

Review Article:

ANATOMICAL ASPECT OF SHOULDER JOINT DISLOCATION FOR VOLLEYBALL PLAYERS

Yuliana

Department of Anatomy

Faculty of Medicine, Udayana University.

ABSTRACT

Shoulder joint is one of the most commonly dislocated joint at our body. Main etiology of shoulder joint dislocation is sport such as volley. Australian Bureau of Statistics report on 2000 said that the incidence rate of shoulder joint dislocation was 32,2%. Data from Victorian hospital on 1996-1999 said that there were 15 acute shoulder injury patients who came to emergency department, four patients had dislocation, seven patients had sprain/strain, two patients had fracture, and one patient suffered from muscle/tendon injury. Therefore, understanding the anatomy of shoulder joint and mechanism of dislocation is very important to establish clear-cut diagnostic and therapeutic objectives.

Keywords: shoulder joint dislocation, volley

Correspondence: Yuliana, Department of Anatomy, Faculty of Medicine Udayana University, Jl PB Sudirman, Denpasar, Bali, Indonesia, email: juju_the_pooh2003@yahoo.com; lee.yuliana@gmail.com.

INTRODUCTION

Shoulder joint has freedom movement because humeral head enter the glenoid cavity less than half part. To strengthen this joint, we need additional structures such as ligaments and muscles (Basmajian 1975). Because the bones' architecture are weak, although there are ligaments and muscles, there is possibility of dislocation in this joint. Shoulder joint dislocation is mostly happened on sport such as volley. Australian Bureau of Statistics report on 2000 said that the incidence rate of shoulder joint dislocation was 32,2%. Data from Victorian hospital on 1996-1999 said that there were 15 acute shoulder injury patients who came to emergency department, four patients had dislocation, seven patients had sprain/strain, two patients had fracture, and one patient suffered from muscle/tendon injury. Dislocation often cause nerve pressure around the joint such as axillary nerve. However most of the nerve pressure is subclinical. To understand the possibility of dislocation comprehensively, we should learn more about anatomical structure of shoulder joint.

ANATOMY

Shoulder joint is multiaxial synovial joint (ball and socket joint). Humeral head enter the glenoid cavity less than half part, it means only a small portion of the humeral head articulating with the glenoid, therefore this joint has freedom movement. This freedom

movement cause instability of the joint. Ligaments and muscles are needed to improve joint stability (Moore 1999).

Bones

Articular head is formed by humeral head and articular cavity is formed by shallow glenoid cavity. Labrum deepen this cavity in its side. However, humeral head enter the glenoid cavity less than half part, that's why this joint is unstable (see Figure 1 and 2) (Moore 1999).

Articular Capsule

Fibrous capsule surround the shoulder joint and attach around glenoid cavity in medial side and anatomical neck of humerus in lateral side. This capsule is penetrated by the long head of biceps tendon. This capsule is strengthened by ligaments and muscles to improve the joint stability and prevent dislocation (Moore 1999).

Ligaments

Glenohumeral ligaments are thickening of articular capsule. There are three parts of glenohumeral ligaments, such as superior glenohumeral ligament, medial glenohumeral ligament, and inferior

glenohumeral ligament. Superior glenohumeral ligament passes from the upper part of the glenoid labrum and base of coracoid process to the upper part of the humeral neck (Soames 1999). Medial glenohumeral ligament located below superior glenohumeral ligament and passes obliquely inferolaterally, after that attach to the lesser tuberosity deep to the subscapular tendon (Soames 1999). Inferior glenohumeral ligament is thicker and longer, it is derived from anterior, middle, and posterior margins of the glenoid labrum. It is the most important ligament because it's the main stabilisator when the arms abducts and are often injured if there is dislocation (Soames 1999).

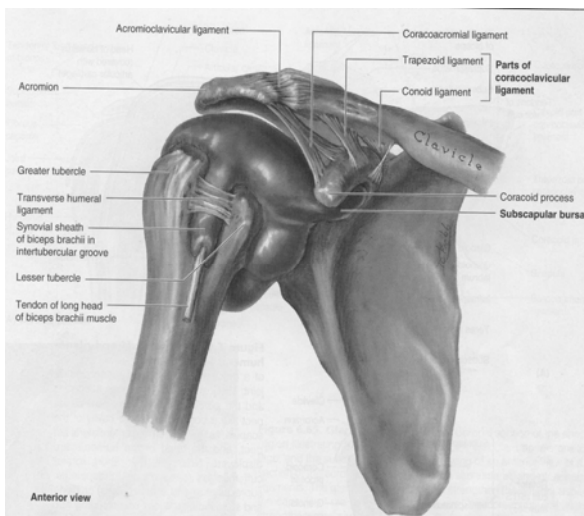


Figure 1. Anatomy of shoulder joint (Moore, 1999)

