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Prevalence and clinical outcomes of heterotopic ossification after ulnar collateral ligament reconstruction

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Background: Ulnar collateral ligament (UCL) reconstruction has become increasingly popular in elite athletes. However, the prevalence of heterotopic ossification (HO) formation after UCL reconstruction has not yet been reported. We sought to determine the prevalence of HO formation after UCL reconstruction and the clinical outcomes following HO treatment.

Materials and Methods: From October 2005 to April 2014, 179 patients underwent primary UCL reconstruction. Of the 179 patients, 161 with a minimum of 2 years of follow-up were retrospectively reviewed to evaluate HO formation and clinical outcomes.

Results: Among 161 patients, HO was detected in 8 cases (5%). Of these 8 patients, 2 were asymptomatic and another 2 complained about transient ulnar neuropathy. The remaining 4 patients had pain; 2 were treated with open excision, and 1 underwent arthroscopic excision. The odds of HO in patients in whom transient ulnar neuropathy develops after UCL reconstruction are 6 times higher than those without transient ulnar neuropathy (odds ratio, 5.957; 95% confidence level, $P = .04$). Of the 8 patients, 7 returned to the same level or a higher level of competition. HO was found, on average, 5 months (range, 3-9 months) after UCL reconstruction.

Conclusion: The prevalence of HO formation was approximately 5% after UCL reconstruction and increased with transient ulnar neuropathy. After UCL reconstruction, the surgeon should carefully observe HO formation, especially in the early stages after the operation. With appropriate treatment, the clinical outcomes of HO treatment after UCL reconstruction are favorable.

Institutional review board approval was obtained from Konkuk University Medical Center (reference No. KUH1060133).

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The anterior bundle of the ulnar collateral ligament (UCL) is the main stabilizer to valgus stress at the elbow.[8] Many athletes, especially throwing athletes, often undergo UCL injuries during competition or training,[14] and repetitive valgus force aggravates UCL injuries.[8,11,12]

UCL injury was first described among throwing athletes in 1946 by Waris.[20] UCL reconstruction was first reported by Jobe et al[10] in 1986 and was initially performed on the baseball pitcher Tommy John in 1974, providing injured athletes with the possibility of avoiding a career-ending injury. Currently, hundreds of athletes, especially baseball pitchers, have undergone UCL reconstruction, also known as Tommy John surgery.[1]

Public opinion on UCL reconstruction is that the surgical procedure may enhance performance. According to Cain et al,[3] after UCL reconstruction, 610 of 743 players (83%) returned to the previous level of competition or higher. However, various complications have also been reported. Initially, Jobe et al[10] reported a greater than 50% complication rate including 4 reoperations. In the largest series examined to date, Cain et al reviewed 1266 UCL reconstruction cases and reported a complication rate of approximately 20%. Other authors have reported complication rates ranging from 0% to 10%. Reported complications included UCL failure, stiffness, ulnar tunnel failure, superficial infection, medial epicondyle fracture, and so on. The most frequently reported complication is ulnar neuropathy. However, most previous studies did not examine heterotopic ossification (HO) formation. Kodde et al[13] reported a single HO complication among 20 patients following UCL reconstruction with an interference screw.[10,13,17,18,21]

A recent study by Andrachuk et al[2] reported symptomatic HO after UCL reconstruction. They reviewed 1420 patients who underwent UCL reconstruction from 2002 to 2012 and found 8 patients with HO. The purpose of our study was to evaluate the prevalence and clinical outcomes of HO formation after UCL reconstruction.

Materials and methods

This is a case-series study with no comparison group. A study population was recruited through a retrospective review of our database system. Subjects who underwent UCL reconstruction performed by 1 senior author (J.-Y.P.) from October 2005 to April 2014 were included in the analysis. Patients with previous elbow surgery, such as revision UCL reconstruction or arthroscopic olecranon trimming, were excluded. Among 179 patients who underwent primary UCL reconstruction between 2005 and 2014, 18 patients with less than 2 years of follow-up were excluded. Finally, 161 patients with a minimum of 2 years of follow-up were left for analysis.

The operation was performed via the flexor-pronator muscle-splitting approach, combined with a modified docking technique. We routinely used contralateral palmaris longus autograft; gracilis autograft was only used when the palmaris longus tendon was not present (4 cases). None of the patients were given indomethacin after surgery.

The elbow was maintained in a hinged brace at 60° of flexion with the forearm in a neutral position for 6 weeks, at which point passive range-of-motion (ROM) exercises began. The brace was set to allow 30°-100° ROM for 3 weeks. After 9 weeks, full ROM exercise was permitted with the arm in the brace. The brace was worn for 12 weeks postoperatively, at which time the athletes began a strengthening exercise program. An interval throwing program was initiated 4 months after the operation. At 6 months after surgery, the athletes began to pitch at half of their previous velocity and anticipated a return to preinjury levels of competition after 9-12 months.

All postoperative images were reviewed to detect HO formation. In our institution, routine postoperative images are obtained to determine the postoperative state and to examine bone tunnel enclosure. Routine radiographic images (anteroposterior, both oblique and lateral) are obtained at 3, 9, 12, 18, and 24 months after the surgical procedure. In addition, in the case of patients with suspected HO formation on radiographs, a 3-dimensional computed tomography (CT) scan was performed to confirm it.

After patients with HO were identified, their charts were reviewed to determine the type of graft used, as well as their age and sex, ROM, clinical score (Mayo Elbow Performance Score), symptoms, time at which HO formation was found, method of treatment, and any procedure performed for the treatment of HO. Return-to-play information was also reviewed on charts and by personal contact via telephone. Images were reviewed to determine the location of the HO. Regarding the observed HO formation site, HO location was categorized as medial, posteromedial, or posterolateral (Fig. 1).

For statistical analysis, the Mann-Whitney U test was used to compare age, body mass index, and operation time between the HO and non-HO groups. The odds ratio and 95% confidence interval according to ulnar neuropathy between the 2 groups were calculated by the Fisher exact test. Statistical analysis was performed using SPSS software (version 20.0; IBM, Armonk, NY, USA). All tests were analyzed with a 95% confidence level. The level of significance was set at $P < .05$.

Results

Among 161 patients reviewed, 8 showed HO formation (5%), which was confirmed by 3-dimensional CT. All patients were male patients, with a mean age of 16.5 years (range, 14-19 years). All patients are baseball players (5 pitchers, 1 catchers, 1 infielder, and 1 outfielder) at either the collegiate (n = 2), high school (n = 5), or middle school (n = 1) level. Seven