Shoulder Arthroscopy

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Abstract. Since 1989, shoulder arthroscopy was performed on 36 shoulders in 30 athletic patients having different kinds of shoulder affections. Their mean age was 24.6 years (range 16–38 years). Swimmers represented the highest number of shoulder affections in this series, affecting 13 of 30 patients (43.35%). It is proved that shoulder arthroscopy is easy, safe, and associated with a low incidence of complications. It can be considered an excellent invasive technique for visualizing shoulder affections. It also helps in detecting the minute details of the affection. A case of initial diagnosis of rotator cuff tear was diagnosed at arthroscopy as being a complete tear of the rotator cuff with tendinitis of the biceps tendon and rheumatoid arthritis. It also helps in the initiation of a new classification of shoulder affection.

Key Words: Shoulder arthroscopy.

Introduction

Methods of surgical treatment of the shoulder have improved, and more differentiated information can now be utilized. This makes arthroscopy interesting. The joint is large enough and the instruments have already been perfected as in knee joint surgery. However, arthroscopy has found few applications in the shoulder, and there have not been many reports in the literature [1–6]. The aim of this study is to assess the value of arthroscopy in different shoulder affections.

Materials and Methods

Thirty-six shoulder arthroscopies were performed on 30 athletes since 1989. Their ages ranged from 16 to 38 with an average of 24.6 years. The number of right shoulder afflictions was 21 (58.3%). Males were more affected than females (24 versus 6) and represented 80% of the study population. Of these 30 athletic patients, swimmers represented the highest number of shoulder affection (13 patients, 43.3%), followed by karate players (5 patients, 16.6%), handball players (4 patients, 13.4%), javelin throwers and weightlifters (3 patients for each, 10% each), while 1 case each was encountered for basketball and tennis players (3.35% each) (Table 1).

The initial indications for shoulder arthroscopy in this series was for rotator cuff tear in 17 shoulders (47.23%), shoulder instability in 11 shoulders (30.55%), synovitis in 4 shoulders (11.11%) (Table 2).

Technique

In the majority of our cases, the arthroscopy was performed from a posterior approach, but in some cases an anterior approach was also used for inserting instruments for surgery or for inspecting the posterior part of the shoulder joint. Although shoulder arthroscopy can be performed by local anesthesia, general anesthesia was preferred because it offers muscle relaxation and the possibility of continuing on and performing either arthroscopic surgical intervention or an open operation.

The patient is placed on his opposite side with the shoulder dropped free. The posterior approach is the one frequently used in this series. It can be performed by

<table>
<thead>
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<th>Game</th>
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<tr>
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</tr>
<tr>
<td>Karate</td>
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<tr>
<td>Handball</td>
<td>4</td>
<td>13.35</td>
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<tr>
<td>Javelin</td>
<td>3</td>
<td>10.00</td>
</tr>
<tr>
<td>Weightlifting</td>
<td>3</td>
<td>10.00</td>
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<tr>
<td>Basketball</td>
<td>1</td>
<td>3.35</td>
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<tr>
<td>Tennis</td>
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<td>3.35</td>
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<tr>
<td>Total</td>
<td>30</td>
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<th>Diagnosis</th>
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<th>Percent</th>
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</thead>
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<tr>
<td>Rotator cuff tear</td>
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<td>47.23</td>
</tr>
<tr>
<td>Shoulder instability</td>
<td>11</td>
<td>30.55</td>
</tr>
<tr>
<td>Synovitis</td>
<td>4</td>
<td>11.11</td>
</tr>
<tr>
<td>Frozen shoulder</td>
<td>4</td>
<td>11.11</td>
</tr>
<tr>
<td>Total</td>
<td>36</td>
<td>100.00</td>
</tr>
</tbody>
</table>

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Figure 1. The first thing to be discovered is the biceps tendon that runs freely in the joint. It can be considered as an arthroscopic landmark.

Figure 2. The biceps tendon can be followed from the opening in the capsule over the head of the humerus.

Figure 3. The insertion of the biceps tendon on the glenoid labrum.

Figure 4. Close-up of the insertion of the biceps tendon.

