Charles University in Prague
Faculty of Physical Education and Sports

Chronic Ankle Distortion

Bachelor Thesis

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Abstract

Title:

Chronic Ankle Distortion

Thesis aim:

The thesis discusses the general aspects and therapy of lateral ankle sprains. The thesis is divided into two parts, the first part is a general theoretical part, and the second is a practical part concerning a patient with a lateral ankle sprain. The theoretical part of the thesis is divided into an anatomical, biomechanical, and kinesiological part. It also discusses types of common ankle injuries, rehabilitation methods and the epidemiology and etiology of ankle sprains.

The practical part is about a 16 year old girl who has developed a chronic lateral ankle sprain from a handball injury. 9 months after an ankle sprain the pain in the ankle made her stop playing handball, and made her seek help. This thesis describes the examination, therapeutically approach and conclusion of a two week therapy period.

Clinical findings:

Important findings in the examination was primarily the pain located at lateral aspects of the right foot and muscles involved in eversion, restrictions in ROM in abduction and flexion in the hip joint, and hypertonic calf muscles. Positive scale test with a bigger load on her left leg was also found.

Methods:

The rehabilitation was mainly focused on reducing the pain in the ankle, regaining normal ROM in hip joint, and relaxing hypertonic muscles found. PIR and soft tissue techniques was used for relaxing hypertonic muscles and for releasing trigger points found, and also increasing the ROM. Sensomotoric exercises was introduced from the beginning and was the main part of the therapy, using wobble boards, Bosu ball, unstable surfaces and gait training. Strengthening exercises was introduced when the pain threshold allowed it.

Result:

The active ROM in hip abduction improved from 25° to 35° and hip flexion from 65° to 75°. But the most significant improvement was the reduction of pain perception, and

that the improved balance shown in training, by the modified balance test on the Bosu ball. Scale test was negative in final examination.

Conclusion:

Patient understands better how not to rush into hard exercises to fast, but gradually and correctly build up stability and core strength from the beginning. Two weeks is a short time to gain big results in this kind of injury, but I can see big improvements in confidence and technique when exercising.

Keywords:

Sport injury, ankle joint, chronic lateral ankle sprain, rehabilitation of ankle sprain, Sensomotoric training.

Declaration

I hereby declare that this work is entirely my own, individual work based on knowledge gained from books, journals, reports and by attending lectures and seminars at FTVS.

I also declare that no invasive methods were used during the practical approach and that the patient was fully aware of the procedures at any given time.

Prague, April 2012

Acknowledgement

I would like to thank my family for all support they have given during my stay in Prague and friends that still are friends after 3 years abroad.

Thanks to PhDr. Edwin Mahr PhD. and Mgr. Lenka Satrapova for very good guiding and supervision through the whole case study at CLPA.

Thank you.

Øyvind Henriksen
Prague, April 2012

Table of contents:

1. Preface

This thesis is divided into two basic parts, first part is a foundation of theoretic information needed to understand the mechanics of chronic ankle distortions. Sub-divisions discusses anatomy of various tissues around the ankle joint, kinesiology and biomechanics of foot and ankle joint, types of ankle sprains and related injuries, rehabilitation possibilities in such injuries and epidemiology and etiology.

The second part is the main part, which consist of a full examination and therapy of a patient with the given diagnosis. The execution of the examination and therapy is provided with the knowledge of the author and with supervision of the advisor and supervisor continually during the therapy period. Final examination and results of the therapy is also included, with an evaluation of the effect of the therapy.

The thesis is equipped with a list of literature, figures, explanation of abbreviations and application of board review, and can be found in the supplement.

2. General part

2.1 Anatomy of the lower extremity

The tibia is the major weight-bearing bone of the lower leg. It articulates with the fibula at both proximal and distal ends. The fibula, which assists minimally with weight bearing, serves as a site for muscle attachment and contributes to stability at the ankle. The foot is made up of 26 bones, including 5 metatarsals and 14 phalanges. (Anderson, et al., 2000)

2.1.1 Tibiofibular joint

Two joints with little motion that are not part of the true ankle joint but play a small role in the proper function of the ankle are the tibiofibular joints. The superior tibiofibular joint is the articulation between the head of the fibula and the posterior lateral aspect of the proximal tibia. It is a uniaxial plane joint. Being a synovial joint, it has a joint capsule. Ligaments reinforce the capsule. The gliding motion present is relatively small. It functions to dissipate the torsional stresses applied at the ankle joint. The inferior tibiofibular joint is a syndesmosis (fibrous union) between the concave distal tibia and the convex distal fibula. Because it is not a synovial joint, there is no joint capsule. However, there is fibrous tissue separating the bones and several ligaments holding the joint together. (Lippert, 2006)

2.1.2 Talocrural joint

The talocrural joint is a uniaxial, modified hinge joint formed by the talus, the tibia, and the lateral malleolus of the fibula. Although the joint capsule is thin and especially weak anteriorly and posteriorly, the ankle is crossed by several strong ligaments that enhance its stability. On the medial side, the main stabilizing ligaments are commonly referred to collectively as the deltoid ligament. The lateral side of the ankle is crossed by three ligaments; the anterior and posterior talofibular and the calcaneofibular. (Anderson, et al., 2000)

2.1.3 Subtalar joint

The subtalar joint lies beneath the talus and articulates with the sustentaculum tali on the superior calcaneus to form a hinge joint. Because no muscles attach to the talus, the stability of the subtalar joint is derived from several small ligaments. The joint functions as a uniaxial hinge joint. (Anderson, et al., 2000)

2.1.4 Lisfranc joint

Consists of five tarsometatarsal joints; the concave base of the first metatarsal articulates with the convex surface of the medial cuneiform. The bases of the second and third metatarsals articulate with the mortise formed by the intermedial cuneiform and the sides of the medial and lateral cuneiforms. The base of the third metatarsal articulates with the lateral cuneiform, and the bases of the fourth and fifth metatarsals articulate with the cuboid. (Loudon, et al., 2008)

2.1.5 Chopart joint

This lies immediately in front of the talus and calcaneum and is connected to the hindfoot by the talonavicular and calcaneocuboid joints. Although the cuboid and navicular bones are not rigidity attached to each other, any relative movement between them is so minor that we entitled to consider the two bones as moving together. It is at this joint that changes in the height of the longitudinal arch occur. (Loudon, et al., 2008)

2.1.6 Arches of the foot

The foot has three major arches that help distribute the weight of the body between the heel and the ball of the foot during standing and walking. Two longitudinal; the medial and the lateral longitudinal arch, and one transverse; the transverse arch, exist. The shape of the arch is maintained by ligaments, the tendons attached to the foot, and the configuration of the bones. The medial arch is formed by the calcaneus, talus, navicular, cuneiforms and the medial three metatarsal bones. The lateral arch is formed by the calcaneus, cuboid, and the two lateral metatarsals. The transverse arch is formed by the cuboid and cuneiform bones. (Premkumar, 2004)

2.1.7 Muscles involved in the ankle

There are extrinsic and intrinsic muscles in the ankle and foot as in the wrist and hand. The extrinsic muscles originate on the leg, and the intrinsic muscles originate on the tarsal bones. The extrinsic muscles of the leg are found in groups of three or combinations of three and are located in three anatomical areas. All have proximal attachments on the femur, tibia, or fibula, and all cross the ankle joint. (Lippert, 2006)

Muscle	Joint crossing	Possible actions
	Posterior Group	
Superf. Posterior Group		
Gastrocnemius	Posterior	Plantar flexion
Soleus	Posterior	Plantar flexion
Plantaris	Posterior	Plantar flexion
Deep Posterior Group		
Tibialis posterior	Posterior, medial	Plantar flexion, inversion
Flexor digitorum longus	Posterior, medial	Plantar flexion, inversion
Flexor halluces longus	Posterior, medial	Plantar flexion, inversion
	Anterior Group	
Tibialis anterior	Anterior, medial	Dorsiflexion, inversion
Ext. halluces longus	Anterior, medial	Dorsiflexion, inversion
Extensor digitorum longus	Anterior	Dorsiflexion
	Lateral Group	
Peroneus longus	Posterior, lateral	Plantar flexion, eversion
Peroneus brevis	Posterior, lateral	Plantar flexion, eversion
Peroneus tertius	Anterior	Dorsiflexion, eversion

Table 1: Muscles involved in ankle joint

(Lippert, 2006)

The gastrocnemius muscle is a two-joint muscle that crosses the knee and the ankle. It is an extremely strong ankle plantar flexor but also has a significant role at the knee. It attaches by two heads to the posterior surface of the medial and lateral condyles of the femur. After descending the posterior leg superficially, it forms a common tendon with the soleus muscle and attaches to the posterior surface of the calcaneus. (Kapandji, 1987)

