# Anatomical Basis of Different Imaging Techniques Dealing with the Shoulder Joint

**An Essay Submitted for Partial Fulfillment of Master Degree in Anatomy and Embryology**

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# Introduction

The shoulder joint is privileged by being one of the most movable and flexible joints that encompasses a wide range of movements along multiple and overlapping planes. However it is stigmatized by being one of the most unstable synovial joints in the human body that is liable to injury **(Williams et al., 1995; Moore and Dalley, 2006 and Snell, 2008).**

The above mentioned anatomical facts lead to a rather wider range of possible complaints and complications that may concern different factors and components that make and surround the joint such as bony, cartilaginous, synovial, muscular, tendinous and ligamentous structures either in a separate or a collective manner in a way that various specialists get to handle such expected and predictable problems. They all rely on and make use of anatomy in their approaches for a proper diagnostic and therapeutic procedures.

The shoulder pain is frequently encountered in clinical practice and its incidence is only exceeded by lower back pain and neck pain. It is usually persistent, might be progressive and it does not get relieved spontaneously without proper management. The latter includes pinpointing the source of pain precisely counting on anatomical basis in the first place and in turn a clinical and radiological ground so that the appropriate treatment afterwards can efficiently be delivered and directed at the cause and the exact anatomical site rather than the symptoms **(Johnson and Pedowitz, 2007 ).**

Moreover shoulder injuries are notoriously common whether by direct and indirect injury, 45% of all dislocations involve the shoulder joint **(Ross et al., 2006).** Such injuries need serious acquaintance on the basic anatomical construction of the joint by the specialist before and throughout the process of management **(Mann et al., 1995).** The orthopedic and arthroscopic surgeries concerning the shoulder aren't isolated from the anatomical vision in terms of diagnostic, operative and rehabilitative aspects.

The role of radiological procedures that in fact are a mere reflection to the anatomical picture in its normal or altered status has become so crucial in confirming or excluding a given problem. Plain X -ray is in a pole position in evaluating certain shoulder pathologies. However complementary procedures including ultrasonography, computerized tomography (CT) and magnetic resonance imaging (MRI) give responses to precise questions. CT scans rather allowing to evaluate the detailed bony structure being very useful in analyzing complex fractures of proximal humerus and the amount of glenoid wear to correct before implanting a prosthesis, while MRI is rather favored when dealing with a soft tissue problem pervading the muscular, tendinous, cartilaginous and ligamentous factors **(Farron and Theumann, 2008).**

Moreover the role that "ultrasonography" plays in evaluating the degree of the inflammatory process that primarily afflicts the synovial membrane of the shoulder joint in case of rheumatoid arthritis has proved to be so beneficial **(Bruyn et al., 2008).** In addition, ultrasonography serves as an initial screening tool in rotator cuff tear especially supraspinatus tears **(Fotiadon , 2008).**

From the above mentioned implications of anatomy in many practically and medically oriented fields concerning the shoulder joint, it became the aim of the present study to elucidate the role of detailed anatomical knowledge in defining and solving such problems as one of the reliable preliminary tools. A role that different specialists hopefully might benefit from in defining and creating the suitable framework for providing appropriate and ultimate management for their patients.

# An Outlook on Different Radiological Modalities Dealing with the Shoulder Joint.

There are various radiological screening procedures that deal with the shoulder joint in terms of delineating the anatomical components of the joint **(Fig.1),** pinpointing an underlying pathological process and showing traumatic insults that might affect the joint accordingly.

