ELSEVIER

Operative Techniques in

Sports Medicine

Osteochondritis Dissecans of the Elbow

Felix H. Savoie, III, MD

Osteochondritis dissecans of the elbow is a disorder noted in young, repetitive-motion athletes. Although often characterized by inflammation, pain, and loss of motion, the pathological changes within the bone involve no inflammatory cells. Nonoperative management includes elimination of the secondary inflammatory changes, by rest and the use of anti-inflammatory modalities, combined with elimination of the stress to the capitellum by rest and the use of an off-loading hinged elbow brace. Nonoperative management is most effective when the cartilage cap overlying the lesion is intact. Surgical intervention may take several forms when the disorder either does not respond to nonoperative management or is discovered in a later stage. Percutaneous fixation of nondisplaced lesions, when there is enough bone in the loose fragment to allow purchase of the fixation device, is an attractive option. Arthroscopic removal of loose bodies, excision of an inflamed posterolateral plica, and microfracture of the residual defect may be of benefit in the intermediate stages. Patients in which these options fail, or in which there is extensive destruction of the bone and involvement of the extreme lateral cortex or "shoulder" of the capitellum, osteochondral grafting may be indicated. Results of each treatment modality are quite good, with success rates reported between 66% and 95%. The primary complications include loss of motion, early arthritis, and a failure to return to the same level of competition.

Oper Tech Sports Med 16:187-193

KEYWORDS osteochondritis dissecans, elbow arthroscopy, elbow, loose body, osteochondral grafting of the humeral capitellum

Osteochondritis dissecans (OCD) is defined as an inflammatory condition of bone and cartilage resulting in localized necrosis and fragmentation of bone andcartilage.[1,2] However, since the original description of this condition in the knee by Konig (1889), no inflammatory etiology has been elucidated.[1-26] In the elbow, the most common area affected is the capitellum, although it has been reported in the olecranon and the trochlea. It has also been confused with Panner's disease, or osteochondrosis, a disease of the ossification center of the capitellum that has a relatively benign and self-limited course.[1-5] This section will focus on true OCD of the humeral capitellum.

Classification

The initial attempt at classification was a radiologic one by Minami and colleagues[6] based on lateral radiographs. Grade I lesions demonstrated a shadow in the middle of the capitellum.[6] Grade II lesions had a clear zone between the lesion and the adjacent subchondral bone. Grade III sessions were those with 1 or more loose bodies. Bradley and Petrie[5] subdivided this system to include magnetic resonance imaging (MRI) as a part of the classification process. Baumgarten[7] classified the lesions according to the appearance on arthroscopy, based on Ferkel's classification of similar lesions of the talus. However, none of these schemes have consistently been able to predict the course of the disease process and thus are of limited value.[8,9]

Evaluation

Clinical Presentation and History

OCD is primarily a disorder of the young athlete. The usual age of presentation is 12 to 14 years of age, compared with 9 to 10 years for Panner's disease. Male athletes are affected more often than female athletes, but there is a high prevalence in young female gymnasts and competitive cheerleaders.[26] The dominant arm is most often involved with bilateral involvement in 5 to 20% of patients.[8] There is usually a history of overuse, most commonly throwing, repetitive impact, or overhead sports.[9] Early on, the symptoms may be

Division of Sports Medicine, Department of Orthopaedic Surgery, Tulane University, New Orleans, LA.

