Transfer of pectoralis major for the treatment of irreparable tears of subscapularis

DOES IT WORK?

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Transfer of pectoralis major has evolved as the most favoured option for the management of the difficult problem of irreparable tears of subscapularis. We describe our experience with this technique in 30 patients divided into three groups. Group I comprised 11 patients with a failed procedure for instability of the shoulder, group II included eight with a failed shoulder replacement and group III, 11 with a massive tear of the rotator cuff. All underwent transfer of the sternal head of pectoralis major to restore the function of subscapularis.

At the latest follow-up pain had improved in seven of the 11 patients in groups I and III, but in only one of eight in group II. The subjective shoulder score improved in seven patients in group I, in one in group II and in six in group III. The mean Constant score improved from 40.9 points (28 to 50) in group I, 32.9 (17 to 47) in group II and 28.7 (20 to 42) in group III pre-operatively to 60.8 (28 to 89), 41.9 (24 to 73) and 52.3 (24 to 78), respectively.

Failure of the tendon transfer was highest in group II and was associated with pre-operative anterior subluxation of the humeral head. We conclude that in patients with irreparable rupture of subscapularis after shoulder replacement there is a high risk of failure of transfer of pectoralis major, particularly if there is pre-operative anterior subluxation of the humeral head.

The musculotendinous forces must be balanced in all planes around the glenohumeral joint for satisfactory function and stability of the shoulder.\(^4,6\) Subscapularis is said to be the most important musculotendinous unit of the rotator cuff.\(^4,7\) Good results have been reported after open or arthroscopic surgical repair of acute and subacute tears of the tendon of the subscapularis.\(^4,7\) However, the considerable retraction of the tendon and fatty infiltration of the muscle, which is found with long-standing tears, makes direct repair difficult and likely to fail.\(^12,13\) Transfer of pectoralis major has been described as a salvage procedure in this situation and has been shown to be a reasonable alternative for the improvement of pain and function in the shoulder.\(^5,14-16\)

Our aim was to describe our experience with transfer of the sternal head of the tendon of pectoralis major for the treatment of irreparable ruptures of the tendon of subscapularis. We report the outcome in three different groups of patients, namely, those with an irreparable tear of the subscapularis after failed instability procedures, those with failed repair after shoulder replacement, and those with an associated massive tear of the rotator cuff.

Patients and Methods

A total of 580 operations on the rotator cuff were undertaken between 2000 and 2005 by the senior author (JJPW). Of these, 36 consecutive patients underwent transfer of pectoralis major for irreparable tear of the subscapularis. Three patients were lost to follow-up and three with follow-up of less than two years were excluded. We thus included in the study 30 patients who had complete pre-operative evaluation, operative records and a minimum follow-up of two years or until the time of revision surgery for failure of the transfer.

The patients were divided into three groups according to the type of tear (Table I). Group I included those with an isolated irreparable tear of subscapularis after a failed instability procedure, group II, those with rupture of the tendon of subscapularis after shoulder replacement and group III, patients with rupture of the tendon of subscapularis associated with a massive tear of the rotator cuff.

Group I. This included 11 patients with a mean age of 37 years (18 to 49). Nine were male and the dominant side was involved in seven. The mean follow-up was 49 months (25 to 68). Previous surgery for anterior instability had been performed by an open technique, in addition to
other procedures. A total of 29 previous operations had been performed elsewhere. Two patients had four, three patients three, five patients two, and two patients one previous operation.

All patients had pain, weakness of internal rotation, increased passive external rotation, a positive belly-press sign and positive apprehension, indicating instability or subluxation of the shoulder. The lift-off test was normal in three. All patients had pre-operative radiographs including an axillary view as well as MRI or CT arthrography to determine the status of the subscapularis and the concentricity of the glenohumeral joint. The joint was concentric in eight patients but there was anterior subluxation in three.