The soleus muscle is a large, one-joint muscle located deep to the gastrocnemius muscle. Originating on the posterior tibia and fibula, it spans the posterior leg, blending with the gastrocnemius muscle to form the large, strong Achilles tendon that inserts on the posterior calcaneus. Because the soleus muscle spans the ankle in the midline, its only function is to plantar flex the ankle. The two heads of the gastrocnemius and soleus muscles make up what is sometimes referred to as the triceps surae muscle, meaning "three-headed calf muscle." (Lippert, 2006)

The plantaris muscle is a long, thin, two-joint muscle with no significant function. It originates on the posterior surface of the lateral epicondyle of the femur, spans the posterior leg medially, and blends with the gastrocnemius and soleus muscles in the Achilles tendon. Theoretically, it should flex the knee and plantar flex the ankle. However, because of its size in relation to the prime movers of those actions, it is assistive at best. The deep posterior group is made up of the tibialis posterior, flexor hallucis longus, and flexor digitorum longus muscles. They all attach to the posterior tibia and/or fibula, and all terminate in the foot. Because they all cross the ankle posteriorly, they all can plantar flex it. However, because of their size in relation to the soleus and gastrocnemius muscles, their role is only assistive. (Lippert, 2006)

The tibialis posterior muscle is the deepest lying posterior muscle with its proximal attachment on the interosseous membrane and adjacent portions of the tibia and fibula. It descends on the posterior aspect of the leg, looping around the medial malleolus to attach on the navicular with fibrous expansions to the cuboid, the three cuneiforms, sustentaculum tali of the calcaneus, and the bases of the second through fourth metatarsals. Because the tibialis posterior muscle crosses the ankle medially and posteriorly, it can plantar flex and invert. Because of its size in relation to the other plantar flexors, it is assistive in this action. (Premkumar, 2004)

The flexor hallucis longus muscle arises from the posterior fibula and interosseous membrane. It descends the leg posteriorly, loops around the medial malleolus through a groove in the posterior talus, and goes under the sustentaculum tali of the calcaneus. This muscle travels down the foot through the two heads of the flexor hallucis brevis muscle to attach at the base of the distal phalanx of the great toe. This distal attachment is similar to the flexor digitorum profundus and superficialis muscles in the hand. The flexor hallucis longus muscle flexes the great toe and assists in inversion and, to a lesser degree, assists in plantar flexion of the ankle. (Premkumar, 2004)

The flexor digitorum longus muscle arises from the posterior tibia. It descends the leg posteriorly, loops around the medial malleolus, and runs down the foot, splitting into four tendons to insert into the distal phalanx of the second through fifth toes. This muscle passes through the split in the flexor digitorum brevis tendon in a similar fashion to the flexor digitorum profundus muscle, which goes through the split in the flexor digitorum superficialis muscle in the hand. It flexes the four lesser toes and assists in inversion and plantar flexion of the ankle. (Lippert, 2006)

The anterior muscle group is made up of the tibialis anterior, extensor hallucis longus, and the extensor digitorum longus muscles. They all attach proximally on the anterior lateral leg and cross the ankle anteriorly. (Lippert, 2006)

The tibialis anterior muscle originates on the lateral side of the tibia and interosseous membrane, then descends the leg to insert medially on the first cuneiform and base of the first metatarsal. It makes up most of the bulk of the anterior lateral leg. Because the tibialis anterior muscle spans the ankle anteriorly and medially, it dorsiflexes and inverts the ankle. (Lippert, 2006)

The extensor hallucis longus muscle, a thin muscle lying deep to and between the tibialis anterior and the extensor digitorum longus muscles, originates on the fibula and interosseous membrane and inserts into the base of the distal phalanx of the great toe. Its primary function is to extend the great toe, but this muscle also assists in dorsiflexing and inverting the ankle. (Premkumar, 2004)

The extensor digitorum longus muscle attaches to most of the anterior fibula, interosseous membrane, and the lateral condyle of the tibia. It descends the leg to attach to the distal phalanx of the four lesser toes. The extensor digitorum longus muscle functions primarily to extend the second through fifth toes, but it also assists in dorsiflexing the ankle. It does not have an inversion/eversion role because it crosses the joint through the middle of that axis. (Anderson, et al., 2000)

The lateral group of muscles consists of the peroneus longus, peroneus brevis, and peroneus tertius muscles. They all originate proximally on the fibula and run distally to the foot. Two cross the ankle joint posteriorly, and one crosses the ankle anteriorly. (Lippert, 2006)

The peroneus longus muscle is the more superficial of the peroneal muscles. Arising from the proximal end of the fibula and interosseous membrane, it descends the lateral leg and loops behind the lateral malleolus along with the peroneus brevis muscle. At this point the peroneus longus muscle goes deep to cross the foot obliquely from the lateral to the medial side of the foot to insert into the plantar surface of the first metatarsal and first cuneiform. (Kapandji, 1987)

The peroneus tertius muscle, not present in all people, is difficult to identify and often is confused as part of the extensor digitorum longus muscle. The muscle arises from the distal medial fibula and interosseous membrane, and crosses the ankle anteriorly to

insert on the dorsal surface of the base of the fifth metatarsal, near the peroneus brevis muscle. (Lippert, 2006)

2.2 Kinesiology of the ankle joint

It's a tightly interlocked joint exposed to extreme mechanical conditions during single limb support. It's is then subjected to the entire body weight and to the force generated by the dissipation of kinetic energy when the foot rapidly makes contact with the ground during walking, running or jumping. (Kapandji, 1987)

2.2.1 Gait cycle

The gait cycle describes what happens to the foot and ankle from the point of initial contact of one foot with the ground to the point at which the same foot contacts the ground again. The gait cycle is divided into the swing phase and the stance phase. During the swing phase the foot is not in contact with the ground. As the name implies it is the phase of the gait cycle in which the foot swings forward to take another step. During the stance phase the foot is in contact with the ground. The stance phase of the gait cycle can also be divided into three stages. The first stage is called heel strike, the second stage is called mid-stance, and heel lift is the final stage. (Anklepaininfo, 2011)

During heel strike of the stance phase the foot begins to pronate. Pronation of the foot is the term that describes the rolling motion of the foot inwards and flattening of the inner (medial) arch of the foot. Pronation allows the foot to adapt to uneven terrain and absorb the impact of the foot striking the ground. It is during this phase that the foot begins to act like a shock absorber. (Anklepaininfo, 2011)

During midstance the entire foot is in contact with the ground and the weight of the body is directly over the foot. It is during this phase that the foot is maximally pronated. The foot acts as a shock absorber during the early part of this phase. As the body weight shifts forward the foot begins to return to a neutral position in preparation for heel lift. (Anklepaininfo, 2011)

Heel lift occurs at the end of the stance phase. Supination of the foot is the term used to describe the rolling motion of the foot outwards and the rising of the inner (medial) arch of the foot. During heel lift, the foot supinates to act as a rigid lever. The plantar fascia is a strong connective tissue that runs along the bottom of the foot connecting the heel to the base of the toes. The bones, muscles and the plantar fascia act together to form this rigid lever. (Anklepaininfo, 2011)

2.2.2 Motor control

Motor control at the ankle is understood most easily be commencing with swing phase muscle activity. Ankle dorsiflexors undergo brief eccentric contraction in preswing, followed shortly by concentric sequence increases mechanical efficiency and assures foot clearance. Continued pretibial muscle isometric contraction through swing maintains this neutral or slightly dorsiflexed posture. Subsequent loading response is notable for eccentric contraction of the pretibial muscles to control plantar flexion. A brief period of co-contraction of ankle plantar flexors and dorsiflexors occurs at the transition from initial stance double support to single support. This co-contraction interval increases limb stability and may smooth the transition from double to single support. (Shekar, 2009)

The orientation of the ankle and subtalar axes couples loading response dorsiflexion with eversion. Both are attenuated by eccentric contraction of the ankle inverters (ie , posterior tibialis). The plantar flexors begin force generation in single support, with peak activity late in terminal stance and preswing. The absorptive power demonstrated in single support is related to their role in restraining forward tibial rotation. The timing of the triceps surae and perimalleolar muscles is similar to that of the triceps surae that supplies most of the ankle plantar flexor moment. The ankle then is plantar flexed vigorously during preswing. (Shekar, 2009)

2.3 Biomechanics

A second class lever has two unique features, first, its axis of rotation is located at one end of a bone. Second, the muscle, or internal force, possesses greater leverage than the external force. A calf muscle group uses a second class lever to produce the torque needed to stand on tiptoes. The axis of rotation for this action is through the metatarsophalangeal joints. The internal moment arm used by calf muscles greatly exceeds the external moment arm used by body weight. Second-class levers are rare in the musculoskeletal system. (Neumann, 2002)

Although the ankle joint may seem like a hinge, it is not in a line perpendicular to the tibia. The axis of rotation does not stay constant during range of motion, despite a relative congruency of this joint. Allowing for rotational forces must be accomplished, while maintaining the stability of the joint and its components. (Deland, et al., 2000)

