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Clinical Outcome of Fragment Fixation for Osteochondritis Dissecans of the Elbow

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Abstract

Background: The choice of surgical or non-surgical treatments for osteochondritis dissecans (OCD) of the humeral capitellum is still controversial. The purpose of this study was to assess the efficacy of fragment fixation for OCD of the humeral capitellum.

Methods: We reviewed 28 patients with OCD of the humeral capitellum after a mean follow up of 17 months. All patients were men and mean age was 14 years. Twenty-seven patients had a history of repetitive overuse of the elbow with baseball pitching, one with tennis. Mean duration of overuse of the elbow was four years. All patients had elbow pain and difficulty in throwing, with a mean duration of symptoms for 17 months. The mean arc of flexion before surgery ranged from 11 degrees to 126 degrees. Radiographs of the elbow showed a radiolucent cystic area of the humeral capitellum in one patient, a non-displaced split type fragment in 12 patients, and a slightly displaced split type fragment in 15 patients. Fragment fixation surgery was performed in all patients by lateral arthrotomy including drilling and fixation of the fragment with a double wiring technique using flexible wire or thread under direct vision. Sport activities using upper extremities were restricted for four to six months until the lesion healed in radiograph.

Results: Post-operatively, 25 patients had no pain and three decreased pain. Average arc of flexion was one to 132 degrees, an improvement of 16 degrees compared with the pre-operative arc. Radiographic findings showed complete healing of the lesion in 11 patients, partial healing in 12, unchanged in three, and loose body formation in two. By Tivnon's evaluation of the elbow function, results were excellent in 19 patients, good in five, fair in two, and poor in two. The ratio of complete or partial healing of the lesion was 100 percent in 16 patients in whom the thickness of the lesion was less than 9 mm on pre-operative radiograph, and 58 percent in 12 patients in whom the lesion thickness was 9 mm or more, which showed a significant difference ($p<0.01$).

Conclusions: Fragment fixation for OCD of the humeral capitellum was effective in patients whose lesion thickness was less than 9 mm. Fixation by flexible wire or thread and revascularization by drilling for the fragment were considered to be insufficient for large lesions with a thickness of 9 mm or more.

Introduction

Osteochondritis dissecans (OCD) of the humeral capitellum is commonly seen in adolescent athletes who engage in throwing sports and activities. Treatment in the

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early stage of OCD lesions is conservative and spontaneous healing is possible (1, 2), but surgical treatment should be applied to advanced lesions. Surgical treatments for OCD include fragment removal (3–5), fragment fixation (6–9), bone peg grafting (10), closed-wedge osteotomy (11, 12), and cartilage transplantation (13). To obtain healing of the lesion, we chose the simple surgical procedure of fragment fixation for advanced OCD lesions (14). The purposes of this study were to assess the efficacy of fragment fixation for OCD of the humeral capitellum and to investigate the factors influencing results.

Patients and methods

Between 1997 and 2006, 28 patients with OCD of the humeral capitellum underwent fragment fixation surgery in our institute, and were followed-up for seven to 36 months (mean, 17 months). All patients were men and mean age at operation was 14 years (12 to 19). Twenty-seven patients had a history of repetitive overuse of the elbow with baseball pitching, and one patient with tennis. Mean duration of overuse of the elbow was four years (two to six). All patients had elbow pain and difficulty in throwing, with a mean duration of symptoms for 17 months (range, 3–73 months). The mean arc of flexion before surgery was 11 degrees to 126 degrees. Radiographic findings were based on the anteroposterior tangential views of the elbow at 45 degrees of flexion. Radiographic findings were classified by Minami's classification (15), type 1 includes those elbows where a radiolucent cystic area is seen in the capitellum, type 2 is the split type, where a clear zone or split line is seen between the fragment and the adjacent subchondral bone, and type 3 includes those elbows with a loose body, where a split fragment has completely separated from its bony bed. Of the 28 patients in our series, one was classified as type 1, twelve were type 2 with a non-displaced fragment, and fifteen were type 2 with a slightly displaced fragment. There were no cases of type 3 in our series. The mean width of the lesion including the clear zone and fragment was 12 mm (6 to 17), and the mean thickness of the lesion was 8 mm (5 to 14) on pre-operative radiograph. Indications for fragment fixation surgery included failure of more than 6 months of non-operative treatment or an unstable displaced fragment on radiograph, or a high signal intensity line between fragment and the adjacent bone in T2-weighted magnetic resonance imaging (8, 9, 16).

