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Nonoperative Treatment for Osteochondritis Dissecans of the Capitellum

Kenichi Mihara,^{*†} MD, PhD, Hiroaki Tsutsui,[†] MD, PhD,
Naoya Nishinaka,[‡] MD, PhD, and Ken Yamaguchi,[‡] MD

From the [†]Department of Orthopaedic Surgery, Showa University Fujigaoka Rehabilitation Hospital, and the [‡]Department of Orthopaedic Surgery, Showa University Fujigaoka Hospital, Fujigaoka, Japan

Background: Spontaneous healing potential and progression of osteochondritis dissecans of the capitellum have been unclear.

Hypothesis: Healing potential is high in the early stage of osteochondritis dissecans and low in the advanced stage.

Study Design: Case series; Level of evidence, 4.

Methods: This retrospective study examines 39 patients with osteochondritis dissecans of the capitellum who were treated conservatively. All patients were baseball players (mean age, 12.8 years). After initial examination, all patients were advised to stop heavy use of the elbow. Physical and radiographic examinations were regularly performed and assessed. Mean duration of follow-up was 14.4 months.

Results: Early-stage lesions were present in 30 patients, while 9 patients were diagnosed with advanced lesions. Open capitellar growth plates were observed in 17 patients, and closed capitellar growth plates were seen in 22 patients. On final radiography, 25 of 30 early-stage lesions were assessed as healed. However, only 1 of 9 advanced-stage lesions was assessed as healed. The remaining 8 advanced lesions were unimproved or progressed. Healing of lesions was seen in 16 of 17 patients with an open growth plate and in 11 of 22 patients with a closed growth plate, representing a significant difference between patients with open and closed growth plates ($P < .05$).

Conclusion: Spontaneous healing potential of osteochondritis dissecans in early lesions, especially in patients with open capitellar growth plates, appears high, and nonoperative treatment is appropriate. Conversely, healing potential is extremely low in advanced osteochondritis dissecans lesions. Surgical intervention is recommended to achieve lesion healing in advanced cases.

Keywords: osteochondritis dissecans; capitellum; baseball; adolescent

Recent biomechanical studies have revealed that the pitching motion generates tremendous stresses at the shoulder and elbow joints.^{4,24} These stresses risk causing intra- and/or extra-articular injuries in these joints. The elbow is the most frequently reported area of complaint in child and adolescent baseball players.⁶ Osteochondritis dissecans (OCD) of the humeral capitellum is an elbow injury that occurs in immature baseball players but is rare in adult players. The main etiologic factor in OCD of the humeral capitellum is thought to be microtrauma,^{8,16,18,19,22,25} caused by repetitive compression and shear forces across

the radiocapitellar joint during pitching motions.^{8,10,23} Although nonoperative treatment, involving cessation of heavy use of the affected elbow, is generally selected for patients with early capitellar OCD,^{12,14,17,20} healing potential and progression have remained unclear. The aim of the present study is to analyze the results of nonoperative treatment for OCD of the humeral capitellum.

MATERIALS AND METHODS

Between 1997 and 2007, a total of 69 patients with diagnosed OCD of the humeral capitellum were treated at our institution. Of these, 46 patients were initially treated conservatively, and 39 of 46 patients were available for the present study; 7 patients were excluded from this study because their follow-up period was inadequate (less than 6 months). All patients were baseball players and regularly practiced baseball. The mean age at the time of initial examination was 12.8 years (range, 10-18 years). The mean experience playing

*Address correspondence to Kenichi Mihara, MD, PhD, Department of Orthopaedic Surgery, Showa University Fujigaoka Rehabilitation Hospital, 2-2-1 Fujigaoka Aoba-ku Yokohama, Kanagawa, 227-8518, Japan (e-mail: mihara@surfrh.com).

