THE ANNALS OF "DUNAREA DE JOS" UNIVERSITY OF GALATI
FASCICLE X APPLIED MECHANICS, ISSN 1221-4612
2008

Models of Gleno-Humeral Joint Stability

D. Boazu and B. A. Gogulescu
Dunarea de Jos University of Galati

ABSTRACT

In this paper two-dimensional and three-dimensional FEM models of gleno-humeral Joint stability under ligaments and muscles actions were studied. In three-dimensional models we used solid elements TETRA4R for humerus, SHELL3T elements for glenoid fossa and very stiff TRUSS3D elements to simulate the contact. This joint is more stable at higher value of its natural frequencies.

By analyzing the variation of the first natural frequency of the Joint versus rotation of humerus in the three planes, in the range 0-180^0, it comes out that the instability positions of humerus are: between 90^0-180^0 (for Inferior-Superior rotation), 60^0 and 180^0 (for Lateral – Medial rotation) and 120^0 (for Anterior– Posterior rotation). These positions are in incidences of glenoid loosing.

For numerical models, with material properties of human bones, the value of subluxation force calculated using FEM was of 500N, which is very close to experimental values of Anglin and al. (510N-540N). This level of subluxation force is possible because of elastic ligaments and muscles action.

Traditional biomechanical methods have shown that there are specific activation patterns used to stabilize the shoulder. Using also the FEA model, we have shown how effective muscles are in stabilizing the shoulder. This modeling method provides a new tool to understand shoulder Joint stabilization.

KEY WORDS: Gleno-humeral Joint, stability using natural frequencies

References

1. AMAKO M, IMAI T., OKAMURA K. – *Recovery of shoulder rotational muscle strength after a combined Bankart and modified Bristow procedure* – I.Shoulder Ellbow Surg 2008 Jun 14.

2. AUFFARTH A., SCHAUER J., MATIS N., KOFLER B., HITZL W., RESCH H. – *The J-bone graft for anatomical glenoid reconstruction in recurrent posttraumatic anteior shoulder dislocation* – Am. J. Sports Med 2008 Apr 36 (4) 638-47.

3. BIGLIANI L.U., PLLOCK R., SOSLOWSKY L., FLATOW E.L. PAWLUK R., MOW V. – *Tensile properties of the inferior glenohumeral ligament* – J. Orthop Res 1992, 10: 187.

4. BOILEAU P., WALCH G. – *Adaptabilité et modularité au cours des perothéses épaule* -

5. FIELD LD., BOKOR DJ, SAVOIE FH 3rd – *Humeral and glenoid detachment of the anterior inferior glenohumeral ligament: a cause of anterior shoulder instability* – J. Shoulder Elbow Surg 1997 Ian- Febr 6 (1) 6-10.

6. IANNOTTI J.P., GABRIEL J.G., SCHNECK S.L., EVANS B.G., MISRA S. - *The normal gleno-humeral relation ships.* – J. Bone and Joint Surg (Am) 1992, 74: 491-500.

7. JAFFAR A.A., ABASS J.S., ISMAEL Q.,M. – *Biomechanical Aspects of Shoulder and JHip Articulations: a comparison of two Ball and Socket Joints*. Al-Nahrain University Baghdad Iraq.

8. KAPANDJI IA. – *Physiologie articulaire t. I* – Ed Maloine Paris 2003 pg: 43.

9. LIMPISVASTI O., YANG BY, HOSSEINZEDEH P., LEBA TB., TIBONE JE., LEE TQ. – *The effect of glenohumeral position on the shoulder after traumatic anterior dislocation* – Am J. Sports Med 2008 Apr 36 (4) 775-80.

10. MENEGALDO L.L., FLEURY ADE T., WEBER H.I. – *Biomechanical modeling and optimal control of human posture* - J. Biomech. 2003 Nov (11) pg 1701-12.

11. MENEGALDO L.L., FLEURY ADE T., WEBER H.I. – *Biomechanical modeling and optimal control of human posture* - J. Biomech. 2003 Nov (11) pg 1701-12.

12. NEER C.S., FOSTER C.R. - *Inferior capsular shift foc-involuntarx and multidirectional instability of the shoulder*. A preliminary report. J. Bone Joint Surg 62A: 897, 1980.

13. SCHEWELOV T., SANZEN L., BORLINZ N., MARKUSSON P., ONSTEN I. – *Accuracy of radiographic and radiostereometric wear measurement of different hip prostheses* – Acta Orthop Scand 2004 vol 75 (6) pg 691-700.

14. SCHEWELOV T., SANZEN L., BORLINZ N., MARKUSSON P., ONSTEN I. – *Accuracy of radiographic and radiostereometric wear measurement of different hip prostheses* – Acta Orthop Scand 2004 vol 75 (6) pg 691-700.
15. SOBOTA – *Atlas of Human Anatomy* – 12th English Edition.
16. WOLF EM, CHENG JC, DICKSON K – *Humeral avulsion of glenohumeral ligaments as a cause af anterior shoulder instability* – Arthroscopy 1995 Oct 11 (5) 600 – 7.