Review of Jobe et al (1986) on reconstruction of the ulnar collateral ligament in athletes

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ABSTRACT
This classic examines the landmark publication ‘Reconstruction of the Ulnar Collateral Ligament in Athletes’ by Jobe et al, published in 1986. Dr Frank W Jobe was the first to perform and describe a standard technique for ulnar collateral ligament (UCL) reconstruction with the use of a figure-of-eight configuration and submuscular ulnar nerve transposition to treat throwing athletes with UCL insufficiency. Before Jobe’s pioneering work, the initial operative approach to patients with UCL tears involved repair of the native ligament. Despite this treatment, injuries of the UCL were considered career-ending in those days. The original article describes the surgical technique for UCL reconstruction and the postoperative rehabilitation and outcomes in 16 throwing athletes, including Major League Baseball pitcher Tommy John (Los Angeles Dodgers). Jobe reported good results, with 10 of the 16 patients returning to their previous level of participation in sports, one patient returning to a lower level of participation and five patients retiring from professional athletics due to reasons not related to the operation. However, a high incidence of ulnar nerve complications was reported, requiring secondary surgery in two patients. In the decades following the original publication by Jobe et al, modifications of the Jobe technique, involving different graft choices, tunnel positions, and graft configurations and fixation methods have resulted in improved clinical results. Originally presented as a treatment option for elite athletes only, UCL reconstruction has gained public interest as a standard technique for ulnar collateral ligament (UCL) repair than after non-operative treatment. The medial elbow has to withstand approximately 60 Nm during an average baseball pitch. Although surrounding muscles help absorb the forces on the medial elbow, the UCL approaches its maximum stress during every pitch.15 16 Disruption of the UCL can lead to medial elbow pain and loss of throwing velocity, endurance and control, and may be accompanied by ulnar nerve symptoms and flexor-pronator tendinopathy. Furthermore, insufficiency of the UCL has been suggested to be the underlying cause of a variety of other elbow complaints, including valgus extension overload, a cascade of symptoms with osteochondritis dissecans at the radial side, osteophytes and chondromalacia in the posteromedial compartment, ulnar nerve symptoms, and even risk of proximal stress fractures of the ulna.17

A recent epidemiological study by Ciccottiet al18 indicated that elbow injuries are the fourth most prevalent type of injury in the US professional baseball population (7.8% in Major League Baseball and 9.8% in Minor League Baseball), accounting for the highest number of days missed of all musculoskeletal injuries. In this population, 39%–53% of elbow ligament injuries require surgery, predominantly in pitchers and primarily involving the UCL.18 Epidemiological studies have shown that the number of UCL reconstructions has been rising steadily.19 Disturbingly, there is a marked increase in the number of UCL reconstructions performed in amateur and adolescent athletes in the last decade.14 15 19

INTRODUCTION
Rationale for selecting this article
The classic work by Jobe et al,1 published in 1986, provided a career-saving surgical technique to treat ulnar collateral ligament (UCL) tears in throwing athletes. The index surgery was performed on 23 September 1974 on baseball pitcher Tommy John of the Los Angeles Dodgers. The publication describing this case among 15 others was chosen for this ‘Classic’ because of the epidemic levels of overhead throwing athletes undergoing UCL reconstruction today.2–7

Injuries to the UCL typically occur in the overhead throwing population, especially baseball pitchers and javelin throwers, but can also be found in other athletes, including gymnasts, quarterbacks, tennis players and wrestlers.3 The UCL is composed of three bundles, of which the anterior bundle is the main soft tissue restraint to valgus instability at 20°–120° of elbow flexion (figure 1).5–13 UCL injuries in overhead athletes are considered overuse injuries resulting from repetitive valgus stress during the acceleration phase of the throwing motion.14 The medial elbow has to withstand approximately 60 Nm during an average baseball pitch. Although surrounding muscles help absorb the forces on the medial elbow, the UCL approaches its maximum stress during every pitch.15 16 Disruption of the UCL can lead to medial elbow pain and loss of throwing velocity, endurance and control, and may be accompanied by ulnar nerve symptoms and flexor-pronator tendinopathy. Furthermore, insufficiency of the UCL has been suggested to be the underlying cause of a variety of other elbow complaints, including valgus extension overload, a cascade of symptoms with osteochondritis dissecans at the radial side, osteophytes and chondromalacia in the posteromedial compartment, ulnar nerve symptoms, and even risk of proximal stress fractures of the ulna.17