**Group II.** This included eight patients with a mean age of 55 years (33 to 74). The relatively young mean age is explained by the inclusion of three younger patients, two of whom had suffered severe fractures and one avascular necrosis. The dominant side was affected in six and six patients were female. The mean time interval between shoulder replacement and transfer of the tendon of pectoralis major was 37 months (6 to 120), and the mean follow-up was 53 months (25 to 80). Total shoulder replacement had been performed in five and hemiarthroplasty in three. Most required additional procedures. One patient had three, three patients two, and three patients one previous operation. The indications for total shoulder replacement included osteoarthritis in three patients, arthritis of instability in one and avascular necrosis in one. All the patients had been operated on previously elsewhere, except for the one with arthritis of instability who had been operated on by the senior author. The indications for hemiarthroplasty included fracture of the proximal humerus in two patients and malunion and avascular necrosis after open reduction and internal fixation in one. All had pain, weakness of internal rotation, increased passive external rotation, a positive belly-press sign and lift-off test and a positive apprehension test. In all patients pre-operative radiographs, including an axillary view, had been taken as well as CT arthrography performed. Anterior glenohumeral subluxation was present in five patients.

Transfer of the tendon of pectoralis major was performed for irreparable subscapularis insufficiency in all patients. The patient in whom hemiarthroplasty had been performed for malunion and avascular necrosis had a failed primary repair of the subscapularis tendon and the remainder had failed healing of the lesser tuberosity, osteotomy or fracture. Three patients had undergone additional revision of the replacement. In one a revision total shoulder replacement was performed using autogenous iliac bone graft to reconstruct an uncontained glenoid defect. In one with an uncemented replacement, an exchange of a fractured polyethylene component was performed in addition to the transfer of pectoralis major. In one a revision total shoulder replacement was performed and an allograft of tendon Achilles was used to reconstruct the anterior capsule in addition to the transfer of pectoralis major. In the patients who had a previous hemiarthroplasty, a revision hemiarthroplasty was performed in one and open release for contracture in two in addition to transfer of pectoralis major.

**Group III.** This included 11 patients with a mean age of 58 years (45 to 77). Seven patients were male and the dominant side was involved in seven. None was the massive tear of the rotator cuff due to a dislocation. The mean follow-up period was 57 months (44 to 82). All presented after failed previous surgery. The initial failed treatment was a primary open repair of the rotator cuff in four patients, arthroscopic repair in two and revision repair of the rotator cuff in five (Table I). In nine patients a previous attempt had been made at repairing the subscapularis tear in addition to tears of the supraspinatus and infraspinatus. Two further patients had a tear of subscapularis associated with the recurrent tear of the rotator cuff. All had massive tears involving supraspinatus and infraspinatus in addition to an irreparable insufficiency of subscapularis. However, teres minor was spared in all. All the patients had pre-operative radiographs including an axillary view as well as CT or MRI arthrography. No patient had subluxation of the glenohumeral joint. In all patients subscapularis was judged to be irreparable based on its retraction to the level of the glenoid neck and advanced

<table>
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<th>Table I. Pre-operative details of the patients in the three groups</th>
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<td><strong>Group I</strong></td>
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<td>Number of patients</td>
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<td>Mean age in yrs (range)</td>
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<td>Gender</td>
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<td>Male</td>
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<td>Female</td>
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fatty infiltration (Goutallier stage-IV). One patient had Goutallier stage-III fatty infiltration of supraspinatus and infraspinatus, three Goutallier stage-II, two Goutallier stage-I and two had stage-I fatty infiltration of infraspinatus only. None had proximal migration of the humeral head on pre-operative radiographs. All had pain, weakness of supraspinatus (abduction in the line of the scapula against resistance with the forearm in full pronation), weakness of internal and external rotation with the arm to the side, a positive belly-press sign and increased passive external rotation. The lift-off test was positive in seven patients. The apprehension test caused apprehension in five patients and pain in six. Revision rotator-cuff repair with transfer of pectoralis major to reconstruct an irreparable subscapularis tear was performed in all patients. Additional surgery included reconstruction using tendo Achillis for capsular insufficiency in one patient.

Operative technique. This has been reported previously. In all patients an extended deltopectoral approach was performed. Considerable scarring between the tissue planes was always found and careful sharp dissection of the tissue planes with scar excision was performed. The axillary nerve was identified, dissected, and protected. The tendinous portion of subscapularis was either absent, or present as a thin, scarred remnant with no elasticity. A small portion of the inferior muscular part of subscapularis remained intact in most patients. The edges of the remnants of the glenohumeral joint capsule were tagged with stay sutures, which were used to repair the capsule later. In none of the patients was a remnant of the subscapularis tendon still attached to the lesser tuberosity. The tendon and scarred remnants of subscapularis were mobilised as far medially, superiorly and inferiorly as possible and an attempt made to attach the tendon and remnants to the lesser tuberosity.

