Does diabetes affect outcome after arthroscopic repair of the rotator cuff?

N. D. Clement, A. Hallett, D. MacDonald, C. Howie, J. McBirnie

From Royal Infirmary of Edinburgh, Edinburgh, United Kingdom

We compared the outcome of arthroscopic repair of the rotator cuff in 32 diabetic patients with the outcome in 32 non-diabetic patients matched for age, gender, size of tear and comorbidities. The Constant-Murley score improved from a mean of 49.2 (24 to 80) pre-operatively to 60.8 (34 to 95) post-operatively (p = 0.0006) in the diabetic patients, and from 46.4 (23 to 90) pre-operatively to 65.2 (25 to 100) post-operatively (p = 0.0003) in the non-diabetic patients at six months. This was significantly greater (p = 0.0002) in non-diabetic patients (18.8) than in diabetics (11.6). There was no significant change in the mean mental component of the Short-Form 12, but the mean physical component increased from 35 to 41 in non-diabetics (p = 0.0001), and from 37 to 39 (p = 0.15) in diabetics. These trends were observed at one year.

Patients with diabetes showed improvement of pain and function following arthroscopic rotator cuff repair in the short term, but less than their non-diabetic counterparts.

Repair of a torn rotator cuff gives relief of pain and functional improvement, with patient satisfaction. The rates of re-rupture of 13% to 68% have been reported after repair, although long-term, follow-up of patients with re-rupture has nevertheless demonstrated significant improvements in pain and function; and 38% of cases have complications. Patients with diabetes mellitus have been reported to incur more complications after orthopaedic surgery in the lower limb. There is a higher incidence of shoulder stiffness in diabetic patients, developing in up to 36% of insulin-dependent diabetics compared to 3% of the general population. One study has reported the outcome in patients with type 1 diabetes after mini-open repair of the rotator cuff, and showed an increased rate of post-operative infection and failure of repair, with a decreased range of movement in diabetics relative to non-diabetic patients. The mini-open repair has been associated with an increased risk of post-operative infection and shoulder stiffness compared to arthroscopic repair.

The effect of diabetes on the outcome after arthroscopic repair of the cuff remains unclear. The purpose of this study was to find out whether diabetes prejudices the outcome. We did this by comparing retrospectively the function and post-operative complications between matched groups of diabetic and non-diabetic patients.

Patients and Methods

We identified 32 diabetic patients with a mean age of 59.5 years (41 to 77) from a prospectively compiled database of 494 patients between 2000 and 2008, all of whom underwent arthroscopic repair of a full-thickness rotator cuff tear by the senior author (JM). Constant-Murley and Short-Form (SF)-12 scores were recorded before operation and after six months and one year. No diabetic patients were excluded from this group, and there was no selection bias by the senior author, who used the same surgical indications in all the patients. From the remaining 462 patients in the database a group of 32 with a mean age of 58.9 years (39 to 76) without diabetes were selected for comparison. These patients were matched for number of comorbidities, as those patients with comorbidities have been shown to have a greater improvement of outcome scores after rotator cuff repair and hence is a confound factor. Patients were excluded...
if there was a history of dislocation or fracture of the shoulder, degenerative or inflammatory arthrosis, infection, neuropathic changes, prior surgical procedures to the shoulder, or fewer than 12 months of post-operative follow-up. A total of 32 patients were lost to follow-up at 12 months. They were discharged from further follow-up as they had good clinical and functional results at the six-month review. They were given an open appointment should they have any concerns. None required an appointment and we assume they remain satisfied. This resulted in 218 patients being eligible for comparison, of which 32 case-match patients were chosen. A total of 22 women and 42 men were evaluated.

Of the 64 patients evaluated, five had a history of a traumatic event associated with the dysfunction of their shoulder, two in the diabetic patients and three in the non-diabetic patients. The remainder had degenerative tears. All patients complained primarily of pain in the shoulder with associated limitation of movement and loss of power. The mean time from presentation to repair was 14.8 weeks (6 to 41). Of the 32 diabetic patients, ten had a history of capsulitis.