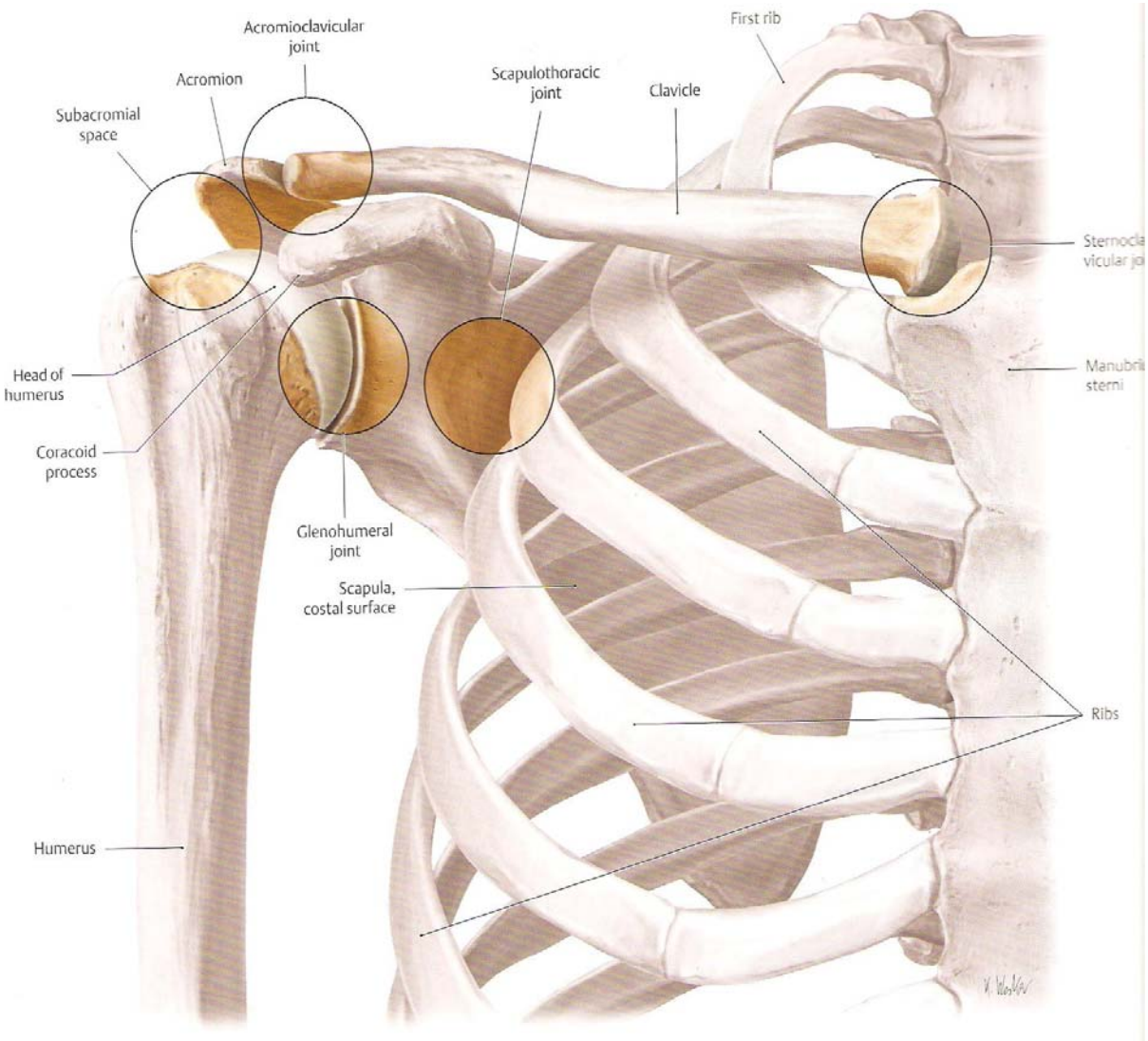


**Fig. (1):** An illustrative diagram showing the shoulder joint among other related essential anatomical joints and landmarks **(Ross et al., 2006).**

## I-Plain radiograph (Plain X-ray):

It lies within the preliminary category of imaging tools that is used in assessing the primary condition of the shoulder joint in a given condition **(Parker et al., 2008)** especially in imaging the dense structures represented by the osseous component of the shoulder joint that block most of the x-ray particles and eventually appear white under normal circumstances. Plain x-ray is beneficial in showing fractures and dislocations cases concerning the shoulder joint **(Adam and Dixon, 2008).** There are standard radiographic views represented initially by the anterior-posterior projection (AP view) where the arm is externally rotated showing the correct positioning of the patient in relation to the X-ray beam and the image receptor (IR), a diagrammatic illustration of the anatomical structures that are supposed to be imaged and finally the radiographic image of the normal joint itself attaining an external rotation position are shown in **(Figs. 2, 3 and 4)** respectively. . Such view must show the proximal humerus , lateral two thirds of the clavicle and the upper part of the scapula including the relationship of the humeral head with the glenoid cavity, the visibility of the greater tubercle signifies that full range of the external rotation has taken place where as the lesser tubercle is superimposed over the humeral head **(Bontrager and Lampignano, 2005).**