Movements involved in walking, normally involve the foot acting as a shock absorber and a lever at different points of the walking cycle. The heel hits the ground first, before the foot rolls inward and the arch of the foot flattens to absorb the impact. When the whole of the foot is on the ground the body's weight moves over the foot and forward, while the foot rolls outward and the heel lifts. Normal foot biomechanics then involve the foot acting as a lever, pushing up off the ground from the toes to propel the body forward. (Bennett, et al., 1984)

The subtalar joints basic motion at the joint is that of male ovoid surfaces moving over female ovoid surfaces and vice versa. The motion generated at the joint is that of flexion-supination-adduction or extension-pronation-abduction. The subtalar motion is generated by the contour and orientation of the articular surfaces and is guided by the intrinsic ligaments: the interosseous talocalcaneal ligament of the canalis tarsi and the cervical ligament. Further support is provided by the extrinsic ligaments: the calcaneofibular ligament and the tibiocalcaneal fascicle of the deltoid ligament. Under tibiotalar vertical loading with internal rotation, the subtalar joint complex is in a close-pack position with maximum talar head surface contact in the acetabulum pedis. The component ligaments of the latter are under maximum tension. The posterior talocalcaneal surfaces are interlocked laterally (Sarrafian, 1993). An important but often overlooked characteristic of the ankle is its capacity for frontal and transverse plane motion. This is critical. When we clinically observe movement of the heel relative to the

leg, we interpret these motions with the knowledge that they occur at a combination of the ankle and subtalar joint, not just the subtalar joint. (Deland, et al., 2000)

2.4 Ankle injuries

2.4.1 Ankle sprain

Patients typically report a history of falling over the ankle; for example, stumbling over an already inverted foot. Subsequent to the injury, the patient reports pain and swelling. At the time of injury, patients may hear a "pop". In a grade-I injury, the patient will be able to bear weight with mild pain. In a grade-II injury, the patient will report difficulty with weight-bearing; and in a grade-III injury the patient will be unable to bear weight on the affected side. Previous lateral ankle sprains and natural hypermobility contribute to ankle laxity and are important risk factors for ankle sprain. The most common cause of chronic pain after an ankle sprain is a missed associated injury. (Cooper, 2006)

The ankle joint's instability and load-bearing function contribute to its being the most frequently injured joint (e.g., basketball). The body of the talus is wedge-shaped, with its anterior portion wider than its posterior. This asymmetry directly contributes to the ankle's position-dependent stability. In extreme dorsiflexion, the wider part of the talus tightly wedges between the malleoli and stabilizes the joint. As the ankle plantar flexes, the narrower portion of the talus rotates between the malleoli. The looser talar fit in extreme plantar flexion permits talar translation and tilt that contributes to lateral ankle instability in this position. An 'ankle sprain' actually involves both the ankle and subtalar (talocalcaneal) joints. These two joints move synchronously to execute combined ankle-foot movement. (Bartlett, et al., 2008)

The majority of ankle sprains result from foot-ankle supination (i.e., combined ankle plantar flexion, subtalar inversion, and internal rotation of the foot). Though often referred to as inversion sprains, these injuries are more appropriately termed lateral ankle sprains. Lateral ankle sprains exhibit sequential ligament failure. The anterior talofibular ligament fails first because of its orientation at the instant of loading and its inherent weakness (Siegler, et al., 1988). When the ankle is plantar flexed (as in ankle-foot supination), the anterior talofibular ligament aligns with the fibula and acts as a collateral ligament (Carr, 2003). This alignment and the anterior talofibular ligament's structural weakness predispose the anterior talofibular ligament to injury. The calcaneofibular ligament typically tears next, followed rarely by failure of the posterior talofibular ligament. (Bartlett, et al., 2008)

The opposite movement pattern creates an eversion sprain (actually pronation, or combined ankle dorsiflexion, subtalar eversion, and lateral rotation of the foot), which is

more accurately termed a medial ankle sprain. Given the deltoid ligament's inherent strength, medial ankle sprains are both less frequent and less severe than lateral sprains. Deltoid ligament rupture is rare and always happens in conjunction with other ligament tears. In medial sprains, the talus is forced against the lateral malleolus, which may result in malleolar fracture. (Bartlett, et al., 2008)

Applied forces can wedge the fibula apart from the tibia with sufficient force to tear the interosseous membrane and tibiofibular ligaments in what is termed a high ankle sprain. The most likely mechanisms for high ankle sprain are talar torsion and forced ankle dorsiflexion. (Bartlett, et al., 2008)

2.4.2 Chronic ankle sprain

Chronic instability can develop whenever an ankle sprain fails to heal. This may be caused by inadequate initial treatment or the presence of conditions that predispose the ankle to recurrent sprain. Re-injury of an ankle sprain can cause particularly serious chronic instability. (Hansen, 2000)

2.4.3 Achilles tendon injury

The Achilles tendon is the largest and strongest tendon in the body. The tendon may become inflamed, fibrotic, and eventually rupture. Repetitive stress on the tendon from running and jumping, particularly in athletes who suddenly begin to exercise after prolonged periods of inactivity, may lead to Achilles tendonitis. Achilles tendon rupture may also result from a sudden stress on the Achilles. (Cooper, 2006)

Patients typically report gradually increasing pain in the Achilles tendon that is brought on by activities such as running. The pain may be described as having a burning quality. If a patient complains of a sudden audible "popping" in the Achilles followed by pain and plantarflexion weakness, the patient may have a ruptured Achilles tendon. (Cooper, 2006)

2.5 Types of rehabilitation of ankle sprains

2.5.1 Acute ankle sprains

The three most common treatments for acute lateral ankle ligament injury include: cast immobilization, functional management, and surgical anatomic repair. Conservative treatment is the management of choice for grade I and II ankle sprains in all patients. (Margheritini, 2011) Cast immobilization usually entails a 3-week period in a below-knee walking cast, followed by ROM, strengthening, and proprioceptive rehabilitation. Immobilization is contraindicated in the high-performance athlete but may be advantageous for low-demand, heavy, or elderly patients. In young, active, and compliant patients with grade I or II ankle sprains, functional management is indicated. This implies early mobilization with external support, rest, ice compression, and elevation, and is followed by a rehabilitation program consisting of ROM exercises, strengthening, proprioception and activity-specific training. (Margheritini, 2011)

The treatment of grade III lateral ankle ligament injury is controversial. One option is to manage conservatively low-demand patients and to surgically repari the lateral ligaments in a few selected athletes, once the decision to stabilize an ankle has been made, a method could be a modified Brostrøm with a Gould modification. (Margheritini, 2011)

During a *Brostrom procedure* the patient will be put to sleep under general anaesthesia. Once asleep the surgeon, or a registered nurse, will thoroughly clean the area that will be operated on. They will then make all necessary incisions. Once the incisions are made they will repair any damaged lateral ankle ligaments in the hope of restoring the ankle back to its pre-injury state. This procedure can also include shortening and reattaching the lateral ligaments to reconstruct them. Once all of the repairs are made the surgeon will suture the incisions and apply any necessary bandages. (Bell, et al.)

Assessment of patients with lateral ankle sprain must address not only joint laxity and swelling, but should include examination for neuromuscular deficits as well. The treatment and rehabilitation goals must also address restoration of neuromuscular function, as well as restoration of mechanical stability to the injured joints. (Hertel, 2000)

2.5.2 Chronic ankle sprains

Appropriate management of a chronic sprain is not based on any standard procedure but on correction of the individual cause of instability. For example, peroneal tendon reconstruction had become a popular operative procedure for management of chronic ankle sprain, and its advocates report a relatively high success rate. However, reconstruction with the short peroneal tendon does not restore normal anatomic features, and it sacrifices in part or completely the most important dynamic stabilizer of the ankle. A basic rule for any proposed surgical procedure is that it must first pass the test of common sense, and peroneus brevis repairs of any kind do not. (Hansen, 2000)

The ankle is carefully evaluated to determine the cause of the abnormality. Bony alignment is assessed with the patient standing, and factors that predispose a patient to secondary hindfoot varus, such as hyperactivity in the peroneus longus, are rues out with dynamic tests. A trial of physical therapy or other nonoperative treatment is undertaken in an attempt to control lateral instability. Surgical intervention is indicated only when non-operative measures do not relive the patient's sense of instability or provide adequate relief of pain. (Hansen, 2000)

2.5.3 Rehabilitation phase

The acute or initial phase of rehabilitation should include management of effusion, pain control, and range of motion. The ankle should be placed in as much dorsiflexion as possible to keep the joint initially stable and to decrease capsular distention. During the first 3 weeks, the ankle should be protected from inversion to prevent formation of type III collagen, which leads to elongation of the ligaments. Exercises should be focused in the sagittal plane. Regaining range of motion in all planes is important early on, to stimulate collagen type I formation as it responds best to tension. (Kolt, et al., 2003)

Once pain and effusion are managed, rehabilitation should focus on full return of full range of motion, weight-bearing status and strength as tested with a manual muscle test. Elastic band or tubing exercises and modalities are common during this phase. Functional strengthening and proprioception should be the focus of rehabilitation once the transition from open to closed kinetic chain exercises has begun. (Kolt, et al., 2003) Sensomotoric exercises like wobble boards, trampoline jumping, unstable surface walking, Bosu ball and one leg standing is examples of therapies that can be used for increasing proprioception and stability.

