Pectoralis Major Muscle Transfer for the Treatment of Shoulder Joint Instability

by

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Inferior instability of the shoulder joint was treated by transfer of the pectoralis major muscle to the inferior angle of the scapula and good results were obtained, especially for the patients complicated with voluntary anterior dislocation. Usefulness of this treatment was confirmed by kinesiological electromyography.

Introduction

Among the patients complaining of dull pain along the arm and shoulder, especially when carrying heavy objects, or of pain while in motion, we sometimes find unstable shoulder joint. This joint instability is classified into the following four types: 1) anterior instability, 2) posterior instability, 3) inferior instability and 4) multidirectional instability. The most suitable method of treatment should be selected for each type.

The pectoralis major muscle transfer we are now going to discuss is a method of operation in cases of inferior instability. This method of treatment was first presented by Endo⁹ for the purpose of restoring normal scapulohumeral rhythm during abduction of the shoulder joint. He transferred two thirds of the muscle to the inferior angle of the scapula, whereas, we transferred the whole muscle.

Clinical Examination

Inferior instability of the shoulder joint was easily detected by its inferior subluxation, caused by downward traction of the arm. In the erect posture a 3 to 5 kg. weight was applied to the arm and an antero-posterior x-ray picture was taken. The rate of inferior shift of the humeral head was calculated by B/A as illustrated in Fig. 1.

This disease is often complicated with recurrent involuntary anterior dislocation or voluntary anterior dislocation of the shoulder joint. We classified this type of disease into the following three types: Type A; inferior instability with voluntary anterior dislocation. Type B; inferior instability with recurrent involuntary anterior dislocation. Type C; inferior instability without dislocation.

Inferior subluxation, caused by downward traction of the arm, completely disappeared or was greatly alleviated by holding the scapula in the abducted position in every type of case. In type A moreover, voluntary dislocation became impossible in this forced position.

Electromyographic Examination

Electromyographic examination was performed on normal adults and patients with inferior instability of the shoulder joint to reveal the role of the shoulder girdle muscles for prevention of inferior subluxation, namely, to analyze the suspension mechanism of the shoulder joint. The examined muscles were the upper portion of the trapezius, the supraspinatus, the long head of the biceps brachii, the middle portion of the deltoideus, the pectoralis major and the rhomboideus. In the relaxed erect posture, action potentials of these muscles were examined with intramuscular fine wire electrodes.
In the normal adults, the results were different in detail from case to case, but, generally, action potentials in the supraspinatus increased in parallel with loading (Fig. 2). In the patients however, such a close relationship between action potential volume and loading was not observed in any muscle (Fig. 3).

The relationship between action potential volume and loading was investigated by the cluster analysis method. The results showed that the supraspinatus had the closest correlation with load in the normal adults (Fig. 4), but such a close correlation to load was not observed in any muscles of the patients (Fig. 5).

On the other hand, muscular activities were examined at the moment of voluntary dislocation.
in the cases belonging to type A. They were different from case to case, but, in general, at the moment of dislocation, intensive action potential appeared in the pectoralis major. However, at the moment of voluntary reduction, this muscle became silent (Fig. 6).
Treatment

1. Materials

The pectoralis major transfer was performed on thirtyfive shoulders of thirty cases with severe complaints. Type A ; 9 cases (5 males and 4 females). Type B ; 8 cases (4 males and 4 females). Type C ; 13 cases (3 males and 10 females). The age range at surgery was 12 to 40 years (mean age 21 years).
2. Operation Method

Through a waved incision on the anterior part of the axilla the pectoralis major was detached from the humerus and freed from the surrounding soft tissues. The second incision was made along the lateral edge of the scapula centered on its inferior angle. Then the detached end of the muscle was passed subcutaneously to the second incision and sutured tightly to the inferior angle of the scapula (Fig. 7).
After surgery, instability of the shoulder joint disappeared completely or showed a reduction in almost all the cases (Fig. 8). Two cases in which instability was unchanged belonged to type C and some factors of multidirectional instability were found. In spite of the loss of the normal function in the pectoralis major, nobody complained of any difficulty in the daily living activities. Preoperative subjective symptoms were also improved. In type A, voluntary dislocation became impossible in every case. The mean value of the upward rotation angle of the glenoid increased to 6.5 degrees after treatment. Compared with the preoperative movement of the scapula in elevation, the postoperative movement showed quicker motion at the beginning of the arm elevation. With this postoperative movement the transferred pectoralis major, which had scarcely participated in arm elevation before

Fig. 9  Scapular movement and EMG of the pectoralis major before and after surgery

Results
surgery, increased its contraction gradually from the initial stage. At the time of depression however, this muscle showed gradually decreasing EMG-discharge (Fig. 9).

Following this, the tracking movement of the shoulder joint was tested using sine curves with a frequency of 1.2 to 4.7 Hz. on the operated and non-operated sides of bilateral unstable shoulders. In abduction and flexion movements from 0 to 30 degrees, the operated side showed better capability of tracking than the non-operated side (Fig. 10).

**Discussion**

abduction-forward rotation of the scapula turns the glenoid fossa upwards and brings the humerus into a relative adduction position to the scapula. Consequently, the coracohumeral ligament, the superior portion of the joint capsule and the su-
praspinatus, which all proved to be important for stability of the shoulder joint as mentioned above, are thought to become tight (Fig. 11). This fact was already confirmed by Basmajian\(^3\). This might be the reason why this operation is effective for stabilization of the shoulder joint. This fact was confirmed by postoperative electromyographic examination and the tracking movement test. Furthermore, it must be emphasized that the pectoralis major, which has played an important role for voluntary dislocation, is converted to the anti-dislocation muscle. Therefore, this surgical procedure is most effective for the patients with voluntary dislocation.

**Conclusion**

It was confirmed that pectoralis major transfer was an excellent method of the treatment for inferior instability of the shoulder joint by analysing the suspension mechanism of this joint in the normal and pathologic cases. Voluntary anterior dislocation was also successfully treated with this method.

**References**