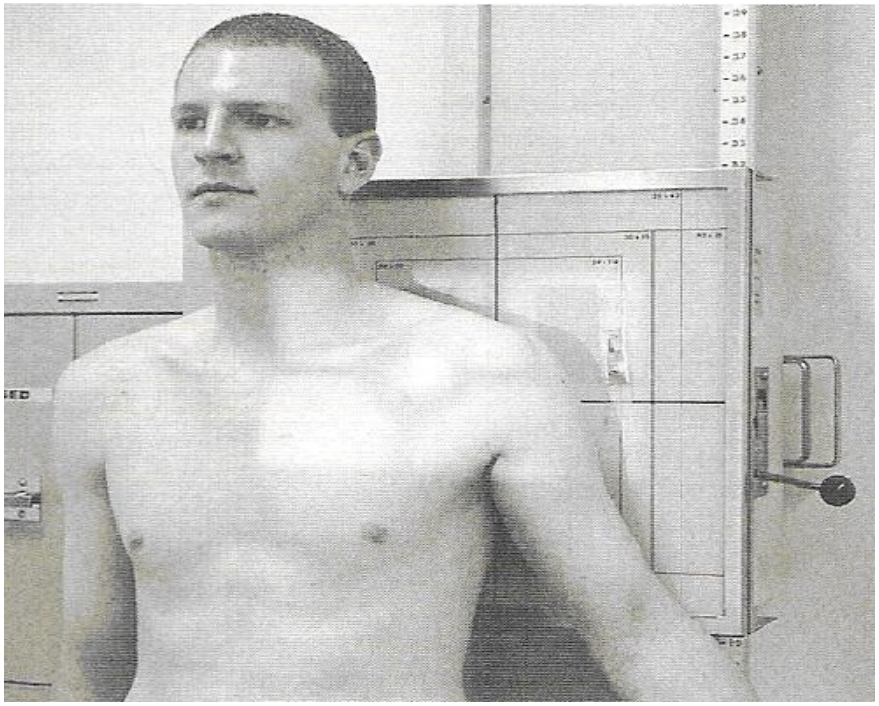

**Fig. (2) :** A photograph showing the position of a patient for taking an AP view of the shoulder joint where the arm is externally rotated **(Whitley et al., 2005).**

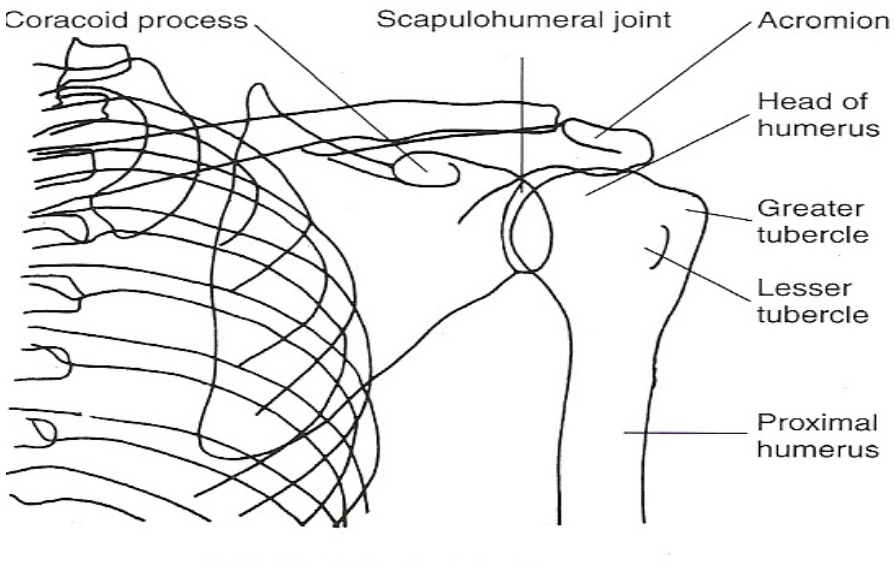


**Fig . (3):** A labeled diagram of a left shoulder joint adopting an external rotation position illustrating how the joint is supposed to appear on the AP radiographic projection with external rotation of the arm (**Bontrager and Lampignano, 2005).**

