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# 수근 주상월상인대 손상이 있는 농구 선수에서 주상월상인대 재건술 후 정상 훈련 복귀를 위한 스포츠 재활운동

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# Wrist Rehabilitation after Scapholunate Interosseous Ligament Reconstruction for a Collegiate Basketball Player

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For a basketball player who had scapholunate interosseous ligament injury related to sport, it is crucial to secure the active range of motion (ROM) and regain proprioception of the wrist. The player was involved in a 21-week rehabilitation procedure based on controlling pain with inactive treatments, restoring the wrist ROM with active treatments. We measured the visual analog scale (VAS) for pain, upper extremity functional outcome measurement (Disabilities of Arm, Shoulder, and Hand [DASH]) for the functionality, and active ROMs of the wrist. The VAS was decreased (after surgical treatment, 8.7; 1 week, 2.5; 12 week, 3–5; 21 week, 0). The DASH score was decreased when he returned to play (after surgical treatment, 78; end of the rehabilitation, 23). Wrist flexion and extension ROM were increased to 55° and 67°, respectively. To restore the function of the wrist for basketball performance, improvement of active ROM and proprioception is the primary goal to return to play.

**Keywords:** Ligament, Mobility, Proprioception, Wrist

## Introduction

Scapholunate interosseous ligament (SLIL) injury as a basketball player is fatal since basketball is a game that uses hands to score. During the basketball game, wrist injury (5.2%) is very common enough to rank next to the ankle injury (17.9%) among all injuries[1]. The wrist joint is the most crucial joint for a basketball player as it is the joint used when making the correct passes and shots.

The SLIL rupture is the most common cause of instability of the wrist. It usually occurs with the wrist hyperextension, ulnar deviation, and intercarpal supination while falling on an outstretched hand on the ground. It has been reported that progressive degenerative arthritis could occur if the diagnosis

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or treatment for the injury is not provided, and eventually leading to scapholunate advanced collapse[2]. To minimize decreasing mobility and function on the wrist, the range of motion (ROM) and proprioceptive exercise is mandatory.

Despite facts[3,4] that many SLIL injuries have occurred in soccer, ice hockey, gymnastics, volleyball, and other sports, there is lack of report to address the process of rehabilitation (inactive treatment and active treatment) for management of the wrist injury. Here, we reported one case of a collegiate basketball team player who was treated with proper interventions for acute SLIL injury.

## Case Report

A 20-year-old right-hand dominant male forward player sustained an injury involving the right wrist while making a defense. The player presented with severe pain following a fall on his outstretched palm during the game. The player denied prior injury involving the wrist. We observed diffused dorsal wrist swelling and tenderness to palpation over the scapholunate joint. The ROM of the wrist was limited in all planes. In addition, on anterior-posterior plain film of the wrist, there was the presence of dissociation (uninvolved, 4 mm; involved, 5 mm) between scaphoid and lunate "Terry-Thomas sign" (a scapholunate interval of >2 mm is suspicious and >4 mm is virtually diagnostic for scapholunate instability)[5]. Lateral radiographs showed the long axis of the scaphoid lies at a normal scapholunate angle (55.5°; normal angle range, 30°–60°) (Fig. 1A).

We analyzed hospital records, X-rays, electronic databases including all the contents of the surgical treatment, image files (including before and after surgical treatment and follow-ups). The player completed the consent form before participating in this study. All study procedures complied with the Helsinki Declaration. The postoperative clinical evaluation was measured a 10-cm visual analog scale (VAS) to check pain levels both at rest and during sports activities, active ROM using goniometer, and functional outcome measurements for the upper extremity (Disabilities of Arm, Shoulder, and Hand [DASH]). The game records such as game time and success rate of 2-points shot were compared to before injury. The time of rehabilitation ranged from week 1 to week 22 postoperation.

For surgical treatment methods, the scapholunate joint was stabilized through open reduction, pinning (preoperation wrist) (Fig. 1B), mini anchors 1.0 mm, Juggerknot soft anchors (Fig. 1C) and Berger capsulodesis procedure. Pins were removed at the following 8 weeks after surgical treatment.