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Figure 1. Classification of osteochondritis dissecans. A, grade I: localized flattening and translucence on the capitellum (arrow); B, grade IIA: small fragment not demarcated by sclerosis; C, grade IIB: typical fragment demarcated by sclerosis (arrow); and D, grade III: in situ loose body.

baseball was 5.0 years (range, 1.3-10 years). The mean height of patients was 1.56 m and mean weight 47.1 kg. The mean duration between onset of symptoms and initial examination was 5.6 months (range, 1 week–30 months).

The most frequent presenting complaint was discomfort or soreness in the elbow during or after throwing (98%). Other complaints of lesser frequency were decreased performance (58%), tenderness at the radiocapitellar joint (43%), and swelling (18%). None of the patients experienced locking. The mean range of the affected elbow was $-4.4^\circ \pm 10.9^\circ$ of extension and $128.4^\circ \pm 9.3^\circ$ of flexion, while the mean range of the nonaffected elbow was $4.2^\circ \pm 2.9^\circ$ of extension and $135.8^\circ \pm 5.0^\circ$ of flexion.

All patients underwent radiography of both elbows on initial examination, including an AP view in full extension, lateral view, and AP with the elbow in 45° of flexion. Radiographic findings were classified into 3 grades, including 2 subgroups, according to Iwase's classification.⁷ Grade I indicated localized flattening or a translucent lesion on the capitellum (Figure 1A), and grade IIA indicated a split lesion or small fragment not demarcated by sclerosis (Figure 1B). These lesions were considered to be early-stage lesions. Grade IIB indicated typical fragments demarcated by sclerosis (Figure 1C), and grade III included elbows with in situ or intra-articular loose bodies (Figure 1D). These lesions were assumed to represent advanced-stage lesions.