Surgical technique

Operations were performed under general anesthesia with an air tourniquet applied. The surgical technique was almost similar to the original description by Kondo et al. (6). The elbow was approached laterally, and the lateral collateral ligament was released anteriorly and posteriorly to obtain a wide operative field. The capitellum was explored and the articular cartilage and subchondral bone were inspected. The osteochondral fragment was commonly still attached to its bony bed by fibrous tissues. The osteochondral fragment was raised and the subchondral fibrous tis-

sue was curetted. Using a 1.2-mm diameter Kirschner wire, drilling from the joint surface was performed for the fragment and bony bed. Two 1.5-mm diameter Kirschner wires were then inserted from the posterior side of the lateral epicondyle to the fragment. The medial Kirschner wire was removed and a 0.4-mm diameter flexible wire (12 patients, from 1997 to 2002) or thread (16 patients, from 2003 to 2006, because of wire breakage in three patients before 2002) was inserted from the lateral epicondyle into the elbow joint. The lateral Kirschner wire was removed and an 18-gauge injection needle was inserted into the joint (Figure 1A). The wire or thread was inserted through a Kirschner wire hole from the joint surface to the lateral epicondyle with the needle as a guide (Figure 1B). The soft wire or thread was then tied on the posterior side of the lateral epicondyle, and the fragment was fixed to its bony bed. The same procedure was repeated to fix the fragment with two wires or threads. All small loose bodies and cartilage debris were removed after checking the coronoid and olecranon fossae. After irrigation was performed, a drain was inserted and the ligament, soft tissue, and skin were sutured.

Post-operative management

A plaster splint held the elbow at 90 degrees of flexion for 3 weeks, and flexion-extension isometric exercise was started on the fourth post-operative day. Active motion exercise was started after 3 weeks. A wire was removed under local anesthesia at our outpatient clinic at 6 months to one year post-operatively. Sport activities were restricted for about six months until the lesion had healed on radiographs.

We assessed the elbow function according to Tivnon's evaluation (17). A return to full preoperative sport activity was rated as excellent; a return to the same preoperative sport, but with decreased performance, was rated as good. With a fair rating, the elbow symptom was improved but persistent pain at throwing caused a change to other sports. A poor result meant that the patient was unable to return to sports and required a second operation.

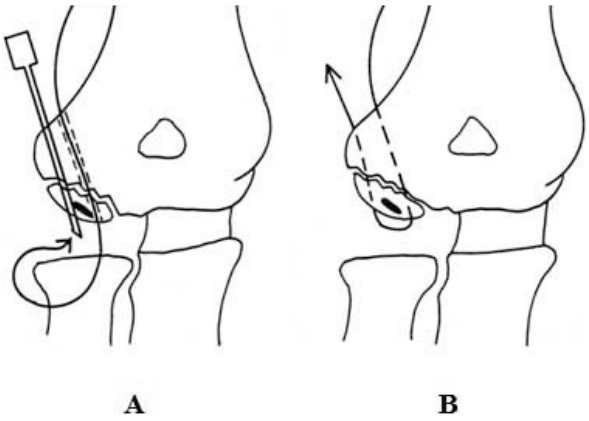

Figure 1. Operative technique. A, Two Kirschner wires were inserted to fix the fragment and the medial wire was removed, and a flexible wire or thread was inserted into the elbow joint. The lateral wire was removed and an 18-gauge injection needle was inserted into the joint. B, The flexible wire or thread was threaded through the Kirschner wire hole from the joint surface to the lateral epicondyle with the needle as a guide. Flexible wire or thread was tied, and the fragment was fixed to its bony bed.

Table 1. Relationship between pre-operative radiographic thickness and post-operative healing of the lesion

	Pre-operative radiographic thickness of the lesion	
Post-operative healing	<9 mm	9 mm≤
Complete (n=11)	7	4
Partial (n=12)	9	3
Unchanged (n= 3)		3
Loose body (n= 2)		2
Ratio of complete or partial healing (percent)	100 (16/16)	58.3 (7/12)

The ratio of complete or partial healing of the lesion was 100 percent in 16 patients in whom the thickness of the lesion was less than 9 mm in pre-operative radiograph, and 58 percent in 12 patients whose thickness of the lesion was 9 mm or more, which showed a significant difference (Chi-square test, $p<0.01$).

We analyzed the data statistically with use of the Student's t-test and Chi-square test. P-values less than 0.05 were considered statistically significant.

