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Novel fixation of medial epicondyle fractures in a throwing athlete using suture bridge technique

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Medial epicondyle fractures constitute 11% to 20% of fractures around the elbow. Surgical options that have been described for fixation of medial epicondyle fractures include the use of sutures, K wires, cannulated screws with and without washer, suture anchor repair or excision of the fragments with advancement of medial soft tissues[6,11,13]. Hardware irritation is one of the disadvantages of wire or screw fixation that might need surgical removal. Fractures with incarcerated fragments, open fractures, and ulnar nerve injuries are the generally accepted operative indications. However, the rationale behind the decision-making on which type of fixation to use in displaced medial epicondyle fractures has not been well-established and optimal treatment for medial epicondyle fractures displaced over 5mm continues to be a topic of debate[1,7,15].

Owing to the ligamentous anatomy, medial epicondyle fractures can jeopardize throwing athletes' ability to return to play. The anterior band of the ulnar collateral ligament functions as a static stabilizer, whereas flexor-pronator mass plays a significant role in dynamic stabilization of the elbow through attachments to the medial epicondyle. These static and dynamic stabilizers exert stress to the medial epicondyle physis during overhead throwing activities in immature athletes. If the stresses exceed the strength of the physis, avulsion fractures across the physis can occur. A nonunion or malunion of a medial epicondyle fracture with ensuing valgus instability can result in a functionally catastrophic result for throwing athletes who rely on elbow stability for their sport.

We present a new surgical technique with its proposed merits for fixation of medial epicondyle avulsion fracture in a throwing athlete using a suture bridge technique.

Surgical technique

A 14-year-old male baseball pitcher injured his right elbow while pitching. Fracture through the medial epicondyle physis with more than 5-mm displacement was confirmed on x-rays and MRI (Figures 1 and 2). Examination under anesthesia revealed valgus instability and loss of 5 degrees of extension with up to 130 degrees of flexion. The elbow was stable to varus stress with a good endpoint and had normal range of motion in pronation and supination.

The medial epicondyle was approached proximally and anteriorly through an approximately 8 cm curvilinear incision made directly over the medial epicondyle. The medial antebrachial cutaneous nerve was protected. The ulnar nerve was visualized posteriorly and was protected throughout the remainder of the case without further exposure. Stability of the ulnar nerve was confirmed with dynamic examination intraoperatively. The fracture site was identified. Débridement of the fracture callus and hematoma with a curette was performed to achieve a bed of bleeding bone. Satisfactory reduction of the medial epicondyle fracture was confirmed on intraoperative imaging. Given that the preoperative MRI imaging showed a possible partial proximal humeral ulnar collateral ligament (UCL) tear, we explored the ligament by making a split in the anterior fibers of the FCU. On visualization of the UCL, there were chronic proximal tissue changes with thinning in the ligament but no frank tear. Given the preoperative imaging in the setting of the visualized proximal

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Figure 1 AP (**a**), internal oblique (**b**), lateral (**c**), and axial views (**d**) before surgery showing displaced medial epicondyle fracture.