For inactive treatments, the player was provided four therapeutic modalities for controlling pain such as moisture heat pack (time, 30 minutes), paraffin bath (10 layers; time, 15 minutes), ultrasound (time, 7 minutes; frequency, 3 MHz; duty cycle, continuous; intensity, 1.0 W/cm$^2$; Intelect TranSport, Chattanooga Medical Supply, Chattanooga, TN, USA), and electrical stimulation (trans-cutaneous electrical neural stimulation [TENS]; a continuous asymmetric biphasic square-pulse wave with a pulse width of 120 ms and a pulse rate of 180 Hz; Intelect TranSport, Chattanooga

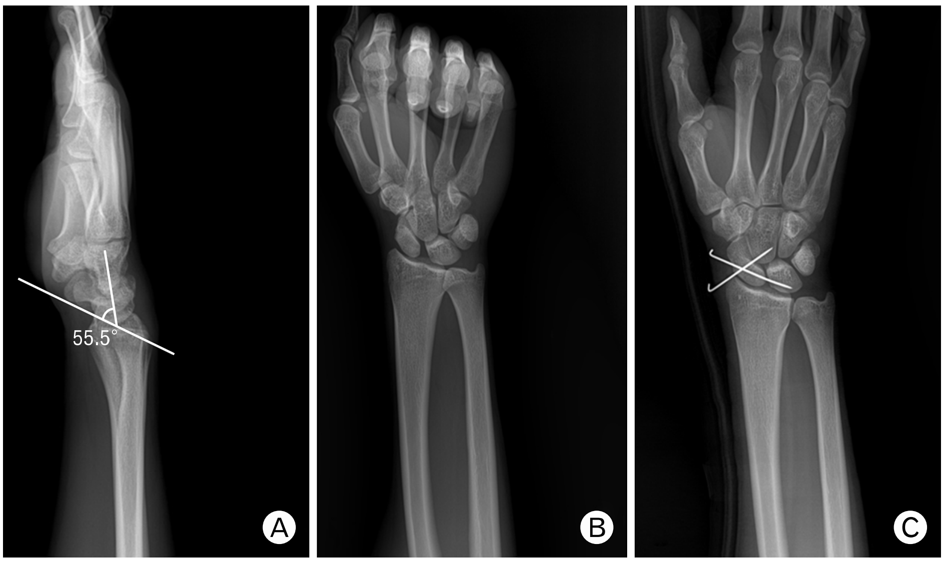


Fig. 1. (A) Lateral X-rays showing a scapholunate angle of 55.5°. (B) Preoperative X-rays showing scapholunate instability. (C) Postoperative X-rays showing reduction and pinning of the scapholunate interval (Juggerknot soft anchors).

Medical Supply) from week 12 to week 15 (Table 1).

For active treatments, the initiate exercise to give a load to the fingers was delayed to week 10 after surgical treatment (Table 1). On the first stage of rehabilitation, continuing to improve edema and pain with therapeutic modalities, ROM exercise was performed actively and passively with using friction massage (time, 5 minutes) and active release technique (ART; time, 5 minutes) (Fig. 2)[6]. The initial exercise for forearm muscles such as isometric finger flexion and extension was started with casted on the day after the surgical treatment. The player performed the mirror therapy (time, 1 minute; 10 repetitions [6-seccond hold each repetition]; 3 sets) that an exercise that moves along the uninvolved wrist while watching the movement of the involved wrist on the mirror on the second stage of proprioception awareness rehabilitation. By the third and fourth stages of a proprioception rehabilitation program, the player performed the same exercise as the joint position sense test (time, 1 minute; 10 repetitions; 3 sets) to improve the kinesthesia of the wrist. The rhythmic stabilization and reactive muscle activation were initiated to facilitate re-education and strengthening of the wrist stabilizer