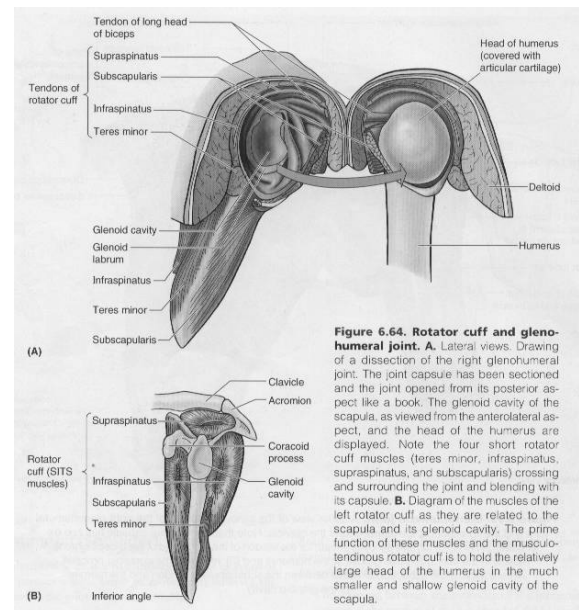


Figure 2. Rotator cuff muscles (Moore, 1999)

Coracohumeral ligament arises from the lateral margin of coracoid process and passes obliquely to inferolateral direction. It is important to prevent lateral and inferior dislocation of adducted arms. It strengthens superior part of articular capsule along with the supraspinatus muscle and long head of biceps tendon (Soames 1999).

Transverse humeral ligament connects crest of the lesser and greater tubercle of the humerus (lihat Figure 3) (Moore 1999, Soames 1999).

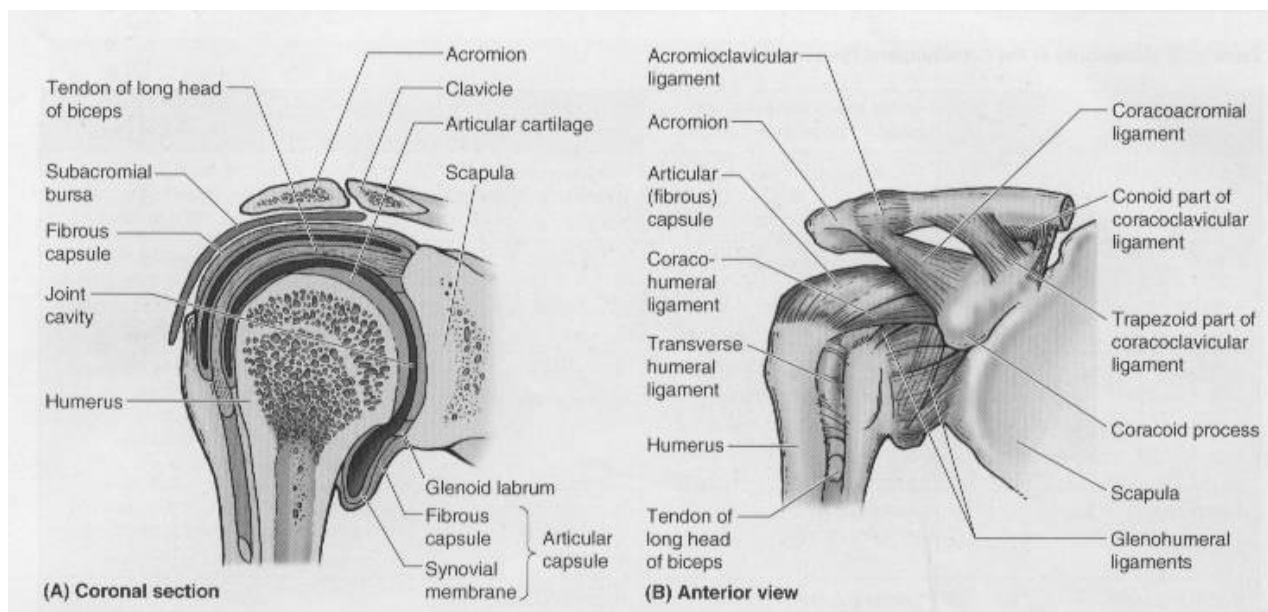


Figure 3. Ligaments of shoulder joint (Moore, 1999)

Muscles

The muscles producing movement are long muscles that move the joint and short muscles that strengthen the joint. Short muscles are rotator cuff muscles, i.e. supraspinatus on superior part, infraspinatus and teres minor on posterior part, and the last is subscapularis on anterior part (see Figure 2) (Basmajian 1975).