Address reprint requests to Felix. H. Savoie, III, MD, Division of Sports Medicine, Department of Orthopaedic Surgery, Tulane University, 1430 Tulane Ave, SL-32, New Orleans, LA 70112-2699. E-mail: busavoie@aol.com

1060-1872/08/$-see front matter
doi:10.1053/j.otsm.2008.12.002

Figure 1 The posteroanterior view of the elbow delineates the area of lucency in the mid capitellum indicative of early osteochondritis dissecans.

obscure, with pain location difficult to determine. It most often begins with some mild aching after activity. Most patients will try self-medicating with anti-inflammatory medicine and ice, which may provide some temporary relief. Symptoms will often worsen very slowly.[10-14] On presentation, the history is most often that of pain that increases with increased activity, loss of motion, and swelling on the lateral side of the elbow.[26] Additional complaints of popping, clicking, or sudden "giving way," especially with load bearing, may also be present.[15-17]

Physical Examination

The classic physical findings include loss of terminal extension, swelling along the posterolateral joint line, along with inflammation of the normal posterolateral plica.[9] Valgus extension overload testing will produce pain over the lateral aspect of the elbow and result in a measurable increase in the loss of terminal extension.[8,26] This is one of the key differentiating factors in the physical examination of OCD.[9] Most throwing or hyperextension overuse injuries, when tested in valgus, will have the primary component of pain along the medial aspect of the elbow: the medial apophysis, the medial ulnar collateral ligament or the flexor-pronator muscle.[9] These may coexist with the OCD, but in patients with OCD, these instability stress maneuvers, especially the moving valgus overload test, will result in pain more on the lateral than medial side.

Radiology and MRI

The initial testing involves standard posteroanterior and lateral radiographs, which usually will show the classic findings of radiolucency in the central aspect of the capitellum. There may be a small area of increased opacity in the center of the radiolucency (Fig. 1).[10] In the later stages, loose bodies may be present.

Additional testing may be warranted early in the course of treatment. Computed tomography (CT), CT arthrograms, and ultrasound have all been used, but MRI has become the standard modality for evaluation of these lesions. The key points to evaluate that will assist in determining appropriate management include the extent of the bone involvement, the integrity of the overlying cartilage cap, and the presence of loose bodies.[18,19] Early lesions will show change on T1-weighted MRI images, but no change on T2. The cartilage covering will be intact, indicating an improved prognosis. Advanced lesions will show changes on both T1 and T2 images and may demonstrate a loose in situ bone fragment (Fig. 2). Assessment of the integrity of the cartilage cap remains paramount. As the condition advances, the cartilage cap is violated, allowing synovial fluid between the fragment and the remaining capitellum. This jeopardizes any chance at union with fixation and may result in one or more loose fragments being shed into the joint. However, the simple presence of loose bodies does not conclusively define a rupture of the cartilage, so MRI assessment remains necessary. In the most advanced cases, 3-dimensional imaging may be helpful. The lesion that advances to the lateral edge or "shoulder" of the capitellum is a much more severe injury that usually requires extensive reconstructive surgery. The use of

Figure 2 The MRI test may indicate either an intact or disrupted cartilage cap as well as the presence of loose bodies within the defect.

3-dimensional imaging can help to define the loss of this critical lateral cortex.[20,21]

Treatment Options

Nonoperative Treatment

Treatment options for OCD remain controversial. Options vary from a total cessation of any irritating activities to immediate surgery.[9] The current classification systems do not help in predicting the course of treatment or the prognosis. The critical determinant in the authors' opinions is the presence or absence of an intact cartilage cap. Patients with intact articular cartilage should be managed nonoperatively. Patients with disruption of the articular cartilage cap may still be managed nonoperatively but with less chance for a full recovery.

The hallmark of nonoperative treatment has been rest and cessation of aggravating activities. This restriction is continued until symptoms resolve (usually 6 to 12 weeks) and radiographs or MRI demonstrate complete healing of the lesion (6 to 12 months). This lengthy recovery may be too long for most patients and families to tolerate, resulting in a premature return to sports and recurrence and worsening of the problem (Fig. 3).[1,5-7,9-17,26]

One alternative method of management has been the protection of these lesions with an off-loading hinged elbow brace.[26] The straight hinge changes the normal valgus tilt of the elbow and off-loads the lateral side, protecting the capitellum from injury. Initially, the brace is set at the limits of pain-free range of motion, often as limited as 60 to 90°. As the inflammation in the plica decreases and pain-free motion increases, the brace is loosened to allow full range of motion. Sports and normal activities are allowed with the brace in place, as long as symptoms do not occur during these activities. Use of this form of treatment allows the patient to continue normal activities without aggravating the lesion in the capitellum. The patient is able to return to normal activities with the brace in place within 2 weeks of initiating treatment. The time of the normal healing process remains unchanged and close monitoring with monthly radiographs and quarterly MRI testing is necessary to adequately follow the healing process if this treatment method is chosen.