**Table 1.** Summary of therapeutic interventions

| Aim | Parameter, dosage, duration |
|---|---|
| Pain | Inactive treatment |
| | TENS |
| | 20 Minutes; 100 pps; phase duration, 100 $\mu$s |
| | US |
| | 7 Minutes; around the scapholunate joint; 50%–100%, 3 MHz, 0.7–1.0 W/$cm^2$ |
| | MHP |
| | 20 Minutes |
| | Paraffin bath |
| | 10 Layers; 15 minutes |
| | Cryotherapy with CWI or ice bag |
| | 20 Minutes |
| ROM | Inactive treatments |
| | Friction massage+ART with wrist flexion & extension |
| | 5–7 Minutes |
| | Joint mobilization |
| | Grade I & II for radiocarpal joint; 5–7 minutes |
| | Active treatment |
| | Mirror therapy |
| | Active movement; 15–20 reps×4–5 sets |
| | PNF with D1 & D2 assisted movement |
| | 15–20 reps×4–5 sets |
| Strength | Active treatment |
| | PNF with D1 & D2 active movement |
| | Manual emphasizing concentric phase; 18–20 reps×4–5 sets |
| | Rhythmic stabilization exercise |
| | Manual emphasizing eccentric phase; 18–20-reps×4–5-sets |
| | Power web and soft ball exercise for conscious finger stabilizer |
| | 18–20 reps×4–5 sets |
| | Tower curl and DTM with medicine ball, and finger pushup for wrist and finger strength |
| | 12–15 reps×4–5 sets |
| | Gyroscope and body blade exercise for unconscious neuromuscular wrist and finger strength |
| | 30–40 Seconds×4–5 sets |
| Function | Active treatments |
| | Dribbling drills with ladder & cone for sports specific training |
| | 40 Minutes |
| | Shooting |
| | 200 reps×3–4 sets |

TENS: transcutaneous electrical nerve stimulation, pps: pulse per second, US: ultrasound, MHP: moisture heat pack, CWI: cold water immersion, ROM: range of motion, ART: active release technique, reps: repetition, D: diagonal, PNF: proprioceptive neuromuscular facilitation, DTM: dart throwing motion.

for the fifth stage of conscious neuromuscular rehabilitation on week 17. In addition, the player performed isometric exercise finger and wrist curl using power web, ball squeeze, and dumbbell. Wrist stabilization exercise with the body blade exercise was performed as conscious and unconscious neuromuscular exercise to develop the neuromuscular motor control on week 19.

The VAS for perceived pain was decreased (after surgical treatment, 8.7; 1 week, 2.5; 12 week, 3–5; 21 week, 0) at the period of returning to play (RTP). The DASH score was 78 at week 1 after the operation. Through 21 weeks of rehabilitation, the DASH score was decreased 75% (23 points) compared to week 1 at the end of the rehabilitation. When he returned to play, active ROM of the wrist in all planes was increased: extension (82%; involved, 66.7$^{o}$, uninvolved, 81.8$^{o}$) (Fig. 3A), flexion (81%; involved, 54.8$^{o}$; uninvolved, 67.8$^{o}$) (Fig. 3B), ulna deviation (90%; involved, 50.6$^{o}$; uninvolved, 56.3$^{o}$) (Fig. 3C), and radial deviation (96%; involved, 5.5$^{o}$; uninvolved, 5.7$^{o}$) (Fig. 3D). There was no difference between the overall game time (before injury, 2 hours and 25 minutes; after RTP, 2 hours and 20 minutes) and success rate of 2-point shot compared to before the injury (before injury, 24/45 [55.5%]; after RTP, 20/35 [57.1%]).