Based on the type of the movement, muscles that move the shoulder joint are classified in 6 group such as, chief flexors – pectoralis major (clavicular part) and deltoid (anterior fibers), accompanied by the coracobrachialis and biceps brachii, chief extensor – latissimus dorsi, chief abductor - deltoid, especially the central fibers, chief adductor – pectoralis major and latissimus dorsi, chief medial rotator – subscapularis, chief lateral rotator – infraspinatus

Coracobrachialis, short head of the biceps, and long head of the triceps, are working together with the deltoid muscle to prevent inferior dislocation (e.g. while carrying heavy things) (Moore 1999).

MOVEMENTS

The possibility of shoulder joint movement is wider than other joints because humeral head enter the glenoid cavity less than half part. The movements that could happen are flexion, extension, abduction, adduction, rotation, and circumduction (Basmajian 1975, Moore 1999).

DISCUSSION

Shoulder joint has freedom movement and unstable from anatomical point of view, therefore this joint need certain mechanisms and structures to strengthen joint stability. Dislocation happens when humeral head is outside its normal position (out of glenoid cavity). Inferior part of articular capsule is the weakest part because it is the only part that is not surrounded by rotator cuff muscle, therefore the dislocation mostly goes to inferior direction. However, it is said anterior dislocation clinically, or it is rarely said as posterior dislocation (the direction refers to which way the humeral head goes, if the humeral head goes to anterior part of infraglenoid tubercle and long head of triceps is in front of glenoid cavity, it is called anterior dislocation, and vice versa) (Moore 1999).

Shoulder joint stability is maintained by active and passive mechanism (Gavin Yeh Tseng 2007). Passive mechanisms (static) are size and shape of glenoid cavity,

vacuum effect (negative pressure adhesion and cohesion between 2 joint surface), ligament structure (superior glenohumeral ligament, medial glenohumeral ligament, inferior glenohumeral ligament, coracohumeral ligament), articular capsule, glenoid labrum, the structure is the same with meniscus on knee. It can't heal properly if it brokes, acromion, coracoid process. Active mechanisms (dynamic) are rotator cuff muscles and long head of the biceps tendon. Rotator cuff muscles is subscapularis, supraspinatus, infraspinatus, dan teres minor. Subscapularis is very essential for joint stability anterior part. If the muscle is cut, it will cause external rotation increasing 15-20 degrees. Supraspinatus is different from other rotator cuff muscle because it is important to pull humeral head superiorly, therefore the function of this muscle is to prevent inferior dislocation.

Mechanism of Dislocation

Although there are active and passive mechanisms to strengthen joint stability, the inferior and posterior part of the articular surface is still weak, therefore the dislocation frequently happens on this area. Based on ligaments and rotator cuff muscles structures, the inferoposterior part is the weakest point, that's why the most common dislocation is inferior and posterior dislocation (see figure 4) (Basmajian 1975, Moore 1999).

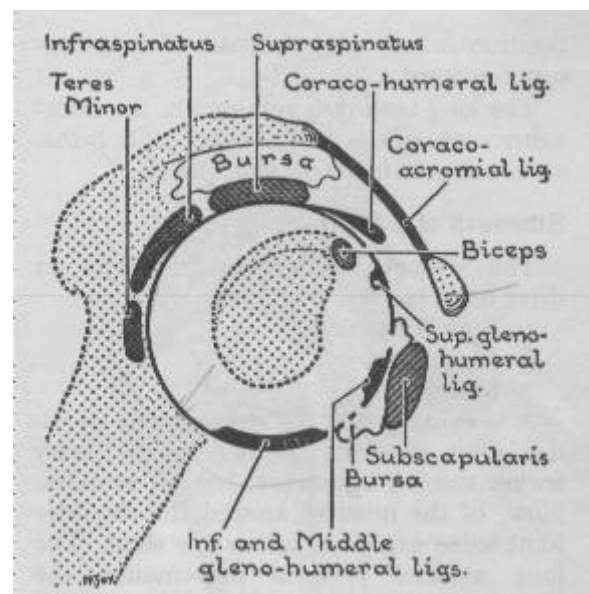


Figure 4. The inferoposterior part of the articular capsule is not covered by rotator cuff muscles (Basmajian, 1975)