Figure 5. The biceps tendon is the white structure of the upper part of the picture. It shows the relationship of the tendon to the humeral head (right, lower corner). The subscapularis tendon is seen in the foramen oval.

Figure 6. The supraspinatus and infraspinatus muscles are seen through the thin capsule of the shoulder.

Figure 7. The supraspinatus and infraspinatus area in a case of partial rupture of the supraspinatus tendon. The biceps tendon can be seen at the bottom of the picture. Notice the torn capsule.

Figure 8. Long-standing total rupture of the rotator cuff. The thickened capsule ruptured longitudinally. There is no supraspinatus tendon.

Figure 9. The opening of the bursa subscapularis.
entering the shoulder joint 1 cm below and 1 cm medial to the posterior-lateral corner of the acromion. The arm is suspended by an assistant in 70° of abduction and 50° of flexion. Prior to insertion of the arthroscope, it is helpful to inject 15–20 cc of Ringer’s lactate or Ringer’s acetate to expand the joint.

When the arthroscope has been inserted from behind and a 30° optics is being used, the first thing the arthroscopist usually discovers is the biceps tendon (Figure 1). This can be considered a landmark of the interior of the shoulder joint. The biceps tendon can be followed from the opening in the capsule over the head of the humerus (Figure 2), down to its insertion on the glenoid labrum (Figure 3). The glenoid fossa and labrum can easily be inspected as seen in Figures 4 and 5. The anatomical relations of the biceps tendon and the subscapularis tendon can be seen in Figure 5. In order to visualize the rotator cuff it is usually wise to change the 30° optics for a 70° optical system. This facilitates the inspection of the ceiling of the shoulder joint, where the rotator cuff can be found. It is sometimes possible to identify the three parts of the rotator cuff, namely, the supraspinatus, the infraspinatus, and the teres minor tendon that can be seen through a thin capsule (Figure 6). If ruptures are present here, they can also be diagnosed. Small ruptures and inflammation of the supraspinatus tendon look like as in Figure 7. In severe long standing cases, the capsule is usually torn and, if the rotator cuff is totally torn, one can look up towards the lower part of the acromion with the arthroscope Figure 8.

The subscapularis tendon and the bursa in front of the subscapularis tendon can also easily be inspected through the arthroscope. The arthroscope is advanced below the biceps tendon towards the front of the joint (Figure 9). Small loose bodies can sometimes hide in this area. The head of the humerus can be inspected and the so-called Hill–Sachs lesions might be seen. If a dislocating biceps tendon is present, this can be diagnosed arthroscopically, partly because the tendon has a very unusual appearance, with a lot of fibrillation (Figures 10 and 11) caused by the repeated dislocations, and partly because one can actually see the seen with the 70° optics.

Postoperative Treatment

The patients were advised that their shoulder, upper arm and maybe their neck would feel swollen for 2–3 days and that they should stay home for 2–3 days. Athletic training was discouraged for a duration of 2 weeks. A physical therapy program that included all those motions pain-free from the beginning was given. The number of training periods and the number of different motions were increased gradually.

Results

Normal Findings

By adduction and rotation of the arm, the whole cuff—which is elevated from the humeral head by fluid pressure—can be inspected (Figure 6). The surface is smooth and white or yellowish in color with very few vessels.

By extension and outward rotation of the arm, the biceps tendon can be followed from its origin on the supraglenoid tubercle to its departure from the joint in the bicipital groove (Figure 1). The tendon runs free in the joint over the humeral head and beneath the rotator cuff. Its contact area to the cuff and head varies according to the movement of the shoulder. In the groove it becomes a synovial cover. The groove offers abundant room for the tendon, but normally little space for side movements.

By rotating the arm, most of the humeral head can be visualized. By abducting the arm with a clothes roll in the axilla, the head is elevated somewhat from the glenoid, which can be inspected together with the glenoid labrum. The glenoid cartilage is surrounded by the glenoid labrum, which is more distinct cranially and anteriorly. Its anteroinferior portion is more adherent to the glenoid cartilage, which may be interpreted erroneously as a lesion of the labrum.

The broad subscapularis tendon is part of the anterior joint capsule, but is elevated and clearly distinguishable from this structure. It is covered by a thin layer of synovial tissue (Figures 5 and 9). The synovial lining is thicker in the rest of the capsule anteriorly and cranially.

