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# Arthroscopic Treatment for Limitation of Motion of the Elbow Joint

## 류마토이드관절염의 인공주관절 전치환술

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While the normal range of flexion-extension of the elbow joint ranges from 0 to 145, most daily activities can be accomplished without any discomfort within the functional range of 100 (30 to 130) of elbow flexion.8 Loss of motion of the elbow joint beyond the functional range poses a serious problem both functionally and cosmetically because the elbow joint serves as the fundamental link between the shoulder and hand. In addition, the elbow joint provides power for lifting as well as stability for precision tasks. Consequently, restoration of the normal range of motion in a stiff elbow is a major concern and various surgical techniques have been attempted to resolve this problem.3,6,13 Since the late 1980s, arthroscopic procedure has been successfully used to treat stiff elbows. However, since arthroscopic intervention of the elbow is technically difficult and riskier than arthroscopy of larger joints, the procedure has not been as widely used and its effectiveness is not well documented. The purpose of this study was to describe the long-term clinical results and serial changes of postoperative range of motion after arthroscopic treatment for limitation of motion (LOM) of the elbow.

## MATERIALS AND METHODS

From July 1990 to Feburary 1997, 88 patients with LOM of the elbow were treated with arthroscopic procedures. Thirteen patients with arthrofibrosis of the elbow caused by inflammatory diseases such as rheumatoid arthritis and tuberculous arthritis were excluded. Twelve patients were lost to follow-up and 63 patients were available for the minimum follow-up of two years. There were 53 males and 10 females. The average age at the time of operation was 34.2 years (range, 11 to 61 years). The interval from the onset of symptoms to arthroscopic treatment ranged from 3 months to 20 years (average 38.3 months). The two most common causes of limitation of motion of the elbow were post-traumatic and degenerative stiffness. There were 33 patients (52%) with stiffness caused by trauma including traffic accidents, falls and sports injuries. Thirty patients (48%) had contractures by degenerative arthritis, including overuse injuries. The dominant arm was involved in 14 patients (42%) with post-traumatic stiffness, and in 23 patients (77%) with degenerative stiffness. Thirteen patients among 33 patients with post-traumatic stiffness had undergone previous surgical procedures for fractures around the elbow.

All patients undergoing treatment for LOM of the elbow received physical therapy prior to consideration for surgery. Arthroscopic surgery was indicated when restricted

elbow motion disturbed daily activities and when range of motion did not improve despite initial treatment by physical therapy for at least 3 months. The senior author (S-J Kim) performed the arthroscopic surgery on all patients. Clinical follow-up was regularly carried out at 1 or 2 weeks, 3 months, 6 months, 1 year and 2 years after operation. The average final follow-up interval was 42.5 months (range, 24 to 90 months). All patients responded to a questionnaire about subjective satisfaction with the surgery and clinical outcomes were examined regularly in the out-patient department during the follow-up. The range of elbow motion was evaluated by a goniometer. Statistical analysis was applied using the Students t-test.

**Surgical Technique and Arthroscopic Findings**

Under general anesthesia, the patients were placed in a prone position. Using a pneumatic tourniquet, the involved arm was brought to the edge of the operating table with the forearm hanging freely and the elbow flexed to 90. The joint was distended with 10 to 20ml saline through the direct lateral portal. Standard anterolateral, anteromedial, posterolateral and posterior portals were used in all patients. The anterolateral portal was established for initial entry of the arthroscope. The anteromedial portal was made using an inside-out technique with a Wissinger rod. Through these portals, arthroscopic procedures were performed with a small joint arthroscope (2.7mm diameter, 30 angulation) in the anterior compartment. In cases with marked contractures of the elbow, the arthroscope was inserted through the proximal medial portal. For inspection of the posterior compartment of the joint, the posterolateral portal was used as the entry portal. An additional straight posterior portal through the triceps tendon was used for instrumentation.

