0030-5898/95 $0.00 + .20

ARTHROSCOPIC REMOVAL OF LOOSE BODIES OF THE ELBOW

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Arthroscopy of small joints of the body has become popular with the advent of sophisticated arthroscopic equipment. In 1932, Burman[6] stated that arthroscopy of the elbow was feasible. Little had been written about arthroscopy of the elbow until the late 1970s and early 1980s when several investigators demonstrated the usefulness of this technique for diagnostic and therapeutic interventions.[1,19,20,22,25,30] In 1979, Ito[13] wrote about the arthroscopic anatomy of the elbow joint and discussed the potential of elbow arthroscopy. Additional reports in the 1980s discussed the results of elbow arthroscopy and outlined both its diagnostic and therapeutic benefits.[2,5,12,20]

One of the most common indications for arthroscopy of the elbow is removal of loose fragments of bone and cartilage from within the elbow joint. Arthroscopy has been so successful that the need for an arthrotomy has been obviated in most cases. Despite the limited working area within the joint and complex anatomic nature of the surrounding tissues, this modest goal of removing loose bodies within the joint has been realized.* Elbow arthroscopy has become an effective method to remove loose bodies from the anterior and posterior compartments of the elbow.

This article presents the common physical findings of patients with loose bodies within the elbow, outlines diagnostic tests that can help confirm this clinical suspicion, details the factors associated with the formation of loose bodies in the joint, and describes the setup and surgical technique by which loose fragments within the elbow joint can be arthroscopically removed. Treatment of osteochondritis dissecans of the capitellum as well as the use of arthroscopy in treating patients with symptoms caused by valgus extension overload are also discussed.

*References 1, 2, 3, 5, 8, 18, 20, 32, 33, 36.

HISTORY AND PHYSICAL EXAMINATION

The patient's history is often sufficient to make the orthopedist suspicious of the diagnosis. The patient typically complains of locking, clicking, or catching within the elbow. The patient may also complain of the inability to straighten the elbow (i.e., a flexion contracture), swelling, and varying degrees of pain. A specific inciting event may sometimes be recalled by the patient, followed by symptoms consistent with loose fragments within the joint. This incident may be recent or remote, but a history of significant trauma to the elbow is common in patients with this problem. The history of a past dislocation, previous fracture about the elbow, or a significant fall on an outstretched arm are all causes for in-

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jury to the osteochondral surfaces of the elbow joint.

Overuse-type injuries can lead to loose body formation, as seen in baseball pitchers of all ages and young gymnasts.[3,11,14,33] Laborers may have an acute onset of symptoms without a significant traumatic event. The repetitive motion involved with their occupation, much like baseball pitching, can lead to fragmentation of the articular surface and the presence of loose bodies within the elbow joint. In children who participate in sports involving frequent overhead throwing, Panner's disease can later lead to symptomatic osteochondritis dissecans of the capitellum.[11]

The patient's history may elucidate how damage to the articular surface of the elbow with the presence of loose fragments may be the sole reason for the patient's presenting symptoms. The physician should always suspect the presence of a loose body in the patient with an acute onset of locking, catching, or the history of a dramatic change in the range of motion of the elbow.

Physical examination should include inspection of the elbow and the entire upper extremity. Evaluation of the limbs' neurologic function and vasculature status should be carried out before specific testing of the elbow. Palpation of the elbow allows the clinician to detect evidence of a joint effusion or areas of tenderness. An elbow effusion is detected by palpating the "soft spot," which is bordered by a triangle formed with the lateral epicondyle, olecranon, and radial head.

Elbow flexion, extension, pronation, and supination are carefully documented. These measurements should be compared with the contralateral unaffected side. Asymmetrical motion with or without evidence of instability to varus or valgus stress should be noted and may provide clues to past injuries. These past injuries may be responsible for the formation of loose fragments.

RADIOGRAPHIC EXAMINATION

Radiographic examination can confirm the presence of a loose body within the elbow joint as well as rule out other potential bony abnormalities which could cause similar symptoms. Standard anterioposterior (AP), lateral, and axial (Jones' view) radiographs of the elbow are obtained to fully evaluate the osseous structures (Fig. 1).

