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Case Report

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A Case of Sport Rehabilitation through the Endoscopic Placement of an Internal Brace for the Ankle Lateral Ligaments that had Re-Ruptured after Reconstruction Surgery

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Abstract

We present a case of Internal Brace repair of the lateral ankle ligament in an athlete with a re- torn ankle ligament (ankle sprain), who wished to return to a women's college basketball league. Lateral ankle ligament injury is caused by a varus-type mechanism in which the foot is forced to turn inward when landing from a jump. The re-injury rate of ankle sprain is very high, and it is estimated that about 70% of injured patients might develop chronic ankle instability (CAI) without healing. It is important to establish a rehabilitation program to prevent recurrence of CAI, especially in basketball games, where repeated jumping and landing movements are common.

Keywords: Ankle sprain; Internal brace, Basketball

Introduction

An ankle lateral ligament injury (a sprained ankle) is one of the most frequent external traumas in the motor organs, accounting for approximately 20% of all sport-related injuries [1]. An ankle lateral ligament injury arises from an inversion injury mechanism where a foot is forcibly inverted while landing on the ground after jumping or other actions. In basketball, a sport which involves repeated jumping and landing, approximately 79% of players have reportedly experienced a sprained ankle [2]. Although the first treatment choice is

conservative therapy, the re-injury rate of a sprained ankle is extremely high [3], with approximately 70% of the injured putatively progressing to Chronic Ankle Instability (CAI) without ever achieving recovery [4,5]. Patients with CAI experience reduced performance and lingering pain in their sports activities because of ankle instability, thereby requiring surgery. In recent years, reinforcement and reconstruction surgery using an internal brace (IB; Arthrex, Naples, Florida, US) for the Anterior Talofibular Ligament (ATFL) has been reported (IB method) for CAI. The IB method is believed to be effective for early sports rehabilitation, for instance, the report stated that it significantly improved the American Orthopaedic Foot and Ankle Society score from the early postoperative stage in one study [6]. The present report documents a case of a female patient who was rehabilitated into a top league in women's college basketball after receiving ligament reinforcement surgery using an IB for a re-rupture, which occurred following surgical treatment for an ankle lateral ligament injury.

Case Presentation

This case concerned a 20-year-old woman playing in a top women's college basketball league. Her sporting background consisted of 12 years of basketball from her second year of elementary school to the present (her sophomore year of college). She initially sprained her ankle when she was in her second year of high school, after which she repeatedly experienced sprains. Therefore, she underwent surgery (ankle lateral ligament reconstruction) in the same year, after which she followed a favorable course and went on to continue playing basketball in college. However, she sustained a sprain again in her freshman year of college. Although she repeatedly sustained sprains later and was aware of a sense of instability, she continued participating in practice because the pain was mild. Eventually, during a game in her sophomore year, she sustained the sprain in question after jumping and landing on the foot of one of her opponents. Shortly after the injury was sustained, swelling was noted around the ankle lateral malleolus, and pressure pain persisted in the anterior part of the medial malleolus and the lower part of the lateral malleolus after the swelling alleviated. The patient presented at the orthopedics department of our hospital, where MRI revealed a rupture in the fibular attachment site of the ATFL, and a stress X-ray detected clear instability with a talar tilt angle of 11.5° on the affected side, as opposed to 3.5° on the unaffected side. At the request of the patient herself, reinforcement surgery for the ankle lateral ligament using an IB was performed with a diagnosis of a postoperative re-rupture of the ankle lateral ligament.

Discussion

As described above, a sprained ankle is an injury with an extremely high incidence of recurrence. Accordingly, rehabilitation programs need to be formulated, taking into consideration how to prevent recurrences. At our hospital, patients are preoperatively screened to clarify risk factors that may affect postoperative course. We believe that preoperative screening allows us to act proactively toward prophylactic programs from the early postoperative stage. **Table 1** lists the results of preoperative screening. In the present case, restricted angle of dorsal flexion, instability in the ankle joint, malalignment in the foot region, and reduced static/dynamic balance were observed. Regarding restricted dorsal flexion in the ankle joint, it is considered desirable to improve dorsiflexion as much as possible preoperatively, given that a proactive approach from the early postoperative stage is infeasible, and that a long period may be required until acquisition. In this case, treatment for the restricted dorsal flexion was initiated once the inflammatory symptoms in the lesion disappeared. The forward tilting angle of the lower leg was 32° on the unaffected side and 24° on the affected side when a load was