Pectoralis major was then exposed and the interval between the sternal and the clavicular heads identified. Separation of the two heads of the tendon and detachment of the sternal portion from the humerus was performed. Non-absorbable No 2 braided sutures were placed in the end of the tendon. The muscle split between the two heads was extended approximately 3 cm to 4 cm medially in order to allow the sternal head to be passed beneath the clavicular head, which acted as a pulley or fulcrum for the sternal head when both contracted. In addition, this helped to guide the axis of pull of the sternal head of pectoralis major more in line with the vector of the subscapularis. While the line of pull of the subscapularis was posterior to the chest wall, that of the split pectoralis transfer was anterior to the chest wall, which placed the pectoralis transfer at less advantage if it was attached to the lesser tuberosity. Suturing of the pectoralis tendon to the medial aspect of the greater tuberosity enhanced the pulley effect when the sternal head was passed beneath the clavicular head. In addition, this attachment offered the advantage of increasing the moment arm of pull of the transferred muscle. Thus, split transfer of the sternal head of the tendon of pectoralis major beneath the clavicular head and its attachment to the greater tuberosity was performed in all patients. After decorticating of the medial aspect of the greater tuberosity and the bicipital groove, the tendon was attached to the greater tuberosity under slight tension using either bone anchors or a transosseous technique with the shoulder in neutral rotation. The incision was closed in layers, and the shoulder gently examined by performing external rotation with the arm to the side to determine the tension on the repair. In all repairs external rotation beyond neutral was not possible without considerable tension on the repair. The arm was then placed in a shoulder immobiliser.

Post-operative rehabilitation. The shoulder was immobilised post-operatively in a sling for six weeks. No movement was allowed during this time. Both active and passive movement was permitted thereafter, although all stretching was gentle and external rotation was never forced. Strengthening exercises were delayed for four months.

Outcome measures. Data included the symptoms at presentation, the time of the injury, the past surgical history, physical and radiological findings, surgical treatment and follow-up information. Pain, function and instability were recorded both as symptoms and on physical examination. Since the tendon transfer was performed in all patients under slight tension, excessive passive external rotation post-operatively indicated failure. In addition, rupture was determined by palpation while applying resistance against the hand with the arm placed to the side, the elbow bent to 90° and with active internal rotation of the shoulder. If there was absence of palpable contraction in the inferior sternal portion of pectoralis major accompanied by increased passive external rotation and weakness of internal rotation, then a ruptured transfer was diagnosed. None of the patients had concomitant absence of contraction of the sternal head of pectoralis major with decreased passive external rotation. Such a scenario would have suggested an intact, but non-functional transfer. We believed that the transfer might still work as a static stabiliser against excessive external rotation if it were in continuity. A positive lift-off test and belly-press sign were reported pre- and post-operatively but were not used as diagnostic tests to assess failure after tendon transfer, because these tests may remain positive even after a successful tendon transfer. Pain was assessed by a visual analogue scale ranging from 0 (no pain) to 10 (severe pain). Functional outcome was determined according to the Constant shoulder subjective scores pre- and post-operatively at follow-up. The shoulder subjective score was determined by asking the patient to estimate the percentage of normal shoulder function which they thought that they had in the involved shoulder.

Subluxation was defined on standardised radiographs as either anterior or posterior depending on the location of the centre of the humeral head with respect to the midpoint of the glenoid. This was best evaluated on the axillary lateral radiograph. In some patients a post-operative MRI or CT arthrogram was used to determine the status of the rotator-
cuff repair, and to confirm the continuity of the tendon transfer and the congruity of the glenohumeral joint. The tendon transfer was considered to have failed if physical examination and radiological parameters suggested that the tendon was ruptured and there was no improvement in pain score, functional evaluation and the Constant score.

Statistical analysis. To determine the statistical significance between the different groups a one-way analysis of variance (ANOVA) test was used. When significant, a Tukey test was performed to identify differences between groups. The level of statistical significance was set at $p \leq 0.05$.

Results

**Group I.** Seven of the 11 patients reported improvement in their shoulder subjective score, seven indicated that pain had decreased, six reported a marked improvement in the shoulder subjective score and four reported no pain (Table II). A belly-press sign remained positive in all patients and four had a normal lift-off test.