Operative Management

Progression of the disease process, the presence of symptomatic loose bodies, or disruption of the cartilage cap that continues despite rest, bracing, and cessation of activity may be considered indications for surgery. Arthroscopic evaluation of the lesion, along with removal of the loose fragments and debridement of the base, currently is the mainstay of operative management. Although much of the older literature focused on open management, most current studies delineate the efficacy of arthroscopic treatment.[1,9]

The operative technique begins with a diagnostic arthroscopy of the anterior compartment of the elbow. It is most useful to begin with a proximal anterior-medial portal for the arthroscope and visualize the radiocapitellar joint. The anterior aspect of the capitellum is usually normal. If there is an anterior lesion, the 70° arthroscope may be used to visualize and the lateral portal to manage the lesion. The anterior compartment is then evaluated for loose bodies, which are removed via an anterolateral portal if necessary. The inflow is

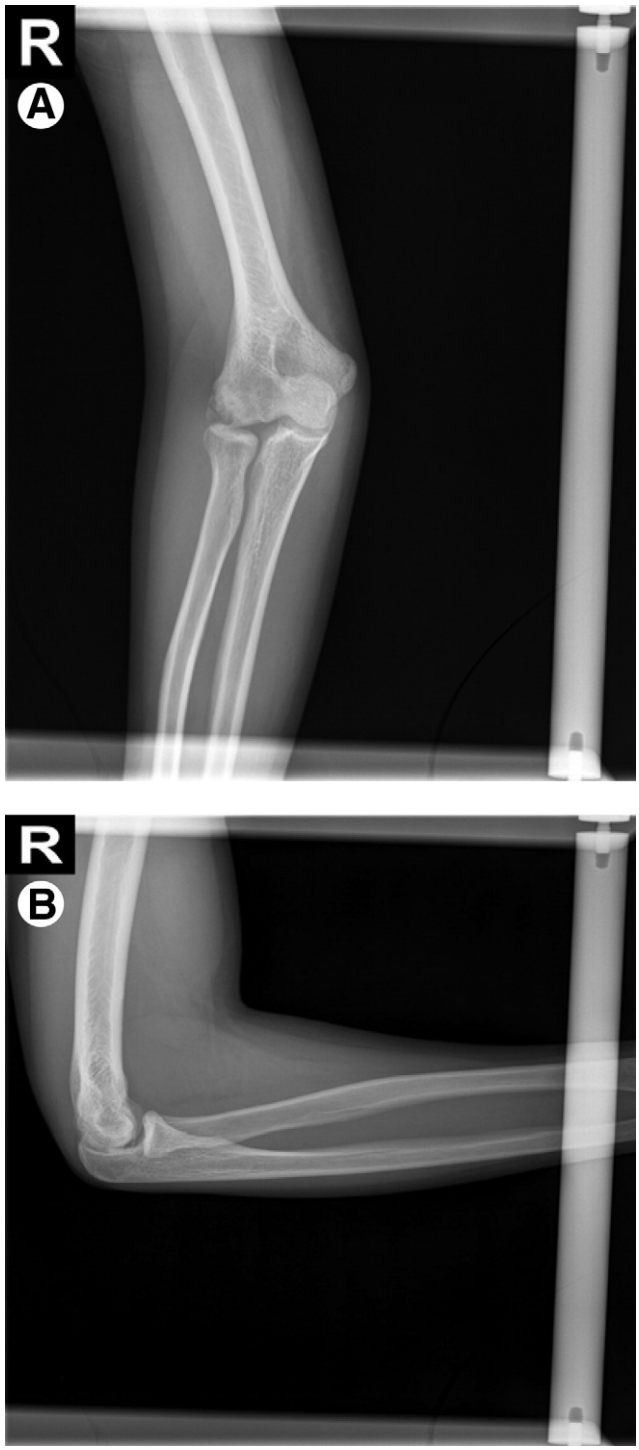

Figure 3 A late-stage OCD lesion as seen on radiograph (A) and on MRI (B). Note the extension into the lateral aspect of the capitellum, usually indicative of an expected poor result with standard microfracture techniques. Osteochondral grafting may be used to reconstruct the "shoulder" or lateral cortical aspect of the capitellum.