2.6 Epidemiology and etiology of ankle sprains

2.6.1Epidemiology

- One per 10.000 in general population sustains ankle injury every day
- 7-10% of emergency room daily visits are linked to ankle sprains
- 40% of sports-related injuries are ankle sprains
- 4% of people in Western countries suffer ankle sprains
- 21 % of people sustaining ankle sprains are absent from school or work
- Recurrence rate of ankle sprains in athletes is approximately 80%
- 30 % of patients with ankle sprains develop functional instability. (Margheritini, 2011)

2.6.2 Etiology:

Lateral ankle sprains are common in sports, which require explosive jumping or running such as basketball, volleyball, soccer and football. Medial ankle sprains involving the deltoid ligament are less common.

Recurrent ankle sprains are caused by mechanical and functional instability. Mechanical instability is failure to achieve stabilization due to ligamentous instability, and functional instability is neuromuscular deficits that contribute to impaired balance. (Margheritini, 2011)

When LAS occurs, structural damage not only occurs to the ligamentous tissue, but also to the nervous and musculotendinous tissue around the ankle complex. While injury to the ligaments may result in laxity of the joints of the ankle complex, neuromuscular deficits are also likely to occur due to the injury to the nervous and musculotendinous tissue. These neuromuscular deficits may be manifested as impaired balance, reduced joint position sense, slower firing of the peroneal muscles to inversion perturbation of the ankle, slowed nerve conduction velocity, impaired cutaneous sensation, strength deficits and decreased dorsiflexion range of motion. Additionally, the abnormal formation of scar tissue after injury may lead to sinus tarsi syndrome or anterolateral impingement syndrome, which may also lead to functional instability of the ankle complex. (Hertel, 2000)

3. Special Part – Case Study

3.1 Methodology

My case study took place at Centrum Léčby Pohybového Aparátu Vysočany, Prague, from 06.02.12 until 17.02.12. The clinic specializes in post adult orthopedic surgery and sports traumatology rehabilitation. The clinic offers a wide range of therapeutical techniques and methods, including electrotherapy, hydrotherapy and a fully equipped fitness room. In cooperation with the rehabilitation clinic is an orthopedic surgery clinic.

My study was supervised by PhDr. Edwin Mahr PhD. and all examinations and therapeutically procedures were done in cooperation with him. A therapy room with a therapy bench was at disposal at supervisor's office. Before exercising, physiotherapeutic methods such as PIR, soft tissue techniques and PNF was performed on the therapy bench. A fully equipped exercise room with sensomotoric devices was used every session. Wobble boards, posturomed, Thera-bands and trampoline are examples of devices used. Treadmills and stationary bicycles was used in warm-ups.

The patient was in therapy six sessions over a two week period, and all sessions took place at CLPA.

My patient was informed that the work has been approved by the Ethics Committee of the Faculty of Physical Education and Sport at Charles University, Prague.

3.2 Anamnesis:

Performed 06.02.2012

Name: K.H Female

Date of birth: 1996

Height: 171 cm

Weight: 60 kg

BMI: 20

BP: N/A

Temperature: N/A

BF: N/A

Diagnosis:

S93.6 Chronic distortion of right ankle

Chief complaint:

Sharp pain in lateral and dorsal parts of right foot, under the lateral malleolus and towards the toes. The pain is not present when she is not using the foot.

History of present problem:

The patient had a distortion of ankle (oversupination) in May 2011 when playing a handball match. Started playing handball again with an ankle brace 3 weeks after the injury. In December 2011 the pain was so intense she had to stop playing, and has not trained since. Did an MRI of the foot in January, no rupture of ligaments or any structural damage found.

Personal/Medical history:

Diseases: No diseases

Injuries: No injuries

Operations: No previous operations

Abuses: None

Psychosocial history:

Work: She goes at school.

Hobbies: She plays handball active, trains with team 3-4 times pr. week.

Living conditions: Lives with her parents. 4. floor with elevator.

Family history: No known family diseases

Medications: No medications

Allergies: She is allergic to pollen. No kinesiotape allergies.

Previous rehabilitation:

2 weeks after injury she did 10 sessions with ultrasound, no other therapy was done. She did not see a physical therapist, only doctor. No more details regarding the ultrasound is obtained.

Health document extract:

N/A

Indications for rehabilitation from the doctor:

- Sensomotoric stimulation with regards to return to handball playing.

- Decrease pain

- Ultrasound, 1,5w/cm² 5 minutes, three times a week.

Differential consideration:

The patients pain originates from the trauma in her ankle may 2011, and to short rest period and use of a brace instead of letting the ankle heal may be the reason of why she has the chronic pain in the right ankle. Changes in muscle balance and compensatory movements may be the result of playing with pain for so long time. This could lead to overuse of certain muscles and lead to pain, muscle imbalance, restrictions in joint play. And this may further lead to altered gait pattern and basic movement patterns.

3.3 Initial Kinesiological examination:

Performed 06.02.2012

Scale test:

Right side	**Left side**
25 kg	35 kg
Total: 60 kg	

Table 2: Scale test

Postural examination:

Anterior:

- Narrow stance, feet touching
- Right leg in slight external rotation
- Slight elevated right shoulder
- Toes "grabbing" the floor

Posterior:

- Narrow stance, feet touching
- Slight valgus in both ankles
- Elevation of right shoulder

Lateral

- Longitudinal arch in both feet is low
- Protraction of shoulders
- Forward head position
- Hyper kyphosis in Th-spine
- Hyper-extended knees

Pelvis alignment:

Iliac crests: are in the same level

Anterior superior iliac spines: are in the same level

Posterior superior iliac spines: are in the same level

Slight anterior tilt of pelvis, which is physiological.

Palpation:

Muscles	**Right side**			**Left side**		
	Tonus	**Pain**	**Trg. point**	**Tonus**	**Pain**	**Trg. point**
Quadriceps	Normal	No	No	Normal	No	No
Hamstrings	Hyper	No	No	Normal	No	No
Adductors	Hyper	No	No	Normal	No	No
Gastrocnemius medial and lateral heads	Hyper	Yes	Yes	Hyper	Yes	Yes
Soleus	Hyper	No	No	Hyper	No	No
Tibialis anterior	Normal	No	No	Normal	No	No
Peroneus(longus/brevis)	Hyper	Yes	No	Normal	No	No
Plantar aponeurosis	Normal	Yes	No	Normal	No	No

Table 3: Palpation

ROM: According Kendall

	Right lower extremity		**Left lower extremity**	
Movement	**Active**	**Passive**	**Active**	**Passive**
Hip Flexion*	60°	75°	70°	85°
Hip Extension	10°	20°	10°	20°
Hip Adduction	10°	10°	10°	10°
Hip Abduction	25°	35°	35°	45°
Knee Flexion	120°	140°	120°	140°
Knee Extension	0°	5°	0°	5°
Plantar Flexion*	50°	50°	50°	50°
Dorsi Flexion*	10°	10°	15°	15°
Eversion*	10°	10°	15°	20°
Inversion*	5°	N/A	30°	35°

Table 4: ROM of lower extremity, initial examination

***Hip flexion with straight knee**

***Restrictions due to pain, when moving ankle and foot.**

Manual Muscle Testing: According Kendall

Muscles	**Right lower extremity**	**Left lower extremity**
Hip Flexion	5	5
Hip Extension	5	5
Hip Adduction	5	5
Hip Abduction	5	5
Knee Flexion	5	5
Plantar flexion*	4	5
Dorsiflexion*	4	5

Table 5: MMT of lower extremity

***performed with pain**

Joint play: According Lewitt

O= No blockage X= Blockage XX= Blockage with pain XXX= Impossible to perform due to pain.