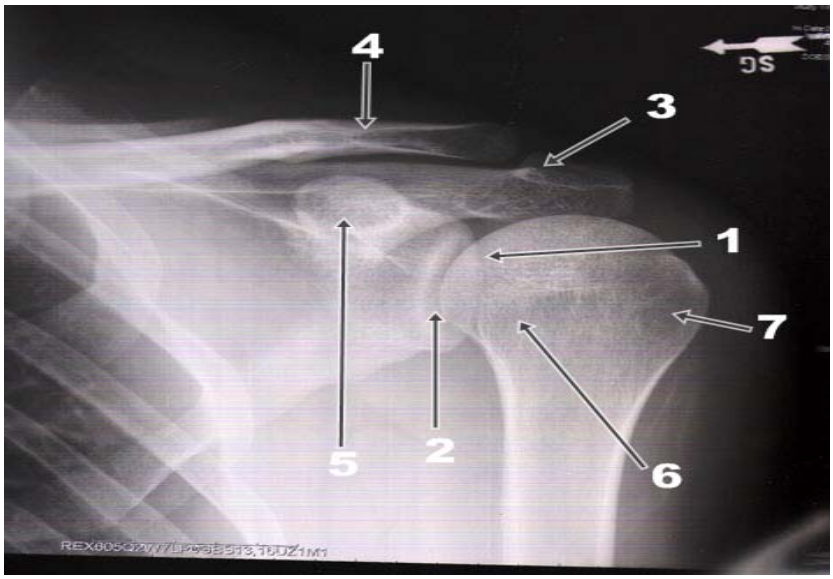


**Fig. (4)**: An anteroposterior radiographic view (AP) of a left shoulder joint where the arm is externally rotated showing **:** 1-Humeral head, 2-Glenoid cavity, 3- Acromion 4-Acromial end of the clavicle, 5-Coracoid process, 6-Lesser tubercle, 7-Greater tubercle of the humerus **(American academy of orthopedic surgeons, 2007).**

On the other hand another AP radiographic image could still be performed while the joint is internally rotated**.** The three figures **(Figs.5, 6 and 7)** showing the correct positioning of the patient in relation to the X-ray beam and the image receptor (IR), a diagrammatic illustration of the anatomical structures that are normally supposed to appear on such a radiographic projection and eventually the radiographic image of the normal joint itself attaining an internal rotation position respectively. Such view show the lateral view of the proximal humerus and the lateral two thirds of the clavicle and upper part of scapula as well so as to encompass the relationship between the head of humerus and the glenoid cavity too. It helps to delineate fractures and/or dislocations of the proximal humerus and shoulder girdle, dystrophic calcium deposits that may inflict the surrounding skeletal muscle, tendon, or bursal sutructures and other pathological conditions such as osteoporosis, osteoarthritis and bony tumors **(Bontrager and Lampignano, 2005).**