applied, and 25° and 19°, respectively, when no load was applied, thereby showing the presence of restricted dorsiflexion. From the early stage, the dorsal flexion motion of the patient under a load caused a foot varus, elevation of the medial longitudinal arch, and decline of the lateral longitudinal arch. From the mid- to late stages of dorsal flexion, a compensatory motion was noted where the medial longitudinal arch was lowered with the knee in. The screening results showed a foot-high arch, which was thought to be affected by the successive mismatches of the talocrural joint due to hypersupination of the talocalcaneal joint (calcaneal inversion). The axes of motion of the talocrural joint plantar flexion and dorsal flexion were inverted by approximately 8° and internally rotated by approximately 6°. During the dorsiflexion motion, the talocalcaneal joint was pronated, the foot was abducted, and the hypersupination of the talocalcaneal joint was considered to cause successive gaps in the axes of motion of the ankle joint. In the dorsiflexion motion when no load was applied, a decrease in the backward sliding in the talus was noted, suggesting decreased flexibility in the long flexor muscle and the ankle joint posterior soft tissue. Therefore, the posterior tibial muscle, the soleus muscle, and the medial head of the gastrocnemius muscle, which were factors for the high arch (foot supination), were postoperatively subjected to stretching to improve the foot supination. Concurrently, the flexibility and sliding of the long flexor muscle and the ankle joint posterior soft tissue were improved to optimize the posterior sliding motion of the talus. Consequently, the patient was able to acquire both active and passive mobility.

Table 1: Our medical screening.

Medical Screening		
(1)	Interview	Medical history / Injury mechanism
(2)	ROM	Ankle plantar flex / dorsal flex
(3)	Ankle stability	Anterior Drawer Test / Inversion Stress Test / Eversion Stress Test
(4)	Strength	Ankle dorsal flex / plantar flex / inversion / eversion (hand held dynamometer)
(5)	alignment	Leg heel alignment / Arch height index / foot poster index
(6)	Balance	static / dynamic balance (Zebris FDM)

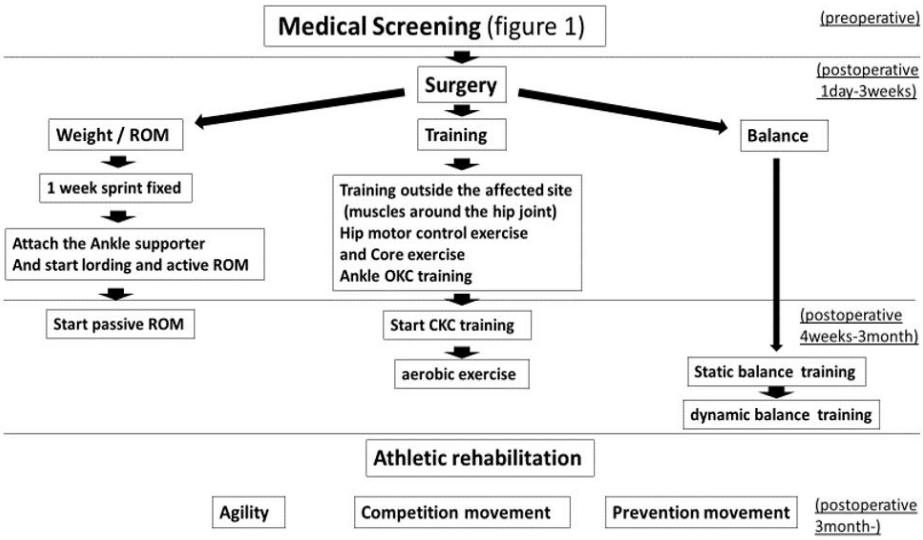
Previous studies have reported that in the increased incidence of sprained ankles [7] and CAI owing to foot high arches, joint position sensibility toward the ankle joint varus is decreased, and the response of the peroneus muscles is delayed compared to the restricted dorsiflexion of the ankle joint and the healthy foot [8,9]. Moreover, multiple functional disorders exist, including problems outside the affected site, such as the reduced strength of the abductor muscle in the hip joint [9,10]. When athletes return to competition while retaining such functional disorders, they are more likely to sustain injuries again, creating a vicious circle.