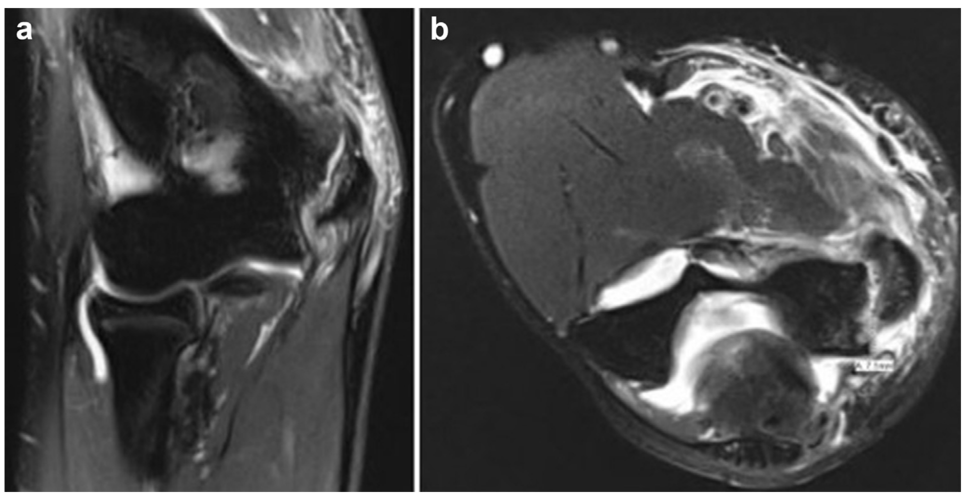

Figure 2 Coronal (**a**) and axial (**b**) MRI views to show displaced medial epicondyle fracture.

ligament changes, we went forward with a proximal imbrication and repair of the tissue to appropriately tension the ligament. The fracture site was then booked open and two 3.5 mm polyetheretherketone (PEEK) SwiveLocks™ loaded with FiberTape™ and #2 FiberWire™ were placed in the distal portion of the medial epicondyle fracture bed. The anchors were confirmed to be extra-articular by ensuring circumferential bone around the drill holes. The FiberTapes™ were then placed through the flexor-pronator tendon, around the medial epicondyle, in a deep to superficial fashion. The #2 FiberWire™ sutures were passed through the flexor-pronator tendon and then subsequently through the ulnar collateral ligament to help repair this back to the medial epicondyle at the same time. Next, the FiberTapes™ were passed in a crossing fashion over the medial epicondyle and then placed through two 3.5 mm PEEK SwiveLocks™ proximal to the medial epicondyle for a transosseous equivalent repair (Figures 3 and 5). The forearm was kept in supination with a varus stress at 20 degrees of elbow flexion during the reduction and placement of the suture anchors.

Adequate compression at the medial epicondyle fracture site was achieved and was confirmed while taking the elbow through motion. The ulnar collateral ligament was repaired and imbricated while keeping varus stress at 20 degrees of elbow flexion with forearm in supination to avoid any medial joint space opening during repair. After standard closure of the wound the patient was placed in a posterior U-splint in approximately 70 degrees of flexion with the hand in supination.

Results

The patient had excellent fracture healing at 8 weeks and complete radiographic union at 12 weeks follow-up (Figure 4). At 12 weeks after surgery, the patient had no pain with activity or palpation of the medial epicondyle. Ulnar collateral ligament testing was negative. The patient had minimal loss of 2 degrees of full extension but was in his normal preoperative range and for throwers in general. An interval throwing program was commenced by 3½ months after the surgery. The patient was evaluated at 6 months and continued to have no pain, a normal elbow physical examination, normal shoulder strength, improved mechanics, and was finishing his interval throwing program successfully. Timmerman-Andrews score and QuickDash score at 6-month follow-up was 100 and 2.3%, respectively. The patient was cleared for full baseball activities, including pitching, at 7 months after the surgery.

Discussion

The spectrum of medial epicondyle injuries in young throwing athletes range from chronic overuse injuries which is commonly known as Little League elbow[2] to acute avulsion fracture from a valgus stress during throwing. However, traumatic injuries can also result from a direct trauma or in association with a traumatic elbow dislocation with concomitant other osseous or ligamentous