The aperture of the subcoracoid bursa (subscapular bursa), which communicates with the joint space, is visible (Figure 9). Inspection of the bursa itself, however, is hampered by the folds of the synovial lining.

Anterocranially, the coracohumeral ligament is visible as it leaves the subcoracoid bursa and attaches to the greater tuberosity. It is a marked structure, sometimes running free in the joint space.

Rotator Cuff Lesions

Patients who came to shoulder arthroscopy after rotator cuff tears or tendonitis first had at least 2–3 months of conservative management to which they had failed to respond. Lesions through some of the layers of the cuff only were classified as superficial ruptures. In such cases the cuff was frayed and uneven (Figure 7). The size of the area involved varied 1–4 sq cm. The defect could be 2–3 cm deep. Such lesions were found in the supraspinatus tendon area, close to the attachment on the humeral head.

By inspection alone, differentiation between a small, full thickness rupture and a superficial rupture could be difficult. Palpation of the cuff with a hook made this eas-
Table 3. Arthroscopic findings in 17 shoulders with cuff rupture

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Number</th>
<th>%</th>
<th>% in relation to the total number</th>
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<tbody>
<tr>
<td>1. Full thickness rupture and:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Partial biceps tendon rupture</td>
<td>4</td>
<td>23.5</td>
<td>11.11</td>
</tr>
<tr>
<td>b. Bicipital groove arthritis</td>
<td>2</td>
<td>11.7</td>
<td>5.55</td>
</tr>
<tr>
<td>c. Total biceps tendon rupture</td>
<td>1</td>
<td>5.9</td>
<td>2.77</td>
</tr>
<tr>
<td>d. Biceps tendon subluxation</td>
<td>1</td>
<td>5.9</td>
<td>2.77</td>
</tr>
<tr>
<td>e. Alone</td>
<td>1</td>
<td>5.9</td>
<td>2.77</td>
</tr>
<tr>
<td>2. Superficial cuff rupture and:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Partial biceps tendon rupture</td>
<td>1</td>
<td>5.9</td>
<td>2.77</td>
</tr>
<tr>
<td>b. Bicipital groove arthritis</td>
<td>1</td>
<td>5.9</td>
<td>2.77</td>
</tr>
<tr>
<td>c. Alone</td>
<td>6</td>
<td>35.3</td>
<td>16.66</td>
</tr>
</tbody>
</table>

Figure 10. Slightly inflamed biceps tendon.

Figure 11. A dislocating biceps tendon. Notice how "shaggy" the biceps tendon looks.

Figure 12. A case of rupture of the labrum with a long loose flap looking like a meniscus.

Figure 13. A small lesion in the form of a loose flap in the labrum in the front of the shoulder joint.

...The cuff could be examined in this way from the inside, or from the outside if the hook was inserted laterally into the subacromial bursa.

Lesions through all layers of the cuff were classified as full thickness rupture (Figure 8). The synovial lining of the subacromial bursa was visible through the defect. The tendonlike cuff structure and the rupture edge were mostly clearly distinguishable from the usually inflamed and red synovial lining of the bursa (Figures 8 and 9).

Full-thickness ruptures limited to one part of the cuff were classified as partial, whereas those with a defect of most of the cuff or of the whole cuff from the infraspinatus to the subscapularis tendon were classified as subtotal or total cuff ruptures. In these ruptures the concomitant tissue defect and retraction of the cuff medially could be estimated.

Cuff rupture was often combined with degenerative changes of the biceps tendon, mostly in the part in the bicipital groove, or proximal to this where it lies between the humeral head and the rotator cuff. Partial rupture of the biceps tendon was frequently seen together with full thickness rupture of the cuff. Some had severe arthritis of the bicipital groove, together with degenerative changes of the biceps tendon (Figure 11).
Table 4. Arthroscopic finding in 11 shoulders with shoulder instability