Lower extremity joints		
	Right side	**Left side**
Sacroiliac joint	O	O
Tibiofibular posterior dir.	O	O
Tibiofibular anterior dir.	O	O
Knee posterior	O	O
Knee anterior	O	O
Patella	X (lateral dir.)	O
Tibiotalar	XXX	O
Choppart	XXX	O
Lisfranck	XXX	O
Metatarsals	XXX	O

Table 6: Joint play of lower extremity, initial examination

Anthropometric measurements:

Lengths	**Right lower extremity**	**Left lower extremity**
Anatomical length	90 cm	90 cm
Physiological length	101 cm	101 cm
Length of femur	47 cm	47 cm
Length of fibula	43 cm	43 cm
Circumference		
Calf	33 cm	33 cm

Ankle	26 cm	24 cm
Metatarsals	21 cm	21 cm

Table 7: Anthropometric measurement of lower extremities

Neurological examination:

Reflexes: scale 0-5, 3 is normal

Lower extremity		
	Right side	**Left side**
Patellar	2	3
Achilles	1*	3
Plantar	1*	3

Table 8: Neurological examination, initial examination

***Inhibited because of pain**

Examination of sensation: Dermatome L1-S2 was tested and compared in both legs. Dermatome L4-L5 was hypersensitive on right foot compared with left.

Gait

- In-line walking
- Weak step off of right foot
- Short steps
- Small rotation of trunk
- Limited dorsiflexion in right foot in swing phase
- Big toes in extension when heel touches floor, both feet
- 1.st metatarsals don't touch floor at same time as the rest of the metatarsals, over-supination.

Heel-walking was done without much pain, but with reduced dorsalflexion in right foot.

*not comfortable when walking in front of therapist.

Standing on Bosu Ball on right leg-test: Painful, waving with arms and did not hold the balance for more than 5 seconds at a time. Did not like it. This test will stand as a reference test to compare with in the final kinesological exam.

Examination Conclusion:

Scale-test was positive, she had a difference of 10 kg, with most loading on the left leg. In aspection I found low longitudinal arches, and a slight valgus in both feet. Narrow base standing, but with hyperactivity of toes for correction of instability. She is has hypertonic calf muscles, with trigger points. Together with hypertone and ROM limitations of hamstrings and adductors of right side tells of a safe contraction of right leg.

Peroneus longus/brevis on right side was painful when palpating, which indicates trauma of tendons after injury. No problems of strength in muscles of lower extremity, only limitations is due to pain in dorsiflex/plantar flexion/eversion and inversion in right ankle.

Joint play could not be performed in right foot due to pain, only blockage found was in right patella, lateral direction. Hypersensitivity in dermatomes L4-L5 on right leg. Pain and imbalance when doing the modified balance test on Bosu Ball.

Anthropometry showed a swelling in right ankle joint, of 2 cm in circumference. No discoloration present. Reflexes scored a lower score on the right side, pain present when testing Achilles and plantar reflex.

Gait shows difficulty in performing good stereotypical walking, not proper toe off and dorsiflexion in right foot, which could be a result of weak dorsi- and plantar flexors, together with pain inhibition. Instability when rolling the foot, leads to supination, and very active toe grabbing in both feet. Not able to walk on tip toe on right foot. Heel-walking was done without much pain, but with reduced dorsalflexion in right foot.

3.4 Rehabilitation Plan

Short-term rehabilitation plan:

- Reduce pain in right ankle by activation of muscles around ankle joint with sensomotoric exercises.
- Reduce hypertone and trigger points in right hamstrings and adductors using PIR.
- Reduce hypertone and trigger points in gastrocnemius and soleus using soft tissue techniques.
- Mobilization of right patella joint by using joint play technique by Lewitt
- No participation in handball training.

Long-term rehabilitation plan:

- Continue with sensomotoric exercises for prevention of repeated injury and increase stability of core muscles using deep stability exercises.
- Increase longitudinal arches in both feet by short foot and sensomotoric exercises.
- Provide patient with self therapy exercises for foot arches, and deep stability exercises for lower extremities.
- Reintroduce handball trainings when ankle is strong enough.

3.5 Therapy progress

3.5.1 Day to day therapy 06.02.2012

Date: 06.02.2012 Time: 09:00

Status:

Subjective:

Patient complaints of lot of pain in her right ankle, can walk without aids, but with a slight limping. Very shy girl, has to have her mother present during session. This week she is not going to school, because of winter holidays.

Objective:

Pain limited the examinations in ankle joint, but found hypertone and trigger points in right hamstring, adductor and gastrocnemius. Also very painful when palpating peroneus muscles on right leg. Overloading of left leg when standing showed by scale test.

Objective of the day:

First day of meeting, so mainly used for anamnesis and initial kinesiological examination. Start with therapy for reducing pain in the right ankle joint and reduce hypertone in right adductors, right hamstrings and gastrocnemius of both sides.

Therapy proposal:

According to findings in the initial kinesiological examination the therapy session is going to be focused on pain reduction in right foot, relaxation of right adductors, hamstrings and gastrocnemius.

Therapy execution:

1) Post isometric relaxation of adductors, right side.

2) Post isometric relaxation of hamstrings, right side.

3) Soft tissue techniques of gastrocnemius both sides.

4) Warm up on bicycle, 10 min.

5) Bosu-ball test, standing on right leg without support.

6) Exercise on walking on wobble boards with focus on the stereotypical walking pattern and correct posture.

7) Exercise on posturomed with correct gait pattern, walking over with stereotypical pattern, with one leg standing for a short time with elevated knee in middle of step. Focus on good roll of foot, with heel and toe off motions. Sideways step, on and off the posturomed , with both feet. 10 times each variant.

Self therapy:

Patient is instructed to work with grasping with toes with the use of Thera-band and nuts for improving the longitudinal arches in feet. And also avoid handball trainings in this period.

Conclusion of today's unit:

Patient was tired and felt pain in the ankle during the exercises so we ended session. 5 degrees of improvement in adduction and hip flexion was managed, but no improvement of tone and trigger points after soft tissue technique on the gastrocnemius. Bosu-ball test was painful and she did not manage to stand on one leg for more the 5 seconds at a time. Wobble boards was not easily performed, waving a lot with arms to keep balance and had problems with correct stereotypical walking and posture. Was frustrated when she felt that she couldn't do it well, and got tired fast. Limitations in dorsiflexion together with weak plantarflexors made the walking on the posturomed difficult with the desired walking pattern, so the next time we will make the descend more shallow, so she can do it with less dorsiflexion in ankle joint when stepping off.

3.5.2 Day to day therapy 08.02.2012

Date: 08.02.2012 Time: 09:00

Status:

Subjective:

Patient feels the same pain today as the first time, no changes. She did not do the exercises as told for self therapy.

Objective:

Still very painful when palpating ankle, can still not perform joint play examination in foot. Some improvement in ROM of adduction and flexion of the hip joint, but need more work. Calves are still in hypertone with trigger points, pain inhibits PIR of gastrocnemius. The circumference is still 2 cm more around the ankle joint on right side compared with left.

Objective of today:

Continue with sensomotoric exercises for activation of muscles around ankle and knee joint for better stabilization and reduction of pain. Relaxation of hypertonic muscles as last session. Improve movement of right patella in lateral direction. Work on stereotypical gait pattern.

Therapy proposal:

Sensomotoric exercises for ankle and knee joint stabilization. PIR on right hip flexors and adductors, and soft tissue technique on gastrocnemius. Mobilization of right patella in lateral direction. Walking on a flat, but soft mat, for gait training.

Therapy execution:

1) Post isometric relaxation of adductors, right side.

2) Post isometric relaxation of hamstrings, right side.

3) Soft tissue techniques of gastrocnemius both sides.

4) Joint play technique on right patella in lateral direction

5) Warm up on bicycle for 10 min

6) Bosu Ball test on one foot.

7) Stereotypical gait training on soft mat, with emphasis on correct posture of upper trunk, and correct rolling with heel and take-off with toes.

8) Exercise on Wobble boards, using the same gait pattern as we just learned

9) Exercise on posturomed with correct gait pattern, walking over with stereotypical pattern, with one leg standing for a short time with elevated knee in middle of step. Focus on good roll of foot, with heel and toe off motions. Sideways step, on and off the posturomed , with both feet. 10 times each variant.

10) Exercise on trampoline, swaying up and down and side to side, and with one foot in front of the other, and trying to break the movement. 10 times each variant

Conclusion:

Same improvement after PIR in hip joint with 5 degrees in flexion and adduction, patient is doing it well and we expect to see permanent changes soon. Patient has big trigger points in gastrocnemius in both sides, especially on lateral parts, and she is complaining of pain when doing soft tissue technique on the area. Left gastrocnemius released well, but right side is still in hypertone. Bosu Ball test showed some improvement, she could stand for a longer time without reaching for support. But the pain was still there and so was the waving of arms. Noticed under the trampoline exercise that her knees buckled when she was swaying up and down, so we had to abort the trampoline and chose to do a squat exercise for activation of hip and knee extensors instead. After walking on the soft mat and practicing on the gait pattern she did a better job on the wobble boards. The patient is not motivated when doing the exercises, and is hard to correct when not doing the exercise correctly. No improvement of joint play of right patella.

3.5.3 Day to day therapy 10.02.2012

Date: 10.02.2012 Time: 13:00

Status:

Subjective:

Patient feels there is less pain than last session when walking, but still very painful when palpating lateral side of foot. This time she said she did the self therapy on the day before.