CONSIDERATION
Historic perspective
The first study on isolated UCL tears was published in 1943 and described UCL injuries in European javelin throwers.20 Although several reconstructive procedures had long been successfully used in ligaments of other joints, such as the knee and ankle, there was no such procedure for reconstruction of a torn ligament in the elbow. Prior to the Jobe publication, UCL injuries were treated either conservatively or with direct suturing of the native ligament.21 22 This ‘UCL repair’ was supported by Barnes and Tullos,23 who reported in 1978 that throwing athletes had better clinical outcomes after UCL repair than after non-operative treatment. Nevertheless, at that time, UCL tears were typically...
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career-ending for athletes.\textsuperscript{24} Unsurprisingly, the utilisation of a tendon graft to reconstruct the insufficient UCL by Jobe \textit{et al}\textsuperscript{1} resulting in the return to professional baseball of Major League pitchers gained significant attention in the public and orthopaedic sports community.

Scientific and societal impact

Evolution of Tommy John surgery

Jobe’s reconstruction technique or ‘Tommy John surgery’ defined a new approach towards the treatment of UCL tears. Although the initial results were already promising, with return to sport in 63\%–68\% of patients, the surgical technique has been optimised over the past 25 years, improving outcomes and minimising associated complications.\textsuperscript{1,25} An important advancement in the surgical technique was the introduction of the muscle-splitting approach to achieve visualisation of the UCL in 1996 by Smith \textit{et al},\textsuperscript{26} eliminating the transection and elevation of the common flexor origin used in the original Jobe technique. Furthermore, this new approach no longer required a submuscular ulnar nerve transposition. Seventy-seven out of 83 athletes (93\%) reported excellent outcomes after performing a muscle-splitting approach, with transient ulnar neuropathy in only four patients (5\%).\textsuperscript{27}

Various subsequent alterations and modifications primarily addressed bone tunnel positioning, graft configuration and fixation, and handling of the ulnar nerve, including the Jobe modification,\textsuperscript{27} American Sports Medicine Institute modification,\textsuperscript{7,28,29} the suture anchor method or hybrid technique,\textsuperscript{30,31} the interference screw or DANE TJ (David Altcheck-Neal ElAttrache Tommy John) technique,\textsuperscript{32–34} and the docking technique\textsuperscript{35–40} (table 1). In turn, there are numerous modifications of the docking technique, mainly focusing on the preparation of the autograft (eg, triple-strand, four-strand).\textsuperscript{39} Many excellent reviews have been published describing the evolution and outcomes of surgical

| Table 1 | Key aspects of modifications of the original Jobe technique for UCL reconstruction |
|---------|--------------------------------------------------------------------------------|
| Modification | Key aspects |
| ASMI modification (1995) | Posterior approach between two heads of flexor carpi ulnaris; elevation of flexor-pronator mass; subcutaneous ulnar nerve transposition |
| Hybrid technique (1998) | Flexor-pronator muscle splitting; humeral and ulnar suture anchors; subcutaneous ulnar nerve transposition |
| Jobe modification (2001) | Flexor-pronator muscle splitting; figure-of-eight graft configuration; no ulnar nerve transposition |
| Docking technique (2002) | Flexor-pronator muscle splitting; triangular graft configuration with a single Y-shaped humeral tunnel; subcutaneous ulnar nerve transposition |
| DANE TJ technique (2006) | Flexor-pronator muscle splitting; humeral docking and ulnar interference screw fixation; subcutaneous ulnar nerve transposition |