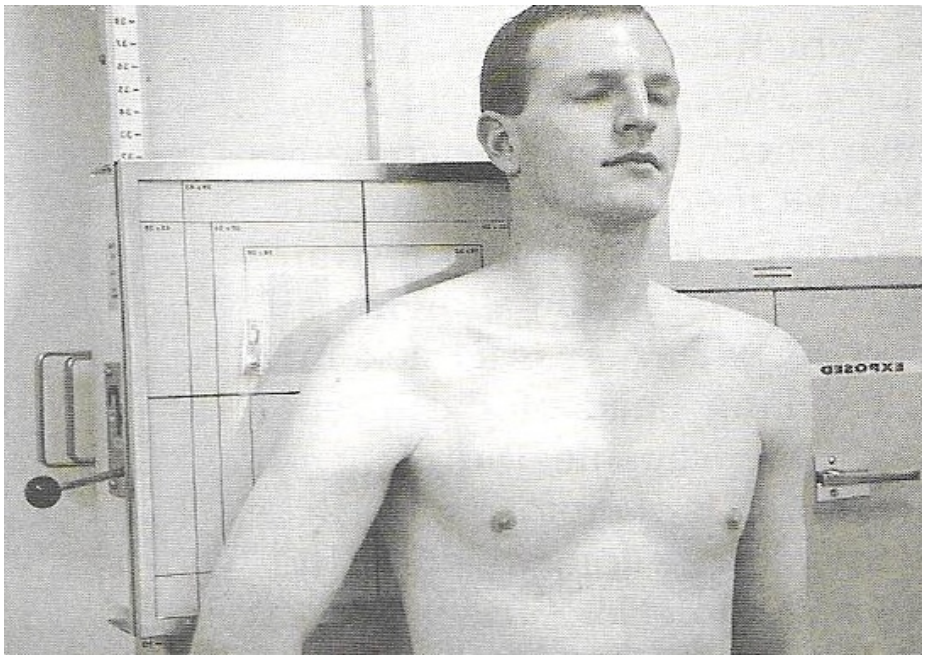

**Fig . (5) :** A photograph showing the position of a patient taking an AP view of the shoulder joint with the arm is internally rotated so as to allow visualization of the proximal humerus at approximately 90-degrees **(Whitley et al.**, **2005**).

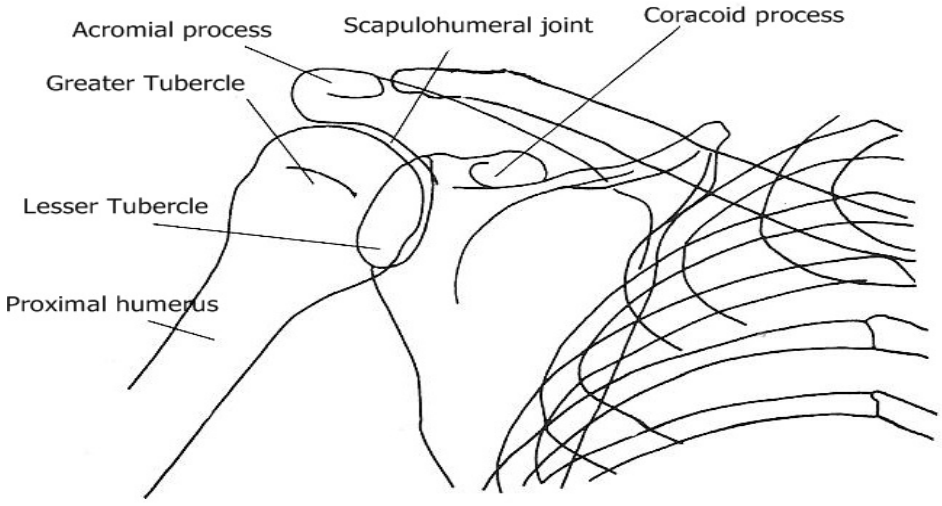


**Fig . (6):** A labeled diagram of a right shoulder joint adopting an internal rotation position illustrating the joint as it is supposed to appear on AP radiographic projection with internal rotation of the arm (**Bontrager and Lampignano, 2005).**

