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Case Report

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Overuse Capsuloligamentous Injury of the First Metatarsophalangeal Joint: A Case Report

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Capsuloligamentous injury at the first metatarsophalangeal (MTP) joint is a common traumatic injury during physical activity, particularly on artificial turf. Mechanism of injury include excessive flexion, extension, or valgus stress. We report a non-operatively treated capsuloligamentous injury at the first MTP joint, which did not occur traumatically but developed by a stress-related mechanism in a collegiate rower.

Key Words: First metatarsophalangeal joint, Turf toe, Overuse injury, Rower

The 1st metatarsophalangeal (MTP) joint is a condyloid articulation of the 1st metatarsal head and the base of the proximal phalanx.[1] It is inherently unstable but a complex of soft tissue structures include joint capsule ligament, collateral MTP joint ligament, plantar MTP joint ligament, and suspensory ligament, as well as extensor and flexor tendons and two sesamoid bones.[2]

A capsuloligamentous sprain over the 1st MTP joint is commonly referred to as "turf toe".[3] Hyperextension is the most common injury mechanism,[1] and excessive flexion and valgus stress of the 1st MTP joint have also been implicated as possible mechanisms.[4] The 1st MTP joint sprain usually occurs with rapid changes in direction, direct axial loading against a non-yielding solid object, and/or playing on the artificial turf.[1] Symptoms include pain, swelling, tenderness, stiffness, and reduced range of motion (ROM) over the 1st MTP joint, thus patients report difficulty with or inability to bear weight on the injured foot during functional movements such as walking and running.[1,4]

The injury case presented was unique because injury of the 1st MTP joint occurred with an insidious onset and aggravated during rowing activities. Differential diagnosis for a musculoskeletal injury to the 1st MTP joint included sprain/strain, infection, capsulitis, hallux rigidus, sesamoiditis, plantar fascia rupture, degenerative joint disease, dislocation, and fracture.

CASE REPORT

A 19-year-old female rower who sustained an overuse injury to her left 1st MTP joint was in her second year of competitive rowing and had no previous history of musculoskeletal injury to the forefoot. She felt initial discomfort around the great toe during rowing and erging (indoor rowing machine), but did not recall a specific traumatic event or onset of discomfort. Pain gradually increased and became sharp and more localized over the 1st MTP joint.

On the initial visit, there was no obvious swelling or tenderness over the 1st MTP joint. Active ROM at the 1st MTP joint was within normal limits compared to the uninvolved side. Manual muscle testing of the great toe revealed 4+/5 during flexion and 4/5 during extension. First MTP valgus/varus stress tests were negative and did not reproduce any pain. A manual fracture test (percussion test) was also negative. And, no neurological symptoms (decreased sensation, altered reflexes) were observed.

Therefore, physiotherapy (cryotherapy, thermotherapy, electro-

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Table 1. Summary of Therapeutic Interventions

Treatment	Parameter, dosage, and duration
NSAIDs	Ibuprofen 400 mg after each meal
Cryotherapy	Cold-water immersion (10°C~12°C) up to malleolus for 15 minutes or ice massage to the 1st MTP joint for 20 minutes
Thermotherapy	Pulsed ultrasound for 4~5 minutes Duty cycle: 50%~80%; Frequency: 3 MHz; Intensity: 1.2 W/cm^2 Treatment area: around the 1st MTP joint
Electrotherapy	High-voltage pulsed stimulation (pain modulation) for 20 minutes Pulse frequency: 200~250 pps; phase duration: < 80 microseconds Active electrode (−): on the top of the 1st MTP joint Dispersive electrode (+): on the quadriceps muscle valley
Iontophoresis	Drug ions used: dexamethasone Current: 3~4 mA; total charge: 40 mA/min Active electrode (−): on top of the 1st MTP joint Dispersive electrode (+): on the gastrocnemius muscle valley
Stretching	Active (assisted) big toe extension/flexion (15~20s×4~5 repetitions) within pain free ROM Ankle dorsi-flexion with knee extended or bended (15~20s×4~5 repetitions)
Strengthening	Towel crunches (1 m) curling (10~15 repetitions) Active heel raises (10~12 repetitions both single and two-legged)
Joint mobilization	1st MTP joint: moved concave surface (proximal 1st phalanx) on the concave surface (head of the 1st metatarsal); Direction: AP and PA (grade I and II) Tarsometatarsal joint: moved concave surface (base of the 1st metatarsal) on the convex surface (medial cuneiform); AP and PA (grade I and II)