ASMI, American Sports Medicine Institute; DANE TJ, David Altcheck-Neal ElAttrache Tommy John; UCL, ulnar collateral ligament.
techniques for UCL reconstruction. Vitale and Ahmad pooled data of clinical series on UCL reconstructions and found that the muscle-splitting approach improved the return to sport from 70% to 87% and reduced ulnar neuropathy from 20% to 6% compared with the flexor-pronator detachment method. Furthermore, they found that the (modified) docking technique improved outcomes from 76% to 90%–95% compared with the original figure-of-eight graft configuration.

Choices of graft include the tendon of the palmaris longus, gracilis, semitendinosus, toe extensor, plantaris, and extensor carpi radialis longus muscle, the triceps fascia and the Achilles tendon. There have been a number of studies on graft choice and graft site morbidity in UCL reconstruction. Currently, there is no evidence for the favourability of one autograft type over another. Hagemeijer et al found that the palmaris longus tendon is the most frequently used graft in elbow ligament reconstruction procedures (58%). However, the use of this tendon is not an option in all patients as the palmaris longus is absent in one-sixth of the world population, with a wide variation among different ethnic groups.

To date, the docking technique and modified Jobe using a palmaris longus autograft are the most commonly performed surgical procedures for UCL reconstruction with high success rates (figure 3). Despite all innovations, Tommy John surgery is still season-ending and requires 12–18 months of rehabilitation.

Rising incidence in UCL reconstructions
In accordance with the increase in the number of participants in overhead throwing sports, there has been an increase in the incidence of upper extremity injuries in the past decades. To date, 25% of Major League pitchers and 15% of Minor League pitchers have had Tommy John surgery at some point in their career. In a recent comprehensive epidemiological study, Ciccottiet al found that 33%–43% of elbow injuries in US professional baseball require surgery, with UCL reconstruction being the most frequently performed procedure. Although no increase in the frequency of elbow injuries was observed over recent seasons in this population, Erickson et al reported a significant increase in UCL reconstructions performed from 2000 to 2012.

Disturbingly, there has been a notable and disproportionate increase in the number of reconstructive surgical procedures performed in elbows of young overhead throwing athletes. The overall number of UCL reconstructions performed between 2003 and 2014 has increased by 343%. In 2014 alone, more pitchers had undergone UCL reconstruction than in the entirety of the 1990s, and the rate of adolescent players undergoing surgery has been rising from none in the early 1990s to more than 40% in recent years (figure 4). The incidence of elbow pain in baseball players ranges from 20%–30% in players aged 8–12 years old, to 45% in those aged 13–14 years old, and over 50% in high school, collegiate and professional athletes. Currently, 57% of Tommy John surgeries are performed on athletes aged 15–19 years old.

The rise in incidence of UCL reconstructions has become a hot topic in recent years, especially in the USA. As the amount of competitive pitching and pitching when fatigued are strong risk factors associated with UCL injury, it is likely that pitching too hard, too fast, too much and too soon are major contributors to this phenomenon. The influence of the widespread use of radar guns by talent scouts and the prospect of college scholarships (that provide an opportunity to secure a higher socioeconomic status in the US educational system) may be underexposed in current literature, pushing young athletes to their limits.

Determining the age and competitive level that define early sport specialisation is challenging, and conclusive evidence linking early sport specialisation to injury is lacking. Nevertheless, it has been stated that the increase in year-round baseball has led to the ‘skyrocketing’ rate of UCL injuries in young baseball players. This idea initiated the institution of age-related pitch count recommendations by USA Baseball in 2008. It is difficult to determine whether these recommendations are inadequate or that there is a lack of compliance, but UCL injury rates have nonetheless continued their steady increase. A cross-sectional study of 754 youth and adolescent pitchers (9–18 years) showed that 45% had no pitch count in place and more than 13% pitched more than the recommended 8 months per year, suggesting the possibility of a lack of compliance. Further research is needed to determine the long-term effects of early single sport specialisation and define ranges of ‘healthy’ single sport specialisation in different types of sport.