then left on the canula in the proximal anterior medial portal and the posterior compartment of the elbow entered. The olecranon fossa also is evaluated for loose bodies, which are removed via a posterior central or posterior lateral portal. The medial gutter is similarly evaluated for loose bodies and inflammation. Attention is then directed to the lateral gutter. The posterolateral plica is evaluated and removed via a soft spot posterolateral portal if there is any inflammation or thickening. The capitellum is then visualized from both the posterolateral and the soft spot portal, and the degree of involvement of the capitellum assessed and documented. If operative management is indicated, the OCD lesion is best visualized via a superior posterior-lateral portal with a 70° arthroscope. This leaves the soft spot, straight lateral and inferior straight lateral portals free for instrumentation (Fig. 4). The cartilage cap may be probed via these portals for softness and fissures. Increasing the flexion of the elbow may be necessary to visualize the entire lesion. If the preoperative workup has shown a large, repairable fragment, fixation in situ is accomplished through the inferior straight lateral portal under arthroscopic and fluoroscopic control using standard fixation techniques. If this is not an option, the full radius shaver is introduced and the necrotic bone debrided to a stable bed. All loose bodies are removed as well. A stable rim of cartilage is left in place. It is important to preserve the lateral aspect of the capitellum (the shoulder) as it provides both bone stability and the attachment of the lateral capsule and ligaments. Once the debridement has been completed the base of the lesion is microfractured to stimulate increased blood flow.