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>No.</th>
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<th>% In relation to the total number</th>
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<tr>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Hill–Sachs lesion</td>
<td>2</td>
<td>18.18</td>
<td>5.55</td>
</tr>
<tr>
<td>b. Bankart lesion</td>
<td>2</td>
<td>18.18</td>
<td>5.55</td>
</tr>
<tr>
<td>2. Glenoid labrum tears:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I. Anterior 1/3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. anterior 1/3 with inflammation of the</td>
<td>2</td>
<td>18.18</td>
<td>5.55</td>
</tr>
<tr>
<td>biceps tendon</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. anterior 1/3 without inflammation</td>
<td>1</td>
<td>9.09</td>
<td>2.77</td>
</tr>
<tr>
<td>II. Body</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. With capsular stripping from the anterior</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>surface of glenoid labrum</td>
<td>2</td>
<td>18.18</td>
<td>5.55</td>
</tr>
<tr>
<td>b. With Bankart lesion</td>
<td>1</td>
<td>9.09</td>
<td>2.77</td>
</tr>
<tr>
<td>3. Subluxation</td>
<td>1</td>
<td>9.09</td>
<td>2.77</td>
</tr>
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</table>

Table 5. The arthroscopic findings in four cases with frozen shoulder

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>No.</th>
<th>%</th>
<th>% In relation to the total number</th>
</tr>
</thead>
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<tr>
<td>Extra synovial contracture of the soft</td>
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<td>25.0</td>
<td>2.77</td>
</tr>
<tr>
<td>tissues</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tightness of the anterior structures</td>
<td>3</td>
<td>75.0</td>
<td>8.33</td>
</tr>
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</table>

One patient (2.77%) with a superficial cuff rupture had severe arthritis of the bicipital groove with marked osteophytes. One patient (2.77%) had a partial biceps tendon rupture, while superficial cuff rupture alone was diagnosed in 6 shoulders (16.66%). Overall, superficial cuff rupture was found in 8 patients (22.2%, Table 3).

Full-thickness rupture was found in 9 shoulders (25.0%). Among these, 4 (11.11%) ruptures were accompanied by partial biceps tendon rupture, and in 2 patients (5.56%) had bicipital groove arthritis.

Full-thickness rupture alone, or in combination with total biceps tendon rupture or biceps tendon subluxation, were encountered in 1 shoulder (2.77%) for each diagnosis (Table 3).

Shoulder Instability

We used the term “instability of the shoulder” to include anterior dislocation, anterior subluxation, and multidirectional instability. Instability was determined by examination under general anesthesia.

At arthroscopy, tears of the glenoid labrum were easily visualized and probed. Tears of the anterosuperior one third of the labrum seemed to be associated with a clicking noise in the shoulder on physical examination and often with adhesions and evidence of inflammation around the attachment of the biceps tendon to the glenoid tubercle (Figure 11). Sometimes the tear was in the main body of the labrum directly anterior to the glenoid: here it was often associated with stripping of the capsule from the anterior surface of the neck of the glenoid, or with a Bankart lesion (Figure 12).

In the presence of instability of the shoulder there were classic arthroscopic findings. The Bankart lesion could often be found as mentioned earlier. There was usually a defect in the posterosuperior aspect of the humeral head, the Hill–Sachs lesion; this defect was often cartilaginous rather than bony, and sometimes there was simply a chondral ulcer in the area where the bony defect is usually seen on the radiograph. In two cases loose bodies were found in the joint.

Of the 36 shoulders, 11 (30.55%) were studied with shoulder instability. Recurrent dislocation of the shoulder was found in 4 cases (11.11%), among which 2 cases (5.55%) were studied with Hill–Sachs lesion and 2 also (5.55%) were accompanied by Bankart lesion.

Glenoid labral tears were diagnosed in 5 cases (13.88%), 2 (5.55%) of which were studied with tears of the anterior one third of the glenoid labrum (Figure 13); 1 (2.77%) of these 2 cases was accompanied by inflammation around the biceps tendon (Figure 10). Of these 5 cases, 3 (8.33%) had had tears of the body of the glenoid labrum, 2 (5.55%) of which were accompanied by stripping of the capsule from the anterior surface of the glenoid neck (Figure 12), while 1 case only (2.77%) was accompanied by Bankart lesion. Subluxation of the shoulder was diagnosed in only 1 case (2.77%) (Table 4).

