

eAppendix.

Rehabilitation Program After Hallux Valgus Surgery

Pichler F.G., Schuh R.

Foot and Ankle Center Vienna

Cryo-cuff (Aircast, DonJoy Orthopaedics, Austria) was applied for 8 hours starting immediately after surgery and on the first postoperative day. This treatment was conducted as an inpatient treatment. Postoperatively, patients were placed in the Rathgeber (OFA Bamberg GmbH, Bamberg, Germany) postoperative shoe for 4 weeks. This shoe allows weight bearing of the operated limb while reducing stress of the forefoot region. Patients also received a special sock (Gilofamed, OFA Austria, Salzburg, Austria) that reduces swelling and the need for dressing changes. Physical therapy treatment was performed by 3 licensed physical therapists following the same treatment protocol. The first session started at 4 weeks after surgery, and there was one session per week.

Session 1

In the first session, elevation of the leg, lymphatic drainage, activation of the muscle pump, and cryotherapy (cool packs) were used to reduce the swelling. Patients also were told to perform these actions at home once a day for 20 minutes.

Lymphatic Drainage

Each patient was placed in the supine position. Lymphatic drainage was performed starting from the anterior cervical region at the fossa supraclavicularis using the poncage technique (careful friction) to stimulate the supraclavicular lymph nodes in order to increase autonomic rhythmic contractions of these nodes. Additionally, the patient was instructed to perform deep inspiration with the therapist's hands on the lower rib cage. The aim of this intervention was to stimulate the diaphragm to increase lymphatic flow toward the cisterna chyli and thoracic duct. The next step was to use the technique described previously for the inguinal lymphatic nodes for continuing with the adductor region, stimulating the popliteal region (popliteal lymphatic nodes) and the calf. After this the therapist started working around the malleolar region and forefoot and finished with a couple of effleurages from the toes to the inguinal region. The lymphatic drainage had an average duration of 20 minutes. The aim of this treatment modality was to prolong the effect of lymphatic contractions over the treatment period.

Activation of the Muscle Pump

For the activation of the muscle pump, each patient was instructed to do repetitive plantar flexion and dorsiflexion of the ankle as well as flexion and extension of the hip and knee. This treatment was performed for approximately 5 minutes. The patient also was told to perform these exercises at least 5 times a day at home.

Scar Tissue Massage

The physical therapist performed scar tissue massage with the fingers, trying to mobilize the tissue from side of ease to side of barrier until a tissue release was evident. The goal of this treatment option was to get a convex skin fold in the scar region and, therefore, avoid pathologic tissue connection. Additionally, the aim was to improve elasticity to ease neoangiogenesis. The scar tissue massage had a duration of 5 minutes. The patient was instructed to perform this exercise at least 3 minutes a day at home.

Cryotherapy

Cryotherapy was performed with ice or cool packs at the first metatarsophalangeal (MTP) joint region as well as the forefoot. The goal of this intervention was to decrease pain. In this session, the intervention had a duration of 5 minutes.

Mobilization

Mobilization was performed at all MTP joints. These manipulations focused on the improvement of plantar flexion for MTP joints 2–5 and on the improvement of dorsiflexion for the first MTP joint. They included caudal sliding of the proximal phalanx to improve plantar flexion and dorsal sliding of the proximal phalanx to improve dorsiflexion (Fig. 3).

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These mobilizations were performed either as described or by shifting the metatarsus and stabilizing the phalanx. Mobilization with movement (manual support of functional sliding mechanism combining active motion of the patient) also was performed.

Manual Therapeutic Interventions

Oscillating traction was performed to activate the mechanoreceptors that inhibit the afferent pain sensors. The main region of this treatment option was the MTP joints. The proximal hand was placed close to the MTP joint line in order to stabilize the metatarsus, while the distal hand was placed on the proximal phalanx. The oscillating traction combined with the mobilization had a duration of 5 minutes.

Gait Training

In this session, the main goal of gait training was to reach optimal load distribution for the whole foot during the entire stance phase, with special focus on weight bearing of the first MTP joint and hallux. Gait training was performed for a duration of 5 minutes.

Session 2

Mobilization

Mobilization of the MTP joints was performed as described for the first session. Additionally, pronation of the forefoot while stabilizing the calcaneus was performed. The physical therapist also performed isolated caudal glides of the navicular toward the talus, the cuneiform toward the navicular, and the first metatarsal toward the cuneiform. For this treatment, the patient was placed in a supine position. The physical therapist's distal hand stabilized the plantar aspects of the manipulated regions, while the proximal hand was applying longitudinal force focusing on the specific joint (imitating the translating movements in the metatarsus). Additionally, pronation was performed in an active assisted manner (the therapist used the pronation of the forefoot, and the patient tried to participate actively). These mobilization exercises also could be performed in a sitting position. In this session, this treatment modality had a duration of approximately 5 minutes.

Soft-Tissue Techniques

They were performed on the flexor hallucis longus, adductor hallucis (oblique and transverse heads), abductor hallucis, and tibialis anterior muscles to increase blood flow and decrease tension. Soft-tissue techniques have been provided on trigger points/tender points of these specific muscles with myofascial trigger point techniques (Simon and Travell). Also, soft-tissue techniques on the peroneal fascial loge (especially in the tendinous region of the muscle) were performed in combination with active pronation in a supine or sitting position. Soft-tissue techniques were performed for 10 minutes in this session.

Motor Learning/Strengthening Exercises

The aim of these exercises was to strengthen the lubrical, interosseous, adductor hallucis, peroneal longus and brevis, and flexor hallucis longus and brevis muscles. The patients had to learn to selectively activate one of these muscles and avoid using the flexor digitorum longus muscle in order to decrease pressure on the MTP joints (eg, patients had to plantar flex the MTP joint without bending the distal and proximal interphalangeal joints). Then the exercise was combined with active pronation. To increase strength, this exercise can be performed with an elastic band (Thera-Band, Akron, Ohio, USA). At the beginning, the patients did the exercises in a positive dynamic manner. When the patients became stronger, the exercises were performed as eccentric training. The exercises were performed for 10 minutes in this session.

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Gait Training

The previous learned understanding of functional muscle control of the transverse arch of the forefoot then was trained in mid-stance as well as the terminal stance position while standing. The focus was the active participation of push-off (10 minutes). Patients were instructed to perform this exercise at home once a day for 10 minutes barefoot.

Session 3

Sensomotoric Training

Intermuscular and intramuscular coordination was the goal of this treatment modality. Exercises were performed mainly in a standing (mid-stance) position, with increasing load on the weight-bearing foot and going into the one-foot position, controlling the foot, the knee, and the hip in a neutral long-standing leg axis (meaning the weight is distributed on the lateral aspect of the heel and MTP 1 and 5 with the knee slightly flexed in a neutral valgus and varus position, the hip in neutral, elevating the contralateral leg and bending the hip in 90 degrees of flexion, and controlling this position in a freehand manner). The eyes were opened and closed in order to focus on the neuromuscular feedback system (proprioceptors) (15 minutes).

Gait Training

The aim of gait training was to increase intense pronation, weight bearing of the first MTP joint, and weight bearing and push-off of the hallux. Patients had to be able to do a calf raise with complete weight bearing on the big toe and control the correct leg axis while walking on stairs, with a focus on controlling the knee in a neutral position and having enough control of the pelvic region with tension toward abduction and external rotation, which otherwise seems to be the common weak pattern (15 minutes).

Sessions 4, 5, and 6

Based on the individual's condition, parts of strengthening exercises or sensomotoric training and gait training had to be repeated and increased.

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