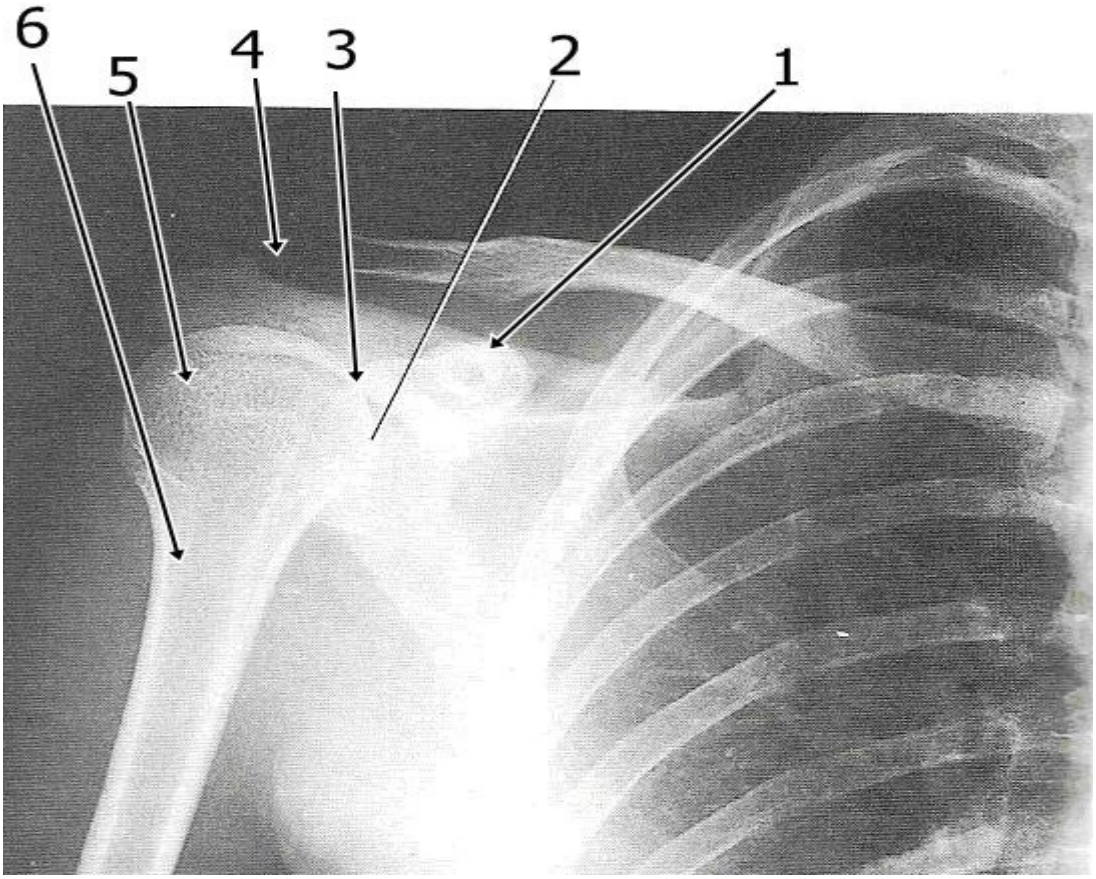


**Fig . (7) :** An antroposterior (AP) plain radiograph of a right shoulder joint where the humerus is internally rotated showing the following: 1-Coracoid process, 2-Lesser tubercle, 3-Shoulder joint, 4-Acromial process, 5-Greater tubercle ,

6- Proximal Humerus **(Sutton et al., 2003).**

A second standard radiographic view is a lateral view which could be taken through an axial (superior-inferior view). The correct positioning of the patient entails the arm being essentially abducted by 45 degrees where the patient is seated at the side of the table which is lowered to waist level **(Whitley et al., 2005).** The cassette is then placed on the table top, and the arm under examination is passively abducted making sure that the patient slightly leans towards the table so as to ensure the glenoid cavity is included in the image **(Fig.8)**. The outcome is a radiographic image **(Fig.9)** that shows the proximal end of humerus, glenoid cavity, coracoid process and the acromial process.