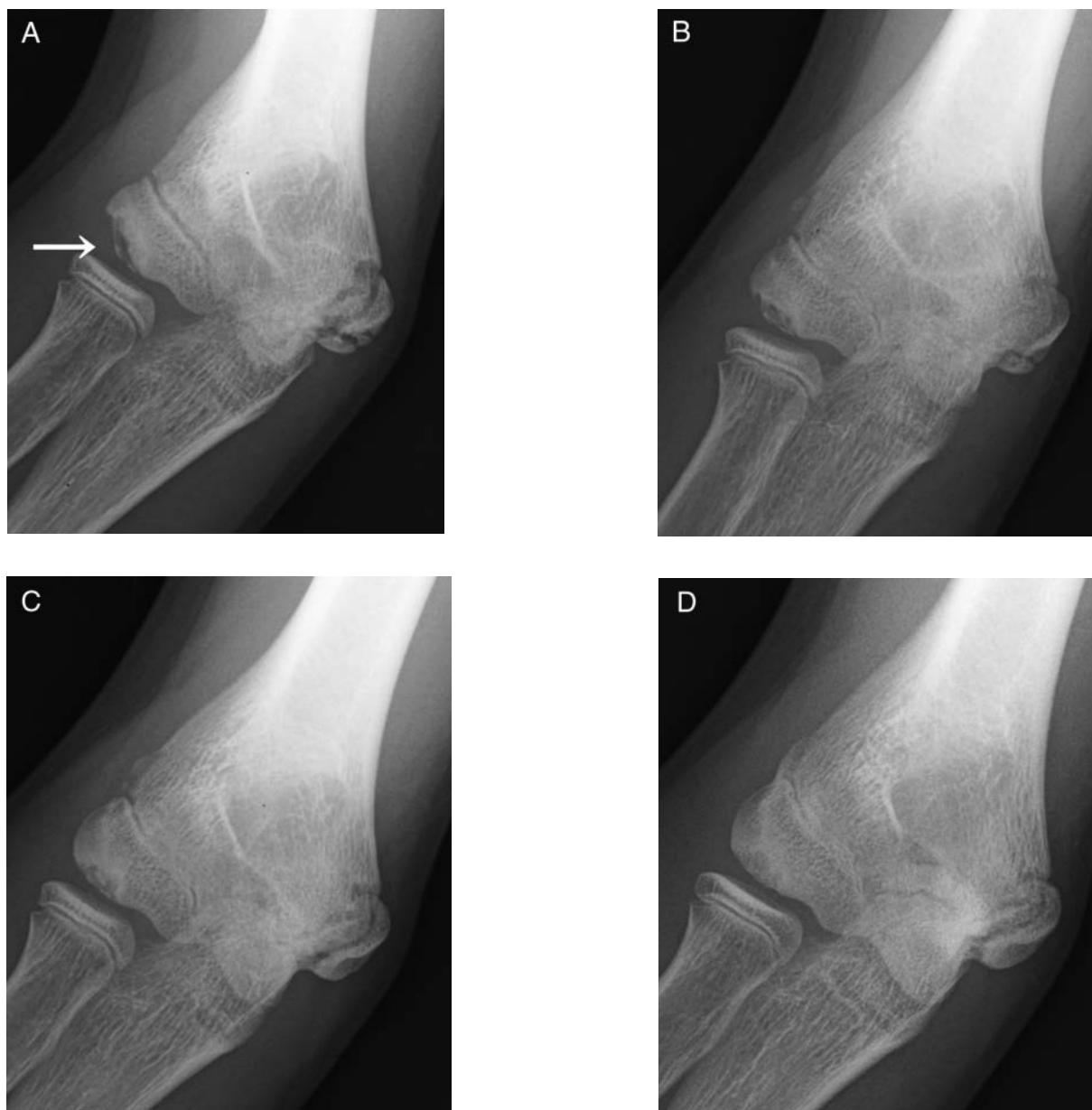


Figure 2. A 13-year-old baseball player with an early stage of osteochondritis dissecans. A, AP view with elbow in 45° of flexion on initial examination, demonstrating localized flattening and a translucent lesion with an open capitellar growth plate (arrow). B, after 2 months, new bone formation is apparent. C, after 6 months. D, after 11 months, the lesion has healed.

The indications for surgical treatment were advanced-stage lesion (grades IIB and III) demonstrated by radiographs and/or MRI, or lack of response to conservative therapy. Of the 39 patients, 9 patients met the criteria and were advised at the time of initial examination to undergo surgical treatment. However, as these patients hoped to avoid surgical intervention and were treated conservatively, they were included in the present study.

After initial examination, all patients were advised to immediately stop heavy use of the elbow, including actions such as throwing, arm wrestling, push-ups, and weight lifting. Physical and radiographic examinations were

regularly performed and were assessed by one of the authors (K.M.). The mean duration of follow-up was 14.4 months (range, 6-56 months).

Final radiographic results were grouped into 4 categories: healed or almost healed (healed with slightly irregular or flattened surface of the capitellum); not healed but improved (partially healed); unimproved (no change); and progressed. Patients with healed or almost-healed lesions were considered as the healed group, and all other patients represented the nonhealed group.

To investigate clinical features of OCD of the humeral capitellum, the Mann-Whitney *U* test was used to compare