The Constant score was recorded by a senior shoulder physiotherapist or the registrar (AH) attached to the senior author at that time, and the patients completed the SF-12 form themselves. These were read by an automated system and stored in a database. Of the 64 patients evaluated 98% of the data was completed. Missing data tended to be as a result of an unticked or completed box.

A total of 15 patients had an ultrasound scan which confirmed a torn rotator cuff in combination with associated dysfunction on clinical examination; an MR scan was not performed. MRI was undertaken in 49 patients, none of whom had stage 3 or 4 fatty infiltration of the cuff muscle, nor was there any difference in the degree of infiltration between the two groups. One patient in the non-diabetic group received corticosteroid injections to the shoulder, or fewer than 12 months of post-operative follow-up. The repair was performed using a standard double-row technique as described by Lo and Burkhart.23 Double-loaded bio-absorbable suture anchors were used. Either one or two anchors were inserted at the junction between the articular cartilage and the medial footprint at the junction of the greater tuberosity. Deep mattress sutures were passed through the tendon. One or two lateral anchors were then inserted and joined as simple or looped sutures to invert the lateral edge of the tear. In U- or V-shaped tears, side-to-side sutures were used to close its medial extent and a double row of anchors were used to secure it to the greater tuberosity.

Post-operatively diabetic patients were re-started on their pre-operative oral hypoglycaemics or insulin regimes. Supplemental regular human insulin was given according to a sliding scale determined by their serum glucose level. Gentle pendular exercises began on the first post-operative day. The patients remained in a poly-sling with instruction to continue pendular exercises with gradual progression as pain allowed for four weeks, after which they were enrolled in a formal physiotherapy programme. This consisted of passive and active-assisted movement leading up to active range at eight to ten weeks, followed by strengthening exercises from three months. If there was no ongoing concern patients were discharged from further follow-up after one year.

**Statistical analysis.** Wilcoxon-signed-ranks test was used to compare pre- and post-operative scores and a Mann-Whitney U test to compare the diabetic with the non-diabetic group. A p-value of ≤ 0.05 was considered statistically significant.

**Results**

The mean age in the diabetic group was 59.5 years (41 to 77) and in the non-diabetic group was 58.9 years (39 to 76) (p = 0.8). There were 11 women (34%) in each group. Intra-operative measurement21 of the size of the tear was a mean of 2.7 cm (1.0 to 4.5) in the diabetic group versus 2.5 cm (0.5 to 4.5) in the comparison group (p = 0.9). Of the diabetic patients, 24 (75%) had an isolated supraspinatus tear and eight (25%) had tears of both supraspinatus and infraspinatus. Of the non-diabetic patients, 22 (69%) had an isolated supraspinatus tear, nine (28%) had tears of both supraspinatus and infraspinatus and one tear of both supraspinatus and subscapularis. The mean number of comorbidities was 2.2 (0 to 7) in the diabetic group and 2.4 (0 to 8) in the non-diabetic group (p = 0.8).

There were no significant differences between the mean pre-operative Constant scores in both groups (Table I), and both groups showed significant improvement in their post-operative scores. There was no significant difference in total Constant scores between the groups at six months and one year after operation (p = 0.19). However, the absolute
mean improvement relative to the pre-operative scores was significantly greater (p = 0.0002) in non-diabetics (18.8 (7 to 44)) relative to diabetics (11.6 (4 to 38)). The absolute improvement for the components of the Constant score compared to pre-operative scores and the difference between the groups at six months is demonstrated in Figure 1. Significant differences were observed in activities of daily living (ADLs), forward flexion, external rotation and power components, with non-diabetic patients scoring higher (p < 0.01). This difference is reflected in the mean range of movement of forward flexion and external rotation at one year (Table I), with a difference of 7° and 11°, respectively, between the groups (p = 0.03).

There were five type I diabetics and 27 type II. A comparison of scores for each type is shown in Figure 2. The mean post-operative Constant score was greater in the type I diabetics, although the absolute improvement was greater in those with the type 2 (p = 0.3). No significant difference was observed between type I and type II diabetic patients for components of the Constant score (all components p > 0.35), but both type I and II had significant improvements relative to their pre-operative scores (p = 0.007 and 0.0002 respectively). Constant scores at 12 months for those diabetic patients who had a history of capsulitis (n = 10) and

### Table I. Pre- and post-operative Constant-Murley scores for diabetic and non-diabetic patients, with a breakdown of the components of the score. The figure in parentheses is the mean degrees of movement for that direction of movement.