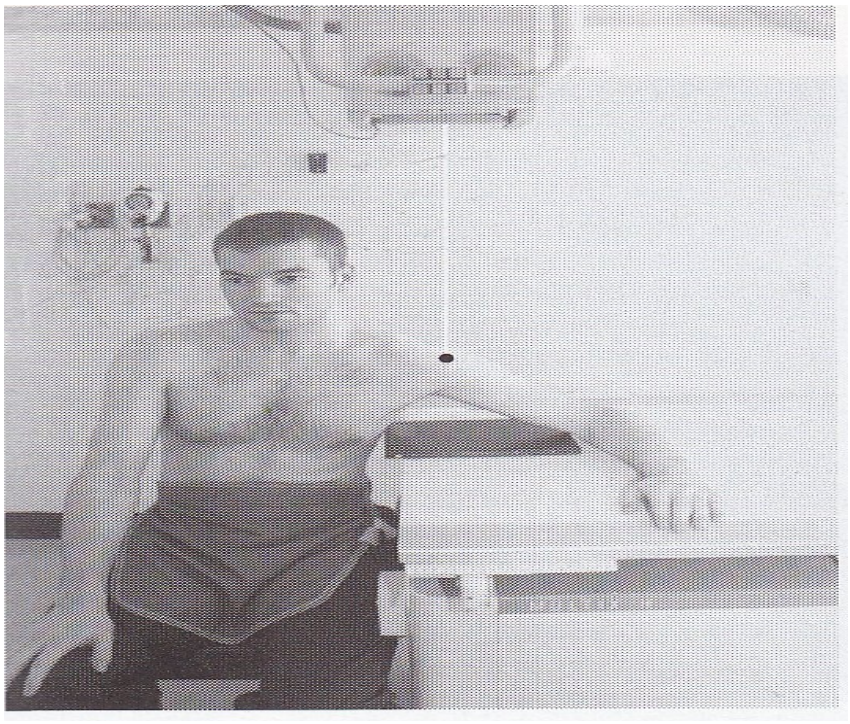

**Fig. (8):** A photograph showing the position of a patient taking a superior-inferior axial projection where the arm is approximately abducted at 45 degrees. Notice the superior direction of the x-ray beam (white line) signifying the term of this projection where the cassette is placed inferior to the shoulder joint **(Whitley et al., 2005).**

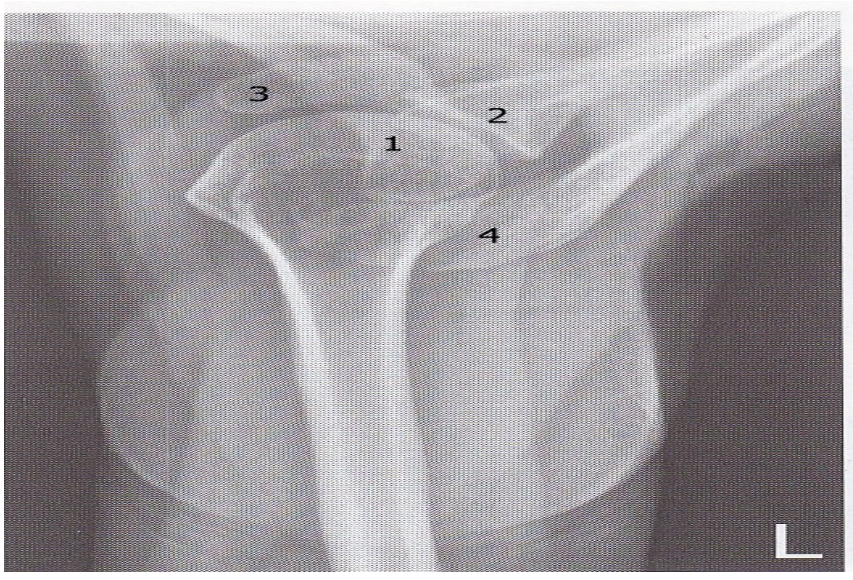


**Fig . (9):** A Superior-inferior axial radiograph of a normal left shoulder joint showing the humeral head **(1)**, the glenoid cavity **(2),** the coracoid process **(3)** and the acromial process **(4) (Whitley et al., 2005).**

Moreover, there is an inferiorsuperior axial projection known as **Lawrence method** which in fact represents an alternative to the superior-inferior projection in cases of dislocations or even where the patient is restricted in a supine position possessing the advantage of applicability even when there is a very limited degree of shoulder abduction with associated hazardous risk of trying to passively increase such limit in case of superior-inferior projection. The patient position is usually supine with the shoulder being slightly abducted and laterally rotated and the arm being raised about two inches (5cm) from the table top by placing non opaque pad support under the arm and the shoulder so as to place the body part near the center of image receptor IR. The cassette is supported vertically against the shoulder and is pressed against the neck in an attempt to pervade as much as possible of the scapula on the film **(Moses, 2008 B).**

The horizontal central ray is directed towards the axilla with minimal angulation towards the trunk **(Figs.10).** A diagrammatic illustration of the anatomical constituents that should appear on this projection is seen in **(Fig.11)** and a radiographic film of the essential characteristics of what anatomical components should appear on the inferior-superior projection as seen in **(Fig.12).** This projection must reveal the head of the humerus in relation with the glenoid cavity, the acromion, and the coracoid process bearing in mind that the acromial process and the superior aspect of the glenoid will be seen superimposed on the head of humerus **(Whitley et al., 2005).**This projection is useful in delineating fractures and/or dislocations of the proximal humerus as well as osteoporosis, osteoarthritis and the Hill-Sachs defect **(Bontrager and Lampignano, 2005).**