Frozen Shoulder

Frozen shoulder was defined as a stiff, painful shoulder that had developed spontaneously with no recognizable pathological cause. The patients had not improved despite physiotherapy for 3 months. They had limited abduction and rotation, and movement could not be improved by injecting local anesthetic into or around the shoulder joint. The joint capacity was found at arthroscopy to be significantly decreased, often being 20 ml or
Figure 14. The arthroscopic appearance of normal synovium.

Figure 15. Rheumatoid synovitis.

Figure 16. Rheumatoid arthritis with its characteristic synovial hypertrophy with thickened synovial villi.

Figure 17. Gouty arthritis. The synovial villi appear markedly thickened and more edematous and slightly glassed. Notice the glassed. Notice the small crystalline deposits reflecting the arthroscopic light.

Figure 18. Crystalline synovitis due to pseudogout. Notice the Ca pyrophosphate crystals deposited in the synovium.

Figure 19. Urate deposited on the humeral head.

Figure 20. Pigmented villonodular synovitis. The synovium shows large, multiple, white, globular osteochondromata suspended in the wall of the inflamed synovium. Notice the presence of several hemorrhagic areas.

Figure 21. Acute synovitis with a tear of the bicipital tendon. It is associated with tearing of anterior capsular wall.

Figure 22. Subsiding acute traumatic synovitis. Notice the generalized matte appearance with some loss of definition and some thickening and edema of the synovium.
less. In most such joints it was possible to see mild synovitis. The infraglenoid recess was visible and was not obliterated by adhesions.

Four cases (11.11%) were diagnosed as frozen shoulder. However, 1 (2.77%) appeared to be extrasynovial contracture of the soft tissue; in 3 cases (8.33%) it was the anterior structures that were particularly tight (Table 5). On laterally rotating the shoulder, one could see the anterior capsular structures pulled tightly across the front of the humeral head, and this was the major cause of the limitation of movement.

**Synovitis**

The joint can be examined for general synovitis or local changes. We had 10 cases (27.77%) with chronic synovitis of the shoulder. Figure 14 shows the arthroscopic appearance of the normal synovium. These patients did not have radiographic evidence of gross degenerative changes.

At arthroscopy rheumatoid arthritis was diagnosed in 2 cases (5.55%) by its characteristic pannus formation with chronic synovial hypertrophy (Figure 15). The synovium appears to be raised from the general level of the synovial lining (Figure 16). Another 2 cases (5.55%) were diagnosed as gouty arthritis with crystalline synovitis (Figure 17). The villi, although having the classic appearance of chronic synovitis, appeared to be more edematous and slightly glassed. The small crystalline deposits can be seen clearly because they reflect light from the arthroscope. Pseudogout was discovered in 3 cases (8.33%); calcium pyrophosphate crystals were seen in the synovium (Figure 18) in 2 cases (5.55%). These patients were asymptomatic, and the crystal deposition was an incidental finding during routine arthroscopy. Another case (2.77%) presented with pseudogout but with urate crystals deposited on the humeral head (Figure 19).

Grossly, these crystals are similar to the calcium pyrophosphate crystals seen in pseudogout, but it is painful like gout.

Pigmented villonodular synovitis was seen in only 1 case (2.77%). The synovium showed large, multiple, white, globular osteochondromata suspended from the wall of the inflamed synovium and several hemorrhagic areas were noted (Figure 20).

Acute synovitis in the bicipital groove was found in 2 patients (5.55%) with a torn bicipital tendon (Figure 21). The acute synovitis was associated with tearing of the anterior capsular wall in a patient (2.77%) with recent shoulder dislocation. The other had subsidence of acute traumatic synovitis due to the intake of antiinflammatory drugs 5 days prior to arthroscopic examination (Figure 22). Instead of tall or long synovial villi interspersed with a clear reticulation of blood vessels, a generalized matte appearance with some loss of definition and some thickening and edema of the synovium itself was seen, which appeared to be heaped into gentle, undulating folds (Table 6). Chronic traumatic synovitis (Figure 23) appears with hypertrophied villi. The synovial proliferation looks almost like corals (Figure 24).

