J Shoulder Elbow Surg (2011) 20, 1155-1162

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Journal of Shoulder and Elbow Surgery

www.elsevier.com/locate/ymse

Magnetic resonance imaging-controlled results of the pectoralis major tendon transfer for irreparable anterosuperior rotator cuff tears performed with standard and modified fixation techniques

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Hypothesis: Irreparable ruptures of the subscapularis tendon lead to impaired function of the shoulder joint. In such cases, transfer of the pectoralis major tendon has led to encouraging results. The procedure fails periodically, typically associated with insufficient in-growth of the transferred tissue. We hypothesized that tendon harvest with chips of cancellous bone would improve the tendon–bone interface.

Materials and methods: Of 62 consecutive pectoralis tendon transfers, 54 shoulders were followed-up at an average of 35 months. In all shoulders, the transferred tendon was rerouted behind the conjoint tendon and fixed by transosseous sutures. In 29 shoulders, the tendon was harvested with a cuff of cancellous bone. In 25 shoulders, the conventional technique with sharp detachment of the tendon was used. Apart from detailed clinical examination of all shoulders, a magnetic resonance image (MRI) was available in 52 shoulders.

Results: The overall Constant score had improved from an average of 38.8 points preoperatively to 63.4 points at follow-up. Shoulders treated with the new fixation technique scored 64.4 compared with 62.2 for the conventional fixations. The MRI showed intact tendons and muscles in 80.8% of shoulders. In 7 shoulders (13.5%), the transferred tendon was ruptured. Two of these were treated with the new fixation technique. Mean patient satisfaction score was 8.2 points.

Discussion: A secure method of fixation that avoids secondary ruptures despite insufficiency of the transferred tendon is of great importance. Also the rerouting of the transferred tendon under the conjoined tendon is essential to imitate the natural force vector and the function of an intact subscapularis tendon. Patients in this investigation were also monitored by MRI to verify the integrity of the transferred tendon.

Conclusion: As a salvage procedure, the pectoralis major tendon transfer provides good results in most cases. Sufficient in-growth of the transferred tissue is essential for the success of the procedure. This seems to be facilitated by both methods.

Level of evidence: Level III, Retrospective Case Control Study, Treatment Study.

Keywords: Pectoralis; tendon; transfer; subscapularis; rotator cuff; MRI; bony chip

Apart from its function in rotating and abducting the arm, the rotator cuff acts as a major stabilizer of the shoulder joint. To do so, balanced traction of the ventral and dorsal portions is needed. The infraspinatus and teres

Institutional Review Board approval was not required for this study.

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1058-2746/$ - see front matter © 2011 Journal of Shoulder and Elbow Surgery Board of Trustees.
doi:10.1016/j.jse.2011.01.023

minor muscles together with the subscapularis muscle provide anteroposterior stability of the glenohumeral joint.[2,5,21] If this balance is compromised by a rupture of the subscapularis, pain and weakness upon internal rotation as well as anterior subluxation can be observed.[15] Still, isolated ruptures of the subscapularis are uncommon[8] but are more likely to be detected early because of their typically traumatic causes.

Combined tears of the supraspinatus tendon along with a rupture of the subscapularis tendon, which are usually of degenerative cause, are more common. These pathologies are usually found in patients aged older than 40 years.[6] In such degenerative cases with retraction of the tendon and atrophy of the muscle, a reinsertion of the subscapularis tendon is usually not possible. The rate of retear after repair of massive rotator tears has been reported to be between 50% and 70%.[13] To address this precondition, transfer of the pectoralis major tendon has been described as a salvage procedure that provides satisfactory results for pain and function.

The present study was undertaken to compare clinical results and magnetic resonance imaging (MRI) results in patients who had undergone a pectoralis major muscle transfer. In addition, a novel technique of harvesting the tendon was compared with the well-described standard procedure.[23,24,30,31] The assumption that a tendon with adherent bone chips would tend to heal better than plain tendon tissue was tested. The clinical outcome and MRIs were compared at follow-up and used to compare the conventional and modified techniques. To our knowledge, no larger group of consecutive pectoralis major muscle transfer procedures, followed-up by MRI assessment, has previously been reported.