The mean pain score decreased from 7.5 (6 to 10) pre-operatively to 3.8 (0 to 9) post-operatively ($p = 0.006$). The mean Constant score improved from 40.9 (28 to 50) pre-operatively to 60.8 (28 to 89) post-operatively ($p = 0.04$) (Table II).

In eight patients the glenohumeral joint remained concentric and centred. All eight had improvement in their Constant score and shoulder subjective score. On examination all patients showed resolution of apprehension in the abducted-external rotation position and of excessive passive external rotation and restoration of internal rotation strength. Examination of the pectoralis transfer also showed continuity of the repair with no indication of rupture. However, three patients who had anterior subluxation of the humeral head on pre-operative radiographs showed no improvement in the pain and Constant scores and the shoulder subjective score. Physical examination in these three patients suggested rupture of the transfer. This was confirmed on CT scans and there was also recurrent anterior subluxation (Fig. 1). In one patient, revision of the fixation of the tendon transfer was performed with considerable relief from pain, but with minimal functional improvement. Another patient underwent fusion of the shoulder with considerable relief from pain but limited functional improvement. In the third patient, aged 33 years with considerable disability after the failure of the tendon transfer, glenohumeral fusion is planned.

**Group II.** Only one of the eight patients reported significant improvement in the shoulder subjective score and pain ($p = 0.011$). The belly-press sign remained positive in all patients and none had a normal lift-off test. The mean pain scores decreased from 7.8 (6 to 10) pre-operatively to 6.1 (3 to 9) post-operatively, which was not statistically significant ($p = 0.7$) The mean Constant score improved from 32.9 (17 to 47) pre-operatively to 41.9 (24 to 73), post-operatively, which was also not statistically significant ($p = 0.7$) (Table II).

Six patients had no improvement in either the pain, Constant or functional scores. Physical examination indicated rupture of the transfer and a post-operative CT arthrogram confirmed rupture of the transfer in all six. In five of these, recurrent anterior subluxation had been present pre-operatively (Fig. 2).

### Table II. Details of the outcome data for the three groups

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<tr>
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<th>Group I</th>
<th>Group II</th>
<th>Group III</th>
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<tbody>
<tr>
<td>Number of patients</td>
<td>11</td>
<td>8</td>
<td>11</td>
</tr>
<tr>
<td>Mean follow-up in months (range)</td>
<td>49 (25 to 68)</td>
<td>53 (25 to 80)</td>
<td>57 (44 to 82)</td>
</tr>
<tr>
<td>Pain relief (number of patients)</td>
<td>7</td>
<td>1</td>
<td>7</td>
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<tr>
<td>Pain score (range)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-operative</td>
<td>7.5 (6 to 10)</td>
<td>7.8 (6 to 10)</td>
<td>7.9 (6 to 10)</td>
</tr>
<tr>
<td>Post-operative</td>
<td>3.8 (0 to 9)</td>
<td>6.1 (3 to 9)</td>
<td>4.2 (0 to 10)</td>
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<tr>
<td>Constant score (range)</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Pre-operative</td>
<td>40.9 (28 to 50)</td>
<td>32.9 (17 to 47)</td>
<td>28.7 (20 to 42)</td>
</tr>
<tr>
<td>Post-operative</td>
<td>60.8 (28 to 89)</td>
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Management of failed transfer of pectoralis major in patients who have had previous shoulder replacement is very challenging. Of the six patients in this category, the first presented with loosening of the glenoid and anterior subluxation of the humeral head. Laboratory studies and CT-guided aspiration indicated deep infection. The patient was treated by irrigation and debridement, removal of the total shoulder replacement and insertion of an antibiotic-impregnated cement spacer. In the second patient, conversion to a reverse shoulder prosthesis was undertaken with functional improvement and relief from pain. The third underwent a revision total shoulder replacement and his pre-operative plan included either a Bristow-Latarjet procedure or capsular reconstruction with the use of allograft tendon. However, a remnant of the inferior part of the muscular portion of subscapularis was found at surgery and it was thought that this could be used as a sling with the addition of a coracoid bony block to stabilise the shoulder. This was performed with considerable functional improvement, relief from pain and a stable shoulder at follow-up six years later. The fourth patient had a revision reconstruction with transfer of the tendon of teres major with improvement in pain but limited functional gain. The remaining two patients did not have further surgical treatment. One had dysfunction of the axillary nerve from the initial surgery and continued to have pain and limited function after transfer of pectoralis major. The other declined further intervention.