NSAIDs: non-steroidal anti-inflammatory drugs, MTP: metatarsophalangeal, pps: pulse per second, ROM: range of motion, AP: anteroposterior, PA: posteroanterior.

Figure 1. The anteroposterior radiograph of the left foot revealed no abnormality at the first metatarsophalangeal joint.

therapy, and iontophoresis) and oral non-steroidal anti-inflammatory drugs (NSAIDs) were prescribed to address pain (Table 1). Symptoms were slightly decreased (visual analogue scale, VAS; worst at 5/10 and best at 1/10) over a treatment period of 4 weeks but she indicated pain continued to persist. Therefore, she was referred to the team orthopedic surgeon for further exam. Plain x-ray was obtained and indicated no fracture or abnormal bony malalignment (Fig. 1). Under the impression of insidious onset of 1st MTP capsulitis (capsuloligamentous sprain), corticosteroid injection into her 1st MTP joint was performed. It seemed to reduce symptoms (VAS; worst at 3/10 and best at 1.5/10) for 4 weeks which allowed her to complete the season. However, pain and discomfort was not completely resolved.

She was seen in the athletic training room five months after the initial treatment (two months after the last treatment) due to persisting pain in the same area. She was able to row and erg, but the symptom have continually been worse with practice and weightlifting. Active and passive ROM at the 1st MTP joint was limited by pain (flexion at 30° and extension at 42°; uninvolved side: flexion at 45° and extension at 55°). To assess general function of her lower extremity, she was asked to complete the lower extremity functional scale (LEFS). The patient scored 59/80. Also, VAS was measured (worst at 8/10 and best at 2/10).

To control pain and increase ROM, therapeutic modalities and ROM exercises were done with active (assisted) big toe flexion/extension and calcaneal tendon stretch. Grade I and II joint mobilization at the 1st MTP joint and grade III and IV tarsometatarsal joint mobilization to increase ROM was also applied (Table 1). Strengthening exercises including towel (1 m) crunches for the toe flexors and active heel raises for plantar flexors were also performed (Table 1). A custom turf toe orthotics and turf toe taping were applied for activities of daily living and team practice (rowing, erging, and

weight lifting). After four weeks, second corticosteroid injection was then administered along with other therapeutic treatments (Table 1). A week after the injection, symptom improved (worst at 4/10 and best at 2/10) and pain free ROM increased (flexion at 35° and extension at 50°; uninvolved side: flexion at 45° and extension at 55°). She was continuously treated with NSAIDs and other therapeutic modalities and exercises. At this point, thermotherapy (therapeutic ultrasound) and electrotherapy followed by stretching and strengthening exercises with grade III and IV joint mobilization were performed (Table 1). Two months after the second injection, she participated in team practice without subjective pain or discomfort. Active ROM at the 1st MTP joint returned to normal (flexion at 41° and extension at 55°; uninvolved side: flexion at 45° and extension at 55°). The LEFS also improved (77/80).

We obtained informed consent from the patient. Medical information includes past medical history, clinical assessments, therapeutic interventions, and outcome measurements (VAS and LEFS).[5]

DISCUSSION

Atraumatic injury to the 1st MTP joint with insidious onset is unusual.[6] To understand the mechanisms of injury in this case, stroke mechanics in rowing should be addressed. The rowing stroke can be divided into recovery, catch, and drive phases.[7] The recovery phase begins when a stroke is finished in the water. During this phase, lower extremity joints and lower back increase flexion angles as shoulder and elbow joints extends until "catch" the water. During the drive phase, lower extremity joints and lower back are going towards to extension with upper extremity flexion, thus the oars push the water. During the recovery phase, the flexor hallucis longus (FHL) may be relaxed or slightly eccentrically contracted while the extensor halluces longus may concentrically contract. The FHL tendon at the 1st MTP joint constantly contracts with plantar flexors and knee extensors during the drive phase.