The AP view is taken in full extension, and the lateral view is taken at 90° of flexion. The axial view is imaged in maximum flexion. Careful examination of the radiographs will sometimes reveal the evidence of osseous fragments within the anterior or posterior aspect of the elbow joint. War and associates[32] attempted to correlate preoperative radiographic studies with arthroscopic elbow findings. They determined that plain radiographs had a 75% accuracy for detecting loose bodies, whereas arthrotomograms increase the accuracy to 89% with 100% sensitivity. In patients with risk factors for loose bodies based on history and physical examination with negative plain films, arthrotomograms may be beneficial in detecting their presence. Other imaging modalities, such as a CT scan, CT arthrograms, or MR imaging may also be useful in this setting; however, efficacy has yet to be proven.[10,29]

Although the plain radiographic examination will not detect all loose bodies, its use in identifying associated pathologic lesions affecting the elbow has allowed most clinicians to make accurate diagnoses. Panner's disease, that is, osteochondritis of the capitellum, may be identified by plain radiographs. Plain radiographs are helpful in diagnosing posttraumatic changes of the elbow with associated spurring, soft-tissue calcification, joint space irregularities from prior fracture, or the presence of loose bodies in the posterior compartment. Patients with synovial osteochondromatosis present with classic radiographic findings of multiple osteochondral pieces about the joint in a diffuse pattern. The diagnosis of rheumatoid arthritis is based on periarticular osteopenia, erosions, and joint space narrowing often seen on a plain radiograph. Osteophyte formation and joint space narrowing are indications of primary degenerative arthritis (Fig. 2).

When the diagnosis is unclear, but the history suggests the presence of loose bodies, surgical intervention is indicated. The arthroscope can be both a diagnostic as well as a therapeutic instrument in resolving the patients symptoms. This treatment course has been supported by numerous case reports of arthroscopically retrieved loose bodies in the face of negative plain radiographs.[5,20]

ORIGIN OF LOOSE BODIES

Loose bodies within the elbow joint are often osteochondral or chondral fragments of the articular surface which have broken free because of some traumatic event or underlying pathology. The origin of loose bodies of the elbow can include posttraumatic sequela from vari-

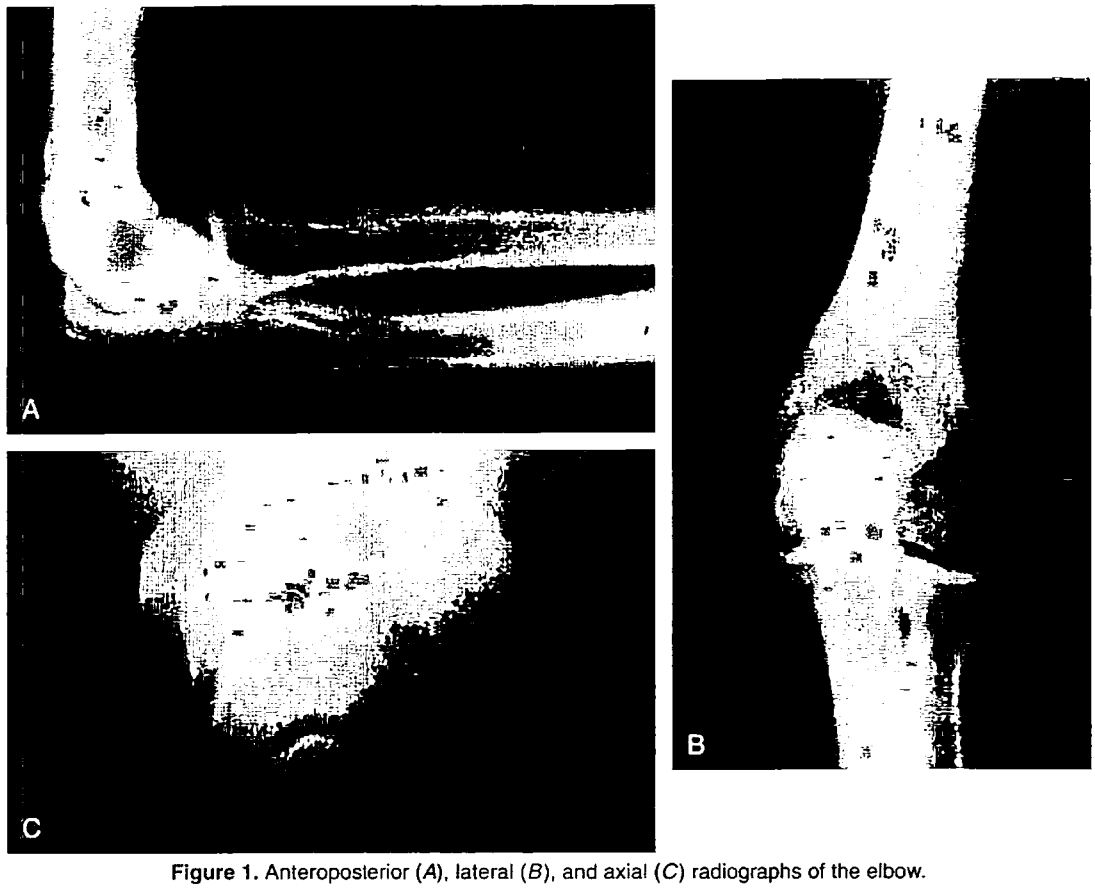

Figure 1. Anteroposterior (*A*), lateral (*B*), and axial (*C*) radiographs of the elbow.

