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CLINICAL ASSESSMENT:
Chronic Ankle Instability

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INTRODUCTION

Chronic ankle instability (CAI) can be a challenging problem in podiatric practice. In some clinical settings, the treatment goal of an acute ankle sprain is limited to having the patient return to functional activity. It is often overlooked that complete healing requires a restoration of proprioception and a failure to address this can lead to CAI.

Hertel (2002) has described that CAI and recurrent ankle sprains can result from mechanical instability, functional instability or a combination of the two (Figure 1).

Mechanical Instability

Pathologic Laxity
Arthrokinematic Restrictions
Degenerative Changes
Synovial Changes

Functional Instability

Impaired Proprioception
Impaired Neuromuscular Control
Strength Deficiency
Impaired Postural Control

Mechanical Instability + Functional Instability =
Recurrent Ankle Sprains

Figure 1: Chronic Ankle Instability Etiological Factors

Mechanical instability describes either excessive ligament laxity, osteophyte spurring and/or soft tissue impingement that can alter the range of motion of the ankle. Functional instability can be attributed to proprioceptive deficits that alter neuromuscular control. The essential elements of the neuromuscular control mechanism in the ankle are: 1) proprioception, 2) balance and postural control, 3) muscle reaction time, and 4) muscular strength. The somatosensory system is composed of the ligament mechanoreceptors and sensory nerves around the ankle, and the mechanoreceptors in the plantar aspect of the foot. The signals from these receptors are sent to the muscles of the leg to control posture.

ASSESSMENT

Postural Control:

Postural control assessment is often included in the evaluation of functional instability of the ankle. A loss of postural control may contribute to future injury and is an indicator for a loss of functional control. Deficits in posture control are a common finding amongst patients suffering with CAI (Hertel, 2002).

Assessment of postural control can be performed in the clinical setting by having the patient perform a modified Romberg test (Figure 2). While performing the test: the patient stands on one foot, the arms are folded over the chest and the test is repeated with eyes open and closed.

Figure 2: Modified Romberg Test

Balance exercises may also be an effective means of preventing recurrent ankle sprains. Researchers (McGuine and Keene, 2006) have reported that balance exercises, with and without visiual stimuli, can lead to a greater prevention of subsequent ankle sprains compared to more conventional strength and conditioning exercise modalities.

Postural control can be analyzed using stabilometry methods. These analyses involve quantifying the mediolateral (M-L) and anteroposterior (A-P) trajectory of the center of pressure (COP) using a force platform. The two variables of interest are the magnitude and velocity of the deviation of the COP during single-leg stance.

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Figure 3: Postural Control Assessment

Clinically, the MatScan® (Tekscan, Inc.) can be used for the assessment of postural control (Figure 3). Patients can be prescribed exercises to enhance postural stability by maintaining a one-legged stance position (eyes closed) for 30 seconds while attempting to minimize postural sway. Visually, the patient can use this device and computer screen to receive immediate feedback on COP trajectory (Figure 4).

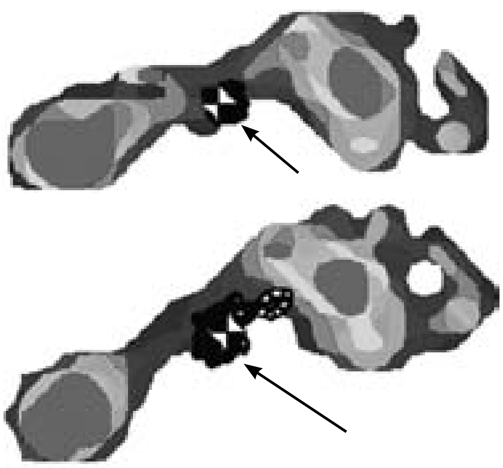

Figure 4: Center of Pressure Trajectory: decreased (top) and increased (bottom) variability

The importance of the human foot as a sensory organ for balance has been reported in several studies (Magnusson et al., 1990; Thoumie and Do, 1996). These types studies involve *blocking* afferent input from the plantar aspect of the feet by cooling, anesthesia, or an applied ischemic device. Studies report that an increase in postural sway occurs with the loss of sensory input from the foot. The signals sent from plantar foot receptors in response to changes in pressure and vibration influence postural sway through the activation of the lower leg musculature.

Muscular Strength:

Peroneal muscle weakness has been associated with lateral ankle instability. The peroneal muscles act concentrically to evert the foot relative to the leg (ankle eversion) and act eccentrically to resist inversion of the foot relative to the leg (ankle inversion).

During the loading phase when the acute sprains typically occur, eccentric muscle action is very important in resisting angular rotations about joints. Leg muscles function eccentrically (produce force while lengthening) to stabilize the ankle to resist ankle inversion and eversion movement patterns. In a recent study by Munn et al (2003), eccentric muscle action was analyzed in the peroneals in subjects with LAI and strength deficits were revealed.

Subtalar Joint Axis Orientation Assessment:

Clinically mapping the subtalar joint axis (STJA) orientation may help to identify those individuals with a lateral deviated subtalar joint axis and, thus, those who may be susceptible to an increased external ankle inversion moment (Figure 5).