**Biceps Tendon Lesions**

The usual lesion consisted of fraying of the tendon with loose fronds hanging down into the joint. The fraying

<table>
<thead>
<tr>
<th>Table 6. Arthroscopic findings in 10 shoulders with synovitis</th>
</tr>
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<td>Diagnosis</td>
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</tr>
<tr>
<td>1. Rheumatoid arthritis</td>
</tr>
<tr>
<td>2. Gouty arthritis</td>
</tr>
<tr>
<td>3. Pigmented villo nodular synovitis</td>
</tr>
<tr>
<td>4. Acute traumatic synovitis</td>
</tr>
<tr>
<td>5. Pseudogout:</td>
</tr>
<tr>
<td>a. Calcium pyrophosphate</td>
</tr>
<tr>
<td>b. Urate</td>
</tr>
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</table>
appeared to be greatest at the point where the biceps tendon entered the bicipital groove (Figure 11). Biceps tendon changes were often found in the bicipital groove or sulcus where rupture, luxations, tenosynovitis (Figure 10), or arthritic changes were seen. In our series there was no case of isolated rupture of the biceps tendon, but it was associated with rotator cuff ruptures. Table 3 shows the incidence of biceps tendon lesions in association with rotator cuff rupture.

Complications

Of the 36 shoulder arthroscopies, 2 cases only (5.55%) had the complication of massive leakage of fluid from the shoulder joint. It tended to track along the posterior and anterior chest wall and down the arm but, apart from the nuisance value, it presented no problems and subsided within a week. In 1 case (2.77%) the articular cartilage of the humeral head was damaged during the arthroscopic procedure; this patient had a tight, frozen shoulder, in which the introduction of the arthroscope was difficult. There was no case of postarthroscopic sepsis. There was 1 case (2.77%) of musculocutaneous nerve palsy following arthroscopy; this resolved in about 6 weeks, leaving no long-term effects.

Discussion

Arthroscopy of the shoulder as an invasive technique for visualizing the shoulder conditions has been established as a safe and reasonable procedure [4,7]. Shoulder arthroscopy itself proved to be safe, and the incidence of complications was low. Although scoring of the articular cartilage injury occurred in 1 case, it was minor and probably will not have any long-term ill effects. The incidence of nerve lesions (1 case of musculocutaneous nerve palsy) is lower than that reported in other series [8]. This may be because we do not use an arm holder, but prefer manual traction; pulling the arm in a longitudinal rather than a vertical direction may decrease the chance of nerve palsy. Also, an assistant’s holding the arm during the insertion of the arthroscope and during the whole procedure allows for freely moving the shoulder during the visualization, as one has difficulties in visualizing some parts of the shoulder joint if it is kept in a suspended position during the whole procedure. It can be helpful at first to inject 15–20 cc of Ringer’s lactate or acetate to distend the joint before the introduction of the arthroscope. It also helps in avoiding articular cartilage damage, even in the tight, frozen shoulder.

The standard 5-mm arthroscope with 4 mm 30° and 70° telescopes is the preferred instrument, as it makes it possible to visualize the whole shoulder joint.

Shoulder arthroscopy has helped the visualization of different accompanying minute shoulder injuries. In rotator cuff rupture it was easy to differentiate a full thickness tear from a superficial rupture. Localization and extension can be usually determined quite well. Differentiation between an old and a recent rupture was also possible, according to the shape of the rupture edges, which are smooth in an old rupture, and frayed and uneven in a recent rupture. The benefit of this information lies not only in accurate diagnosis, but also in preoperative planning.

Degenerative changes of the biceps tendon, together with cuff rupture, occurred frequently. More than half of the patients of rotator cuff rupture (10/17, 58.82%) and almost all of those with full thickness rupture had partial or total rupture of the biceps tendon, with or without bicipital groove arthritis. The degree of these changes seemed to increase along with the severity of the cuff rupture (Table 3).

Although shoulder arthroscopy gives differentiated information on the state of the cuff, the biceps tendon, and the bicipital groove, it also helps in understanding the shoulder pathology regarding synovitis, whether it is acute (e.g., gout, pseudogout, urate, rheumatoid, and pigmented villonodular synovitis).

References