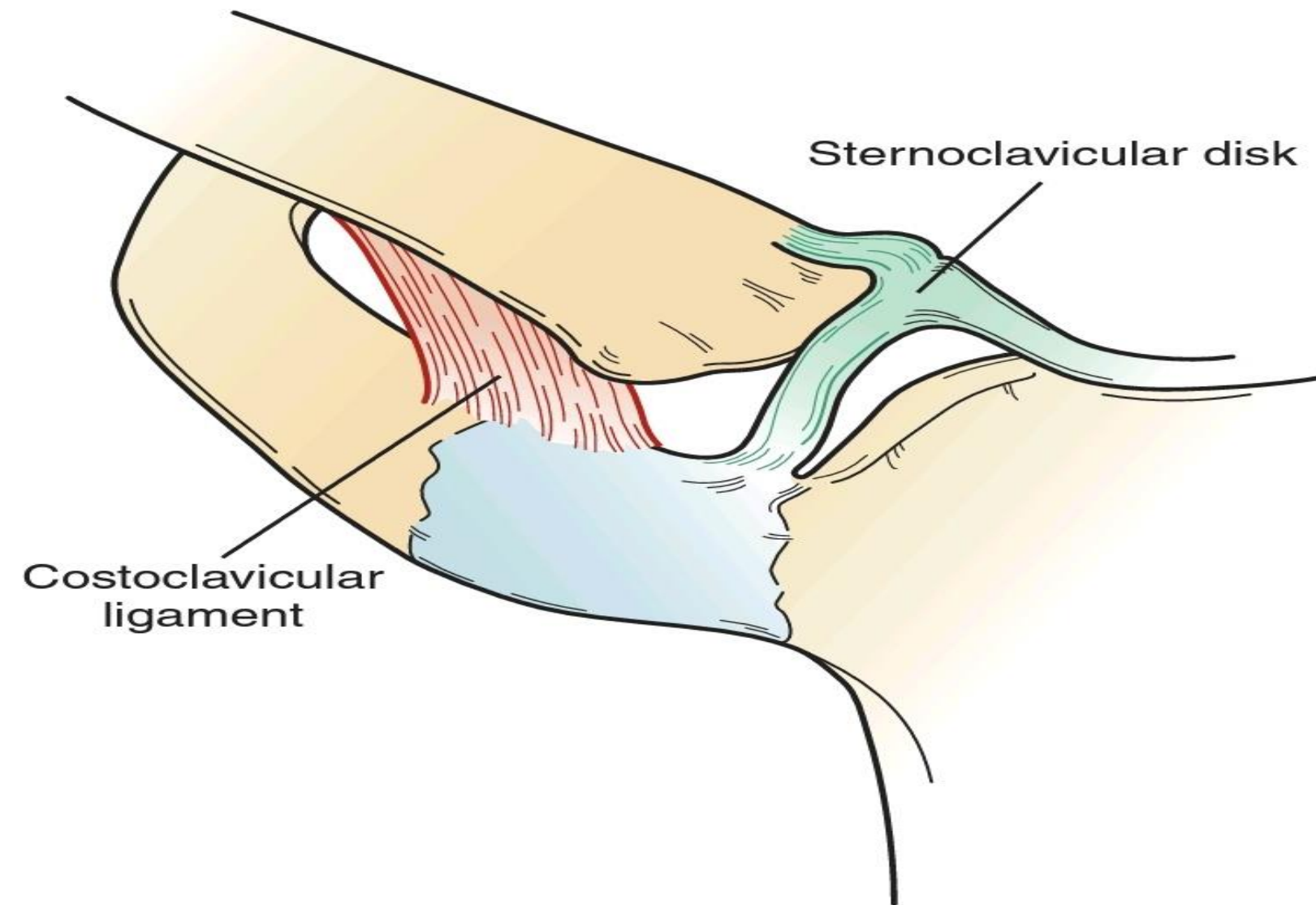


Figure 7-3 The sternoclavicular disc transects the joint into two separate joint cavities.