ous types of injuries including elbow dislocations, fractures, penetrating trauma,[7] as well as valgus or varus impacts or loading. Osteochondritis dissecans can be a cause of osteochondral fragments in young patients with this lesion.[14] Primary degenerative arthritis can result in single or multiple loose bodies, as can synovial osteochondromatosis and rheumatoid arthritis.[22]

Repetitive overuse injuries can result in shearing of cartilaginous fragments and the formation of loose bodies (Fig. 3). Penetrating trauma has been described as a cause of a loose body.[7] The knowledge of these common causes combined with a thorough history and a physical examination with routine plain radiographs allow the treating orthopedist to make an accurate diagnosis.

VALGUS EXTENSION INJURIES OF THE ELBOW

Valgus extension injuries are common among throwing athletes. Repetitive stress of the triceps insertion on the ulna can occur during baseball pitching,[30] with resultant fracture of the olecranon tip as well as osteophyte formation. This mechanism can lead to the formation of loose bodies within the posterior compartment of the elbow. DeHaven and Evarts[9] have defined the valgus extension overload syndrome as the result of forced hyperextension of the ulnar humeral joint with a valgus force causing shear between the olecranon and the olecranon fossa. Osteophytes impinge on the ulna humeral articulation and prevent full extension of the elbow, and loose bodies created by fragmentation of osteophytes can create a mechanical block to full motion. This process may lead to chondromalacia.

King and colleagues[15] have shown humeral hypertrophy in some throwers. This hypertrophy, combined with valgus instability, results in a compromise in the space available for the olecranon process to sit in its fossa. This leads to impingement in elbow extension. It is not unusual for pitchers or tennis players with this condition to complain of pain in the posterior elbow (Fig. 4).

Although most patients with this condition can be treated conservatively, the removal of

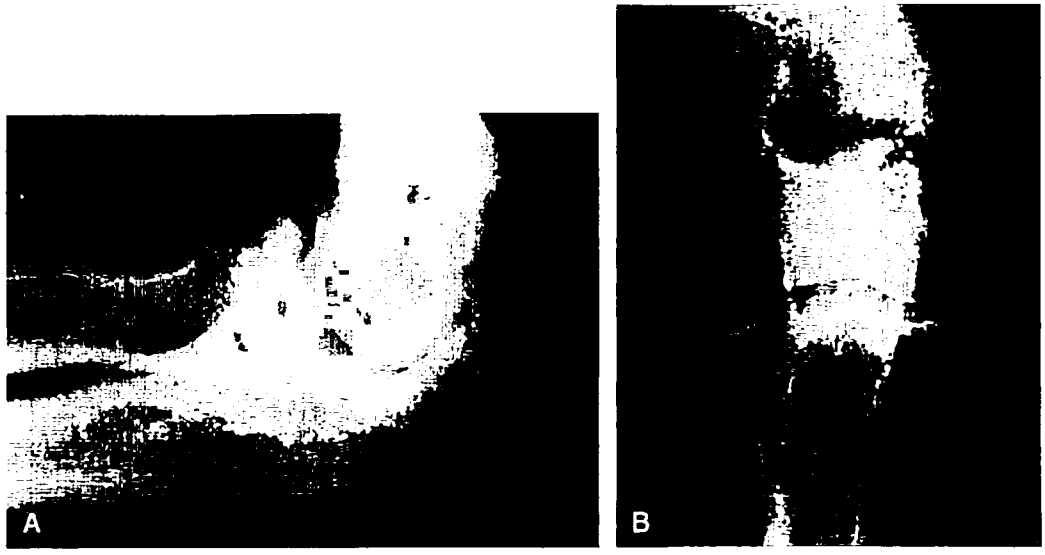

Figure 2. (*A, B*) Primary degenerative arthritis of the elbow with joint space narrowing, osteophyte formation, and loose bodies.

the osteophytes, debridement of spurs, and decompression of the fossa are readily performed arthroscopically. The condromalacia is treated with debridement, decompression of the olecranon fossa, and removal of spurs on the posterior and medial olecranon surfaces.[34]

Rehabilitation for this procedure relies on the patient to begin performing range-of-motion exercises after the arthroscopy. Physical therapy aids in maintaining a full range of motion. This therapy begins as soon as the pain and swelling subside, usually in 7 to 10 days. Athletes can expect return to their sport within 6 to 8 weeks. In patients who remain sympto-