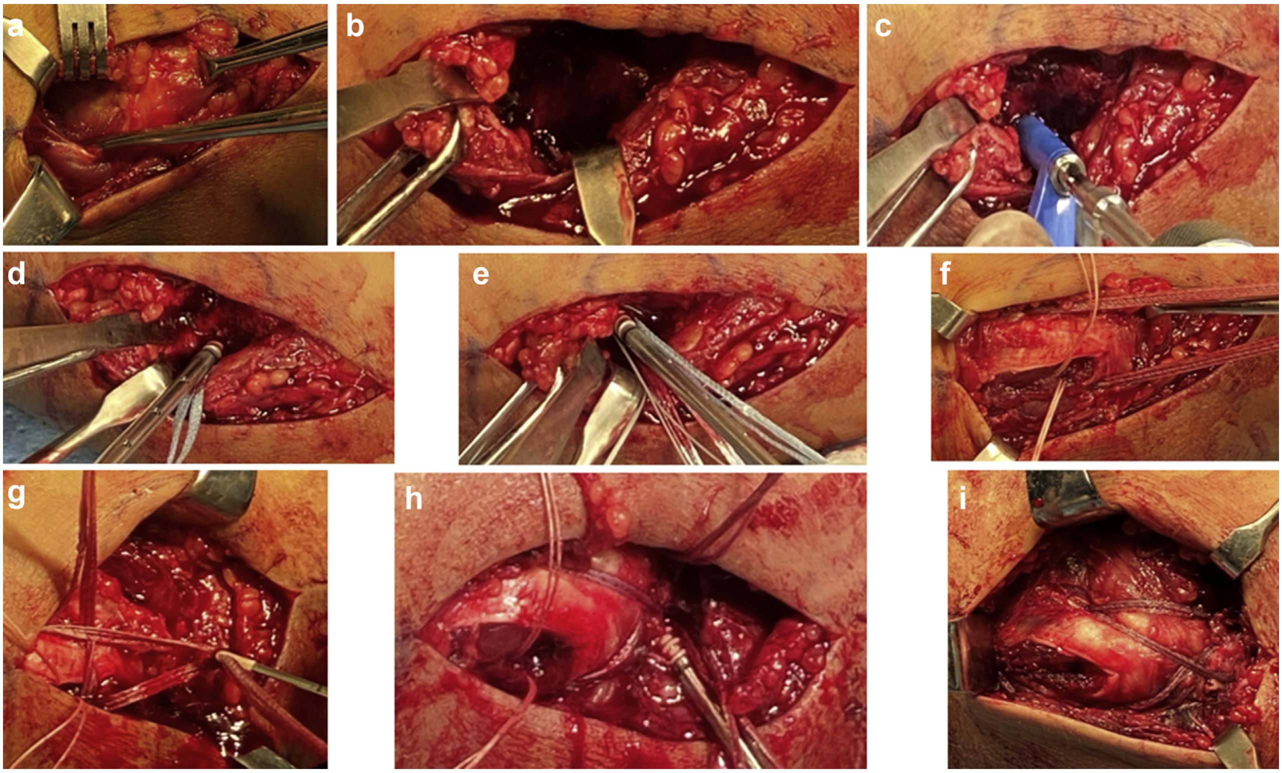

Figure 3 Exposure (**a**), fracture site after débridement (**b**), drilling for distal swivelocks (**c**), placement of distal swivelocks (**d, e**), passing of FiberTapes and FiberWire through pronator mass and ulnar collateral ligament (**f**), placement of proximal swivelocks (**g, h**), crisscross sutures after fixation (**i**).

Figure 4 Excellent bone healing at 8 (**a**)- and 12 (**b**)-weeks follow-up.