**Group III.** Five of the 11 patients in this group reported significant improvement with this shoulder subjective score ($p = 0.01$) and seven moderate improvement in pain. The belly-press sign remained positive in all patients and none had a normal lift-off test. Ten patients had a concentric and centred glenohumeral joint at follow-up.

The mean pain score decreased from 7.9 (6 to 10) pre-operatively to 4.2 (0 to 10) post-operatively ($p = 0.01$). The mean Constant score improved from 28.7 (20 to 42) pre-operatively to 52.3 (24 to 78) post-operatively ($p = 0.01$).

Based on lack of improvement of the pain and the Constant and shoulder subjective scores the transfer failed in four patients. In all of these, physical examination suggested failure and this was confirmed by arthrography. One patient had Goutallier stage-III and three Goutallier stage-II fatty infiltration of supraspinatus and infraspinatus pre-operatively. The pectoralis major transfer and the supraspinatus tendon repair were shown by MRI and physical examination to have failed in all four. One had anterior subluxation of the humeral head (Fig. 3). In one further patient with mild fatty infiltration of supraspinatus pre-operatively, only the supraspinatus repair failed. None of the patients in whom the transfer failed had further surgery.

**Summary of the findings.** Comparing the three groups, statistical analysis using one-way ANOVA showed that the patients in group I were younger than those in groups II and III. When pain after the pectoralis transfer was compared between groups, seven of the 11 patients in group I, one of eight in group II, and seven of 11 patients in group III indicated that the pain has decreased. The mean pain score decreased from 7.5 (group I), 7.8 (group II), and 7.9 (group III) to 3.8, 6.1 and 4.2, respectively. Functional gains were more limited. The mean Constant score improved from 40.9 (group I), 32.9 (group II), and 28.7 (group III) pre-operatively to 60.8, 41.9 and 52.3 points, respectively, post-operatively. The least improvement in the Constant score was seen in the group of patients who had transfer of pectoralis major after a failed shoulder replacement (group II). Seven of 11 patients in group I, one of eight in group II and seven of 11 in group III showing marked improvement in the shoulder subjective score, respectively. Failure of the tendon transfer was highest in group II (six of eight), compared with...
three of 11 in group I and four of 11 in group III. Tendon transfer failure was associated with pre-operative anterior glenohumeral subluxation in patients in group I and group II, and with more advanced fatty infiltration of the supraspinatus and infraspinatus in group III.

Discussion

When the subscapularis tendon is deficient or irreparable, the reconstruction options available to restore its function as an internal rotator and dynamic stabiliser of the shoulder are limited. Various tendons have been tried as a substitute for subscapularis but transfer of pectoralis major has evolved as the most popular and successful. This transfer has been reported by several authors using various techniques. These include subcoracoid transfer by passing the tendon beneath the conjoint tendon, direct transfer of the whole or part of the muscle to the lesser tuberosity, transfer of the sternal head of pectoralis major by passing it beneath the clavicular head and fixing it to the medial aspect of the greater tuberosity, all with similar outcomes. Regardless of the repair technique, it should be remembered that the vector of pull of subscapularis is posterior to the chest wall while the vector of pull of the split pectoralis transfer, even when the sternal head is passed beneath the clavicular head, is anterior to the chest wall.

Gerber et al, Gerber and Krushell and Gerber and Hersche originally described the surgical technique for the mobilisation and repair of the tendon of subscapularis. They recommend repair of the lower portion of the tendon with transfer of the sternal head of pectoralis major to augment the deficient upper portion.

Wirth and Rockwood described their experience with capsular repair and transfer of either pectoralis major alone, pectoralis minor alone, or both, to manage irreparable tears of subscapularis in patients after failure of instability procedures. They reported 13 patients with failure of capsular repair for the treatment of instability in association with an irreparable tear of the tendon of subscapularis. Seven of these had transfer of pectoralis major, one had transfer of pectoralis minor, and five had transfer of both. Using a modification of the Neer and Foster grading system, they reported satisfactory results in ten shoulders and unsatisfactory in three at a mean follow-up of five years. All those with a satisfactory outcome had resolution of instability and marked reduction in pain. Two had restoration of a normal lift-off test. No patient had fixed anterior subluxation of the shoulder pre-operatively and the continuity of the tendon transfer was not evaluated at the last follow-up.