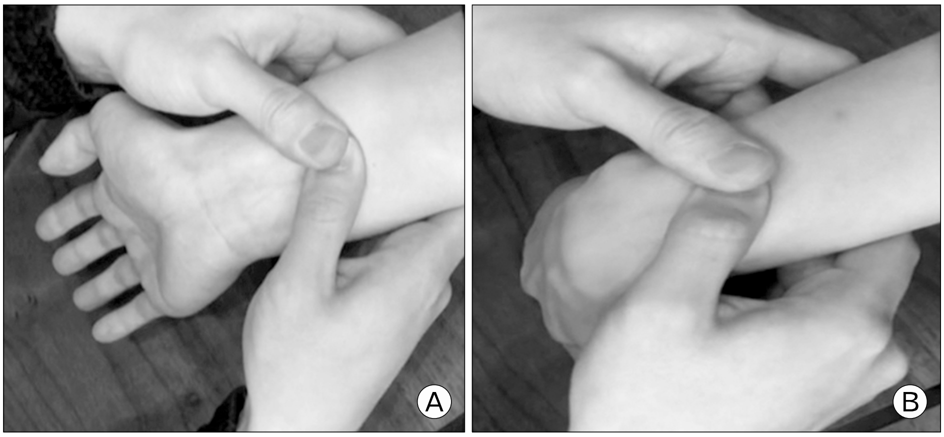


**Fig. 2.** (A, B) Active release technique for active range of motion.

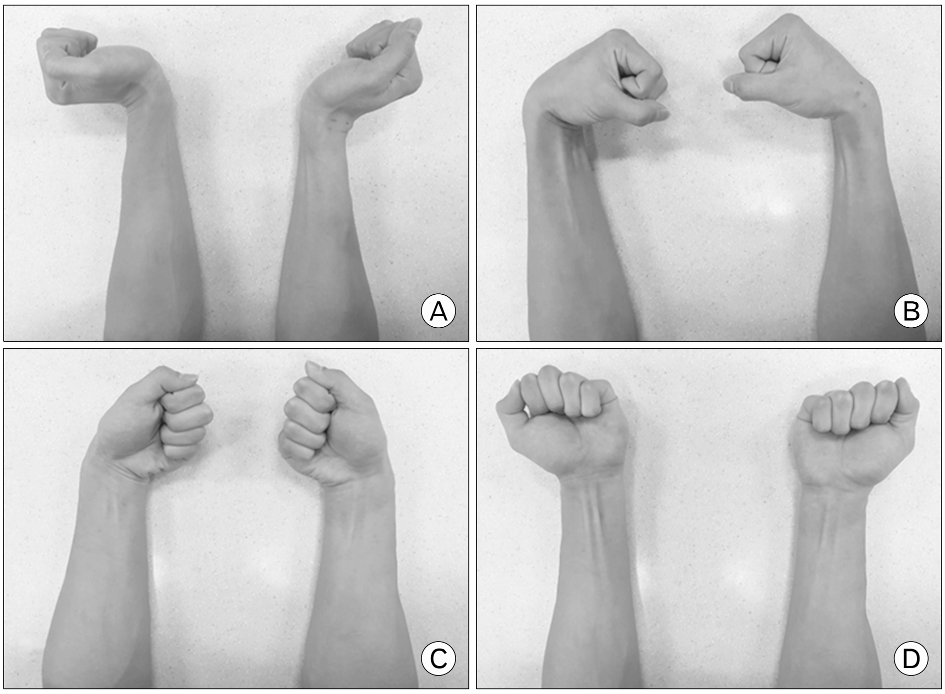


**Fig. 3.** Active range of motion of the wrist in all planes. (A) Extension. (B) Flexion. (C) Ulna deviation. (D) Radial deviation.

## Discussion

Once SLIL is injured, the wrist would have pain, lack of ROM, and instability[1]. As a shooter in basketball, highly maintenance of controlling pain, active ROM, and the proprioceptive function on the wrist is the key factor. The VAS for perceived pain right after surgical treatment was increased up to 8.7 and then gradually decreased down to 2.5 after week 1. Mild to moderate pain (3 to 5 out of 10) was occurred during middle phase of rehabilitation. When the player returned to play, the VAS for perceived pain was 0 out of 10. We used therapeutic modalities for controlling pain and regenerating tissues as inactive treatments. To relieve pain on wrist, TENS was primarily used as an inactive treatment. TENS provides symptomatic pain relief by stimulating sensory nerves either the pain-gate mechanism or the opioid system[7]. Other thermal therapies such as moisture heat pack, paraffin bath, therapeutic ultrasound, and manual therapy were used. Those thermal therapies has a thixotropic effect that changed its structure to become more fluid that provides tissue reorganization with facilitating blood circulation[8].

The player regained over 80% on the all planes of ROM in this case. We used friction massage and ART for regaining active ROM. Previous studies stated that ART is beneficial for joint pain and ROM[6]. Especially, ART is beneficial to increase hamstring flexibility and ROM[9]. Soft tissues that connect the myofascial meridians from the wrist to the shoulder need direct stimulation to have elasticity and rearrangement of tissues[10]. The most priority for basketball player after wrist surgical treatment is to secure the full functional ROM. However, optimal stiffness and stability in the wrist joint as a congruent joint is very important to maintain healthy joint condition as a player. For standard free throw shooting in basketball, an active ROM of 50$^{o}$ of extension and 70$^{o}$ of flexion in the shooting hand is required[2]. We suggest that the ability to sports performance such as an accurate pass and shooting skills is expected enough with over 80% of active ROM.