- During shoulder motion, the disc acts like a hinge or pivot point for the medial end of the clavicle.
- During **elevation and depression of the clavicle**, the **medial articular surface rolls and slides on the relatively stationary disc**, with the upper attachment of the disc serving as a pivot point.
- During **protraction and retraction of the clavicle**, the **SC disc and medial articular surface roll and slide together on the manubrial facet**, with the lower attachment of the disc serving as a pivot point.



- The **disc**, therefore, is **considered part of the manubrium during elevation and depression** and **part of the clavicle during protraction and retraction.**
- The **SC disc provides stability by increasing joint congruence** and by **absorbing forces transmitted along the clavicle from its lateral end to the SC joint.**
- The unique diagonal attachment of the SC disc helps limit medial movement of the clavicle, which might otherwise cause the medial articular surface of the clavicle to override the shallow manubrial facet.



SC JOINT CAPSULE AND LIGAMENTS

- The SC joint is surrounded by a fairly strong fibrous capsule but depends on 3 ligament complexes for the majority of its support:
 1. Anterior and Posterior SC ligaments,
 2. Costoclavicular ligament, and
 3. Interclavicular ligament.
- The anterior and posterior SC ligaments reinforce the capsule and function primarily to check anterior and posterior translatory movement of the medial end of the clavicle.