The patient was diagnosed as the 1st MTP joint capsulitis. Inflammation in the soft tissue structure is confirmed with magnetic resonance imaging data, which we did not obtain for this particular injury. Radiograph images (Fig. 1) ruled out bone related injuries such as fracture, osteoarthritis, osteochondritis dissecans, or osteophytes. Joint infection (e.g., septic arthritis) may have been a possible etiology. We assumed that this was not the case because joint infection is common in children and elderly adults, typically one large joint (e.g., knee) is affected, and our patient did not have fever or fatigue. Passive ROM at the 1st MTP joint provoked pain, which may indicate that joint capsule structure is inflamed. The patient also reported that she had more pain with resisting the 1st MTP joint during the drive phase compared to the recovery phase. External load that had to be resisted during the drive phase may have increased intraarticular pressure at the 1st MTP joint, resulting in pain. We believe that repetitive flexion and extension at the 1st MTP joint may have been a contributing mechanism to this injury. Additionally hypomobility at the 1st tarsometatarsal joint may have possibly aggravated inflammation at the capsuloligamentous structure at the 1st MTP joint.

The patient's 1st MTP joint active ROM was within normal limit on both sides at the initial examination. During the second visit, however, ROM at the 1st MTP joint had bilateral asymmetry. This ROM deficit in the involved side is thought to be from persistent pain at the same structure. A recent study suggested that low back pain may be related to ROM asymmetry at the hip joint in rowers.[8] In our case, the 1st MTP joint injury may be a consequence of compensatory movements due to bilateral ROM asymmetry in lower limb such as ankle or knee joint. For example, repetitive ankle dorsi- and plantar-flexion with a limited mobility and/or a weaker force production in involved side compared to the uninvolved side may have caused the 1st MTP joint in the ipsilateral side to compensate the deficits. It is unclear if this was the case in our patient since we did not obtain patient's joint ROM and strength data. We suggest that clinicians and physicians should consider ROM and strength at the joint above and below of the injured structure.

Recently, a stress-related 1st MTP joint injury in an elite soccer player has been reported in a case report.[6] The patient felt discomfort without swelling around the 1st MTP joint during a soccer game. Then, repetitive high intensity stress (playing soccer) to the 1st MTP joint caused a traumatic injury, finally resulting in a surgical repair. This case was similar to ours in that the 1st MTP joint injury may be an atraumatic etiology. It appears that the 1st MTP joint injury with an overuse mechanism may be related to both closed-kinetic chain movements (dorsi- and plantar-flexion in our case) and a combination of open- and closed-kinetic chain movements (playing soccer).[6]

Effectiveness of the interventions and rehabilitation programs were not clear. We treated the patient with typical 1st MTP joint treatments, which includes rest (modified activity), NSAIDs, cryotherapy, thermotherapy (therapeutic ultrasound), electrotherapy, iontophoresis, joint mobilisation, stretching, strengthening exercise, orthotics, turf toe taping, and corticosteroid injection.[9,10] We

believe alleviation of the symptom and function improvement were from a combination of all treatments not significantly from one or two specific treatments or exercises.

This study is to report a unique case of the 1st MTP joint injury occurred in rowing. The possible mechanism of injury was repetitive rowing and erging motion with stiffness of the 1st tarsometatarsal joint. The symptoms lasted longer than a year even though appropriate therapeutic interventions were applied. The patient was treated with cryotherapy, therapeutic modalities, and NSAIDs to control pain. The patient performed stretching and joint mobilization to restore normal ROM. Corticosteroid injection was administered to decrease inflammation in the joint. In addition, orthotics and taping were applied to support joint movements and function. It took 16 months for the patient to return to normal function and competitive rowing without pain. The combination of all treatment modalities may have contributed to reduce pain and restore normal function.

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