A third factor that has been suggested for the disproportionate rise in UCL reconstructions is the occurrence of ‘false’ public perceptions of Tommy John surgery among athletes, coaches, parents and the media. Ahmad et al noticed the increasing
number of uninjured young throwers who presented at their clinic for medical evaluation, seeking UCL reconstructive surgery, and hypothesised that the general public has misguided perceptions regarding the causes of UCL injury and the indications, operative technique, risks, benefits and required rehabilitation. They found that over 25% of baseball coaches, players and parents do not believe that pitch count is a risk factor for elbow injury. In the same study, and arguably most importantly, 30% of baseball coaches, 37% of parents, 51% of high school athletes and 26% of collegiate athletes believed that UCL reconstruction in athletes without elbow injury would improve performance (figure 5). In 2015, Conte et al performed a similar study to examine the media’s perception regarding UCL injury treatment. One in four respondents believed the primary indication for UCL reconstruction was performance enhancement, and 20% felt that throwing velocity increased compared with presurgery velocities. No studies have truly demonstrated performance above preinjury level after Tommy John surgery, but did report the ability to return to the same level of performance after surgery.

Current evidence as related to the original article
Outcomes and revision surgery
Reported success rates of UCL reconstruction, defined as a patient being able to return to his or her previous level of sport, consistently range between 80% and 90%. In a 10-year follow-up study on long-term outcomes in competitive baseball players, Osbahr et al indicated a return to throwing in 4.2 months and return to game competition by 11.6 months. Furthermore, they found that most patients are satisfied, with few reports of persistent elbow pain or limitation of elbow function during activities of daily living. Overall complication rates range from 10% to 15%, with ulnar nerve paresthesias averaging at 6%. Systematic reviews have suggested that the docking technique may have the lowest complication rate and a higher rate of return to play relative to other techniques, but these differences are not statistically significant.

Although excellent results can be expected in most patients who undergo primary UCL reconstruction, less is known about revision reconstruction of the UCL. Incidence of revision surgery has been found to range between 13% and 15%. Dines et al provided a clinical report on the postoperative outcome of revision UCL reconstruction in a series of 15 baseball players in 2008. Only five patients (33%) were able to return to their previous level of competition for at least 1 year. The complication rate was high (40%), with two of the complications being major (retnear of the revision graft and loss of motion requiring release of adhesions). Interestingly, the rate of ulnar nerve complications was similar to that observed for primary UCL reconstruction. Marshall et al compared 33 Major League pitchers who underwent revision UCL reconstruction with 33 age-matched controls, and found a low rate of return to sport (66%) and shortened careers after return to sport (minus 0.8 years). Although various statistics of performance (earned run average, walks/hits per innings pitched) were maintained, pitchers returned with a significantly decreased workload, that is, number of innings pitched. Liu et al recently presented similar results in a retrospective analysis of publicly available Major League data.

No difference has been found in workload between pitchers who did and pitchers who did not require revision surgery after UCL reconstruction, except for total pitch counts, which were lower for the pitchers who required revision surgery. In addition, pitchers who required revision surgery underwent primary reconstruction at an earlier age and had less Major League experience. In a different study, comparing a group of pitchers who underwent primary UCL reconstruction and subsequently required revision surgery with a group of pitchers who did not require revision surgery, the revision group was observed to pitch at or above their preprimary UCL reconstruction workload, whereas the non-revision group pitched significantly less (ie, below their preprimary UCL reconstruction workload).

New developments and the revival of primary UCL repair
As UCL reconstruction is reaching its full potential as a surgical intervention, current research is focusing on alternative interventions for UCL injuries to further improve outcomes and decrease time to return to play. Recent developments include the utilisation of orthobiologics and advanced UCL repair methods, including internal bracing.