<table>
<thead>
<tr>
<th>Component</th>
<th>Pre-operative</th>
<th>Post-operative 6 months*</th>
<th>1 year*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetic</td>
<td>5.2</td>
<td>9.2</td>
<td>9.9</td>
</tr>
<tr>
<td>Non-diabetic</td>
<td>5.5</td>
<td>9.6</td>
<td>10.3</td>
</tr>
<tr>
<td>Activities of daily living</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetic</td>
<td>7.9</td>
<td>11.8</td>
<td>12.0</td>
</tr>
<tr>
<td>Non-diabetic</td>
<td>7.4</td>
<td>13.3</td>
<td>13.5</td>
</tr>
<tr>
<td>Forward-flexion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetic</td>
<td>6.8 (1275, 70 to 140)</td>
<td>7.9 (148.1, 80 to 160)</td>
<td>8.0 (150.2, 80 to 160)</td>
</tr>
<tr>
<td>Non-diabetic</td>
<td>6.6 (123.8, 75 to 135)</td>
<td>8.5 (159.4, 100 to 170)</td>
<td>8.4 (157.5, 95 to 175)</td>
</tr>
<tr>
<td>Abduction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetic</td>
<td>6.1 (114.4, 60 to 135)</td>
<td>7.7 (144.4, 100 to 155)</td>
<td>8.1 (151.9, 100 to 170)</td>
</tr>
<tr>
<td>Non-diabetic</td>
<td>6.0 (112.5, 70 to 130)</td>
<td>8.0 (150.0, 90 to 170)</td>
<td>8.1 (149.1, 90 to 175)</td>
</tr>
<tr>
<td>Internal rotation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetic</td>
<td>7.1</td>
<td>8.3</td>
<td>8.5</td>
</tr>
<tr>
<td>Non-diabetic</td>
<td>6.6</td>
<td>7.8</td>
<td>8.2</td>
</tr>
<tr>
<td>External rotation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetic</td>
<td>5.6 (39.2, 10 to 55)</td>
<td>6.1 (42.7, 0 to 55)</td>
<td>5.9 (40.3, 5 to 60)</td>
</tr>
<tr>
<td>Non-diabetic</td>
<td>5.9 (41.3, 13 to 50)</td>
<td>7.5 (52.5, 20 to 70)</td>
<td>7.4 (51.1, 20 to 80)</td>
</tr>
<tr>
<td>Power</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetic</td>
<td>10.6</td>
<td>9.8</td>
<td>10.1</td>
</tr>
<tr>
<td>Non-diabetic</td>
<td>8.6</td>
<td>10.6</td>
<td>11.3</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetic</td>
<td>49.2†</td>
<td>60.8</td>
<td>62.6</td>
</tr>
<tr>
<td>Non-diabetic</td>
<td>46.4†</td>
<td>65.2</td>
<td>67.3</td>
</tr>
</tbody>
</table>

* p < 0.01 relative to pre-operative scores
† no difference between total pre-operative Constant-Murley score score, p = 0.2

Bar chart showing the absolute improvement for the components of the Constant Murley score and the difference in absolute improve relative to pre-operative sores for both groups, and the difference between the groups at six months (*p < 0.01).
those who did not is shown in Figure 3. The latter had a 3.7-point greater improvement than those with previous capsulitis, but this was not statistically significant (p = 0.09).

The mean mental component of the SF-12 improved for both groups from 48.1 to 50.0 in diabetic patients (p = 0.3) and 51.6 to 51.7 in non-diabetic patients (p = 0.45). The mean physical component of the SF-12 increased from 36.7 to 39.4 (p = 0.2) in diabetic patients and 35.6 to 40.8 (p = 0.0001) in non-diabetic patients at six months. Analysis of the individual physical components revealed no significant differences between the groups (p = 0.2), although the absolute improvement in the total SF-12 score between the groups was significant (2.7 for diabetic patients vs 5.2 for non-diabetic patients, p = 0.008).

