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ORIGINAL ARTICLE

Olecranon physeal nonunion in the adolescent athlete: identification of two patterns

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Background: This study aimed to present the outcomes of patients undergoing surgical management of persistent, symptomatic olecranon physes.
Methods: Consecutive patients undergoing surgical management for symptomatic persistent olecranon physeal abnormalities were reviewed. Preoperative data, intraoperative findings, and postoperative clinical outcomes including physical examination findings, radiographs, complications, and reoperations were analyzed.
Results: A total of 13 elbows in 12 patients (100% male; average age, 18 ± 4 years) were identified. All patients were pitchers at the high-school or college level. Two unique radiographic patterns were identified: *distal persistent olecranon physis* (n = 9), identified by an irregular sclerotic lucency at the site of the olecranon physis; and *proximal persistent olecranon physis* (n = 4), identified by a radiolucency exiting proximal to the triceps insertion at the site of an accessory ossification center that failed to unite. Surgical management included débridement, autograft bone grafting, and internal fixation. There were 3 reoperations (1 for infection, 2 for painful hardware). All patients achieved successful radiographic union (average, 8 ± 2 weeks). At an average follow-up of 4.4 ± 1.2 years, the average postoperative Disabilities of the Arm, Shoulder, and Hand score was 1.1 ± 1.6; the Mayo Elbow Performance Score was 98.5 ± 2.4; the American Shoulder and Elbow Surgeons score was 99.3 ± 0.4; and average Likert score for satisfaction was 9.95 ± 0.2. At final follow-up, there were no significant differences in strength, motion, or stability in comparing the operative with the nonoperative elbow ($P > .05$ for all).
Conclusions: Two unique patterns of olecranon physeal abnormalities in young, overhead throwing athletes have been identified. Open reduction with internal fixation is clinically and radiographically successful in obtaining union and symptom resolution in these patients.
Level of evidence: Level IV; Case Series; Treatment Study

Keywords: Olecranon stress fracture; olecranon nonunion; persistent physis; throwing athlete; youth pitcher; olecranon physis

The elbow is a common source of pain in the adolescent athlete, particularly in throwing and overhead athletes.[20,33] Secondary to stress from repetitive motion, overuse injuries are common in this population of patients. The spectrum of injuries is wide and is typically subclassified on the basis of chronicity and anatomic location: medial, lateral, and posterior. Common conditions include medial epicondylitis, avulsion fracture of the medial epicondyle, ulnar neuritis, injury to the medial collateral ligament of the elbow, and capitellar

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osteochondritis dissecans.[13,31] Abnormalities of ossification among fusion centers of the elbow are less common but remain an important consideration in the young athlete with elbow pain.

The olecranon physis appears at approximately 8 years in girls and 10 years in boys and fuses at age 14 years in girls and 16 years in boys.[7,20,21] The epiphysis of the olecranon typically ossifies from 2 or more ossification centers, most commonly one nucleus that forms the majority of the articular surface and a second ossification center that forms the apex of the olecranon. The anterior nucleus is smaller and located more proximally, at the site of the tip of the olecranon, whereas the posterior nucleus is larger and forms the majority of the articular surface. These centers usually fuse with each other before fusing with the main metaphyseal segment (Fig. 1).[6,7,23,24,28,29]

The first case of an olecranon physeal fusion abnormality appeared in the literature in 1942, when O'Donoghue and Sell described a 31-year-old patient who sustained a traumatic injury to the elbow.[17] At time of surgical intervention, cartilaginous tissue was found at the fracture site, indicating the presence of a persistent physis. Contralateral elbow radiographs in that patient revealed a persistent widened physis. Since that time, multiple case reports have been presented of patients of varying ages. Most have been reported as either a "persistent physis" (or nonunion) or a "stress fracture" in the area of the physis. However, considerable variation in nomenclature and etiology exists, and there is no consensus on treatment options for patients with symptomatic elbows attributable to pain at the location of the olecranon physis. The purpose of this study was to present the clinical and radiographic outcomes of patients undergoing surgical management of persistent, symptomatic olecranon physes and to provide recommendations for the surgical management of these patients. The authors hypothesized that patients would be able to return to their preinjury level of play after surgery without deficits or loss of function.

Figure 1 Lateral radiograph of a 12-year-old boy demonstrating the epiphysis of the olecranon, which typically ossifies from 2 or more ossification centers.

Materials and methods

The records of the senior author were retrospectively reviewed to identify consecutive patients who presented with elbow pain and underwent surgery for a symptomatic persistent olecranon physis. Patients were indicated for surgery if they remained symptomatic after a course of nonoperative treatment, including activity modification with or without physical therapy. Preoperative data, including mechanism of injury, level of sports participation, and prior injuries to the involved extremity, were recorded. Preoperative physical examination findings and imaging data were also obtained. Postoperative data, including physical examination findings and patient-reported outcomes surveys, were analyzed at a minimum of 2 years after surgery. Physical examination at follow-up was performed by a provider not involved with the surgery; outcomes included visual inspection, assessment of tenderness to palpation, passive and active range of motion, varus and valgus stress testing, triceps motor testing, stability testing, grip and pinch strength testing, and complete neurovascular examination. Surveys included the Disabilities of the Arm, Shoulder, and Hand score, the Mayo Elbow Performance Score, and the Likert score. Elbow radiographs were analyzed for the appearance of union at a minimum of 6 weeks after surgery. Postoperative return to sport, complications, and reoperations were also analyzed.

Operative technique

Autograft harvest

Distal radius autograft was used in 12 of 13 cases (92%). After administration of regional anesthesia to the affected extremity, all patients were placed in supine position, with the extremity placed on a hand table. After exsanguination with a tourniquet, an incision was centered over Lister tubercle and carried proximally. After identification of the growth plate with use of intraoperative fluoroscopy, the extensor tendons were retracted, and subperiosteal dissection was performed medially and laterally. A cortical window was then made, and pure cancellous bone graft was harvested. The defect was packed with Gelfoam, and the wound was closed in a standard fashion. In 1 case, iliac crest bone graft was harvested by standard technique instead of the distal radius bone graft.

Olecranon physis exposure and fixation

The arm was then placed across the body over a bolster. A 6- to 8-cm posterior incision was made over the olecranon, curving medially. After dissection to the fascia, the ulnar nerve was identified within the cubital tunnel and protected. After identification of the nonunion site by fluoroscopy, subperiosteal dissection was continued to the level of the nonunion site. By use of a combination of a low-speed burr, rongeur, and curet, the nonunion site was débrided, with care taken to stop just shy of the subchondral bone and joint surface (Fig. 2).

After irrigation, the nonunion site was packed with cancellous autograft harvested from the distal radius. A figure-of-8 tension band was then applied to compress and to stabilize the nonunion site. After tightening, the wire ends were cut and impacted into soft tissue to produce a low-profile construct. Care was taken to drive the proximal bent pins down to bone with a tamp by making small openings in the triceps. After irrigation, the fascia, subcutaneous tissue, and