Inferior dislocation is prevented by locking mechanism. The mechanism depends on three factors such as, slope

of the glenoid cavity, the strength of the superior capsule structures, include coracohumeral ligament, supraspinatus muscle activities. Inferior dislocation happens when arms abducts, extends, and external rotates, i.e. spike on volleyball. This is the most common dislocation and the incidence rate was 95% (see Figure 6) (Basmajian 1975, Moore 1999, Afsari 2004, Scott C et al 2007).

Posterior dislocation happens when humeral head dislocates to the posterior part of glenoid cavity. It is usually accompanied by rotator cuff muscle tear on elderly because the muscle tendon is weakened due to increasing age and disuse (lihat Figure 5) (Anonim, 2005, Afsari 2004, Scott C et al. 2007).

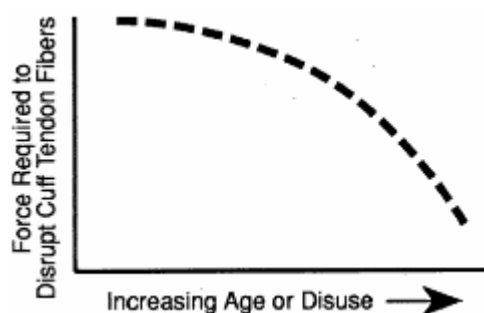


Figure 5. Rotator cuff tendon become weaker due to increasing age and disuse (Anonim 2005)

Incidence rate of posterior dislocation was 2–4%. Mechanism of injury is direct trauma, such as direct blow to arms that are in adduction, flexion, and internal rotation position (Cluett 2007, Levangie PL & Humprey EC 2008, Seade LE 2006) and also seizure, electrical injury, or Electro Convulsive Therapy without giving any muscle relaxant before (it will cause internal rotator muscles strength more than external rotator muscles) (Seade LE 2006, Welsh S 2004, Price D 2005).

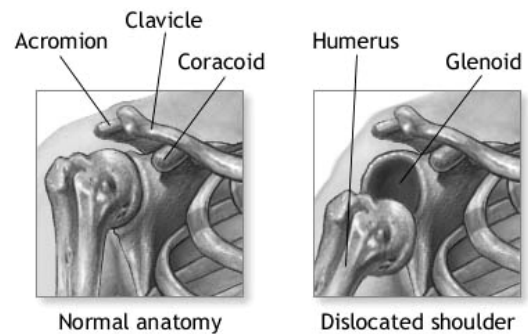


Figure 6. Shoulder joint dislocation (Smith B et al. 2004)

Shoulder Joint Dislocation on Volleyball Players

Inferior shoulder joint dislocation happen on abduction, extension, and external rotation position. In clinical term, we call it anterior dislocation, it is mostly encountered when volleyball players are doing spike. Spike is the climax of every volleyball play. Spike is the most difficult motor skill in all of sport. Spikers have to strike the ball at precise time so the blockers can't reach it. Spike is very essential to determine the group winning score. Statistic analysis showed that good spike can affect game score until 80%.¹⁷ The prerequisite for good spike is accurate good beginning, jump, strike, and landing. When the volleyball players are doing spike, their arms are in external rotation, abduction, and extension position. If these movement are done repeatedly, it will increase the risk of shoulder joint dislocation (see Figure 8, 9, 10, 11) (Reid J 2008, Hsieh C & Heise GD 2006, Roemer et al. 2008).