Materials and methods

Patients

The indication for the tendon transfer was severe pain that often was combined with anterior subluxation or a superior migration of the humeral head. In a 5-year period from 1999 until 2005, 64 consecutive pectoralis major transfer operations were performed in 62 patients. Of these, 53 patients (85.5%) with 54 tendon transfers (84.0%) were included in this investigation. Of the 9 patients excluded, 1 had a fracture of the humeral head at the time of follow-up. In a case of bilateral transfer, 1 shoulder had to be excluded due to a rupture of the transferred tendon during a car accident. Two patients died, and the remaining 6 patients were lost to follow-up.

Patients were followed-up after an average of 35 months postoperatively (range, 12-78 months). Of the 54 shoulders included, 27 (50.0%) had already been operated on 1.6 times (range, 1-6 operations) before the tendon transfer. Four patients (7.5%) underwent tendon transfer for an isolated rupture of the subscapularis tendon with fatty degeneration. An anterosuperior rotator cuff-tear (Patte AB, Bateman II-IV) was present in 31 patients (57.5%).[3,28] In the remaining 19 patients (35.0%), an anterosuperior rotator cuff tear was accompanied by an additional partial rupture of the infraspinatus tendon.

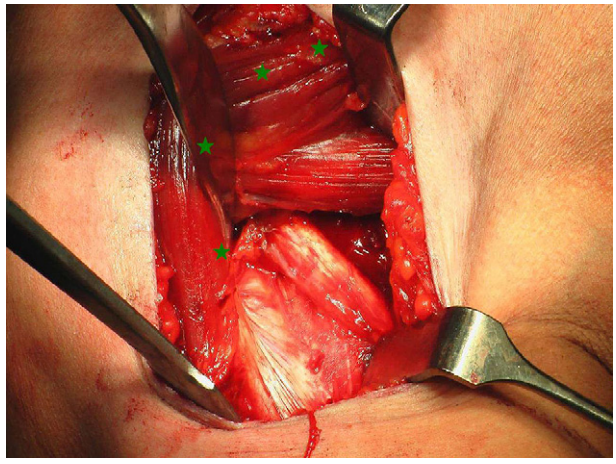

Figure 1 An intraoperative photo shows the original insertion of the pectoralis major (indicated by *green stars*) at the humerus.

The modified fixation technique with bone chip was developed in 2002. From then on it replaced the former harvesting technique with sharp detachment of the tendon and was applied in 29 shoulders (54.0%).

Surgical technique

Procedures were performed according to the technique described by Resch et al.[30,31] General anesthesia is initiated and the patient is placed in the beach chair position. The arm is draped flexibly. Access to the rotator cuff, coracoid process, and conjoined tendon is achieved using a deltopectoral approach. Next, the insertion of the pectoralis major tendon at the humerus is prepared (Fig. 1).

For the alternative technique, the tendon was not sharply detached using a scalpel. Instead, two-thirds of the tendon was separated from the bone using a chisel with adherent chips of cancellous bone (Figs 2 and 3). After identification of the musculocutaneous nerve, passage below the conjoined tendon was achieved. After ensuring that there was enough space between the coracoid process and the musculocutaneous nerve, the tendon was fixed to the humeral head. For this purpose for both fixation techniques, the chisel was used to create a superficial crevice 2-mm deep, 5-mm wide, and about 2-cm long to ensure a sufficient blood supply at the bone-to-bone or bone-to-tendon interface. Fixation to the lesser tuberosity was made with nonabsorbable sutures (Fig. 4).

Postoperative rehabilitation

The shoulder was immobilized in a sling for 4 weeks. The day after surgery, passive mobilization with restricted external rotation was initiated. Active motion without restriction was allowed after 6 weeks. Muscle strengthening was allowed after 3 months. The postoperative rehabilitation plan was identical for both groups.

Clinical evaluation

Clinical examinations were performed by 3 examiners who were not involved in this investigation in any other way.