The surgical procedures depended on the intraarticular findings. If the joint was difficult to visualize because of extensive scarring and hypertrophic synovium, the soft tissue covering the compartment was debrided using a full radius resector. Once the joint could be visualized, attention was turned to the osseous structures in order to look for loose bodies or osteophytes. Loose bodies were frequently found in any compartment of a stiff elbow. For the removal of loose bodies, the smallest ones were extracted first. When the loose bodies were larger than the portal size, these were left in place until other procedures were completed. Localized osteochondral lesions were treated by debriding the articular surface with a high-speed burr and full radius resector or drilling. In the anterior compartment, if the coronoid process or distal humerus had prominent osteophytes preventing full flexion, the osteophytes were excised using an osteotome or motorized burr. The osteophytes were completely removed until no mechanical block of joint motion was observed. Then the shape of the radial head and capitellum were carefully examined through the same portals to ensure that the joint was free of bony or soft tissue impingement. After bony impingement was relieved, the anterior capsule was inspected. A tightened anterior capsule was divided transversely under direct view from the medial to the lateral side on the proximal capsule to protect neurovascular structures until the posterior fibers of brachialis muscles were identified proximally. Complete release of the tightened capsule using the combination of full

radius resector and retrograde knife was necessary to regain an acceptable range of motion.

In the posterior compartment, scar tissue around the olecranon fossa and posterior capsule was removed to improve visibility through the straight posterior portal. When the arm was extended under arthroscopic visualization, any osteophytes creating impingement at the olecranon tip or in the posterior olecranon fossa, were resected using a motorized burr. If any ingrown bony hypertrophy or loose bodies that limited the range of motion were found in the olecranon fossa, it was debrided and deepened if necessary to prevent mechanical block. Postoperatively, an active and gentle passive range of motion exercises were begun as soon as pain and swelling had subsided. In patients with a marked limitation of motion preoperatively, continuous passive motion exercises were used during postoperative physiotherapy for 1 week.

## RESULTS

Among 33 patients with trauma as the etiology, the cause of injury was a falling down for 16 patients, sports injury for 9, traffic accident for 7, and crushing injury for 1. Twenty-five patients had fractures around the elbow, 6 patients had an isolated elbow dislocation, and 2 patients had a fracture with dislocation. The fractures around the elbow included 13 radial head fractures, 7 supracondylar fractures, 5 olecranon fractures and 2 humeral condyle fractures. Among 30 patients with no trauma history (degenerative arthritis), 20 had occupations or avocations that involved repetitive use of the arms, including 11 manual laborers and 9 athletes.

As a preoperative symptom, 40 patients (63%) suffered from pain with a limitation of motion. While 15 patients (45%) with post-traumatic stiffnes complained of painful elbow motion, 25 patients (83%) with degenerative stiffness suffered from a painful limitation of motion. Overall, five patients (8%) had occasional mild pain after the operation. The intraarticular main pathology of a stiff elbow was fibrous tissue adhesion in 42 cases, loose bodies in 35, and osteophytes in 33. The average number of loose bodies found in one joint was 1.3 (post-traumatic group 0.6 and degenerative group 2.0, respectively). The most frequent predilection site of osteophytes was the coronoid process (15 cases), followed by olecranon tip in 11, olecranon fossa in 10 and distal humerus in 6 cases.

The preoperative mean flexion contracture of 28.5 (range 0 to 65) improved to a postoperative mean flexion contracture of 8.6 (range 0 to 35). The maximum flexion increased from an average of 107.8 (range 60 to 135) preoperatively to an average of 131.4 (range 100 to 145) postoperatively. The mean range of motion was 79.3 preoperatively. The mean range of motion increased markedly to 121.9 immediately after the arthroscopic procedures while the patients were still under general anesthesia in the operating room. However, the mean range of motion was quickly lost during the first and second postoperative weeks (average 101.3) mainly due to pain and swelling. The range of motion then increased progressively until 6 months after the operation (mean 109.2 at 3 months and mean 118.4 at 6 months follow-up). At 1 year after operation, the mean range of motion had nearly increased to the intraoperative range of motion (average 121.5). There was no significant change in the mean range of motion checked

at 1-year after operation and at the last follow-up. The total range of motion checked mean of 122.8 at an average 42.5 months follow-up. In 59 patients (94%), there were statistically significant improvement in flexion contractures and increases in maximum flexion and the mean range of motion between preoperative and postoperative values ($p=0.001$).