Results

Post-operatively 25 patients experienced no pain and three had decreased pain. Post-operative average arc of flexion was one to 132 degrees, an improvement of 16 degrees compared with the pre-operative arc. According to Tivnon's evaluation of the elbow function (17), the results were excellent in 19 patients, good in five, fair in two, and poor in two. The rate of return to the previous level of sports was 86 percent (24 of 28). Post-operative radiographic findings were evaluated into four categories according to Minami's criteria (15). Complete healing of the lesion was seen in 11 patients, partial healing in 12, unchanged in three, and loose body formation in two. According to the pre-operative radiographic findings, the patient with type 1 showed complete healing. In type 2 with a non-displaced fragment, there was complete healing in seven, partial healing in three, and loose body formation in two (Table 1). Type 2 with a slightly displaced fragment showed complete healing in three, partial healing in nine, and unchanged in three. The ratio of complete or partial healing of the lesion was 82 percent (23 of 28). The time of healing of the lesion after operation in 23 patients with complete or partial healing was six to 16 months, the mean being eight months. In four patients with fair or poor results, post-operative radiograph showed partial healing in one patient, unchanged in two, and loose body formation in one. The ratio of complete or partial healing of the lesion on the radiograph was 100 percent in 16 patients in whom the thickness of

the lesion was less than 9 mm on pre-operative radiograph, and 58 percent (7 of 12) in the patients whose lesion thickness was 9 mm or more, which showed a significant difference (Table 1, $p<0.01$). There was no correlation between the width of the lesion on pre-operative radiographs and post-operative radiographic healing. Age at operation, duration of overuse of the elbow, duration of the symptoms had no correlation with post-operative radiographic healing. There were no infections, no irritation from wire, but wire breakage was seen in three patients at the time of wire removal.

Discussion

The aims of treatment for OCD of the humeral capitellum are a return to the previous level of sports activities and prevention of osteoarthritic changes of the elbow in the future. The early stage of OCD lesions, which are observed as radiolucent cystic areas on radiograph are commonly treated conservatively with prohibition of sporting activities and rest of the arm. However, surgical treatment should be applied to advanced lesions to obtain healing of the lesion. Takahara et al. (18) described that OCD of the capitellum can be classified as stable and unstable, and stable lesions can heal completely with elbow rest, whereas unstable lesions require surgery to obtain better results. They reported that unstable lesions had a capitellum with a closed growth plate, fragmentation, or restriction of elbow motion of 20 degrees or more. Completely detached lesions or symptomatic loose bodies should be excised and good results are obtained (19, 20). Arthroscopic removal of loose bodies, debridement and abrasion chondroplasty have the advantage of providing good results with minimum invasion (21–23). This procedure can provide a prompt return to sports if the remaining defect of the capitellum is small (18). However, several studies showed that patients who had the removal of the osteochondral fragment or loose body with drilling or curettage could not return to their previous level of sports (2, 3, 17). Takahara et al. (18) reported that the results of fragment fixation or reconstruction were significantly better than those of fragment removal alone, and that fragment removal is the best option only if the capitellar defect is small.

Fragment fixation is one of the surgical procedures for a partially attached lesion (19) which is shown as the split type on the radiograph. Fixation by wiring with a bone graft (6, 8), Herbert screw fixation (7), fragment fixation with a bone graft and dynamic staples (9), and bone peg grafting (10) were reported with approximately 100 percent of healing and return to a previous level of sports. In our series, the rate of healing was 82 percent (23 of 28) and the rate of return to the previous level of sports was 86 percent (24 of 28) which were worse than the previous studies (6–10). In our surgical procedure, regardless of the size or the thickness of the lesion, fibrous tissues between the fragment and the bony bed was curetted, and the fragment was drilled and fixed without a bone grafts. It is commonly thought that the blood supply to the fragment is damaged if the fragment is detached or if the fibrous tissues between the fragment and the bony bed is curetted (9). There has

been no report that mentions the correlation between the size or the thickness of the lesion and the possibility of healing after fragment fixation. In our patients, the ratio of healing was 58 percent in the patients whose lesion thickness was 9 mm or more (Table 1). Therefore, we believe that fixation by a wire or thread and revascularization by drilling were insufficient for large lesions with a thickness of 9 mm or more. Matsuura et al. (24) reported that low-intensity pulsed ultrasound was useful for healing because of increased revascularization. Based upon studies of blood supply of the capitellum (25), OCD is a disorder of endochondral ossification caused by vascular insufficiency and induced by repetitive microtrauma to a stressed and vulnerable epiphysis. A bone graft seems to be effective (6, 7), or a combination of the fragment fixation and the low-intensity pulsed ultrasound (24) is thought to be useful to revascularize and heal large OCD lesions.

This study has several limitations. First, the follow up period was short (mean, 17 months). Accordingly, we were not able to investigate the development of osteoarthritic change of the elbow. Second, the Importance of drilling the lesion to stimulate revascularization and healing has never been established (19), but we presume that drilling might be of value for revascularization and healing.

Conclusions

Fragment fixation for OCD of the humeral capitellum was effective in patients whose lesion thickness was less than 9 mm. Fixation by soft wire or thread and revascularization by drilling for the fragment seemed to be insufficient for large lesions with a thickness of 9 mm or more.

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