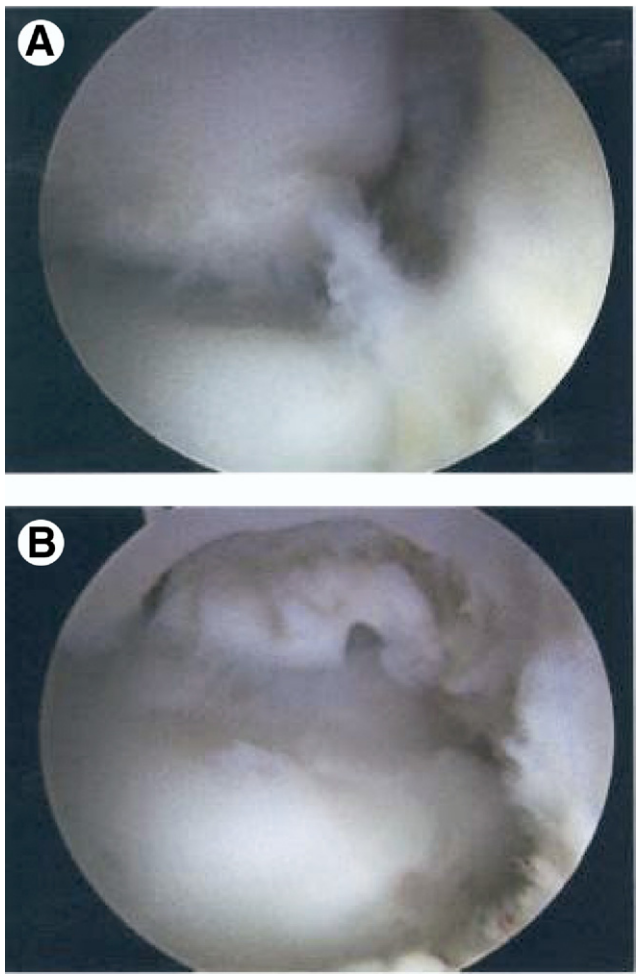

Figure 4 (A) The OCD lesion of the capitellum visualized with a 30° arthroscope from the posterolateral portal with the patient in the prone position. The radial head is below and the lateral capsule to the right. The capitellum is at the top left of the figure. (B) The OCD lesion of the capitellum as visualized from the same portal with a 70° arthroscope. Note the radial head below and the capitellum above with the loose lesion in the center of the capitellum.

Occasionally, one may encounter a large and viable fragment. The fragment is "hinged" open and the base debrided. The fragment is then replaced into the defect and stabilized using a Kirschner wire. Many techniques for permanent stabilization have been described, including Herbert-Whipple screw fixation, retrograde suturing, cancellous screws and bioabsorbable implants.

In the most severe cases, osteochondral grafting from the knee, ribs, synthetics, or allograft has been reported. None of the synthetic implants have been approved for use in this area and their use should be considered experimental at this time. The procedure is as listed above for debridement, and then the distal soft spot or distal lateral posterior portal is used to place the plugs. The elbow must be hyperflexed to allow correct orientation of the implants, which are then contoured to match the capitellar surface (Fig. 5).

Discussion

There is no level I study available on OCD of the elbow. Most of the long-term studies are case series identified retrospectively. Takahara and colleagues[12] followed 24 patients with OCD of the capitellum nonoperatively for an average of 5.2 years and found the results correlated directly with the severity of the lesion on presentation, with 6 of 11 "early" lesions healing or improving. In the same year, these authors presented a comparison study of 53 patients with 14 managed nonoperatively and 39 managed by surgery. The end result correlated mostly with the size of the lesion rather than type of treatment. This was not a randomized study.[13] Woodward and Bianco[11] retrospectively reviewed 42 patients and followed up on 24 patients, 2 to 34 years after initial treatment. They found that although most subjectively thought their elbow was normal, there was a consistent loss of full extension.

Surgery in athletes has been reported via several case series with mixed results. Baumgarten and colleagues[14] and Ruch and colleagues[15] have reported relatively good results (13 of 16 and 9 of 12, respectively) with short-term follow-up after arthroscopic debridement. In each series, the more extensive the lesion at the time of surgical treatment the less successful the result.

In contrast to the aforementioned work, Byrd and Jones[16] presented a retrospective cohort series of 10 baseball players, with only 4 returning to unrestricted play and 5 cases of arthrofibrosis. Jackson and colleagues[17] presented the classic