The symptom duration was significantly correlated with the postoperative improvements of range of motion. Patients who suffered from limitation of motion less than 1 year gained average 49 improvement in total range of motion after arthroscopic surgery. However, total range of motion in patients with symptom duration over 2 years improved average 30 postoperatively.

Four patients had no improvement in postoperative range of motion. Although they obtained a slight improvement in the range of motion in the operating room, the contracture recurred during the rehabilitation period. The two out of the four patients had degenerative stiffness for a long duration (15years and 18years, respectively), and showed severe cartilage degenerative changes in arthroscopic findings. The third patients had stiffness caused by radial head fracture and dislocation, and had adhesion surrounding triceps muscle. The remaining fourth patients had post-traumatic stiffness and showed severe periarticular contractures after supracondylar fracture.

Patients with post-traumatic stiffness had more severe flexion contracture than those with degenerative stiffness preoperatively (32.4 and 24.5, respectively). However, patients with post-traumatic stiffness had more improvement in flexion contracture postoperatively. At the last follow-up, the average improvement in flexion contracture was 23.4 for the patients with post-traumatic stiffness compared to 16.2 for patients with degenerative stiffness. The total range of motion for patients with post-traumatic stiffness improved from a preoperative mean of 73.1 to a postoperative mean of 122.8, while the patients with degenerative stiffness improved from a preoperative mean of 85.7 to a postoperative mean of 120.5. Although there was a statistically significant difference in the preoperative mean range of motion between the two groups, no significant difference existed in the postoperative range of motion at 6 months follow-up. Among patients with post-traumatic stiffness, previous operations for fractures around the elbow did not affect the final total range of motion. Total range of motion at the last follow-up averaged 124.1 in the previous operative group and 120.7 in the group previously undergoing conservative treatment.

Anterior capsular release was performed in 22 patients (67%) with post-traumatic stiffness and 10 patients (33%) with degenerative stiffness. The total range of motion in the patients who received anterior capsular release increased from 74.7 preoperatively to 120.4 postoperatively. The total range of motion in patients who received different treatments other than anterior capsular release increased from 85.2 preoperatively to 125.2 postoperatively. The improvement in flexion contracture in patients who received anterior capsular release (22.4) was greater than in the group who did not receive anterior capsular release (15.7). However, there was no significant difference in the increase of maximum flexion between the two groups (21.3 and 25.8, respectively).

Overall, fifty-nine patients were satisfied with the surgery. Even with four patients (6%) whose range of motion did not markedly improve postoperatively, the pain subsided

after arthroscopic procedures. In two cases, transient median nerve palsy occurred immediately after the operation. The transient median nerve palsy recovered completely 4 weeks after the operation without any surgical intervention.

## DISCUSSION

As a result of its specific anatomy and potential for serious injury, the elbow joint, more than any other joint, is prone to develop stiffness. Morrey et al7 suggested that the predisposing factors of stiffness in the elbow included the close interrelationship of the joint capsule to extracapsular muscles, the high degree of congruency of the joint and the somewhat unique response of the joint capsule to trauma. Although some contractures of short duration and little evidence of intraarticular damage may respond to conservative treatment, most stiff elbows require surgical management. Open techniques, including open arthrotomy with or without anterior capsulotomy and distraction arthroplasty, have been used and have obtained good functional results.6,15 However, open procedures require extensive dissection and muscle splitting, which have the potential for stiffness and longer rehabilitation. Conversely, elbow arthroscopy provides the benefits of less surgical morbidity and the ability to start an aggressive physical therapy soon after the operation.5,9,12 In addition, arthroscopy allows for improved visualization of intraarticular structures and more thorough debridement of all compartments of the elbow. Although arthroscopy of the elbow is technically demanding and risky because the portals are located relatively close to vital neurovascular structures, serious complications could be avoided with thorough knowledge of the intra-articular anatomy of the elbow and proficiency in technique.