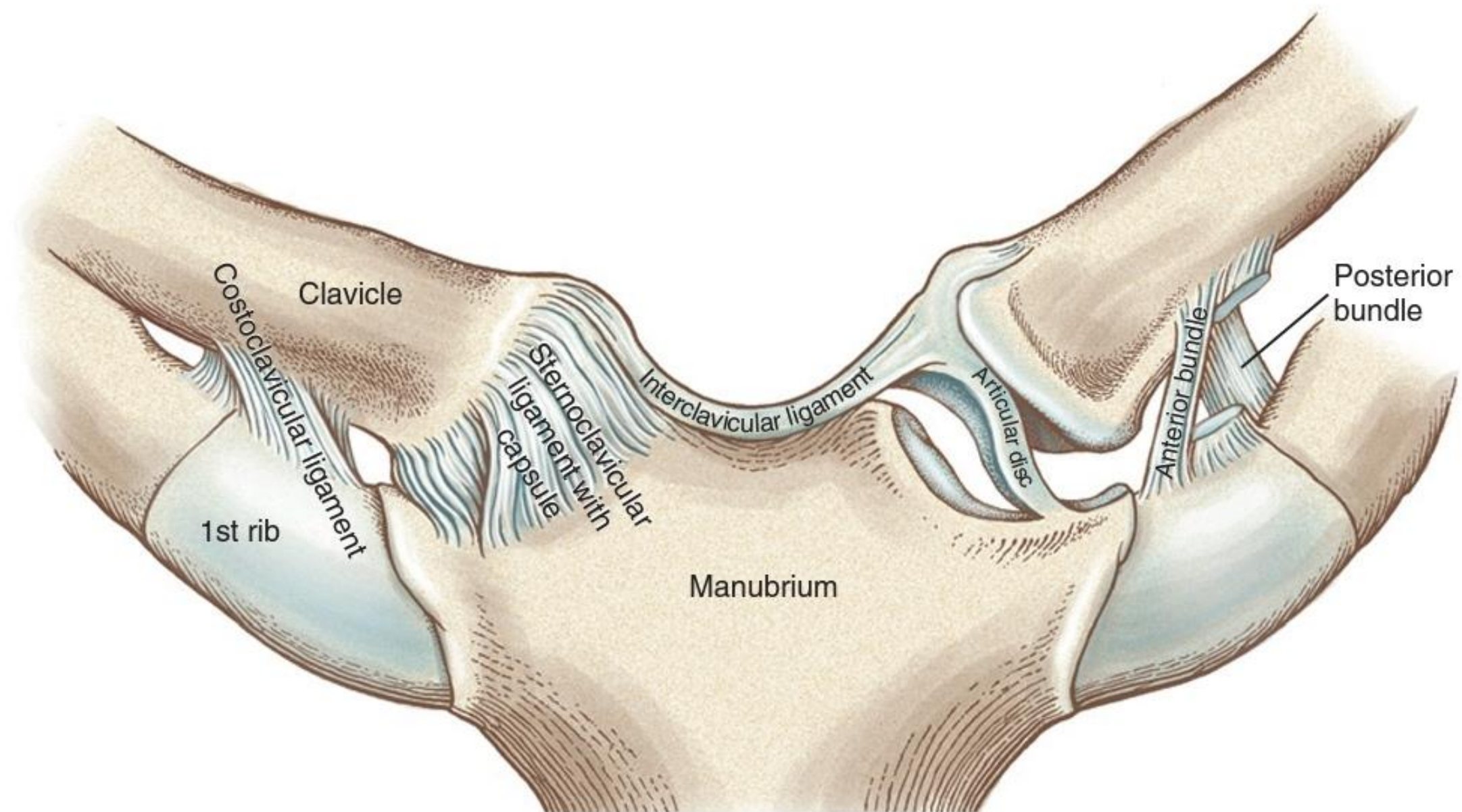


FIG. 5.11 The sternoclavicular joints. The capsule and lateral section of the anterior bundle of the costoclavicular ligament have been removed on the left side.



- The posterior capsule provides the primary restraint to both anterior and posterior translations of the medial clavicle on the sternum.
- The **costoclavicular ligament** is a very strong ligament between the clavicle and the first rib and has two segments, or laminae.
- The **anterior lamina** has fibers that are **directed laterally** from the first rib to the clavicle, whereas the fibers of the **posterior lamina** are **directed medially** from the rib to the clavicle.