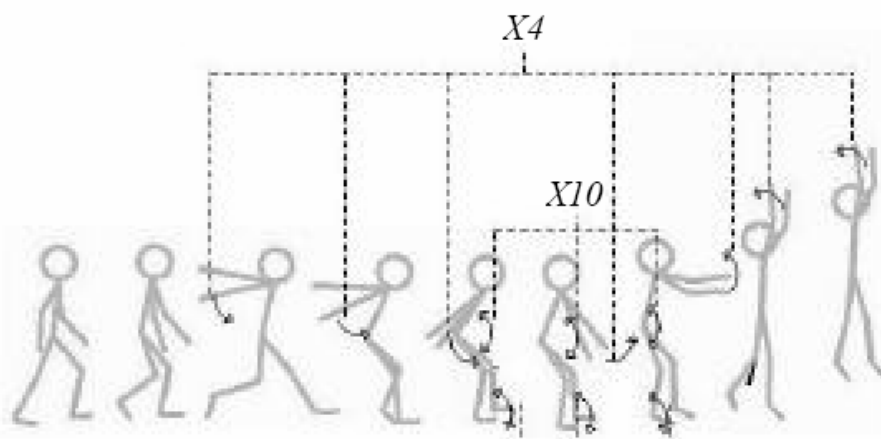


Figure 7. Some movements that have to be done by volleyball players before spike (Hsieh C & Heise GD 2006)

A tremendous spike is the one that unpredictable by the opponent group. To produce a hard spike, the volleyball players have to swing their arms quickly, not using the hard strike, so the important factor is the speed. They have to jump, swing their arm, and strike the ball simultaneously (Reid J 2008).

Some technique that has to be done before spike (see Figure 7) (Hsieh C & Heise GD 2006) jump as high as possible, Swing arm backward, Raise the other arm to maximize height of the jump, Strike the ball in front of the shoulder.

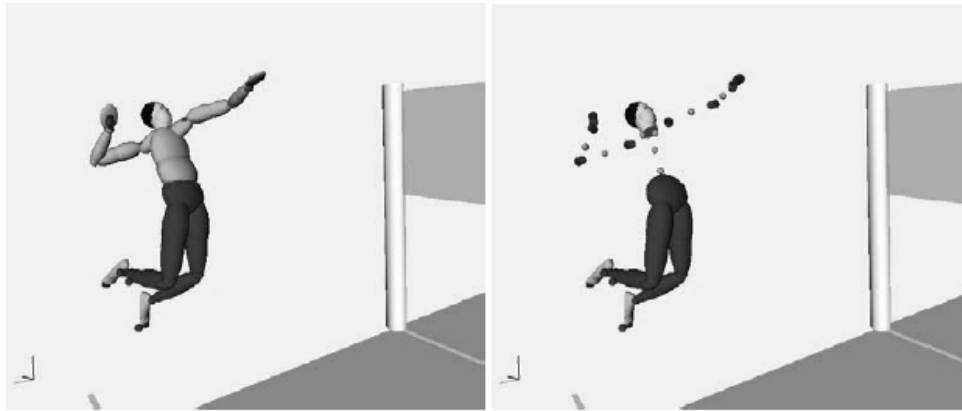


Figure 8. The position of volleyball player's shoulder while spiking (using the multi body system (MBS) man model DYNAMICUS) (Roemer K et al. 2008)



Figure 9. The volleyball players are doing spike (taken from: http://www.sport-world.org/sports/images/volley_girls.jpg).



Figure 10. When volleyball player is doing spike, her arm is extended (taken from <http://www.eteamz.com/jammersvbc/images/MaryaSpik e2.jpg>).



Figure 11. Volleyball player has to jump while doing spike, so the ball can pass the blockers (taken from: <http://www.paloaltodailynews.com/pics/padn/400xN/padn/2006-11-29-st-francis-mitty-volley>).

CONCLUSION

Shoulder joint is the most common dislocated joint at our body. This joint has freedom movement and it is anatomically unstable, therefore active and passive mechanism is needed to strengthen joint stability. Passive mechanisms are ligaments, articular capsule, glenoid labrum, coracoid process, and acromion, meanwhile active mechanism are rotator cuff muscle and long head of biceps tendon. Dislocation mostly happens on inferoposterior part, because this part is not strengthened by rotator cuff muscle. Incidence rate of inferior dislocation was about 95%, meanwhile for posterior dislocation, the rate was 2-4%. Inferior dislocation happens when arms abducts, extends, and external rotates, meanwhile posterior dislocation happens when arms are on adduction, flexion, and internal rotation position. Inferior dislocation is mostly encountered by volleyball players while they are doing spike. Spike is the most difficult motoric skill on volley. Volleyball players have to strike the ball precisely and full of power, so the arms abducts, extends, and external rotates. If they do spike frequently, they will have increasing risk of inferior shoulder dislocation. The most common complication is axillary nerve injury. Literature wrote that 9-18% shoulder dislocation patients suffered from long period pain because of axillary nerve injury.

