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Short Communication

The Sternum: Central Support in Human Anatomy and Its Vital Role in Medicine

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DESCRIPTION

The sternum, commonly known as the breastbone, is a flat, elongated bone located at the center of the chest. It serves as an important component of the human skeletal system, providing structural support and protection for vital organs such as the heart and lungs. Despite its relatively simple appearance, the sternum plays a significant role in both anatomy and medicine, particularly in surgeries, trauma care, and diagnostics. This article explores the anatomy of the sternum, its biological functions, and its importance in medical practice.

Anatomy of the sternum

The sternum is part of the axial skeleton, which includes the bones that form the central axis of the body. It is divided into three main parts: The manubrium, the body (or gladiolus), and the xiphoid process.

Manubrium: The manubrium is the uppermost section of the sternum. It is roughly trapezoidal in shape and connects to the clavicles (collarbones) at the sternoclavicular joints. The manubrium also articulates with the first pair of ribs and part of the second pair. At its superior end, the manubrium features the jugular notch, a noticeable depression that can be felt at the base of the neck [1].

Body (Gladiolus): The body, or gladiolus, is the longest part of the sternum and lies below the manubrium. It is somewhat rectangular and connects to the manubrium *via* the sternal angle, an important anatomical landmark where the second rib attaches. The body of the sternum articulates with the second through seventh pairs of ribs, providing a stable attachment for the rib cage [2].

Xiphoid process: The xiphoid process is the smallest and most variable part of the sternum, located at its inferior end. In youth, the xiphoid process is cartilaginous, but it typically ossifies into bone in adulthood. Although it does not directly articulate with any ribs, the xiphoid process serves as an attachment point for muscles involved in respiration and abdominal wall stability [3].

Biological functions of the sternum

The sternum performs several essential functions within the human body, primarily related to protection, support, and movement.

Protection of vital organs: One of the sternum's most critical roles is to protect the heart and lungs, which are situated directly behind it within the thoracic cavity. The sternum, along with the rib cage, forms a protective barrier that shields these organs from physical trauma. This protection is vital, as injuries to the heart or lungs can be life-threatening [4].

Support for the rib cage: The sternum serves as the central attachment point for the rib cage, connecting the ribs to the front of the body. This connection is essential for maintaining the structure and integrity of the rib cage, which in turn supports the thoracic cavity and helps facilitate breathing. The flexibility and strength of the rib-sternum connections allow the rib cage to expand and contract during respiration.

Anchor for muscles: The sternum acts as an anchor for several important muscles, including the pectoralis major, which is involved in arm movements, and the diaphragm, which plays an important role in breathing. The muscles attached to the sternum contribute to the mechanics of respiration, upper limb movement, and abdominal wall stability [5].

Sternum in medical practice

Due to its central location and critical functions, the sternum is a focal point in various medical procedures and diagnostic practices. Its role in trauma care, surgical interventions, and imaging is particularly significant [6].

Trauma and the sternum: The sternum is susceptible to injury in cases of blunt chest trauma, such as that caused by car accidents or falls. Sternal fractures, though relatively uncommon, can result from significant force applied to the chest. Such fractures are often associated with injuries to underlying organs, such as cardiac contusions or pulmonary damage, making them a serious concern in trauma care.

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Sternal fractures are typically diagnosed through physical examination and imaging techniques like X-rays or Computed Tomography (CT) scans. Treatment may involve pain management, rest, and, in severe cases, surgical intervention to stabilize the fracture and prevent complications [7].

Surgical significance of the sternum: The sternum plays a critical role in several types of surgical procedures, most notably in open-heart surgery. During a median sternotomy, a common approach in cardiac surgery, the sternum is split longitudinally to provide access to the heart and major blood vessels. This procedure allows surgeons to perform complex operations, such as Coronary Artery Bypass Grafting (CABG) or valve replacement, with direct access to the heart.

Following the procedure, the sternum is typically wired back together to promote healing and ensure stability. The recovery process requires careful monitoring to prevent complications like infection or sternal dehiscence (where the bone fails to properly heal and comes apart) [8].

Diagnostic imaging and the sternum: The sternum is also a key focus in diagnostic imaging, particularly in the assessment of bone marrow. The sternum contains red bone marrow, which is active in hematopoiesis (the production of blood cells). Bone marrow biopsies are sometimes performed on the sternum to diagnose blood disorders such as leukemia or lymphoma. Additionally, the sternum is evaluated in imaging studies to detect metastases in cases of breast cancer or other malignancies [9].

In radiography, the sternum's position and structure are carefully analyzed to identify any abnormalities, such as sternal fractures, osteomyelitis (bone infection), or other pathological conditions. Advanced imaging techniques, like Magnetic Resonance Imaging (MRI) or CT scans, provide detailed views of the sternum and surrounding tissues, aiding in accurate diagnosis and treatment planning [10].

Recent advances

Recent advances in medical technology and materials science have led to new approaches in the treatment and management of sternal conditions. Innovations such as custom-made sternal implants, 3D-printed prosthetics, and minimally invasive surgical techniques are improving outcomes for patients with sternal fractures or defects [11]. For example, in cases where the sternum is severely damaged or resected due to cancer, 3D-printed titanium implants can be used to reconstruct the sternum and restore its protective and structural functions. These implants are designed to match the patient's anatomy precisely, ensuring a better fit and reducing the risk of complications [12].

Additionally, the development of new materials, such as biocompatible polymers and bioactive coatings, is enhancing the effectiveness of sternal fixation devices. These advancements not only improve the stability of sternal repairs but also promote faster healing and reduce the risk of infection. In the field of diagnostics, advancements in imaging technology are providing more detailed and accurate assessments of the sternum and surrounding structures. These improvements are enabling earlier detection of sternal pathologies and more precise monitoring of treatment outcomes.

CONCLUSION

The sternum, while often overlooked in discussions of anatomy, is a vital component of the human body with significant implications in both health and disease. Its roles in protection, support, and movement are indispensable, and its significance in medical practice, particularly in trauma care, surgery, and diagnostics, cannot be overstated. As technology continues to advance, the sternum will remain a focal point in the development of new medical treatments and diagnostic tools, further enhancing our ability to care for patients and improve outcomes.

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