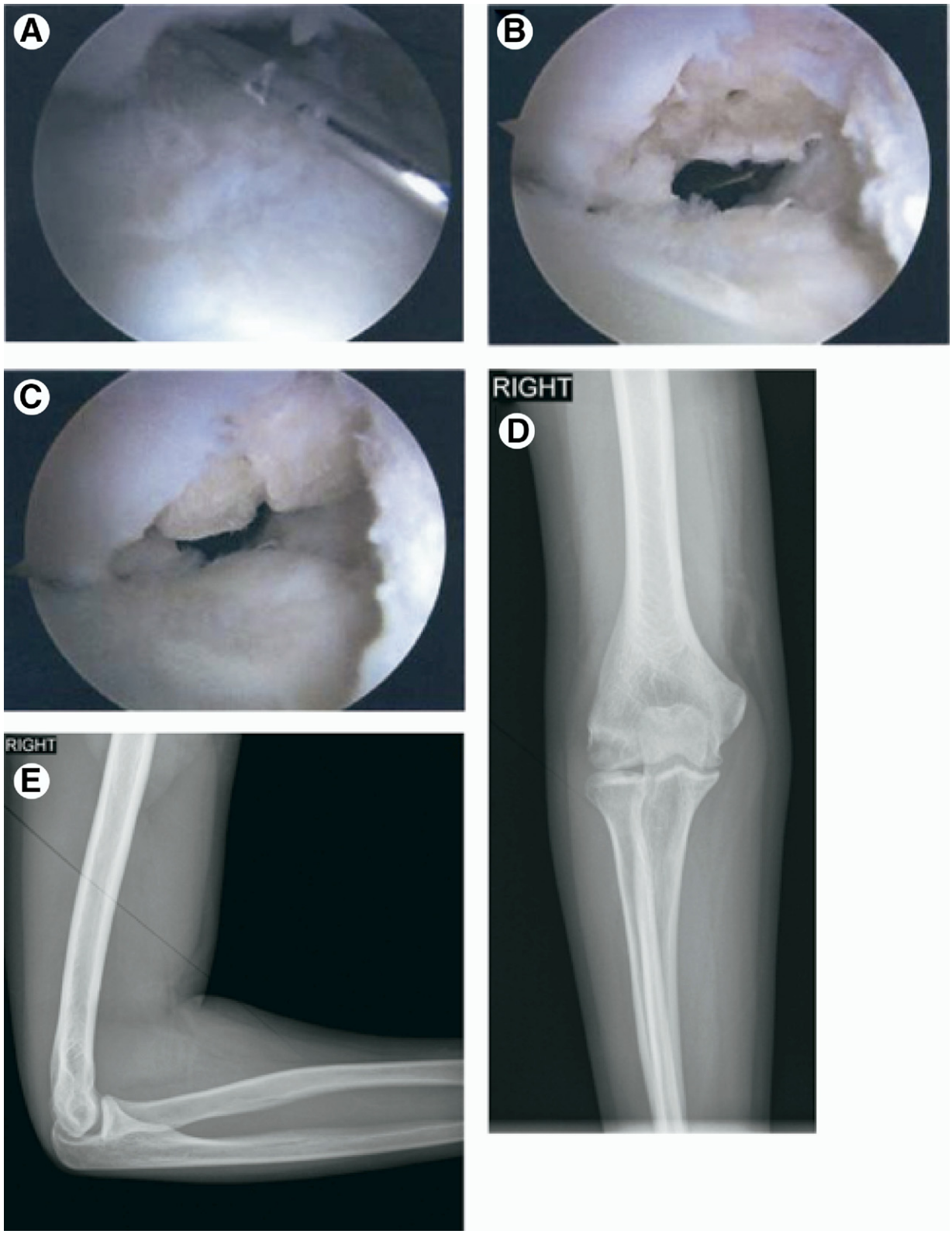

Figure 5 The sequences in the treatment of OCD lesions of the capitellum: (A) simple debridement and removal of the loose fragment. The arthroscope is in the posterolateral superior portal and the instruments are through the distal soft spot portal. (B) Drilling and/or microfracture of the residual defect is thought to stimulate cartilage formation. The capitellum and defect are above and the radial head below in this view from the superior soft spot portal. (C) In rare late-stage OCD or when the lateral aspect of the capitellum has been lost, arthroscopic osteochondral grafting may be indicated to bolster the lateral joint and possibly prevent instability and progressive arthritis. Note the 2 plugs within the center of the defect. (D) The radiograph of the patient in (C) 6 weeks after osteochondral grafting, revealing reconstitution of the lateral cortex or "shoulder" of the capitellum. (E) Lateral radiographic view of the patient.

article on elite female gymnasts with osteochondritis and found only 1 of 10 was able to continue her career.

Other series have echoed the findings of the aforementioned authors, with results related to the size of the lesion rather than treatment. Of the cases of grafting for the more severe defects, only anecdotal evidence exists. El Attreche and Savoie have presented, but not published, cases of osteochondral grafts placed in the more severe cases for loss of the structural integrity of the capitellum with satisfactory short term results (personal communication, N. El Attreche, 2007-2008).