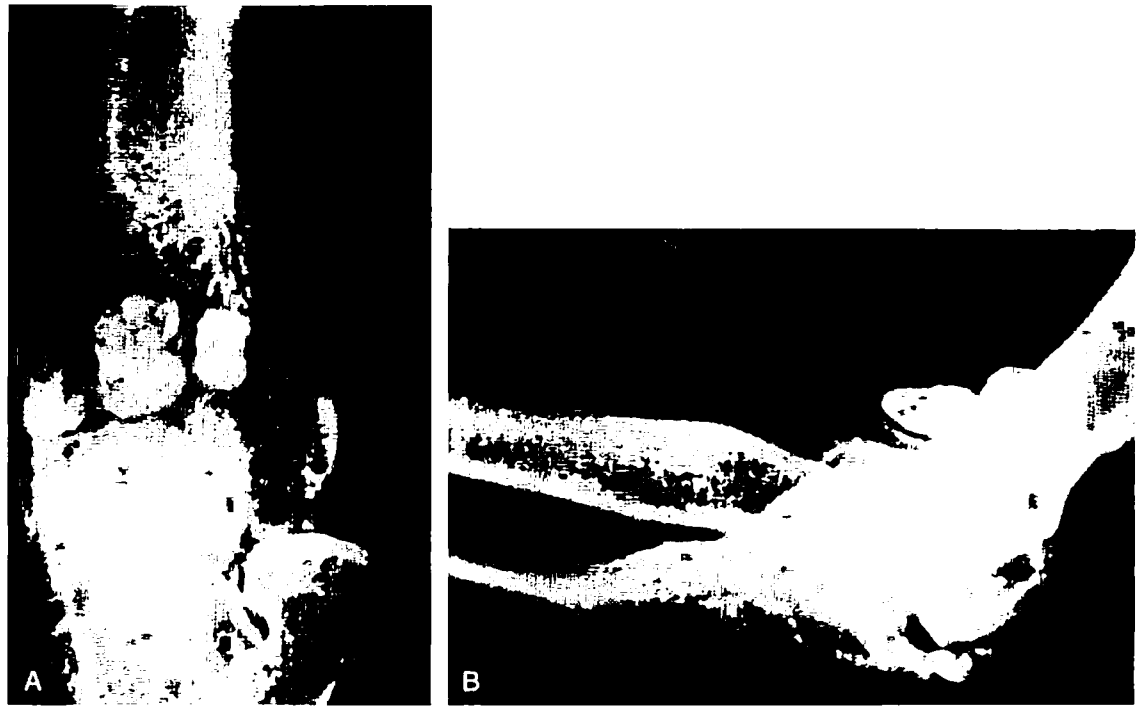

Figure 3. (*A, B*) Sixty-year-old man with a history of Panner's disease diagnosed at age 10. (Courtesy of Leonard P. Seimon, MD.)

matic after an initial course of conservative treatment and find their restrictive range of motion painful, arthroscopy of the elbow, in our experience, has proven to be quite beneficial.

OSTEOCHONDRITIS DISSECANS OF THE CAPITELLUM

Osteochondrosis affecting the humeral capitellum was first described by Panner in 1927.[23] Panner's disease represents an early stage of osteochondritis dissecans (Fig. 5). The cause may be idiopathic, secondary to blood dyscrasia, steroid therapy, or repetitive microtrauma.

Stress to the elbow in the form of a valgus movement as is seen in baseball pitching during the acceleration phase, results in compression of the radiocapitellar joint.[28,30] This compression is believed to cause vascular injury to the capitellum and serves as an explanation for the incidence of osteochondritis dissecans in baseball pitchers.[28,30] There have been reports of osteochondritis dissecans of the capitellum in gymnasts,[17,26] as well as athletes who participate in basketball, tennis, wrestling, football, and shot-put.[17,27]

In Panner's disease, the vascular supply to the ossific nucleus of the capitellum is compromised resulting in a defective enchondral ossification. This process may lead to subsequent fragmentation and the presence of a loose body in the elbow joint. This syndrome may be asymptomatic and resolve spontaneously, or more uncommonly, it may persist. In the older patient, age 10 to 17 years, loose bodies can be seen as large fragments dislodged from the capitellum and floating free in the elbow joint. Top-level female gymnasts are usually involved in aggressive training at a young age exposing their radiocapitellar joint to repetitive shear and compressive forces when growth is occurring. Jackson and associates[14] found that once radiograph results were positive, surgery

Figure 5. Intraoperative photograph of a osteochondritic lesion of the elbow.