Objective:

This time the improved ROM done last session in right hip flexion and adduction lasted. 5 degrees improvement than initial examination, tone of muscles much better then initial, but still limitations of ROM. No other changes. Still a slight swelling around the ankle joint, 2 cm more that left side.

Objective of today:

Continue with same therapy plan as last time. Also find exercises that can increase the motivation and then increase therapy output. Stretching of adductors and flexors of right hip. Work on gait and sensomotorics. Keep on working on mobilization of right patella. Reduce swelling and muscle tension around ankle joint. Start working with strengthening exercises for dorsi/plantarflexion and eversion of ankle joint for increased stability.

Therapy proposal:

Increase ROM in hip add. and hip flexion of right leg. Various sensomotoric exercises for increased stabilization of ankle and knee joints. Apply kinesiotape on right ankle joint for inflammatory fluid drainage, will also help restore normal muscle tension. Joint play therapy of right patella.

Therapy execution:

1) Stretching of right hip adductors.

2) Stretching of right biceps femoris and semitendinosus/semimembranous.

3) Mobilization of right patella in lateral direction.

4) Gait exercise on soft mats. Rolling from heel and toe off pattern.

5) Bosu ball test

6) Sensomotoric exercise, standing on bosu ball with both feet, with correct posture. Throwing a ball to the patient, for increasing the difficulty of the exercise.

7) Sensomotoric exercise, wobble board walking, same as previous sessions.

8) Strengthening of plantar flexors with use of overball against a wall, sitting position. 3X10 repetitions

9) Strengthening of dorsiflexors, using Thera-band and the patient is sitting with support of hands. Use wall bars for fastening the Thera-band to the foot, 3X10 repetitions

10) Strengthening in eversion, using Thera-band, in sitting position with Thera-band fastened to each of the feet. 3X10 repetitions.

11) Kinesiotape on right ankle joint, provided by supervisor PhDr. Edwin Mahr PhD. For stabilization of joint, and for prevention of oversupination.

Conclusion:

Today she felt much more confident in the exercises, the throwing of ball on the Bosu Ball increased motivation and she became much more responsive to corrections. Bosu Ball test improved, more concentrated and more quality in exercise. Technique and walking pattern on Wobble boards greatly improved. Got tired fast when doing the strengthening exercises, she will apply these in the self therapy plan, since she got the equipment needed at home. Felt a release in right patella today. Kinesiotape will stay on through the weekend.

3.5.4 Day to day therapy 13.02.2012

Date: 13.02.2012 Time: 14:00

Status:

Subjective:

Feels less pain in ankle when walking. She says the kinesiotape make her less nervous, so she can walk more normal. She has not done any exercises in the weekend, just rested.

Objective:

The limping is much less then the first session. Less pain when palpating, and allowed me to examine Choppart and Lisfranck joint of right foot, no blockage found. Swelling is gone, same circumference of ankles and metatarsals of both feet. ROM in right ankle joint not improved. Gastrocnemius improved tone in right leg, less pain when palpating calves. ROM in hip joint, 5 degrees improvement in adduction and flexion compared with initial exam. Therapy seems to be working on removal of pain and increase stability of ankle joint. More mobility of the right patella, but need more work.

Objective of today

Remove kinesiotape and continue with sensomotoric and strengthening exercises of lower extremity. Relaxation of right gastrocnemius muscle. Joint play therapy of right patella. Apply kinesiotape on ankle after session.

Therapy proposal

Sensomotoric exercises is as usual indicated, last session was positive, so we continue with the same exercises. PIR on gastrocnemius for the first time, since the pain threshold can allow us to perform it. PNF strengthening techniques can also be introduced. Continue work on increasing ROM in hip adduction and hip flexion of right side. Joint play therapy of right patella. Kinesiotape seemed to have a good effect so we will apply this at end of session.

Therapy execution:

1) PIR of right gastrocnemius.

2) Stretching of right hip adductors.

3) Stretching of right biceps femoris and semitendinosus/semimembranous.

4) Mobilization of right patella in lateral direction.

5) PNF, 2. Diagonal flexion and extension patterns.

6) Bosu ball test

7) Sensomotoric exercise, standing on Bosu ball with both feet, with correct posture. Throwing a ball to the patient for increased difficulty.

8) Sensomotoric exercise, Wobble board walking, same as previous sessions.

9) Strengthening of plantar flexors with use of overball against a wall, sitting position. 3X10 repetitions.

10) Strengthening of dorsiflexors, using Thera-band and the patient is sitting with support of hands. Use wall bars for fastening the Thera-band to the foot, 3X10 repetitions

11) Strengthening in eversion, using Thera-band, in sitting position with Thera-band fastened to each of the feet. 3X10 repetitions.

12) Kinesiotaping of right ankle joint, provided by supervisor PhDr. Edwin Mahr PhD. For stabilization of joint for prevention of oversupination.

Conclusion:

For the first time the patient was introduced to PNF techniques. The first time it was only an introduction to the movements, and the patient had some difficulties in performing it in a correct manner, and she could not perform the diagonals to the full extent due to restricted ROM and pain. Patient however showed good muscle coordination and muscle strength. She is getting comfortable with the techniques of the sensomotoric exercises and the strengthening exercises for the ankle. She can now stand on the Bosu ball on her right leg without having to abort due to pain. Patella is less restricted to lateral direction, so the joint play therapy seems to be working fine.

3.5.5 Day to day therapy 15.02.2012

Date: 15.02.2012 Time: 08:00

Status:

Subjective:

More pain in foot today, and when confronted with the question if she had done some exercises last day, she said that she had joined with her handball team in training. She was not running and playing, but was shooting alone at a goal. She felt the foot was good enough to start slow handball training again, but when she got home the old pain returned.

Objective:

Pain in palpation is like it was last week, with additional pain in right knee because of a blow to the knee when playing with friends. This pain in the knee increases her limping. Patella is now painful when palpation too, so could not check the restriction. This is a setback in the therapy. Told patient again that she must refrain from handball trainings while in therapy. PIR of gastrocnemius is not possible today because of the pains. No swelling has returned.

Objective of today

Start over again with pain free sensomotoric exercises and stretching of short muscles in right hip joint. Remove kinesiotape before and apply new one after end of session. PNF is also contraindicated today because of pain. Work on the hypertone in gastrocnemius right side.

Therapy proposal

Start with easy and pain free exercises like gait training on soft mats, and sensomotoric exercises. Stretching of short muscles in hip joint. Soft tissue technique on right gastrocnemius.

Therapy execution

1) Soft tissue techniques of gastrocnemius right side.

2) Stretching of right adductors and right hamstrings.

3) Bosu ball test.

4) Sensomotoric training on wobble boards.

5) Gait training on soft mats

Conclusion:

Since the setback in pain, we did make this session a short one, so she can recover. The pain diminished during the session so we hope she is back on track for the next and last session in two days. She has improved a lot in technique, so she is training well. Bosu ball test was as expected, painful.

3.5.6 Day to day therapy 17.02.2012

Date: 17.02.2012 Time: 14:00

Status:

Subjective:

Feeling a lot better since last session, did the home therapy and knee pain is almost gone. She says she understands now that this healing process takes time, and she promise to follow the recommendations given by therapist.

Objective:

Looks like the patient is back on track, no big limping when using the kinesiotape. Right patella is moving well to the lateral side with some pain after the small injury she had earlier this week. Checked the right hip adduction and hip flexion, a 10 degree improvement from initial examination in both movements. Most important, the pain has been reduced. Still painful when palpating, but the reduction of pain has made the ankle more functional and she is able to trust it more. Swelling is still down and the circumference is equal to the left side.

Objective of today:

This session will largely be used for the final kinesological examination. Continue with strengthening exercises of plantar-dorsiflexion and eversion in ankle joint. Sensomotoric training is also indicated today as the previous sessions.

Therapy execution:

1) Strengthening of plantar flexors with use of overball against a wall, sitting position. 3X10 repetitions.

2) Strengthening of dorsiflexors, using Thera-band and the patient is sitting with support of hands. Use wall bars for fastening the Thera-band to the foot, 3X10 repetitions

3) Strengthening in eversion, using Thera-band, in sitting position with Thera-band fastened to each of the feet. 3X10 repetitions.

4) Bosu ball test

5) Sensomotoric exercise, standing on Bosu ball with both feet, with correct posture. Throwing a ball to the patient for increased difficulty.

6) Sensomotoric exercise, Wobble board walking, same as previous sessions.

Conclusion:

This last session was positive, and the pain she got from the handball training earlier in the week was gone. Patient is more confident, and was training without her mother beside her this time, and did a better job exercising. She wanted to improve the technique and listened to corrections very well. Big improvement on the Bosu ball test, no pain when standing on right leg, with correct posture. Confident on the Wobble boards, no waving with hands and good stereotypical walking pattern was seen. She is also doing the strengthening exercises with the Thera-band at her home. Did not have time for stretching today, but she has shown a good improvement in ROM of hip abduction and hip flexion the last two weeks, this will make her gain a better and more correct walking pattern.