In the diabetic group there was one superficial portal site infection at six weeks. There were no clinical failures of repair, nor was revision surgery performed in the study period. In the non-diabetic group there were no infections or revisions. There was a suspected failure at six months, with worsening of symptoms and deteriorating scores, but an ultrasound scan confirmed an intact rotator cuff. The patient’s symptoms, resolved at one year, with improvement in their scores.

**Discussion**

To our knowledge, no previous study has specifically examined the results of arthroscopic repair of the rotator cuff in a diabetic population. We have demonstrated significant relief of pain and improvement of function in a group of diabetic patients after arthroscopic repair of the rotator cuff, with a low complication rate.

The Constant scores improved in both groups but non-diabetic patients had a significantly greater improvement, owing to better scores for ADLs, forward flexion, external rotation and the power components. Only the non-diabetic patients had a significant improvement in the physical aspect of the SF-12 score. The diabetic cohort had an apparent improvement in the physical component of the SF-12 score, but this was not significant. This may represent a type 2 error.

Our cohort included an unselected group of diabetic patients, five of whom had type I and 27 type II diabetes.
Sub-group analysis revealed no significant differences in the pre- and post-operative Constant scores or in the absolute improvement. Type I diabetics did have a higher score pre-operatively and this was reflected by a greater score post-operatively relative to the type II diabetic patients. This may indicate that type I diabetics have better overall shoulder function, possibly related to tighter glucose control with the use of insulin as opposed to oral hypoglycaemicals.

Diabetes mellitus is associated with joint stiffness. This was reflected in our group of diabetics, in whom we observed a significant reduction in forward flexion and external rotation post-operatively compared to the non-diabetics. Furthermore, if the patient had a history of capsulitis there was an associated reduced improvement in outcome of 3.7 points relative to those without a history of capsulitis, although this was not significant. This stiffness may be due to a secondary inflammatory response to the rotator cuff repair. Chen et al13 also observed significant differences in forward flexion and external rotation in diabetic versus non-diabetic patients. Non-diabetics had a better outcome than type I diabetics, which is similar to our findings. This would indicate that there may be a role for early physiotherapy in diabetic patients to address this increased risk of post-operative stiffness. More recently, Huberty et al26 reported a 4.9% (24 of 489) incidence of shoulder stiffness after arthroscopic repair of the rotator cuff. This increased to 15% in patients with a history of adhesive capsulitis. All 24 of these patients underwent arthroscopic capsular release, with restoration of normal shoulder function and 100% satisfaction. There is evidence that the outcome of coronary artery bypass surgery is improved if the peri-operative serum glucose level is tightly regulated,27 but the retrospective nature of this study meant that we were unable to record peri-operative glucose levels. If a prospective study were conducted, HbA1c, a marker of glycaemic control over the operative glucose levels. If a prospective study were conducted, HbA1c, a marker of glycaemic control over the

One potential weakness of this study is that no imaging studies were performed after operation to confirm the integrity of the repair. Previous studies have demonstrated a correlation between improvement of the functional scores and an intact repair.30 All the diabetic patients had improved outcome scores at 12 months relative to their pre-operative scores. This would suggest that their repair was intact, although some studies have shown improved scores even with failure of the repair.30,31 The difference in improvement between the diabetics and non-diabetics may relate to failure of the repair, suggesting that diabetic patients may have incurred a greater failure rate with impaired outcome measures. A second weakness of this study is the limited follow-up at one year. Boileau et al,32 however, suggested that patients with an intact repair of the rotator cuff will maintain their improved functional status and may even continue to improve into the long term. It would seem from our patients that there is little improvement from six months to one year (Table I), indicating that they have reached a plateau that hopefully will be maintained into the future.

Arthroscopic rotator cuff repair may be performed in diabetic patients with the expectation of significant pain relief and functional improvement. The functional improvement, however, is not as good as in their non-diabetic counterparts. The post-operative range of movement is limited compared to non-diabetic patients and the risk of infection is higher, although less of a risk than with a mini-open repair.

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