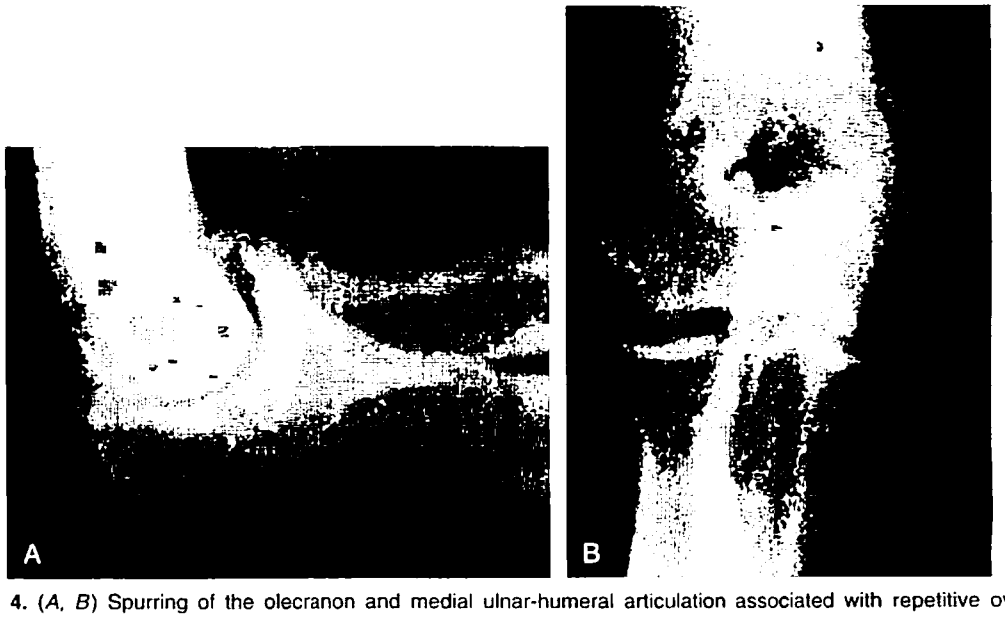

Figure 4. (*A, B*) Spurring of the olecranon and medial ulnar-humeral articulation associated with repetitive overuse trauma.

might improve symptoms but the gymnast's return to competitive gymnastics was unlikely.

Results for treatment of Panner's disease have varied. The damage of the capitellum appears to be the limiting factor. The anteromedial portal may be used to view the capitellum, and the anterolateral portal can be used to palpate the loose articular cartilage. A small K-wire or burr can be used to drill the defect and hopefully improve the blood supply. Return to sports is not encouraged until complete healing is seen on the postoperative plain radiographs. The advantage to arthroscopic treatment over an arthrotomy includes a speedier recovery and outpatient surgery. Patients must be told preoperatively that they may not be able to resume their sports or activities without some restrictions.

Delay in treatment of these disorders should be avoided. The presence of loose bodies within the elbow joint can lead to a painful particulate synovitis. Further damage to the articular surfaces occurs if loose bodies are present in the elbow for an extended period of time. Unlike the knee where a loose body may cause locking of knee motion and present as a surgical emergency, a loose body in the elbow does not always cause the patient to seek medical attention. As the elbow is not subject to the same large load the knee experiences, the morbidity related to this disease may be less than that for the patient with a loose body in his or her knee. The exception may be the professional athlete involved in overhead sports who may require arthroscopic excision of the loose bodies on an emergent basis.

OPERATING TECHNIQUES

Positioning/Arthroscopic Setup

The surgeon has several choices for positioning the patient once the decision has been made that operative intervention is indicated on the patient with the suspected diagnosis of a loose body within the elbow. Elbow arthroscopy has been described in the patient in the supine position, the prone position, and the lateral decubitus position.[1,22,25,35] Each position offers some potential benefits, and the surgeon's comfort level with each is often the determining factor for which position is used.

Elbow arthroscopy performed with the patient in the supine position offers ease of access for anesthesia so that airway control is not a concern and positioning is quite simple. The shoulder is abducted 90° with the elbow flexed 90°. The affected extremity is prepared with a sterile suspension device holding the hand. The elbow and upper extremity are held directly in front of the surgeon with the overhead traction device. Disadvantages of this position include the need for an accessory traction device, a less-stable base from which to work given that the arm is suspended in the air, and difficulty with access to the posterior olecranon fossa if open treatment is required.[2,19]

The prone position may facilitate removal of loose bodies located posteriorly.[4,25,32] The patient is positioned face down on two longitudinally placed foam rolls. The surgeon has a stable base on which the arm rests without the need for an additional traction device. The upper arm is placed in a support such as a rolled towel or foam pad allowing the elbow to freely flex with gravity to 90°. The shoulder is abducted 90°. The tourniquet is placed on the upper arm. The hand is free of any traction device allowing the surgeon to bring the elbow joint through a full range of motion during the examination. This position may enhance the diagnostic accuracy of the examination. The posterior fossa of the olecranon is freely accessible to the surgeon, which is of benefit when posterior work is required.