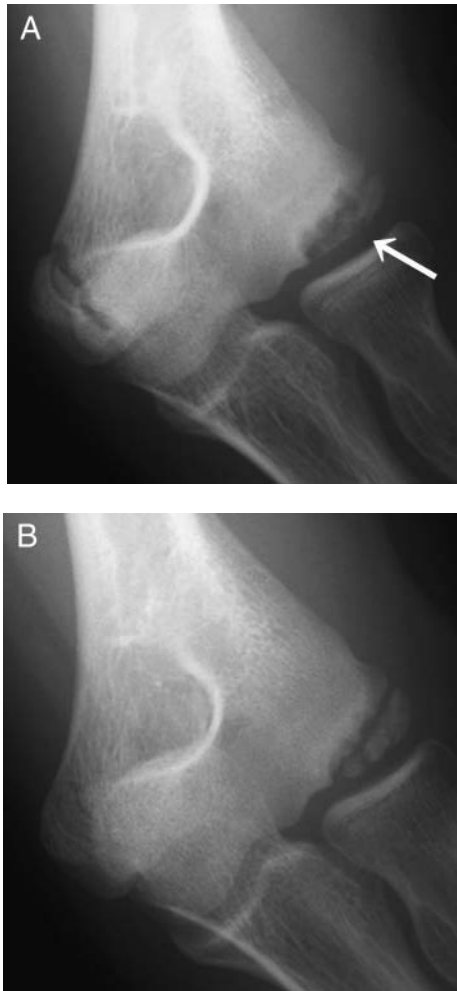


Figure 3. A-16-year-old baseball player with an advanced stage of osteochondritis dissecans. A, AP view with elbow in 45° of flexion at initial examination, demonstrating typical fragments demarcated by sclerosis (arrow). B, after 12 months, radiograph shows nonhealed lesion.

differences in age, years of play, and duration from onset of symptoms to initial examination between healed and nonhealed groups. The Fisher exact test was used to elucidate the relationship between final radiographic findings and the capitellar growth plate. Values of $P < .05$ were considered statistically significant.

All patients and their families were informed that data from cases would be submitted for publication and provided consent.

RESULTS

Initial Radiographic Findings

Early-stage lesions were identified in 30 patients, with 26 having grade I lesions and 4 having grade IIA lesions. Advanced-stage lesions were seen in 9 patients, and

radiography demonstrated typical fragments demarcated by sclerosis but no intra-articular loose bodies.

Open capitellar growth plates were observed in the affected elbows of 17 patients, while a closed capitellar growth plate was seen in the elbows of 22 patients.

Final Radiographic Findings

On final radiography, 20 of 26 patients with grade I lesions were assessed as completely healed, and 3 of 26 patients were assessed as almost healed, with a slightly irregular or flattened surface of the capitellum (Figure 2). The remaining 3 patients were assessed as progressed. In the 4 patients with grade IIA lesions, 2 patients were assessed as healed, 1 patient was assessed as unimproved, and 1 patient was assessed as progressed, displaying a loose body. Three of 4 patients who were assessed as progressed at final examination continued to throw, against their physician's advice to stop, in training and/or games after initial examination, causing lesion progression.

Among the 9 patients with grade IIB or III lesions on initial radiography, healing was obtained in 1 patient. Of the remaining 8 patients, 6 patients were assessed as unimproved (Figure 3), 1 patient was assessed as not healed but improved, and 1 patient was assessed as progressed with loose bodies. Eventually, 26 patients were classified into the healed group, and 13 patients were classified into the nonhealed group (Table 1).

Age, Years of Play, and Duration Between Onset of Symptoms and Initial Examination

The mean age of participants was 12.7 years (range, 10-15 years) for the healed group and 13.2 years (range, 10-18 years) for the nonhealed group. The mean years of play was 5.1 years (range, 2-10 years) for the healed group and 4.7 years (range, 1.3-9 years) for the nonhealed group. No significant differences were seen with respect to age or years of play between groups ($P \geq .05$). The mean duration between onset of symptoms and initial examination was 4.3 months (range, 1 week-6 months) in the healed group, and 9.3 months (range, 1-30 months) in the nonhealed group. Duration thus tended to be longer in the nonhealed group than in the healed group, but we could not detect a significant difference ($P = .059$).

Relationship of Capitellar Growth Plate to Final Radiographic Findings

The relationship between capitellar growth plate and final radiographic findings was investigated. Healing was seen in 16 of 17 patients (94%) with an open growth plate and in 11 of 22 patients (50%) with a closed growth plate, representing a significant difference ($P = .0031$). When the same investigation was performed only for patients assessed as early stage (30 patients), healing was seen in 15 of 16 patients (94%) with an open growth plate and in 10 of 14 patients (71%) with a closed growth plate. Although the healing rate tended to be higher in early-stage patients with

TABLE 1
Final Radiographic Findings

Grade of Lesion	No. of Patients	Final Radiographic Findings			
		Healed or Almost Healed	Not Healed but Improved	Unimproved	Progressed
I	26	23			3
IIA	4	2		1	1
IIB	4	1	1	1	1
III	5			5	

an open growth plate than in those with a closed growth plate, we could not detect a significant difference ($P = .1017$).