3.6 Final Kinesiological examination:

Performed 17.02.2012

Changes from the Initial Kinesiological Examination are marked with bold letters

Scale test:

Right side	**Left side**
29 kg	**32 kg**
Total: **61 kg**	

Table 9: Scale test, final examination

Postural examination:

Anterior:

- **Still a narrow stance, but her feet is not touching**

- Right leg in slight external rotation

- Slight elevated right shoulder

- **No "grabbing" of toes as in initial examination.**

Posterior:

- **Still a narrow stance, but her feet is not touching**

- Slight valgus in both ankles

- Elevation of right shoulder

Lateral

- Longitudinal arch in both feet is low

- Protraction of shoulders

- Forward head position

- Hyper kyphosis in Th-spine

- Hyper-extended knees

Pelvis alignment:

Iliac crests: are in the same level

Anterior superior iliac spines: are in the same level

Posterior superior iliac spines: are in the same level

Slight anterior tilt of pelvis, which is physiological.

Palpation:

Muscles	**Right side**			**Left side**		
	Tonus	**Pain**	**Trg. point**	**Tonus**	**Pain**	**Trg. point**
Quadriceps	Normal	No	No	Normal	No	No
Hamstrings	**Normal**	No	No	Normal	No	No
Adductors	**Normal**	No	No	Normal	No	No
Gastrocnemius medial and lateral heads	Hyper	**Yes***	**Yes***	Hyper	**No**	**No**
Soleus	Hyper	No	No	Hyper	No	No
Tibialis anterior	Normal	No	No	Normal	No	No
Peroneus(longus/brevis)	Hyper	Yes	No	Normal	No	No
Plantar aponeurosis	Normal	**No**	No	Normal	No	No

Table 10: Palpation, final examination

***Still painful, but better then initial examination**

ROM: According Kendall

	Right lower extremity		**Left lower extremity**	
Movement	**Active**	**Passive**	**Active**	**Passive**
Hip Flexion*	**70**°	**80**°	70°	85°
Hip Extension	10°	20°	10°	20°
Hip Adduction	10°	10°	10°	10°
Hip Abduction	**35**°	**45**°	35°	45°
Knee Flexion	120°	140°	120°	140°
Knee Extension	0°	5°	0°	5°
Plantar Flexion*	50°	50°	50°	50°
Dorsi Flexion*	10°	10°	15°	15°
Eversion*	**15**°	**20**°	15°	20°
Inversion*	**15**°	**20**°	30°	35°

Table 11: ROM of lower extremities, final examination

***Hip flexion with straight knee**

Manual Muscle Testing: According Kendall

Muscles	**Right lower extremity**	**Left lower extremity**
Hip Flexion	5	5
Hip Extension	5	5
Hip Adduction	5	5
Hip Abduction	5	5
Knee Flexion	5	5
Plantar flexion	**5**	5
Dorsiflexion	**5**	5

Table 12: MMT of lower extremities, final examination

Joint play: According Lewitt

O= No blockage X= Blockage XX= Blockage with pain XXX= Impossible to perform due to pain.

Lower extremity joints		
	Right side	**Left side**
Sacroiliac joint	O	O
Tibiofibular posterior dir.	O	O
Tibiofibular anterior dir.	O	O
Knee posterior	O	O
Knee anterior	O	O
Patella	**O**	O
Tibiotalar	XXX	O
Choppart	**O**	O
Lisfranck	**O**	O
Metatarsals	XXX	O

Table 13: Joint play of lower extremities, final examination

Anthropometric measurements:

Lengths	**Right lower extremity**	**Left lower extremity**
Anatomical length	90 cm	90 cm
Physiological length	101 cm	101 cm
Length of femur	47 cm	47 cm
Length of fibula	43 cm	43 cm
Circumference		
Calf	33 cm	33 cm
Ankle	**24 cm**	24 cm

Metatarsals	21 cm	21 cm

Table 14: Anthropometric measurement, final examination

Neurological examination:

Reflexes: scale 0-5, 3 is normal

Lower extremity		
	Right side	**Left side**
Patellar	2	3
Achilles	**2**	3
Plantar	**2**	3

Table 15: Neurological examination, final examination

Examination of sensation: Dermatome L1-S2 was tested and compared in both legs. Dermatome L4-L5 was still hypersensitive on right foot compared with left as in initial examination.

Gait

- In-line walking
- **Better step-off of right foot compared with initial examination**
- **Short steps, but with better stereotypical pattern of gait**
- Small rotation of trunk
- **Dorsiflexion of right foot in swing phase is visible smaller, but greater than the initial examination.**
- Big toes in extension when heel touches floor, both feet
- **1.st metatarsals touches the floor together with the rest of the metatarsals, no marked supination in feet.**

Heel-walking was done without pain, but with a slight lesser dorsiflexion of right foot.

***Standing on Bosu Ball on right leg-test*: Big improvement, can stand on right leg without much pain, and shows better stability and balance. Small movement of upper extremities and can hold a correct posture.**

3.7 Evaluation of the Effects of Therapy

Tables of the changes during therapy.

Scale test

	06.02.2012	**17.02.2012**
Difference in left and right loading of legs	10 kg more on left (positive)	**3 kg more on left (negative)**

Table 16: Scale test, evaluation

Postural examination:

	06.02.2012	**17.02.2012**
Anterior		
	Narrow stance, feet touching	**Still a narrow stance, but her feet is not touching**
	Right leg in slight external rotation	Right leg in slight external rotation
	Slight elevated right shoulder	Slight elevated right shoulder
	Toes "grabbing" the floor	**No "grabbing" of toes as in initial examination.**
Posterior		
	Narrow stance, feet touching	**Still a narrow stance, but her feet is not touching**
	Slight valgus in both ankles	Slight valgus in both ankles
	Elevation of right shoulder	Elevation of right shoulder
Lateral		
	Longitudinal arch in both feet is low	Longitudinal arch in both feet is low
	Protraction of shoulders	Protraction of shoulders
	Forward head position	Forward head position
	Hyper kyphosis in Th-spine	Hyper kyphosis in Th-spine
	Hyper-extended knees	Hyper-extended knees

Table 17: Postural examination, evaluation

Pelvis examination:

	06.02.2012	17.02.2012
Crista	Level	Level
SIAS	Level	Level
SIPS	Level	Level

Table 18: Pelvis examination, evaluation

Palpation:

Right lower extremity only

Muscles	**06.02.2012**			**17.02.2012**		
	Tonus	**Pain**	**Trg. Point**	**Tonus**	**Pain**	**Trg. Point**
Quadriceps	Normal	No	No	Normal	No	No
Hamstrings	Hyper	No	No	**Normal**	No	No
Adductors	Hyper	No	No	**Normal**	No	No
Gastrocnemius medial and lateral heads	Hyper	Yes	Yes	Hyper	**Yes***	**Yes***
Soleus	Hyper	No	No	Hyper	No	No
Tibialis anterior	Normal	No	No	Normal	No	No
Peroneus(longus/brevis)	Hyper	Yes	No	Hyper	Yes	No
Plantar aponeurosis	Normal	Yes	No	Normal	**No**	No

Table 19: Palpation, evaluation

ROM:

Right extremity only:

	06.02.2012		**17.02.2012**	
Movement	**Active**	**Passive**	**Active**	**Passive**
Hip Flexion*	60°	75°	**70°**	**80°**
Hip Extension	10°	20°	10°	20°
Hip Adduction	10°	10°	10°	10°
Hip Abduction	25°	35°	**35°**	**45°**
Knee Flexion	120°	140°	120°	140°
Knee Extension	0°	5°	0°	5°
Plantar Flexion*	50°	50°	50°	50°
Dorsi Flexion*	10°	10°	10°	10°

Eversion*	10°	10°	**15°**	**20°**
Inversion*	5°	N/A	**15°**	**20°**

Table 20: ROM of lower extremities, evaluation

Manual Muscle Testing: According Kendall

Right lower extremity

Muscles	**06.02.2012**	**17.02.2012**
Hip Flexion	5	5
Hip Extension	5	5
Hip Adduction	5	5
Hip Abduction	5	5
Knee Flexion	5	5
Plantar flexion	4	**5**
Dorsiflexion	4	**5**

Table 21: MMT of lower extremities, evaluation

Joint play: According Lewitt

O= No blockage X= Blockage XX= Blockage with pain XXX= Impossible to perform due to pain.