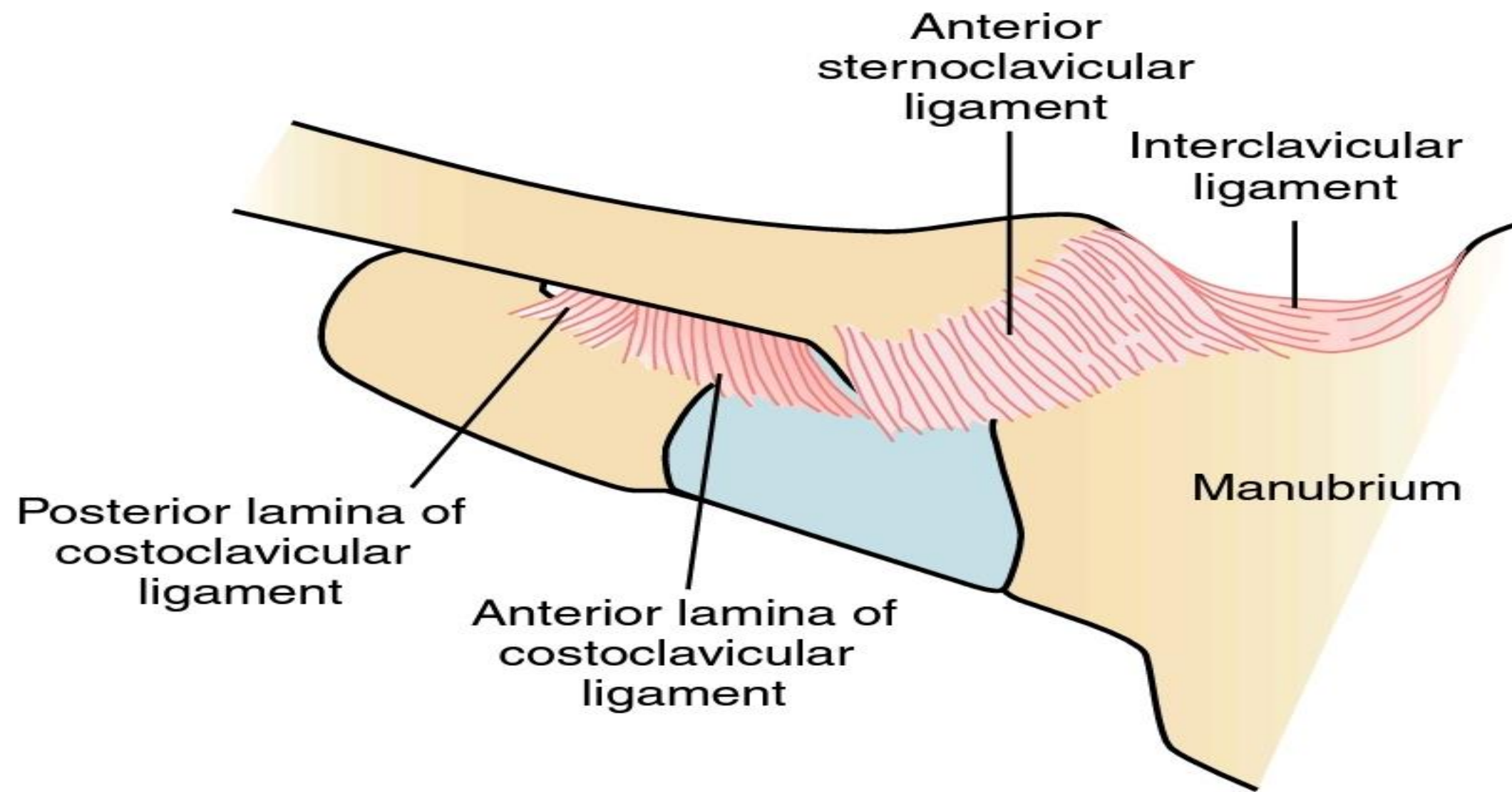


Figure 7-4 The sternoclavicular joint ligaments. The axes for sternoclavicular joint motion appear to occur at the location of the costoclavicular ligament.



- Both laminae **limit elevation** of the lateral end of the clavicle and, when taut, may contribute to the inferior gliding of the medial clavicle on the manubrium that occurs with clavicular elevation
- The costoclavicular ligament also **limits the superiorly directed forces applied to the clavicle by the SCM and sternohyoid muscles.**
- The posterior lamina will resist **medial movement of the clavicle**, absorbing some of the force that would otherwise be imposed on the SC disc.



- The interclavicular ligament limits excessive depression of the distal clavicle and superior gliding of the medial clavicle on the manubrium.
- The limitation of clavicular depression by the interclavicular ligament is critical to protecting structures such as the brachial plexus and subclavian artery, which pass under the clavicle and over the first rib.



SC MOTIONS

- The 3 rotary DOF at the SC joint are most commonly described as
 1. Elevation/depression,
 2. Protraction/retraction, and
 3. Anterior/posterior rotation of the clavicle.
- The motions of elevation/depression and protraction/retraction should be visualized by referencing movement of the lateral end of the clavicle.

