SHOULDER MUSCLE ACTIVITY PATTERNS ARE CHANGED AFTER GLENOHUMERAL ARTHROPLASTY

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Introduction: Glenohumeral arthroplasty is a commonly used method for treatment of glenohumeral joint destruction due to trauma or arthritis. The goal of arthroplasty is to restore normal shoulder motion as closely as possible. As the shoulder joint is a mainly muscle stabilized joint, muscle function has been closely related to shoulder function. Impaired rotator cuff function may allow increased glenohumeral joint translation and lead to excessive wear of the components and to instability, and disturbed interaction between the deltoid muscle and the rotator cuff muscles may result in fatigue and loss of function. However, little is known about muscle function following shoulder arthroplasty, especially in quantitative objective terms. Therefore, the goal of this study was to assess the effect of shoulder arthroplasty on rotator cuff muscle activity. Specifically, the following research question was asked: How are the activities of m. deltoideus, infraspinatus, supraspinatus and subscapularis in shoulders with glenohumeral arthroplasty compared to intact shoulders during rotation and abduction? To answer these research questions we performed loading tests in patients with glenohumeral arthroplasty and examined rotator cuff muscle activity using surface and fine-wire electromyographic (EMG) analysis.

Methods: Eleven patients from the Hannover Medical School (5 male, 6 female, age 57-79 years) were included in this study. The study design and procedure was approved by the ethics committee of Hannover Medical School. All patients had received a shoulder prosthesis at least 1 year prior to testing (Indications: arthrosis 8, trauma 2, necrosis 1). A preliminary validation study including 11 healthy volunteers (6 male, 5 female, age 22-34 years) was performed to establish the EMG (Dantec Keypoint) and subsequent testing (Indications: arthrosis 8, trauma 2, necrosis 1). At higher elevation, the increase in activity of the main abductors m. deltoideus and supraspinatus seems to be less than that of the stabilizing m. subscapularis, and deltoid muscles in shoulders with glenohumeral arthroplasty compared to intact shoulders during rotation and abduction. To answer these research questions we performed loading tests in patients with glenohumeral arthroplasty and examined rotator cuff muscle activity using surface and fine-wire electromyographic (EMG) analysis.

Results: As in the normal joint, the results indicate increasing muscle activity with increasing elevation after glenohumeral arthroplasty (Fig. 1). Compared to the intact unoperated side, muscle activity of the infraspinatus, supraspinatus and subscapularis muscles of the arthroplasty side increased at all abduction angles tested (Fig. 2). The observed increases were greatest for the infraspinatus and subscapularis muscles at 60° and 90° abduction. Internal, external rotation and abduction loads were applied using adjustable weights directed over a pulley-cable system and hand held weights. The load held at each position was set to 50% of the maximum the patient was able isometrically hold over a 10 second period. Signals were low pass and high pass filtered (10Hz, and 10KHz) and amplitude was averaged over a 5 second period. Data are reported normalized with respect to the maximum exertion test for each muscle. Mean differences were compared using the Wilcoxon signed rank test at a significance level of α=0.05.

Discussion: The results of this study suggest that the activity of infraspinatus, subscapularis, and deltoid muscles in shoulders with glenohumeral arthroplasty is significantly elevated, while the supraspinatus remains almost unchanged. At higher elevation, the increase in activity of main abductors m. deltoideus and supraspinatus seems to be less than that of the stabilizing m. infraspinatus and subscapularis. This finding may be interpreted as an insufficiency of infraspinatus and subscapularis in acting as stabilizing counterpart to the elevating forces of the m. deltoideus during abduction and rotation. Potentially the increased activity of the m. infraspinatus subscapularis may be related to instability during shoulder arthroplasty. In interpreting the results of this study, it should be noted that muscle activity as a parameter cannot directly be compared to muscular forces, as muscle size and intrinsic muscular strength could not be assessed. In conclusion the data of this study suggest that increased activity of all shoulder muscles is necessary for postoperative arm elevation. Increased activity of the supraspinatus and subscapularis muscles at higher elevation angles suggest an alteration of deltoid-cuff synergy.


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