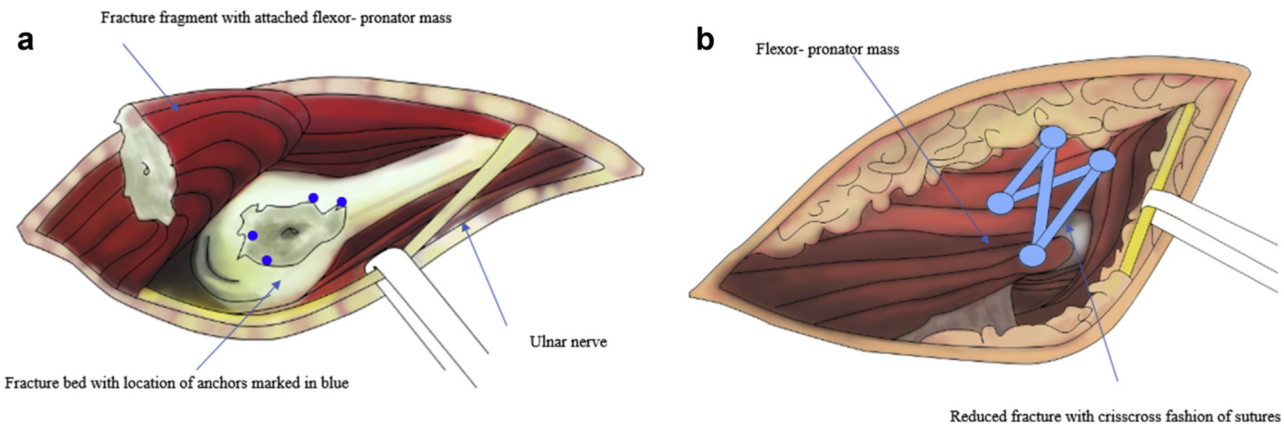

Figure 5 Illustration of the technique before (**a**) and after (**b**) reduction of the fracture.

injuries. The occurrence of medial epicondyle fractures during throwing activities, such as pitching, underscores the importance of injury prevention and following safety guidelines established by USA Baseball medical and safety advisory committee[17].

The ossification center of the medial epicondyle generally appears between 5 and 7 years of age and is usually the last center to fuse at the elbow at around 15–20 years of age. The medial epicondyle gives origin to the flexor-pronator group and the anterior and posterior bands of the ulnar collateral ligament. The anterior band of the ulnar collateral ligament is the most important stabilizer to valgus torque at the elbow during overhead activities. Magnetic resonance imaging should be considered in all situations as it would provide further information about the presence of chronic changes as well as possible ulnar collateral ligament injury. The ulnar nerve must also be considered as a potential source of neuritis or neuropathy with or without surgery as it runs directly posterior to the medial epicondyle and is at increased risk for injury[12].

There is no established consensus and much debate exists in literature about optimal treatment of isolated displaced medial epicondyle fractures. The authors typically get AP/lateral and internal oblique x-rays along with an MRI to evaluate "true displacement"[3] and the integrity of UCL. More recently, displacement of 5mm[9] has been used as the cutoff for surgery, although some authors[5] even advocate for surgical fixation with displacement over 2 mm, especially in young throwing athletes. For displacement more than 5mm, equally good outcomes have been reported among patients treated with both nonoperative treatment and with open reduction and internal fixation[1,7]. However, some studies have found a significantly higher incidence of nonunion and mal-union in nonoperatively treated patients compared with operative group[15]. Although some studies have reported 73%-100% return to sports after ORIF of medial epicondyle fractures in throwers[4,9], there is no clinical evidence to support earlier return to sports with surgical fixation.

In general, cannulated screws with or without washers are typically utilized for fixation of medial epicondyle fractures[14]. K-wires or suture anchors are used if the fragment is too small to accept a screw or there is concern about further fragmentation. Szymanska et al[16] showed that children treated with screw fixation demonstrated better outcomes when compared to those treated with k-wires; however, others reported no significant difference in clinical outcomes[7,8]. Patel et al[10] refuted that the use of washer may lead to future need for hardware removal even in athletes; however, there is no consensus to guide the use of washers in younger children.

As discussed in a previously published bone anchor suture repair technique[13], the authors suggest that the use of the proposed suture bridge technique would not require subsequent hardware removal due to irritation, seen with k-wire or screw fixation[15]. PEEK anchors are a nonabsorbable, strong, and radiolucent anchor that retains strength during the critical phases of tissue healing. The biomechanical testing is underway, and we believe that the suture bridge construct will be equal or better in pull out strength than the traditional cannulated screws or bone anchor suture repair. By potentially avoiding the nutrient foramen[18] and with the fenestrated design of the SwiveLocks™, the suture bridge technique can help preserve the natural blood supply of the medial epicondyle and potentially preventing osteonecrosis and nonunion by promoting optimal blood flow. The authors also advocate that this technique can avoid the bone fragmentation and any inadvertent injury to the UCL possible with screw fixation.

Conclusion

In our case, the use of suture bridge technique achieved excellent patient satisfaction, no residual pain, negative physical examination findings, and complete bone healing of the medial epicondyle fracture at 12-week follow-up. He had complete return to full baseball activities, including pitching, by 7 months after surgery. Further studies can evaluate the merits of the described technique as compared to the traditional methods, especially in throwers.

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