The use of biologics to stimulate and enhance tissue healing has garnered increasing attention in sports medicine. Platelet-rich plasma (PRP) is an ultrafiltrate of autologous blood with high concentrations of platelets, resulting in an increase in the number of growth factors. These growth factors theoretically act as chemotactants involved in cell proliferation and immune cell regulation, having the ability to stimulate endothelial growth and angiogenesis. Numerous studies have demonstrated the ability of PRP to heal damaged tissue, including medial collateral ligament injuries of the knee, elbow tendinitis and Achilles tendon tears. Podesta et al recently reported the clinical outcomes of 34 patients undergoing a single PRP injection for partial UCL tears and concluded that PRP is a viable and safe option for young athletes, older recreational athletes or
in-season professional athletes with partial tears who do not want to undergo a season-ending UCL reconstruction. They reported promising results, with return to play in 30 athletes (88%) at an average of 12 weeks after injection. In addition, significant findings were noted for improved clinical outcomes and decreased medial joint space opening to valgus load. Recently, Dines et al. reported successful results using PRP injections for partial tears in competitive throwing athletes. Further research on dosage, number and timing of injections, composition of the ultrafiltrate, ultrasound guidance for injection, and clinical comparison with placebo treatment is needed.

Due to the success of the UCL reconstruction technique, relatively little has been published on UCL repair. From a global perspective, UCL repair provides an interesting treatment option, as a substantial amount of UCL injuries outside of the USA does not involve the poor quality native ligament tissue that is generally observed in baseball pitchers. Although UCL repair has initially been reported to lead to suboptimal results with a return to sports rate of 71%, in some patients, this treatment option may offer similar results as UCL reconstruction, with the advantage of a shorter rehabilitation time. Dugas report that the UCL reconstruction technique is currently applied in patients with a wide range of UCL pathology—from partial undersurface tearing to complete disruption of the ligament—and that there may be a place for UCL repair in athletes with less structural pathology to the ligament, for example, avulsion-type injuries in young athletes or acute hyperextension-valgus trauma in wrestlers and other contact sports.

Outcomes of UCL repair in young patients with avulsion injuries have been described by Savoie et al. with good to excellent results in 93% of patients. Biomechanical evidence of UCL repair using the InternalBrace (Arthrex) showed significant improvement of joint stability, with less joint line gaping on the medial side of the elbow compared with the modified Jobe technique. This technique may therefore be a viable option for the treatment of end avulsions and partial thickness injuries, with a more rapid return to competition compared with UCL reconstruction. In a 2017 systematic review, Erickson et al. reviewed the literature surrounding UCL repair and determined the viability of new repair techniques for the treatment of UCL tears, reporting an overall return to sports rate of over 87% within 6 months after primary UCL repair. Clinical studies evaluating UCL repair with internal bracing in patients from different disciplines compared with UCL reconstruction procedures are necessary before definitive recommendations can be made.

Conservative treatment of UCL injuries

Although literature on this topic is sparse, there is evidence that UCL injuries may be successfully managed with rehabilitation, especially when involving acute, partial, traumatic UCL tears in non-throwing athletes. In general, conservative treatment should be exerted before considering surgical intervention in incomplete UCL tears. Conservative treatment typically consists of early management of pain and inflammation and gradual increase of elbow range of motion, followed by a progressive strengthening programme including the elbow, trunk and shoulder musculature. The final phase of rehabilitation emphasises dynamic strengthening of the upper extremity and includes an interval throwing programme.

Ford et al. assessed the correlation between return to play rates following non-operative treatment and radiological findings on MRI in professional baseball players with UCL injuries and found a return to sport rate in players with incomplete UCL injuries of 84% (26/31). In 2001, Rettig et al. reported a significantly lower success rate with only 42% (13/31) of overhead athletes returning to their previous level of sport after following a supervised rehabilitation programme, with no significant difference between acute injuries and injuries with an insidious onset.