Author's Preferred Method

The author prefers nonoperative management of early lesions. If the radiographs and MRI reveal an intact cartilage cap or a relatively small lesion (8 mm or less), then the patient is managed with full-time hinged elbow bracing and physical therapy. Once the elbow is pain free, the patient is allowed to return to sports with the brace in place and with improvement of core strength, posture and correction of any improper sporting techniques that may produce increased stress on the elbow. The patient is allowed to return to sports with the brace in place once the elbow has regained a full and painless arc of motion. All activities are allowed with the brace in place until radiographic evidence of healing occurs. In female gymnasts, we usually recommend quarterly MRI if possible and also will suggest radiographs and at least 1 MRI of the opposite, asymptomatic elbow.

If the patient has loose bodies, extensive involvement of the capitellum, or progression of the disease, then surgery is recommended. The procedure is performed arthroscopically with removal of loose bodies and debridement and drilling of the base of the lesion. Large lesions are repaired with a cannulated Herbert-Whipple type screw, but this type of lesion is extremely rare in our practice. In the more extensive lesions with loss of the lateral cortex, we use osteochondral grafting, with the proximal olecranon as the source of the graft.

Postoperative Protocols

The patient is started on a continuous passive motion machine on the day of surgery. The elbow is placed in a brace to offload the capitellum. Physical therapy for gentle stretching, compressive pumping out of edema and hand/wrist exercises are initiated as early as possible, usually with 1 week of surgery. The patient is started on general conditioning within the first 3 weeks of surgery. The elbow is followed on serial radiographs as well as clinically. Once a pain-free range of motion and satisfactory strength are obtained, return to sports is allowed, usually between 6 and 16 weeks.

The main outcome measurement used in most studies is the return to unrestricted sporting activity. This usually occurs between 10 and 90% of the time with both nonoperative and operative management. This success or failure is most often determined by the extent of the lesion and the level of sport rather than by the type of treatment.

Complications

Complications include recurrence or advancement of the lesion, arthrofibrosis, and heterotopic ossification. Advancement may occur despite adequate nonoperative treatment. Arthrofibrosis or stiffness often is present preoperatively and may occur postoperatively as well. Most patients respond to nonoperative protocols, but capsular release or resection may be indicated in refractory cases. Heterotopic ossification occurs more frequently after open surgery. In the early stage, it may be addressed by arthroscopic excision and radiation. Later stages require open excision with exploration and protection of the nearby neurologic structures, along with radiation therapy. The more extensive lesions were associated with increased risk of arthritis, stiffness and ongoing pain. Failure to return to sport at the preinjury level is quite common, occurring 10 to 20% of the time in the best case series.[1,4-7,10-17]

Special Populations

The elite female gymnast/competitive cheerleader represents a special population. Although osteochondrosis (Panner's disease) is more common in this age range (younger than 10 years), the lesions in these athletes behave more like a severe osteochondritis. It may often occur bilaterally, and should be managed in an aggressive but nonoperative manner. In these patients evaluation of the opposite elbow by radiographs and MRI is recommended. Surgery in these patients often will end their career; therefore, early detection and management by bracing and protection is essential. Surgery should be undertaken with great reluctance and with full knowledge of the possibility of a good objective patient outcome but poor subjective athletic result.