We provided proprioceptive facilitation exercises as active treatments for development of motor control in progressively. The SLIL plays a role in stabilizing the scapholunate joint by suppressing the separation of the joint in the wrist flexion and extension. It also provides critical proprioceptive input, which is involved in the dynamic wrist stability[11]. Proprioception provides both conscious and unconscious kinesthesia of joint motion. Primary sensory nerve ending located in SLIL is the Ruffini ending that directly linked to muscle activation. Instability after torn SLIL with the presence of mechanoreceptors would involve a convulsion of proprioception[12]. Previous studies[10,13] reported that sensory-motor technique such as proprioceptive neuromuscular facilitation could improve pain, neuromuscular control, and mobility in patients with wrist injury. Other study reported that improvement of proprioception should be based on strength[14]. Improvement of controlling pain, active ROMs and function is the primary goal to return to play. Therapeutic modalities facilitated the healing process for tissues. Eighty percent of improvement on active ROMs needs to perform as a shooter. Players could avoid injuries by increasing proprioceptive capability.

## Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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## References

1. Zuckerman SL, Wegner AM, Roos KG, Djoko A, Dompier TP, Kerr ZY. Injuries sustained in National Collegiate Athletic Association men's and women's basketball, 2009/2010-2014/2015. Br J Sports Med 2018;52:261-8.
2. Mugnai R, Della Rosa N, Tarallo L. Scapholunate interosseous ligament injury in professional volleyball players. Hand Surg Rehabil 2016;35:341-7.
3. Johnson BK, Brou L, Fields SK, Erkenbeck AN, Comstock RD. Hand and wrist injuries among US high school athletes: 2005/06-2015/16. Pediatrics 2017;140:e20171255.
4. Farana R, Jandacka D, Uchytil J, Zahradnik D, Irwin G. The influence of hand positions on biomechanical injury risk factors at the wrist joint during the round-off skills in female gymnastics. J Sports Sci 2017;35:124-9.
5. Frankel VH. The Terry-Thomas sign. Clin Orthop Relat Res 1977;(129):321-2.

6. Kim JH, Lee HS, Park SW. Effects of the active release technique on pain and range of motion of patients with chronic neck pain. J Phys Ther Sci 2015;27:2461-4.
7. Maeda T, Yoshida H, Sasaki T, Oda A. Does transcutaneous electrical nerve stimulation (TENS) simultaneously combined with local heat and cold applications enhance pain relief compared with TENS alone in patients with knee osteoarthritis? J Phys Ther Sci 2017;29:1860-4.
8. Axelson HW, Hagbarth KE. Human motor control consequences of thixotropic changes in muscular short-range stiffness. J Physiol 2001;535(Pt 1):279-88.
9. Kage V, Ratnam R. Immediate effect of active release technique versus mulligan bent leg raise in subjects with hamstring tightness: a randomized clinical trial. Int J Physiother Res 2014;2:301-4.
10. Do K, Kim J, Yim J. Acute effect of self-myofascial release using a foam roller on the plantar fascia on hamstring and lumbar spine superficial back line flexibility. Phys Ther Rehabil Sci 2018;7:35-40.
11. Wolff AL, Wolfe SW. Rehabilitation for scapholunate injury: application of scientific and clinical evidence to practice. J Hand Ther 2016;29:146-53.
12. Hagert E, Garcia-Elias M, Forsgren S, Ljung BO. Immunohistochemical analysis of wrist ligament innervation in relation to their structural composition. J Hand Surg Am 2007;32:30-6.
13. Karagiannopoulos C, Sitler M, Michlovitz S, Tucker C, Tierney R. Responsiveness of the active wrist joint position sense test after distal radius fracture intervention. J Hand Ther 2016;29:474-82.
14. Salles JI, Velasques B, Cossich V, et al. Strength training and shoulder proprioception. J Athl Train 2015;50:277-80.