In an effort to avoid placing the patient face down, the lateral decubitus position has been advocated by some authors.[19,20] Similar to the prone position, the lateral decubitus position offers most of the same advantages. In the lateral position, airway management is somewhat easier and positioning time less consuming. In our practice, we have recently changed to the lateral decubitus position for elbow arthroscopy. We have found that this position allows for an ease of positioning, adequate access to the airway, and provides a stable base from which to work, while still allowing the arm to be moved through a full range of motion during the arthroscopic examination.

Once the patient has been positioned, a pneumatic tourniquet is placed about the proximal arm. Arthroscopy of the elbow is done under tourniquet to limit bleeding, as well as extravasation of fluid up the arm. A compressive bandage is placed distally on the forearm to limit swelling. Following sterile preparation and draping, approximately 25 mL of sterile saline is injected into the midlateral portal with the elbow flexed 90° (Fig. 6). This portal is located in the soft spot between the lateral epicondyle, radial head, and tip of the olecranon.[14] Previous work by O'Driscoll and

Figure 6. Distention of the elbow through the midlateral portal.

coworkers[21] has shown this amount to be the normal capacity of the elbow joint. We use the midlateral portal for the introduction of fluids because it is the easiest to find and allows distention of the joint capsule without risk to the neurovascular structures.[16,31] There is controversy among arthroscopists as to which portals should next be used. Verhaar and colleagues[31] found in a cadaver study that risk of injury to the radial nerve in the anterolateral approach was higher than the risk of damaging the median nerve in the anteromedial approach.

ANTEROMEDIAL PORTAL

The anteromedial portal is made 1 cm proximal and 1 cm anterior to the medial epicondyle using a scalpel to pierce the skin and a hemostat to dissect through soft tissue.[31] A blunt trocar loaded in a cannula is directed distal, radial, and posterior through the joint capsule. Upon penetration of the capsule, the trocar is removed and confirmation of an intraarticular location is obtained by flow of normal saline from the cannula. A 4-mm 30° arthroscope with inflow is placed through the cannula and the joint is visualized. This portal allows visualization of the capitellum and the radial head. Confirmation of anatomic structures is made by supinating and pronating the forearm and observing radial head motion. Removal of fragments in treatment of an osteochondritis dissecans lesion can also be performed with the camera in the anteromedial portal and the instruments in the anterolateral portal.

ANTEROLATERAL PORTAL

The anterolateral portal is made as described by O'Driscoll[19] and Morrey[18] 1 cm distal and 1 cm anterior to the lateral epicondyle to avoid the radial nerve and its deep branch. A scalpel is used to pierce the skin and a hemostat is then used for dissection through the soft tissue. The joint is entered using a blunt trocar as previously described. This portal may be used for inflow or to better visualize the medial joint. The articulation of the ulna and trochlea can be visualized, and by flexing the elbow, the coronoid process can be easily seen. All loose bodies present and any other procedure needed to be performed in the anterior joint, such as debridement or drilling of an osteochondritic lesion, should be completed before examination of the posterior elbow joint.

Loose bodies can be found in the anterior compartment, but studies have shown that a significant number of patients will have additional loose bodies within the posterior compartment.[3,22] Arthroscopic evaluation must include a thorough examination of the posterior compartment.

POSTERIOR PORTALS

The anteromedial portal may be used for inflow when examining the posterior compartment. We see the posterior compartment through a posterolateral portal. This portal can be placed with the elbow slightly extended to relax the triceps muscle. An entry point approximately 3 cm proximal to the olecranon tip near the lateral margin of the triceps is used. In this fashion, adequate visualization of most of the posterior compartment can be completed. Loose bodies within the posterior compartment can be seen using this technique. If additional working portals are required to remove loose debris in the posterior compartment, a straight posterior portal is made, which neces-

sitates the splitting of the triceps. The straight posterior portal is made approximately 3 cm proximal to the olecranon tip in the midtriceps region. We stay well lateral to the medial border of the triceps to avoid injury to the ulnar nerve. The arthroscope and instruments can be passed through these two portals to allow removal of any loose body that may be found.

Although accessory portals have been described, we have found them to be unnecessary. Through the standard use of these four portals, most of the work that needs to be done within the elbow joint can be accomplished.