References

1. Schenk RC, Jr, Goodnight JM: Osteochondritis dissecans. J Bone Jt Surg Am 78:439-456, 1996
2. Konig F: Ueber Freie Korper in den Gelenken. Dtsch Zeitschr Chir 27:90-109, 1887
3. Panner HJ: A peculiar affection of the capitulum humeri, resembling Calve-Perthes' disease of the hip. Acta Radiol 10:234-242, 1927
4. Nagura S: The so-called osteochondritis dissecans of Konig. Clin Orthop 18:100-122, 1960
5. Bradley JP, Petrie RS: Osteochondritis dissecans of the humeral capitellum: Diagnosis and treatment. Clin Sports Med 20:565-590, 2001
6. Minami M, Nakashita K, Ishii S: Twenty-five cases of osteochondritis dissecans of the elbow. Rinsho Seikei geka 14:805-810, 1979
7. Baumgarten TE: Osteochondritis dissecans of the capitellum. Sports Med Arthrosc Rev 3:219-223, 1995
8. Shaughaessy WJ: Osteochondritis dissecans, in Morrey BF (ed): The Elbow and Its Disorders (ed 3). Philadelphia, PA, WB Saunders, 2000, pp. 255-260
9. Cain EL, Dugas JR, Wolf RS, et al: Elbow injuries in throwing athletes: A current concepts review. Am J Sports Med 31:621-635, 2003
10. Bauer M, Jonsson K, Josefesson PO, et al: Osteochondritis dissecans of the elbow: A long-term follow-up study. Clin Orthop 284:156-160, 1992
11. Woodward AH, Bianco AJ, Jr: Osteochondritis dissecans of the elbow. Clin Orthop 110:35-41, 1975
12. Takahara M, Ogino T, Fukushima S, et al: Nonoperative treatment of

osteochondritis dissecans of the humeral capitellum. Am J Sports Med 27:728-732, 1999
13. Takahara M, Ogino T, Sasaki I, et al: Long term outcome of osteochondritis dissecans of the humeral capitellum. Clin Orthop 363:108-115, 1999
14. Baumgarten TE, Andrews JR, Satterwhite YE: The arthroscopic classification and treatment of osteochondritis dissecans of the capitellum. Am J Sports Med 26:520-523, 1998
15. Ruch DS, Cory JW, Poehling GG: The arthroscopic management of osteochondritis dissecans of the adolescent elbow. Arthroscopy 14: 797-803, 1998
16. Byrd JW, Jones KS: Arthroscopic surgery for isolated capitellar osteochondritis dissecans in adolescent baseball players: Minimum three-year follow-up. Am J Sports Med 30:474-478, 2002
17. Jackson DW, Silvino N, Reiman P: Osteochondritis in the female gymnast's elbow. Arthroscopy 5:129-136, 1989
18. Holland P, Davies AM, Cassar-Pullicino VN: Computed tomographic arthrography in the assessment of osteochondritis dissecans of the elbow. Clin Radiol 49:231-235, 1994
19. Kijowski R, De Smet AA: MRI findings of osteochondritis dissecans of the capitellum with surgical correlation. AJR Am J Roentgenol 185:1453-1459, 2005
20. Peiss J, Adam G, Casser R, et al: Gadopentetate-dimeglumine-enhanced MR imaging of osteonecrosis and osteochondritis dissecans of the elbow: Initial experience. Skeletal Radiol 24:17-20, 1995
21. Fritz RC, Stoller DW: The elbow, in Stoller DW (ed): Magnetic Resonance Imaging in Orthopaedics and Sports Medicine (ed 2). Philadelphia, PA, Lippincott-Raven, 1997, pp 743-849
22. Kuwahata Y, Inoue G: Osteochondritis dissecans of the elbow managed by Herbert screw fixation. Orthopedics 21:449-451, 1998
23. Harada M, Ogino T, Takahara M, et al: Fragment fixation with a bone graft and dynamic staples for osteochondritis dissecans of the humeral capitellum. J Shoulder Elbow Surg 11:368-372, 2002
24. Takeda H, Watarai K, Matsushita T, et al: A surgical treatment for unstable osteochondritis dissecans lesions of the humeral capitellum in adolescent baseball players. Am J Sports Med 30:713-717, 2002
25. Oka Y, Ikeda M: Treatment of severe osteochondritis dissecans of the elbow using osteochondral grafts from a rib. J Bone Jt Surg Br 83:738-739, 2001
26. Yadao MA, Field LD, Savoie FH: Osteochondritis dissecans of the elbow. Instr Course Lect 53:599-606, 2004