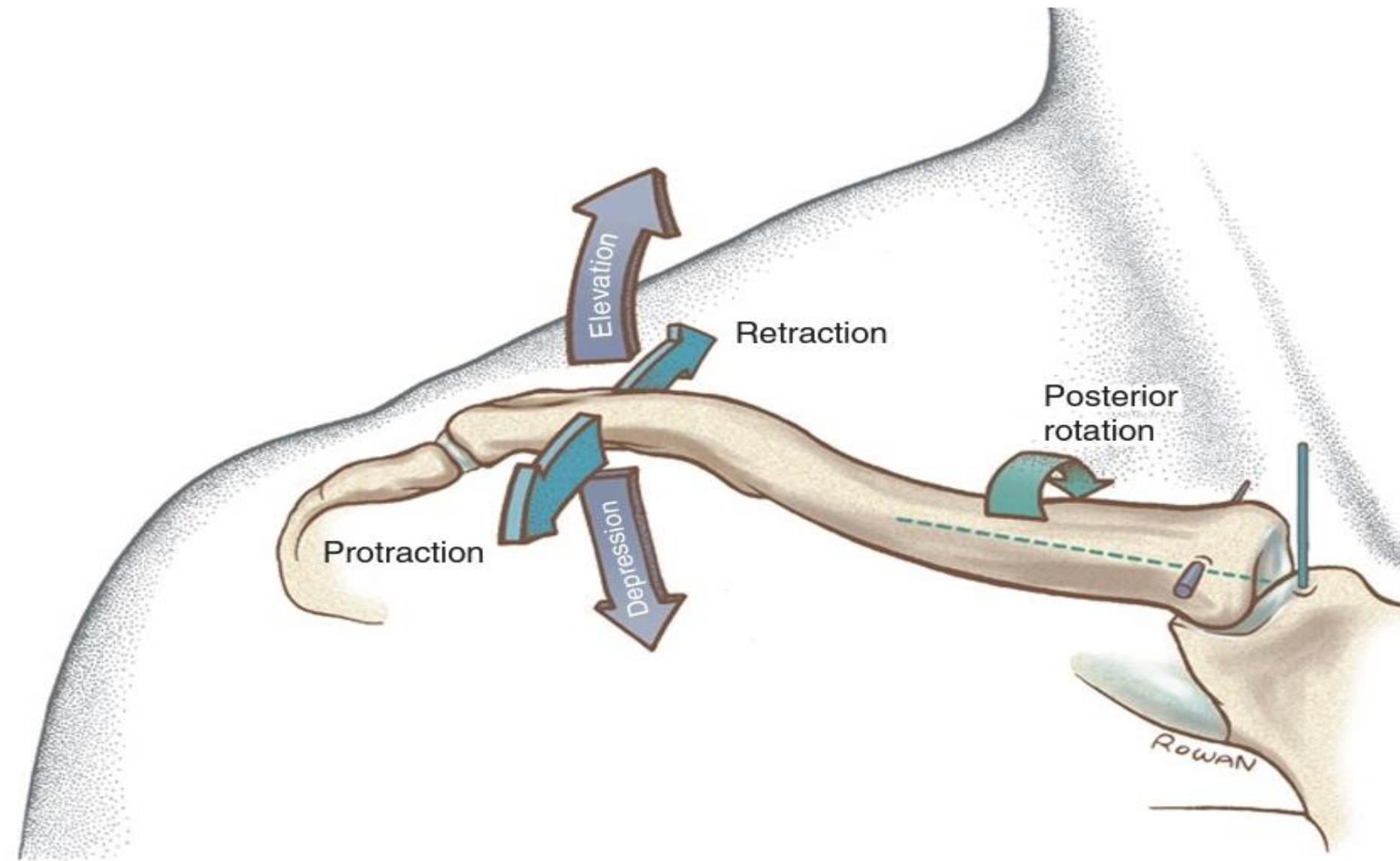


FIG. 5.13 The osteokinematics of the right sternoclavicular joint. The motions are elevation and depression in a near frontal plane (*purple*), protraction and retraction in a near horizontal plane (*blue*), and posterior clavicular rotation in a near sagittal plane (*green*). The vertical and anterior-posterior axes of rotation are color-coded with the corresponding planes of movement. The longitudinal axis is indicated by the dashed green line.



Elevation and Depression of the Clavicle

- The motions of elevation and depression occur around an approximately **A-P axis** between a convex clavicular surface and a concave surface formed by the manubrium and the first costal cartilage.
- With **elevation**, the **lateral clavicle rotates upward**;
- With **depression**, the **lateral clavicle rotates downward**.