The task of removing loose pieces of bone or cartilage from either the anterior or posterior compartment is accomplished using a pituitary grasper. Small fragments can be removed in one piece, whereas larger fragments may have to be taken out piecemeal (Fig. 7). On some occasions, enlargement of a portal may facilitate removal of large fragments in the posterior fossa. This can be done posteriorly without risk to the neurovascular structures. The use of a 1/4-in osteotome placed through the posterior portal will allow for debridement of large osteophytes often seen in an elbow with degenerative joint disease (Fig. 8). Anteriorly, the portals are in much closer proximity to the neurovascular structures and enlargement of portals is not without risk. Except in unusual circumstances, large fragments in the anterior compartment should be taken out in pieces to avoid any risk to adjacent structures which may occur with attempts at enlarging the anterior portal.

At the completion of the procedure, the elbow is irrigated, the arthroscopic equipment is removed, and a soft bulky dressing is applied. A sling may be used for comfort and activity is unrestricted.

Figure 7. Large loose body of the anterior compartment. This was taken out in pieces without enlarging portal.

RESULTS

Arthroscopic removal of loose bodies from the elbow joint is one of the most common therapeutic interventions performed for treatment of disorders of the elbow. Although arthroscopy of the elbow can be used as a diagnostic modality, therapeutic modalities are undergoing significant evolution. Removal of loose bodies, joint debridement, removal of osteophytes, drilling and debridement of osteochondritic lesions, and synovial resection are all now used as therapeutic interventions.[1,20,24] Literature on the removal of loose bodies has demonstrated that the arthroscopic approach can be successful with a low operative morbidity.[12,20,22,35]

In 1985, Andrews and Carson[1] demonstrated the efficacy of arthroscopic loose body removal. In a preliminary report of 12 patients undergoing operative arthroscopy, 3 patients underwent isolated loose body removal whereas 3 other patients underwent loose body removal plus some additional arthroscopic treatment (two chondroplasties, one rheumatoid synovectomy). Of the 12 patients evaluated, the 3 who underwent isolated loose body removal showed the most improvement using an objective and subjective rating scale.[1] The authors had no significant complications and believed that of all the procedures performed in the elbow, arthroscopic loose body removal gave them the best clinical results.

In 1986, Boe[5] reported on the experience of nine surgeons who performed elbow arthroscopy on 35 elbows (33 patients), for suspected loose bodies. The cause of the loose bodies was presumed to be osteochondritis in 8 patients, fracture or dislocation in 7, degenerative arthrosis in 7, and various other causes in the remaining 13. Thirteen of the 35 elbows (36%) were found to have loose bodies. The primary diagnosis in the remaining 22 was degenerative joint disease in 9 patients, synovitis in 2, osteochondritis in 1, and a normal examination was found in 10 patients. Radiographs were believed to be falsely negative in 2 patients and falsely positive in 12. This early experience demonstrated the diagnostic value of the arthroscope with limited associated morbidity.

O'Driscoll and Morrey[20] reported on 24 el-

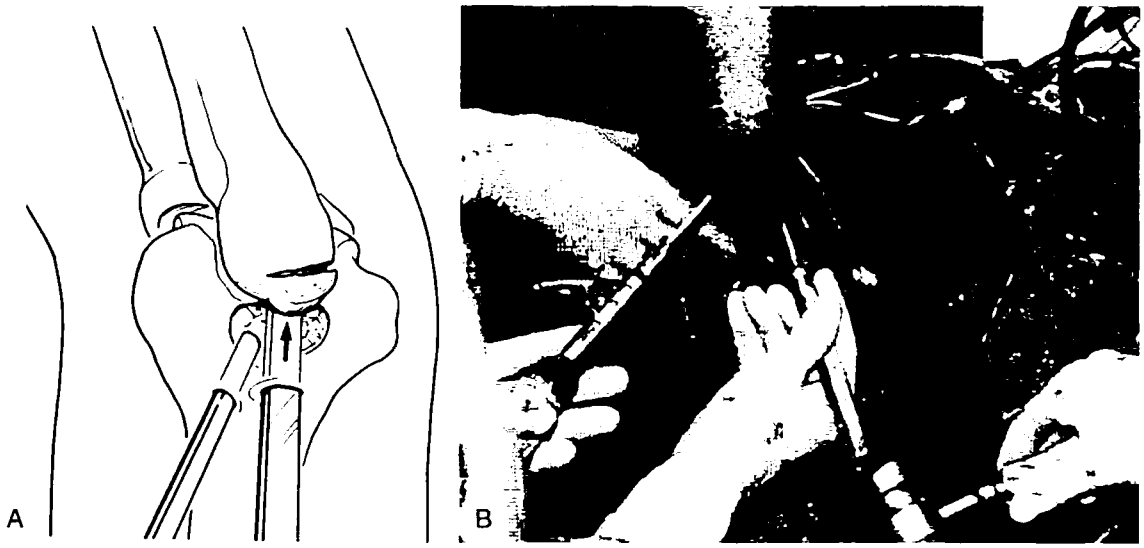

Figure 8. (*A, B*) Osteotome placed to remove posterior osteophyte (*from* Poehling GC: Arthroscopy of the Wrist and Elbow. New York, Raven, 1994, p 178; with permission).