The lessons learned

The introduction of the UCL reconstruction technique in 1986 may be one of the most successful orthopaedic inventions of the 20th century. Without this procedure, the careers of overhead throwing athletes are at high risk to come to an abrupt and premature end. After 30 years of alterations and modifications, the surgical procedure for UCL injuries appears to have reached its full potential. However, one in five pitchers still do not make it back to their previous level of sport after undergoing reconstruction of the UCL. To improve outcomes of elbow injuries in overhead athletes, our emphasis should be on primary and secondary prevention, evidence-based rehabilitation and the development of individualised return-to-play criteria for the upper extremity.

The notable increase in medial elbow pain, UCL injuries and UCL reconstructive procedures performed in young overhead athletes over the past decades is especially worrisome because of our lack of knowledge about long-term outcomes after surgical intervention. The durability of the autograft is unknown and current numbers of reinjury of the UCL after reconstruction are relatively high. With an increasingly young population undergoing UCL reconstruction, the absolute number of athletes who suffer reinjury of their elbow requiring secondary surgery is expected to rise substantially over the coming decades, with uncertain consequences for their careers.

Supraphysiological high forces at the level of the medial elbow are probably inevitable when performing an overhead throwing motion, and we may consider ‘throwing a couple dozen (sub)maximal pitches in a short period of time’ as unnatural behaviour. Therefore, a certain amount of wear and tear of the medial structures of the elbow may be unavoidable in overhead throwing athletes. More than throwing velocity and pitch count, it may be the allowance of sufficient time to recover that is paramount to prevent permanent and irreversible damage to the UCL. It may well be that it is this factor (‘rest’) that is abused in young athletes to date, leading to early structural changes of the UCL, resulting in increased vulnerability to tearing of the UCL. Parents, coaches, trainers and medical professionals should be aware of the necessity of rest and enforce healthy recovery behaviour in their throwing children, pupils and patients.

ADDITIONAL EXPERT OPINION

We asked two leading orthopaedic surgeons and authorities in the field of elbow injuries, Dr James R Andrews (Gulf Breeze, Florida, USA) and Prof. Dr Roger van Riet (Antwerp, Belgium), for their opinion on the current ‘epidemic’ of UCL injuries, return to sport decision-making, the development of novel treatment modalities and preferred surgical technique for UCL reconstruction. The full interviews are attached to this article as online supplementary material 1.

CONCLUSION

A combination of urgency, limited alternatives and desperation led to the experimental surgical procedure performed on the elbow of pitcher Tommy John in September 1974 by the late
Dr Frank W Jobe (1925–2014). This invention incited a new era in professional baseball and sports medicine, as tearing of the UCL was no longer career-ending. Nowadays, UCL reconstruction surgery saves many careers, with success rates higher than 80%, allowing athletes from different levels of sport to keep up their level of play. However, rehabilitation after primary UCL reconstruction still requires up to 18 months and revision surgery is performed in approximately 15% of patients. Furthermore, the incidence of medial elbow complaints and the number of performed UCL reconstructions are rising, especially in young amateur and adolescent athletes. An increased workload at younger age (increasing throwing velocities, early single sport specialization and socioeconomic incentives to maintain performance) as well as false public perceptions regarding UCL surgery may be contributing factors. This worrisome trend requires attention and supports research into primary prevention, early detection and conservative treatment of elbow injuries.