Phillips and Strasburger9 reported average 41 increase in total range of motion in 25 patients with arthritis. Timmerman and Andrews11 obtained increased range of motion in 84% of patients with post-traumatic elbow stiffness. In this study, 94% of patients overall had significant improvement in the range of elbow motion (average 43.5) through arthroscopic procedures. The range of motion acquired during surgery, while patients were still under general anesthesia, was usually in the same range that patients achieved during the rehabilitation period. From 1 to 2 weeks after the operation, the range of motion observed in the operating room decreased because of postoperative pain and swelling. After that, the range of motion began to increase with continuous postoperative physical therapy and showed a progressive increase between the first and sixth months postoperatively. The range of motion continued to increase slowly until 1 year after the operation. However, after one year postoperatively, the range of motion showed little further increase. Almost the same range of motion was observed at the last follow-up. The changes of total range of motion at each follow-up showed a similar pattern in both patients with post-traumatic and degenerative stiffness. It seemed that the etiology of the stiff elbow had no correlation with the recovery pattern after the arthroscopic procedures.

The clinical results varied according to the optimal operation time, underlying pathology and appropriate treatment. The authors obtained the marked improvement in patients whose symptom duration less than 1 year. The restoration of range of motion

in patients with symptom duration over 2 years was less favorable. It seemed that the optimal time for arthroscopic surgery in stiff elbow was less than 1 year after symptom development. In this study, the patients with post-traumatic stiffness had more severe flexion contractures than those with degenerative stiffness. However, they also had larger gains in total range of motion. In contrast to Urbaniaks series,15 we found no differences in the results of those with post-traumatic arthrosis compared to those with non-traumatic etiology of contracture at the latest follow-up. Of particular importance was the primary involvement of the dominant arm in patients with degenerative stiffness. This predisposition was probably due to repetitive microtrauma. The number of loose bodies was also higher in patients with degenerative stiffness. Most loose bodies were found with osteophytes in the degenerative joint.

Ogilvie-Harris et al10 reported the importance of procedures in the posterior compartment of the elbow to restore normal range of motion, especially full extension. The olecranon tip is subjected to repetitive impingement when weight lifters lock out the elbow in extension and also when throwing atheletes reach terminal extension. As a result, osteophyte lipping of the olecranon and a reduction in the depth of olecranon fossae contributed to posterior impingement and a decrease in elbow movement. The authors routinely investigated the posterior compartment of every stiff elbow. In addition to posterior impingement, full extension is restricted by anterior scarring if the capsule has adhered to the distal humerus, preventing proximal movement of the coronoid process. Many studies have reported that it was difficult to improve the range of motion by simple release of intraarticular adhesions without anterior capsular release.4,11,14 In this study, anterior capsular release was performed in patients who had flexion contractures over 30. Since patients with post-traumatic stiffness had more severe flexion contracture, anterior capsular release was performed more frequently in patients with post-traumatic stiffness than in patients with degenerative stiffness. The authors obtained improvement in flexion contracture with anterior capsular release.

Gallay et al2 reported that capsular compliance of the stiff elbow is only 15% of the normal elbow. With stiff elbow, adequate capsular distention is not attainable, increasing the potential for nerve injury with the use of the portals. To avoid complications, the elbow should remain flexed to 90 and forceful manipulation during the introduction of instrumentation should be avoided. Attention must also be given to correct the forearm postion and to be aware of the location of anatomical structures, which may have shifted after previous elbow surgery or trauma.1,16 In our series, there were two transient median nerve palsies with no other serious complications. The complications occurred in patients with large loose bodies which were removed with difficulty.

Based on our experience, 94% of patients who received arthroscopic procedures obtained a functional range of motion after the operation. The range of motion improved progressively during the first six months and then slowly up to one year. The minimally invasive nature of elbow arthroscopy is a safe, reproducible and effective procedure in limitation of motion of the elbow with minimal morbidity.

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