bows (23 patients), 18 of which had loose bodies within the joint. Patients who had isolated loose bodies within the joint without other significant pathology and those patients with osteochondritic lesions with loose bodies all were markedly improved following arthroscopic removal of these fragments. These authors cautioned the reader that in the setting of significant posttraumatic arthritis, degenerative joint disease, or other significant pathologic lesions within the joint, simple removal of loose bodies was not of significant benefit to the patient. This group of patients remained symptomatic. The authors believed that an appropriate preoperative workup must be completed and that the symptoms should correlate with those of loose fragments in the joint and not of degenerative joint disease.

O'Driscoll and Morrey[20] confirmed the work by Ward and others when they noted that 7 of 23 patients had loose bodies in the joint, not identified by plain radiographs. These loose bodies were all located in the posterior compartment of the elbow.[20,33] Approximately 20% of his patients had multiple loose bodies within the joint which were not recognized preoperatively by plain radiographs. The authors recommended that a thorough and systematic examination of the joint be done at the time of arthroscopy, with special attention to the posterior compartment.

Ogilvie-Harris and Schemitsch,[22] in their report on arthroscopic removal of loose bodies of the elbow, demonstrated that pain could be relieved in 85% of their patients, swelling in 71%, and symptoms of locking or catching in 92%. The number of flexion contractures was reduced by over 50%; however, they noted that the feeling of crepitus was reduced in less than half of these patients. Ninety percent of their patients had significant improvement with an arthroscopic procedure. Complications were few and involved only transient numbness of the forearm in two patients without any permanent neurologic deficit. The most common cause of loose bodies was believed to be repetitive trauma; however, they did have three patients with loose bodies from synovial osteochondromatosis, and one patient with rheumatoid arthritis.

The authors noted that the range of motion in patients with a flexion contracture did not improve in up to one third of cases, but these patients did not have any arthroscopic soft-tissue releases. Fourteen patients had a restricted range of motion preoperatively. Five of these patients did not have significant improvement in their flexion contracture after removal of the loose body. The symptoms of locking and catching did improve upon removal of the loose bodies. These authors concluded that when treating a significant flexion contracture, simple removal of loose bodies was not adequate to alleviate all symptoms. The authors believed that coexistent pathologic lesions, such as degenerative joint disease or a significant chronic contracture about the joint, may limit the effectiveness of isolated loose body re-

moval and should temper the surgeon's expectations of what the patient gains will be with this arthroscopic procedure.

Our experience has been similar. Patients with degenerative changes about elbow do not seem to have a significant benefit from isolated removal of loose bodies. Those patients with findings of locking and catching which are clearly attributed to loose bodies within the joint have excellent results. Patients with long-standing flexion contractures or degenerative joint disease do not seem to improve dramatically with removal of loose bodies alone and may require an additional soft tissue release. Arthroscopic osteophyte debridement and anterior capsular release can be helpful in enhancing results in this subset of patients. We have been able to successfully eliminate flexion contractures of 45° or less with elbow arthroscopy.

Studies reveal that return of function and alleviation of symptoms is most often seen after arthroscopic removal of loose bodies in the elbow.[2,20,32,33] Those patients with chronic degenerative changes, however, will likely not experience an increase in range of motion postoperatively.[36] Additional work with the soft tissues in conjunction with loose body removal may improve range of motion of the elbow. In the athletic population, the median time for return to performing strenuous sport activities after arthroscopy of the elbow is 1.3 months.[33]

CONCLUSION

Arthroscopy of the elbow has rapidly advanced in recent years. There are several advantages to performing arthroscopy rather than an arthrotomy in helping patients with problems involving their elbow. The ability to have a thorough visualization of the entire elbow joint and allowing for less postoperative scarring is one such reason. An earlier and more aggressive rehabilitation program and reduced risk of infection are other reasons. The ability for a patient to have outpatient surgery with less postoperative morbidity and time away from recreational or professional sports or work is another important consideration.

There is no doubt that elbow arthroscopy is technically demanding and requires a thorough knowledge of the regional anatomy. The potentially dangerous close proximity of the neurovascular structures has already been discussed in previous articles and must be well-recognized. It is hoped that these articles on elbow arthroscopy will allow the orthopedist to approach the elbow with a keen appreciation of just how useful the arthroscope can be as a diagnostic and therapeutic instrument.

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