Duration From Initial Examination to Healing Detected on Follow-up Radiography

We investigated the duration from initial examination to healing detected on follow-up radiography in the healed group. The repair process initially started in the lateral area of the lesion and progressed medially.¹⁷ In flattening or translucent lesions at initial examination, new bone gradually appeared over the lesions and the configuration of the capitellum was remodeled. In lesions with nondisplaced fragments, the gaps between the fragments and the bony beds became narrow and the fragments then united with the surrounding bone. These conditions indicated healing of the lesion. The mean duration to the time of initial new bone formation detected on radiography was 4.2 months (range, 2-6 months) in patients with an open capitellar growth plate and 8.1 months (range, 4-26 months) in patients with a closed growth plate. The duration in patients with open capitellar growth plates was earlier than in those patients with closed growth plates ($P < .0067$).

Return to Sport

Resumption of gentle overhead throwing was initiated at 3 to 4 months according to the follow-up radiographic findings and subjective and objective findings, taking into account individual physical differences. Full return to overhead throwing was generally allowed after confirming radiographically that the lesion was almost healed.

A total of 22 of the 39 patients were able to return to baseball at their previous performance level after nonoperative treatment. Another 5 patients could return to baseball but demonstrated occasional mild discomfort in the shoulder and/or elbow. Eventually, 69% of 39 patients, including 88% of 26 patients with grade I lesions, 50% of 4 patients with grade IIA lesions, 25% of 4 patients with grade IIB lesions, and 20% of 5 patients with grade III lesions could return to baseball after nonoperative treatment. Three patients retired from baseball, with 1 patient retiring because of OCD and 2 from causes unrelated to OCD of the capitellum.

Of the 12 patients who were assessed as unimproved or progressed on final radiography, 7 patients underwent

surgery at a mean of 16.7 months after initial examination for residual elbow pain in sports activities and/or activities of daily living. Three patients underwent fragment removal and drilling, 2 patients underwent fragment fixation with bone pegs, and 2 patients underwent osteochondral graft from a rib. All 7 could return to baseball after surgery.

DISCUSSION

Osteochondritis dissecans of the elbow is a relatively unusual disorder seen in young athletes, predominantly among adolescent baseball players, and can be a difficult condition to treat. In general, nonoperative treatment is selected for cases with early-stage OCD of the capitellum, but the healing potential and natural progression of this condition remain poorly understood. Matsuura et al¹² reported that 90.6% of lesions in the early stage and 52.9% of lesions in the advanced stage show improvement after nonoperative treatment. Takahara et al¹⁷ stated that stable lesions, which demonstrate flattening or radiolucency of the subchondral bone on radiography, could heal almost completely with elbow rest. In the present study, 25 of 30 early-stage lesions were assessed as healed or almost healed on final radiography. However, only 1 of 9 lesions in the advanced stage was assessed as healed on final examination. The remaining 8 lesions were unimproved, partially healed, or progressed. These results suggest that healing potential of the lesion is high in the early stage and extremely low in the advanced stage.

Takahara et al¹⁷ indicated the importance of determining whether the lesion is stable when selecting treatments. They concluded that surgery should be considered to obtain better clinical results if the lesion is assessed as unstable. In the present study, 8 of 9 patients with advanced OCD lesions were assessed as partially healed, unimproved, or progressed with loose bodies at the time of final examination. Although 1 patient obtained almost complete healing, this took 26 months after the initial examination (Figure 4). These results suggest that surgical intervention should be recommended for patients with advanced capitellar OCD lesions to achieve healing of the lesions and quickly return to sports activities and/or activities of daily living.