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**James R Andrews, MD**

A major reason that we are seeing more UCL injuries than ever is the fact that athletes are getting bigger, taller, and faster and that their tremendous muscle development overdoes their ligament development. In other words, when they are high school seniors, they are often throwing 90 miles per hour (MPH) and their UCL is not ready to take that kind of high stress. Research that we have done at the American Sports Medicine Institute indicates that the ‘redline’ of the UCL in high school is around 80 MPH and anything over 85 MPH becomes suspect. The UCL is a developmental ligament and gets stronger with throwing and gradual applied stress until the age of 26. Because of the emphasis on the radar gun and velocity in high school, we are seeing a markedly increased number of these kids with UCL injuries. The largest number of UCL reconstructive surgeries used to be in the professional ranks at the Major Leagues. The next level was the Minor Leagues, then college, and the least in elite high school players. Nowadays, the high school players are the largest group with UCL injuries over all the other groups, including the Major League players.

Unfortunately, I do not see this trend stabilizing. Although a lot of work is being done relative to prevention, it falls upon deaf ears and very little change is being done to the culture associated with youth baseball. There has been a lot of work done at the professional level trying to minimize the stresses across the elbow and to decrease fatigue, which hopefully will help diminish the injuries that we see at the professional level. Further follow-up will be the only way to bear this out. Hopefully, we will be able to gradually get control of this epidemic rise of UCL injuries at all levels of baseball, but as of right now it is still only hope.

I think the big thing that we want to know is how we can enhance the biological healing properties of a UCL reconstruction using an autogenous graft. If we can do that, perhaps research will show that we can use an allograft. By using stem cell therapy, we might be able to get the cadaver grafts to heal as well as an autograft. In the meantime, we are all looking for means to get these athletes well quicker and get them back into their sport, so they don’t miss a whole season and perhaps – in some cases – two seasons. That research is still underway and as of this writing, we do not have any clear basis to make any claims relative to biologic healing enhancement using stem cell therapy at the time of the surgical procedures. Its use does however appear promising.

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**Roger van Riet, MD PhD**

The rising incidence of UCL reconstructions performed in young overhead athletes is a complex matter. Significant pressure is placed on young athletes to perform at a high level at a young age and return to sport as soon as possible once an injury has occurred. I do not expect a similar trend in UCL injuries in Europe, as overhead sporting activities are less high profile when compared to the US. An additional reason to pursue aggressive treatment for young athletes in the US may be that a scholarship for a future college degree is on the line, while sports are not a way to get a college education in most European countries. This means that there is much less pressure on timing of surgery. Many patients do well with conservative treatment if symptoms are detected early and patients get optimal treatment. A large portion of young athletes may avoid surgery with prolonged conservative therapy if they are allowed to invest the time it takes.

My preferred technique for UCL reconstruction depends on the sport of the patient and the mechanism of injury. Athletes with extreme valgus forces on their elbow, such as javelin throwers, often have an acute-on-chronic mechanism. In these patients, there is a degenerative tear or avulsion with poor quality remaining tissue. The ligament needs to be reconstructed as strongly as possible. My preferred graft is an extensor hallucis longus allograft, as it is very predictable with respect to strength, length, and width and avoids any co-morbidity that may occur from harvesting an autograft. The medial elbow is approached through a flexor split and the ulnar nerve is released but not transposed. The graft is pulled through an ulnar tunnel and fixed with a modified docking technique in a narrow humeral tunnel under maximal tension. The graft is sutured to itself and to any remaining UCL tissue. The flexor split is closed and sutured to the graft as well.

In chronic injuries without acute onset (and failure of conservative treatment) the remaining tissue is insufficient and needs strengthening. This is relatively common in professional tennis players. In these patients, I have developed a different approach to decrease the time to return to sport. The same flexor split is used, but the ulnar nerve is not released and no bone tunnels are used. Instead 1.4 all-suture anchors are placed in both the humeral and ulnar UCL insertion. The extensor hallucis longus graft is folded over the remaining UCL, typically using a three or four strand reconstruction depending on the thickness of the graft. The graft is fixed firmly at the humeral anchor and tensioned using the humeral sutures. The native UCL is imbricated and sutured to the graft. Sutures of both ulnar and humeral anchors are then tied together as a non-biological reinforcement of the reconstruction. Finally, the flexor split is closed and sutured to the graft.
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