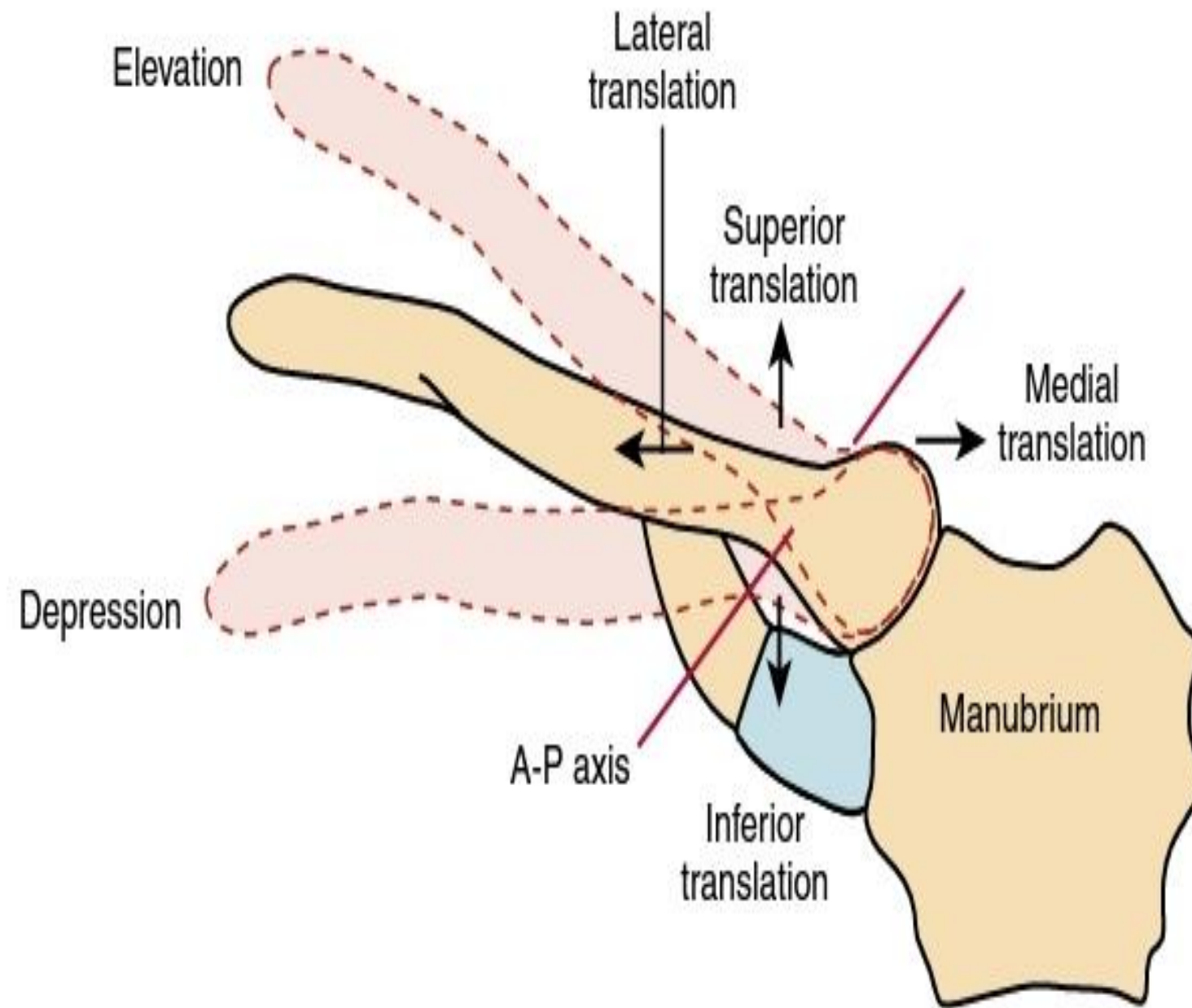


Figure 7-5 Clavicular elevation/depression at the sternoclavicular joint occurs as movement of the lateral clavicle about an A-P axis. The medial clavicle also has small magnitudes of medial/lateral translation and superior/inferior translation at the sternoclavicular joint.