Resch et al were the first to report the technique and outcome of subcoracoid transfer of pectoralis major to the greater tuberosity for the treatment of irreparable tears of subscapularis. In their group of 12 patients with a minimum follow-up of two years, the mean Constant score improved from 22.6 pre-operatively to 54.4 post-operatively. Most of their patients had a considerable improvement of pain, and four patients with pre-operative instability regained stability.

Galatz et al reported 14 patients who had undergone subcoracoid transfer of pectoralis major for anterosuperior subluxation of the humeral head secondary to a massive rotator-cuff tear and deficiency of the coracoacromial ligament. At a mean follow-up of 17.5 months, 11 had satisfactory and three unsatisfactory results. They reported marked improvement in pain using a visual analogue score and function using the American Shoulder and Elbow Surgeons functional outcome score.

Rupture of the subscapularis tendon is a rare complication of shoulder replacement and may result in pain, weakness and instability. Reports of this complication and recommendations for treatment are sporadic. Miller et al evaluated the function of subscapularis after total shoulder replacement. In their study, despite meticulous attention to the repair of subscapularis, dysfunction was identified in most patients and insufficiency was seldom recognised. In another study, they reported seven patients with rupture of subscapularis after shoulder replacement. All were treated by surgical repair of the ruptured tendon. Four of the repairs were augmented with a transfer of the tendon of pectoralis major. After repair and pectoralis transfer, two of the four patients who had instability or subluxation as a result of subscapularis insufficiency continued to have anterior instability and required additional procedures.

Moeckel et al described seven patients who developed anterior instability after replacement. All were found to have disruption of the sutured subscapularis tendon, which was then repaired. Three had recurrent instability and required static reconstruction of the anterior capsule with bone-tendo Achillis allograft, with resolution of the instability. Iannotti et al reported the static reconstruction of the anterior capsule using an iliotibial band graft. Seven patients with recurrent anterior instability secondary to capsular deficiency and irreparable deficiency of subscapularis, underwent this reconstruction. At a mean follow-up of two years all the shoulders were considered to be stable.

In our study, we report the outcome of split transfer of pectoralis major in three different groups of patients with irreparable tear of subscapularis. The technique favoured by the senior author involves passing the sternal head of pectoralis major beneath its clavicular head to create a fulcrum for the sternal head when both contract. This allows the axis of pull of the sternal head to be more in line with the vector of subscapularis. It obviates the need to pass the muscle beneath the conjoint tendon, thus risking the musculocutaneous nerve, and avoids excessive scarring. Improvement in the pain, Constant and shoulder subjective scores was better in group I and group III compared with group II. Three patients in group I with a failed tendon transfer had non-concentric anterior glenohumeral subluxation on pre-operative radiographs. The remaining eight patients did well with improvement of all outcome measures. In the review by Wirth and Rockwood, none of their patients had fixed pre-operative subluxation of the shoulder. This may explain the inferior results in our study.
Group III patients had a fair outcome. Seven of the 11 patients had a decrease in pain, five had an improved shoulder subjective score and their mean Constant score improved from 28.7 pre-operatively to 52.3 post-operatively. In the four patients in whom the transfer failed it was associated with more advanced fatty infiltration of supraspinatus and infraspinatus. These results are similar to those of Jost et al., who showed a better outcome in patients with an irreparable subscapularis tear associated with a supraspinatus tear, and in whom a successful repair was performed in addition to the transfer of pectoralis tendon.

The poorest results were in Group II patients with subscapularis insufficiency associated with shoulder replacement. Only one patient of eight reported subjective functional gain and their mean Constant score improved only from 33 to 41.9 points. The pectoralis tendon transfer failed in six of the eight patients, five of whom had pre-operative anterior subluxation of the glenohumeral joint. Thus the pectoralis tendon transfer did not re-centre the humeral head once it was subluxed as a result of an irreparable subscapularis tear after replacement. One patient who had a failed tendon transfer underwent a Bristow-Latarjet coracoid bone transfer to the anteroinferior aspect of the glenoid. This bony block stabilised the shoulder mostly through a sling effect by increasing the tension on the aspects of the glenoid. This bony block stabilised the shoulder replacement, when the humeral head is not concentric the transfer of pectoralis tendon is more likely to fail and alternative treatment such as a bone block, transfer of the coracoid or capsular reconstruction using tendon allograft or autograft, should be considered as a salvage procedure.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

References