Of 30 patients diagnosed with early-stage lesions on initial examination, 4 lesions in 4 patients were assessed as more advanced at the time of final examination. Three of these 4 patients had continued to throw against the advice



Figure 4. A 13-year-old baseball player. A, radiograph at initial examination demonstrating a fragment demarcated by sclerosis (arrow). B, after 9 months, the lesion is unimproved. C, after 26 months, nearly complete healing of the lesion is apparent.

of their physicians because of team or personal circumstances. During the repair process, the healing subchondral bone is particularly vulnerable. Takahara et al^{18,22} noted that repetitive force on the lesion disturbs new bone formation, causing lesion progression. These results suggest that cessation of repetitive stress on the affected elbow is essential to obtain healing of OCD lesions of the capitellum, especially in patients with early OCD of the capitellum. The patients themselves, as well as their parents and coaches, need to be made aware that the condition of capitellar OCD represents a potentially sport-ending injury for an athlete, with long-term sequelae of degenerative arthritis.¹ In an earlier study that examined the elbows of 101 high-level baseball pitchers (20 professional, 53 semiprofessional, and 28 college baseball pitchers), incidence of residual capitellar deformities seen on radiography was quite low.¹³ This suggests that young players who develop degenerative elbow resulting from a failure of treatment do not reach high-level baseball.

As predictors of good or poor results, Pappas¹⁴ suggested that younger patients display better outcomes. However, both Takahara et al¹⁹ and Ruch et al¹⁵ found no correlations with age. The present study likewise found no correlation with age. In patients with open capitellar growth plates, however, the healing rate was 94%. Conversely, the healing rate in patients with a closed growth plate was 50%, representing a significant difference between patients with open and closed growth plates ($P < .05$). Although we could not detect a difference for the same comparison among patients with early-stage lesions, patients with open growth plates tended to display better outcomes (lesion repair) than patients with closed growth plates. Furthermore, durations of new bone formation for patients with an open capitellar growth plate were shorter than those in the patients with a closed growth plate. Endochondral ossification at the capitellar growth plate may be an advantage in the healing of lesions. This suggests that bone age rather than actual age may offer a useful predictor of the outcomes of conservative treatment.

The present study used 3 radiographic views of both elbows to classify lesions and estimate the course of conservative treatment, as radiography is the initial screening modality and progress and healing of the lesion are usually assessed via plain radiography as a routine examination. Of the 3 directions, AP radiography with the elbow in 45° of flexion is the most useful view to detect small and early lesions.⁹ However, routine radiographic examination has limited sensitivity for detecting very early lesions³ and assessing stability of the fragment.²¹ Magnetic resonance imaging, magnetic resonance arthrography, and ultrasonography have recently improved staging accuracy and have proven helpful for assessing stability and viability of the fragment and treatment selection.^{2,5,11,20,21} Magnetic resonance imaging was performed in 18 patients and ultrasonography was performed in 12 patients in the present series. However, as not all patients in this series were routinely assessed using such modalities, the present study did not address the findings of other imaging modalities.

On the basis of the present findings, we have adopted the following guidelines for treatment of OCD of the capitellum.

For patients with early-stage capitellar OCD lesions with an open growth plate, nonoperative treatment is the treatment of choice. Cessation of repetitive stress on the affected elbow is essential. For patients with early-stage lesions but a closed growth plate, we still select nonoperative treatment at first. We recommend surgery if new bone formation is not observed on radiography within 3 to 6 months or when the lesion progresses. For patients with advanced-stage lesions, surgical intervention is recommended to achieve quick healing of the lesions and return to sports activities and/or activities of daily living. If the patient hopes to avoid surgical intervention, we provide nonoperative treatment, informing the patient and family that the spontaneous healing potential of the lesion is extremely low in the advanced stage.

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