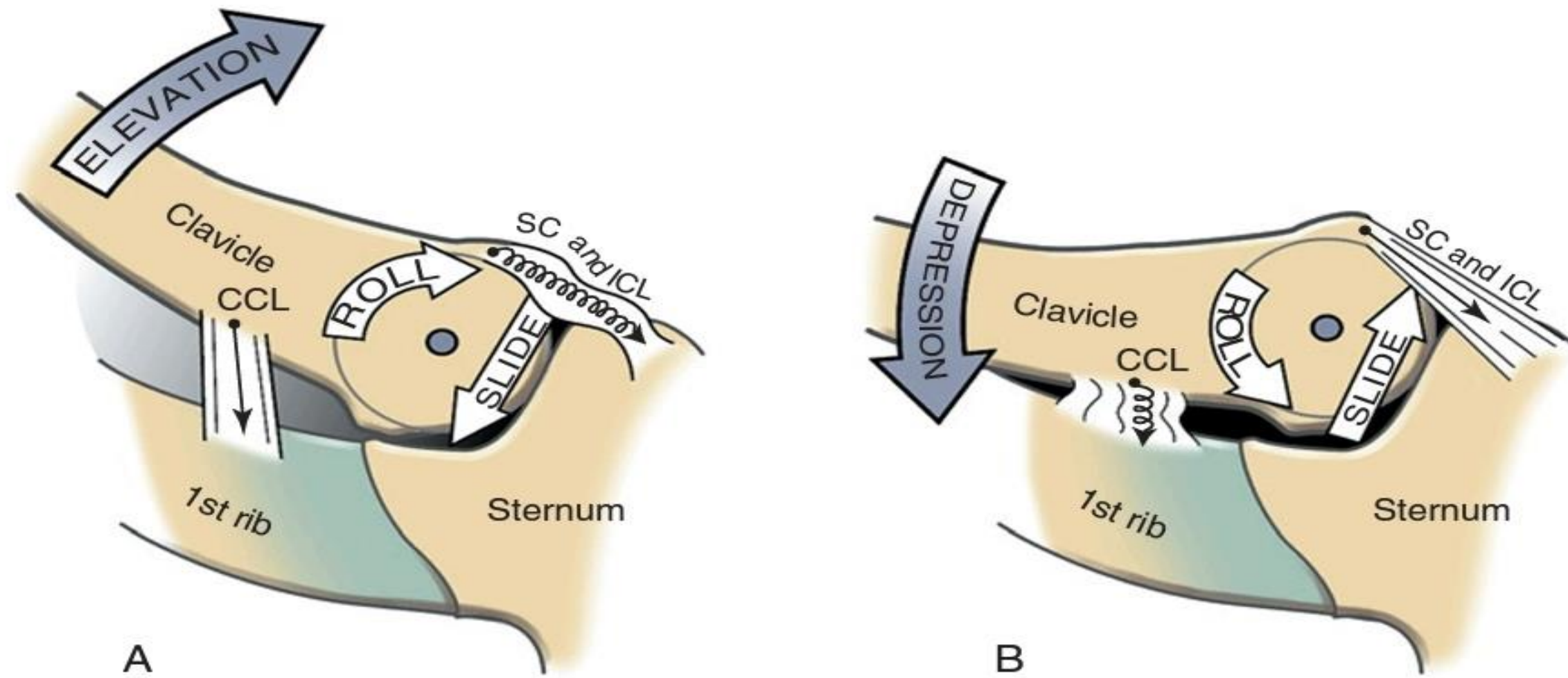


FIG. 5.14 Anterior view of a mechanical diagram of the arthrokinematics of roll and slide during elevation (A) and depression (B) of the clavicle around the right sternoclavicular joint. The axes of rotation are shown in the anterior-posterior direction near the head of the clavicle. Stretched structures are shown as thin elongated arrows; slackened structures are shown as wavy arrows. Note in (A) that the stretched costoclavicular ligament produces a downward force in the direction of the slide. *CCL*, costoclavicular ligament; *ICL*, interclavicular ligament; *SC*, superior capsule.



Protraction and Retraction of the Clavicle

- Protraction and retraction of the clavicle occur at the SC joint around an approximately vertical axis that also appears to lie at the costoclavicular ligament.
- With **protraction**, the **lateral clavicle moves anteriorly**, and with **retraction**, the **lateral clavicle moves posteriorly**.