Early postoperative rehabilitation

Table 2 describes the postoperative rehabilitation protocol for ankle lateral joint reinforcement surgery at our hospital. The postoperative rehabilitation program was initiated with sessions avoiding mechanical stress to the reinforced ligament. For one week after surgery while the splint was fixed, any direct approach to the affected site was avoided; however, direct stretching and releasing techniques between tissues were employed to the

extent that would not cause pain. In particular, attempts were made from the early stage to assist acquiring the flexibility and sliding of the deep flexor muscles (triceps surae muscle and flexor hallucis longus muscle, among others) and the ankle joint posterior soft tissues (Kager's fat pad, among others) because they were likely to reduce the dorsal flexion motion **(Figure 1).** Training outside the affected site (muscles around the hip joint, among others) was also implemented from the early postoperative stage. After the removal of the sutures and the splint, a supporter was attached, and loads were applied depending on the pain. Although no pain was induced by loading, the patient started walking for rehabilitation but with crutches to prevent recurrent inflammation.

Table 2: Our postoperative rehabilitation protocol for ankle lateral joint reinforcement surgery.



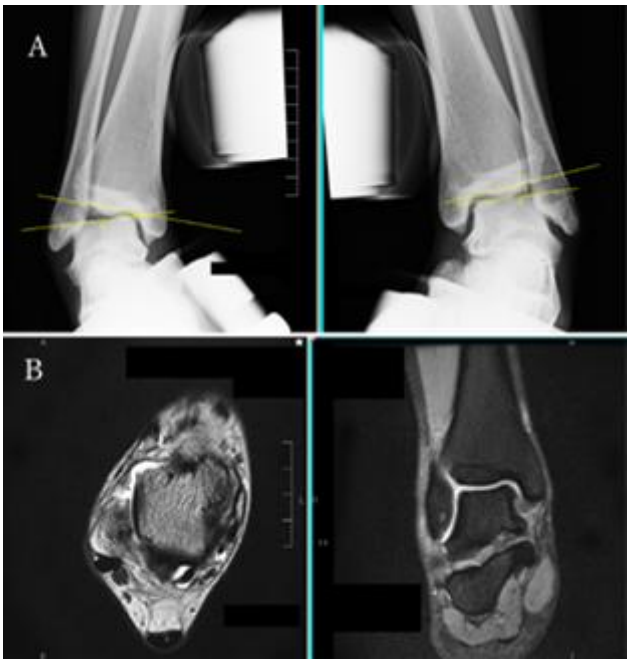


Figure 1: A) Stress X-ray, B) MRI.

Middle postoperative rehabilitation

In our hospital, the load is started from the early postoperative stage (1 week after surgery), and if it becomes possible to improve the output of the ankle joint muscle and acquire proprioception, start training under load. In this case, crutches were also used except during rehabilitation until 3 weeks after surgery, and since there was no relapse of pain or inflammation, balance training on a balance board or air stabilizer was started from 6 weeks after surgery **(Figure 2).** In our hospital, we evaluate static, dynamic balance, and center of gravity position over time using the foot pressure distribution measurement system (Zebris FDM), and it is one of the indicators at the return to sports, including foot alignment. In this case, even in preoperative screening, lateral shift of the affected center of gravity and poor balance were observed in static one-legged standing and toe standing. Regarding the lateral shift of the center of gravity, it was considered that the influence of the foot-high arch (excessive supination) was large. The preoperative approach improved the foot malalignment, gained dorsiflexion mobility, and improved the lateral shift of the center of gravity. However, there was a clear decrease in static balance compared to the healthy side. It has been reported that in sports motion, ankle lateral ligament injury is often caused by excessive varus in the deceleration motion in the plantar flexion position **[11].** Therefore, the stability of the ankle joint and the position of the center of gravity are evaluated over time while standing on the toes **(Figure 3 and 4).**