Right lower extremity only:

Lower extremity joints		
	06.02.2012	**17.02.2012**
Sacroiliac joint	O	O
Tibiofibular posterior dir.	O	O
Tibiofibular anterior dir.	O	O
Knee posterior	O	O
Knee anterior	O	O
Patella	X (lateral dir.)	**O**
Tibiotalar	XXX	XXX
Choppart	XXX	**O**
Lisfranck	XXX	**O**
Metatarsals	XXX	XXX

Table 22: Joint play of right lower extremity, evaluation

Anthropometric measurements:

Lengths	**06.02.2012**	**17.02.2012**
Anatomical length	90 cm	90 cm
Physiological length	101 cm	101 cm
Length of femur	47 cm	47 cm
Length of fibula	43 cm	43 cm
Circumference		
Calf	33 cm	33 cm
Ankle	26 cm	**24 cm**

Table 23: Anthropometric measurement of lower extremities, evaluation

Neurological examination:

Right extremities only:

Reflexes: scale 0-5, 3 is normal

Lower extremity		
	06.02.2012	**17.02.2012**
Patellar	2	3
Achilles	**2**	3
Plantar	**2**	3

Table 24: Neurological examination, evaluation

Gait:

06.02.2012	17.02.2012
In-line walking	In-line walking
Weak step off of right foot	**Better step-off of right foot compared with initial examination**
Short steps	**Short steps, but with better stereotypical pattern of gait**
Small rotation of trunk	Small rotation of trunk
Limited dorsiflexion in right foot in swing phase	**Dorsiflexion of right foot in swing phase is visible smaller, but greater than the initial examination.**
Big toes in extension when heel touches floor, both feet	Big toes in extension when heel touches floor, both feet
1.st metatarsals don't touch floor at same time as the rest of the metatarsals, over-supination.	**1.st metatarsals touches the floor together with the rest of the metatarsals, no marked supination in feet.**
Heel-walking was done without much pain, but with reduced dorsalflexion in right foot.	**Heel-walking was done without pain, but with a slight lesser dorsiflexion of right foot.**

Table 25: Gait evaluation

From these results and the author's subjective opinion the PIR of the hip joint together with the sensomotoric training had the most positive effect for this patient. The prominent pain reduction is believed to be the result of the increased stability and pain free exercises provided in the two weeks of therapy.

4. Conclusion

This patient was chosen for me because she had an interesting injury related to sport, which I would like to learn more about. What looked like a straight forward case of a sprained ankle, had a twist when I found out that initial injury happened 9 months ago. She had neglected to take care of the sprained ankle after the injury and started to play handball with a brace 3 weeks after the accident. Continued to play with pain for 6 months more until the pain got so bad that she had to stop due to the pains. In this period she have overloaded her left foot and gained a general safe contraction in her right leg, and an altered gait pattern as a result.

Her complaints mainly concerned the pain around the right ankle joint and towards the lateral border of the foot. In my initial examination I found trigger points and hypertonicity in both calves, and they were very painful. Peroneus muscles of the right side was also painful on palpation. The pain hindered me to check the joint play of the right foot. ROM limitations in hip flexion and hip abduction was a result of the safe contraction due to the pain when walking.

My choice of therapy was to reduce the pain, increase ROM in hip joint and relax muscles in hypertone with trigger points. PIR was my choice of therapy when I wanted to relax muscles and release trigger points. Followed with sensomotoric training for removal of pain and increase stability in the joints in ankle/knee/hip. When I have released trigger points and gain normal tone in muscles, stretching was induced to increase the ROM further. When pain was reduced enough, she started with light strength training of the ankle joint to further increase stability and improve confident in her ankle. PNF was briefly introduced and will be used more in the long term plan.

When comparing initial and final examination, I could see an improvement already in the first examination, scale test was now negative with only 3 kg in difference. ROM in hip joint is now similar as the left side. Pain is much less in the ankle joint, and that allow her to change her gait and is now able to train more intensive than before. Bosu ball test shows the same, much better stability than first session.

Hypertone and trigger point therapy was not as successful as intended, soft tissue was applied when PIR was contraindicated due to pain, and this had not the desired effect. So there is still something to work with regarding hypertonic muscles and trigger points, especially in the right gastrocnemius and peroneus muscle.

For future therapies, exercises focusing on the deep stabilization system of lower extremities, is advised. Not only focus on the right leg, but create symmetry and good cooperation of both legs, for prevention of muscle imbalance in the future.

The flatfoot issue was not addressed in the short therapy plan, but the patient have been showed several self therapies for improving the arches. The patient have also Thera-band at home and she will continue to exercise the same as we did in the sessions. The patient was positively receptive to new techniques, and understood instructions without noticeable difficulties, and was able to follow them.

During the first week the patient disregarded my advice on staying away from the handball trainings, similar behavior that have caused her the problems in the first place, but I think after our last session she understood the importance of use the time required to heal her ankle. She can see and feel the therapy working and she is in good spirit and will be able to get back to handball playing again without complications if she will continue with my long term plan and therapy.

5. List of literature

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6. Appendixes

6.1 Appendix 1 - Approved application for Ethics Board Review

CHARLES UNIVERSITY IN PRAGUE
FACULTY OF PHYSICAL EDUCATION AND SPORT
José Martího 31, 162 52 Praha 6-Veleslavín
tel. +420 2 2017 1111
http://www.ftvs.cuni.cz/

Application for Ethics Board Review

of the research project, doctoral research, master degree research, undergraduate research, involving human subjects

Project title: Chronic ankle distortion

Nature of the research project: Bachelor thesis

Author : Øyvind Henriksen

Supervisor Mgr. Lenka Satrapova

Research project description: Case study of physiotherapy treatment of a patient with a chronic distortion of right ankle, after handball accident last summer (2011), will be conducted under the expert supervision of an experienced physiotherapist at Centrum Léčby Pohybového Aparátu.
Guaranteed safety to be judged by experts:
No invasive methods will be used.
Ethical aspects of the research:
Personal data obtained during the investigation will not be published.
Informed consent (attached)

Date: Author's signature:

Faculty of Physical Education and Sport, Charles University in Prague
ETHICS BOARD REVIEW

Ethics Board members: Doc. MUDr. Staša Bartůňková, CSc.
Prof. Ing. Václav Bunc, CSc.
Prof. PhDr. Pavel Slepička, DrSc.
Doc. MUDr. Jan Heller, CSc.

The Ethics Board at the Faculty of Physical Education and Sport, Charles University, approved the research project.
Approval number: 061/2012
Date: 17.2.2012

The Ethics Board at the Faculty of Physical Education and Sport, Charles University, reviewed the submitted research project and **found no contradictions with valid principles**, regulations and international guidelines for biomedical research involving human subjects.

The chief investigator of the project met the necessary requirements for receiving the Ethics Board approval.

Official school stamp

UNIVERZITA KARLOVA v Praze
Fakulta tělesné výchovy a sportu
José Martího 31, 162 52, Praha 6
1

Signature, REB Chairman

6.2 Appendix 2 - Informed consent form

INFORMOVANÝ SOUHLAS

V souladu se Zákonem o péči o zdraví lidu (§ 23 odst. 2 zákona č.20/1966 Sb.) a Úmluvou o lidských právech a biomedicíně č. 96/2001, Vás žádám o souhlas kvyšetření a následné terapii. Dále Vás žádám o souhlas knahlížení do Vaší dokumentace osobou získávající způsobilost k výkonu zdravotnického povolání v rámci praktické výuky a s uveřejněním výsledků terapie v rámci bakalářské práce na FTVS UK. Osobní data v této studii nebudou uvedena.
Dnešního dne jsem byla odborným pracovníkem poučena o plánovaném vyšetření a následné terapii. Prohlašuji a svým dále uvedeným vlastnoručním podpisem potvrzuji, že odborný pracovník, který mi poskytl poučení, mi osobně vysvětlil vše, co je obsahem tohoto písemného informovaného souhlasu, a měla jsem možnost klást mu otázky, na které mi řádně odpověděl.
Prohlašuji, že jsem shora uvedenému poučení plně porozuměla a výslovně souhlasím s provedením vyšetření a následnou terapií. Souhlasím s nahlížením níže jmenované osoby do mé dokumentace a s uveřejněním výsledků terapie v rámci studie.

Datum:.....
Osoba, která provedla poučení:.....
Podpis osoby, která provedla poučení:.....
Vlastnoruční podpis pacienta /tky:.....

6.3 Appendix 3 - List of tables

6.4 Appendix 4 - List of Abbreviations

ABD- Abduction

ADD- Adduction

BMI- Body mass index

CLPA- Centrum Léčby Pohybového Aparátu Vysočany (clinic)

Cm- Centimeter

E.g.- Exempli gratia=for the sake of example=for example

ER_ External rotation

FTVS- Fakulta Telesne Vychovy a Sportu

IR- Internal rotation

Kg- Kilogram

Min- Minutes

N/A- Not applicable/Not available

PIR- Post isometric relaxation

PNF- Post neuromuscular facilitation

ROM- Range of motion