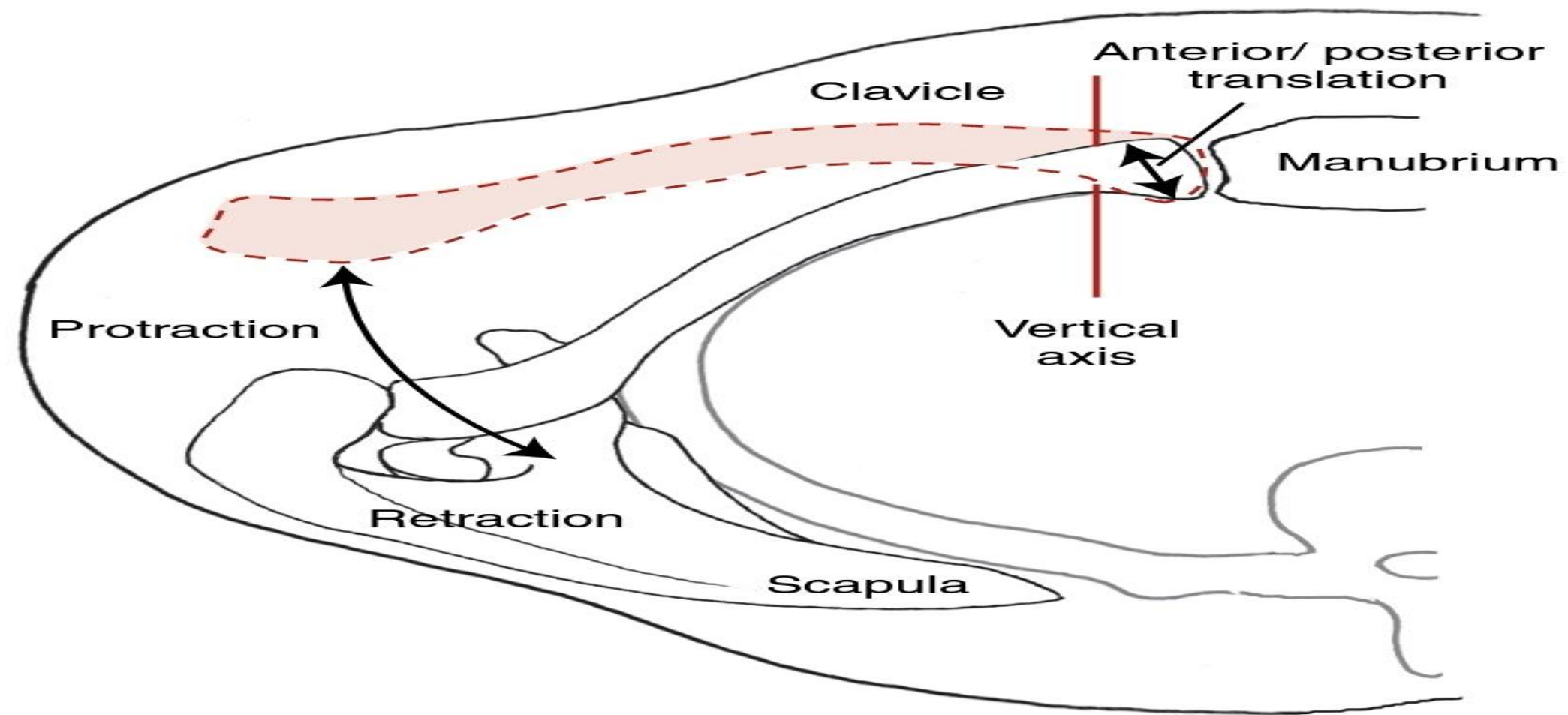


Figure 7–6 Shown in a superior view, clavicular protraction/retraction at the sternoclavicular joint occurs as movement of the lateral clavicle (and attached scapula) around a vertical axis. The medial clavicle also has a small magnitude of anterior/posterior translation at the sternoclavicular joint.



Anterior and Posterior Rotation of the Clavicle

- Anterior/posterior rotation of the clavicle occurs as a spin between the saddle-shaped surfaces of the medial clavicle and manubriocostal facet.
- The clavicle rotates posteriorly from neutral, bringing the inferior surface of the clavicle to face anteriorly. This has also been referred to as backward or upward rotation rather than posterior rotation.
- From its fully rotated position, the clavicle can rotate anteriorly again to return to neutral.



SC STRESS

- The bony morphology, capsule, ligaments, and disc of the SC joint combine to create an articulation that contributes to the great mobility of the arm while remaining a stable link to the axial skeleton.
- Although the SC joint is considered incongruent, it does not undergo the degree of degenerative change common to the other joints of the shoulder complex.
- Dislocations of the SC joint represent only 1% of joint dislocations in the body and only 3% of shoulder girdle dislocations.



- Strong force-dissipating structures such as the SC disc and the costoclavicular ligament minimize articular stresses and also prevent excessive intra-articular motion, which could lead to subluxation or dislocation.