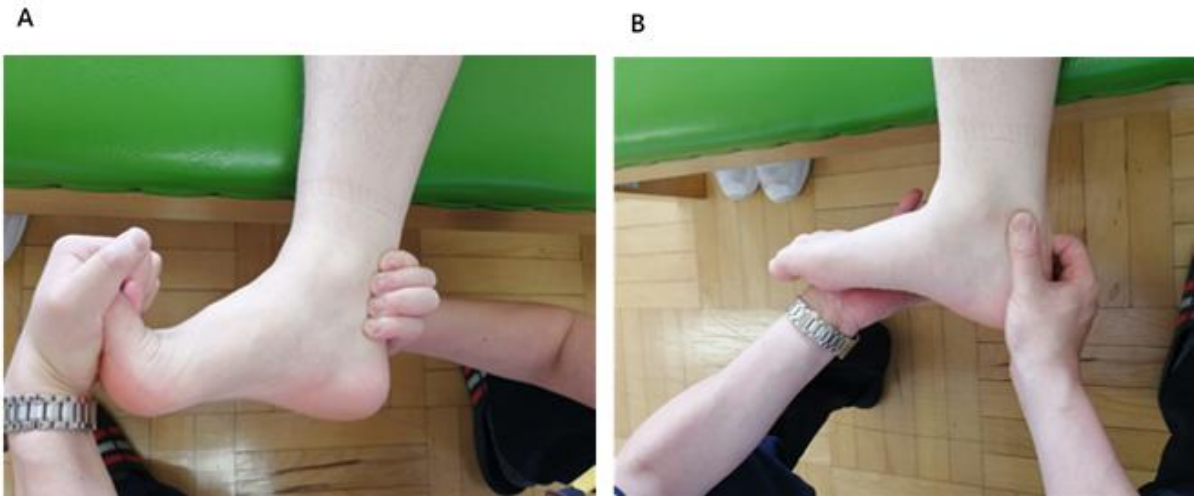


Figure 2: A) Releasing techniques (flexor halluces longus muscle, B) Kager's faf pad.

Figure 3: Balance training (A: standing B: standing on the toe).

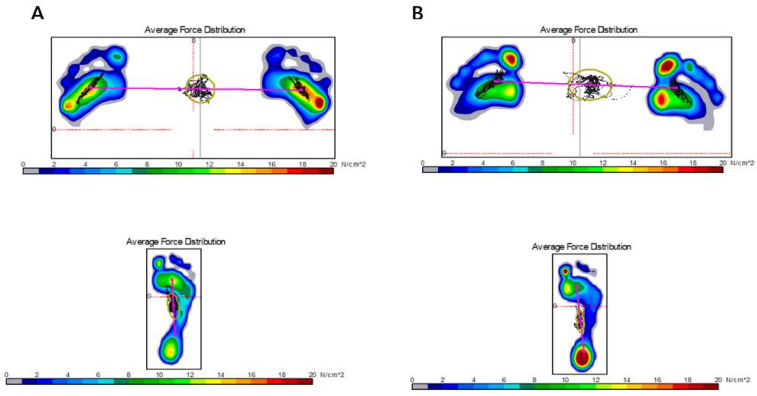


Figure 4: The center of gravity (A: preoperative B: return of sports).

Late postoperative rehabilitation

The affected area training including balance training was carried out, and after acquiring the same foot function as the healthy side, motion training including agility and jumping motion for returning to the competition was started. During the movement training, functional evaluation during movement is performed, and by sharing and instructing the problems with the athletes, final adjustments are made to prevent re-injury. The standard for returning to the competition is the performance of tasks under certain fatigue conditions in the static / dynamic balance evaluation using the foot pressure distribution measurement system. The first return criterion is that there is no difference in the position of the center of gravity between the left and right sides or an obvious imbalance. Since this case met the return criteria 3 months after the operation, she returned to the competition from practice other than interpersonal practice. After that, there was no pain or inflammation relapse, so I returned to interpersonal practice. Currently, she has participated in the game, and one year has passed since the operation, but he has passed without any problems in the regular medical examination.

Conclusion

For rehabilitation after ankle lateral ligament injury, it is important to establish a rehabilitation program to prevent re-injury. It is particularly to establish a program combining minimally invasive surgery and rehabilitation to prevent recurrence of CAI, especially in basketball games, where repeated jumping and landing movements are common. In order to perform rehabilitation aiming for safe and early recovery, it is important to comprehensively evaluate and approach not only the healing status of the affected area but also the entire body.

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