REFERENCES

- Anonim. Mechanics of shoulder strength. http://www.orthop.washington.edu/uw/shoulderstrength/tabID__3376/ItemID__194/PageID__387/Articles/Default.aspx. Last updated 10 Februari 2005. Last accessed 5 Januari 2008.
- Anonim. http://www.sportworld.org/images/volley_girls.jpg. Last accessed 29 Mei 2008.
- Anonim. <http://www.eteamz.com/jammersvbc/images/MaryaSpike2.jpg>. Last accessed 29 Mei 2008.
- Anonim. <http://www.paloaltodailynews.com/pics/padn/400xN/padn/2006-11-29-st-francis-mitty-volley>. Last accessed 29 Mei 2008.
- Afsari A. Anterior Glenohumeral Instability. <http://www.emedicine.com/orthoped/topic464.htm>. Last updated 7 Juli 2004. Last accessed 20 Desember 2007.
- Basmajian, JV. Joints of Upper Limb. Grant's Method of Anatomy. 9th edition. Baltimore: The Williams & Wilkins Company; 1975. P 155-61.
- Baltimore: Lippincot Williams and Wilkins; 1999. P 788-95.
- Cluett J. Assessment and Management of Painful Shoulder. <http://www.utahyouthfootball.com/injury.htm>. Last accessed 18 Februari 2007.
- Gavin Yeh Tseng. Shoulder, Dislocation. Available from: URL: <http://www.emedicine.com/radio/topic630.htm>. Last updated 21 Juni 2007. Last accessed 4 Januari 2008.
- Hsieh C, Heise GD. Important Kinematic Factors for Female Volleyball Players in the Performance of a Spike Jump. Available from: URL: <http://www.asbweb.org/conferences/2006/pdfs/76.pdf>. Last accessed 20 Mei 2008.
- Levangie PL, Humphrey EC. The Shoulder Girdle Kinesiology Review. Available from: URL: http://www.apta.org/Content/ContentGroups/Education/ContinuingEducation/OnlineCoursesText/CEU_20_Shoulder.pdf. Last accessed 12 Februari 2008.
- Moore KL, Dalley AF. Upper limb. In: Clinically oriented anatomy. 4th edition.
- Price D. Dislocations, Shoulder. Available from: URL: <http://www.emedicine.com/emerg/topic148.htm>. Last updated 29 November 2005. Last accessed 5 Februari 2008.
- Reid John. Redwood City Daily News. Available from: URL: <http://www.redwoodcitydailynews.com/article/2007-10-3->

- volley&h=603&w=402&sz=22&hl=id&start=19&um=1&tbnid=tefnqKFukotgqM:&tbnh=135&tbnw=90&prev=/images%3Fq%3Dvolley%2Bspike%26um%3D1%26hl%3Did%26safe%3Dvss%26sa%3DN. Last accessed 29 Mei 2008.
- Roemer K, Kuhmann C, Milani TL. Body Angles in Volleyball Spike Investigated by Modeling Methods. Available from: URL: http://www.tu-chemnitz.de/phil/sportwissenschaft/betec/forschung/sport_aten1.pdf. Last accessed 22 Mei 2008.
- Scott C. Sherman. Jeff Schaidler. Shoulder Dislocation. Available from: URL: http://www.patient.uptodate.com/opic.asp?fi;e+ad_pro c?2057#4. Last updated 1 Mei 2007. Last accessed 2 Januari 2008.
- Seade LE. Shoulder dislocation. Available from: URL: <http://www.emedicine.com/sports/topic152.htm>. Last updated 29 November 2006. Last accessed 17 November 2007.
- Smith B, Connie L, Solomon D, Whitson M, Chang S. Mechanism of Shoulder Injury. Shoulder dislocation and separation. Available from: URL: http://www.biomed.brown.edu/Courses/BI108/BI108_2004_Groups/Group01/me chSSD.htm. Last updated 5 Februari 2004. Last accessed 18 Februari 2008.
- Soames RW. Skeletal system. In: Williams PL, et al, editors. Gray's Anatomy. The Anatomical Basis of Medicine and Surgery. 38th edition. London: Churchill Livingstone; 1999. P 622-632.
- Welsh S. Shoulder dislocation. Available from: URL: <http://www.emedicine.com/orthoped/topic440.htm>. Last updated 7 Juli 2004. Last accessed 5 Februari 2008.