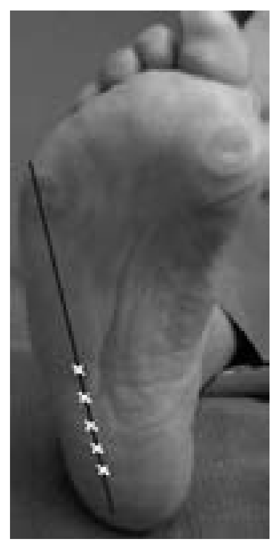

Figure 5: STJA Mapping

Fuller (1999) postulated that individuals with a rigid, supinated foot type may have a laterally-deviated STJA and that this could predispose an individual to lateral ankle sprains. Uncompensated and partially compensated rearfoot varus, rigid forefoot valgus and a rigid plantar flexed 1st ray deformity may predispose the ankle to inversion. In addition, it is plausible that these conditions may predispose the ankle to recurrent ankle sprains and CAI.

CASE STUDY:
Chronic Ankle Instability

CASE STUDY

History:

A 30 year old, male school teacher presented to the clinic describing: 1) right-side ankle and knee pain (12 mos. duration), 2) lateral lower leg and thigh muscle tightness/ discomfort, and 3) a pain level of 5/10 on a visual pain scale (VPS).

The patient also described that he was more comfortable when standing in supinated position and that he had a history of iliotibial friction syndrome. The gentleman was a runner and typically ran 20-40 kilometers per week in Saucony running shoes. Previously, the patient had worn foot orthoses.

Gait Analysis and Physical Examination:

Gait analysis revealed that the gentleman walked with a wide base of gait and that the calcaneus was inverted at foot contact. A supine and prone examination revealed:

- A laterally-deviated STJA (Figure 6)
- Peroneal muscle weakness due to overuse
- Rearfoot inversion relative to the leg
- Bilateral plantar flexed 1st ray

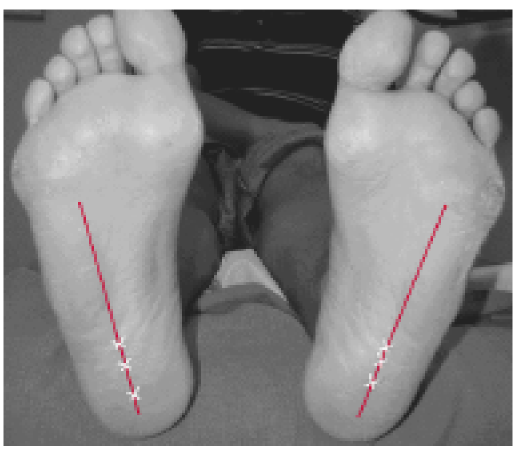

Figure 6: STJA Orientation

In a standing position, the patient exhibited:

- Tibial varum
- Within normal limits (WNL) hallux dorsiflexion
- WNL resupination test
- Inverted resting calcaneal stance position (RCSP)
- STJ not maximally pronated in RCSP
- WNL single heel raise
- Modified Romberg maintained until 5 seconds with eyes closed

Diagnosis:

Peroneal muscle overuse syndrome secondary to rearfoot varus and a plantar flexed 1st ray.

Exercise Prescription:

A daily, modified Romberg exercise was prescribed with the goal of attaining minimal postural sway for 30 seconds (with eyes closed). Single heel raise exercises were recommended until the patient was able to lift the heel off the ground without becoming unstable. Theraband® peroneal muscle strengthening was also prescribed.

Foot Orthotic Prescription:

The prescription included:

- Standard *Functional,* with a XT Sprint® orthotic shell and an extrinsic rearfoot post
- Intrinsically posted to calcaneal vertical (moderate cast dressing)
- 1st Met cut-out with an extrinsic supporting post
- Reverse Morton's extension (with 5th met cut-out)
- Lateral flange, lateral EVA arch fill and a Poron *sweet spot* for the base of the 5th metatarsal

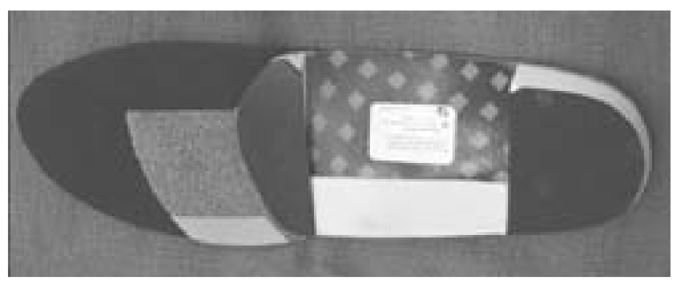

Figure 7: Custom Foot Orthoses

Follow up:

6 months: Patient was able to run a 1/2 marathon event and had recently joined the Canadian Armed Forces Reserve.

24 months: Patient returned with a recurrence of previous symptoms and a new complaint of right, plantar fascial irritation (9/10 on the visual pain scale). Symptoms exacerbated by increased training requirement with the Armed Forces.

The initial follow up involved replacing the lateral arch fill with a high density material and after 4 weeks the pain report on the VPS improved to 5/10. The patient was then recasted and new orthoses were designed that included the high density, lateral arch fill and a right plantar fascial accommodation.