To our knowledge, there are limited studies on the topic of orthoses and proprioception. Most of these studies were designed to assess the impact of usage of ankle foot orthoses or insoles to proprioception and due to balance. However we could not run into any studies about the effect of upper extremity splints on proprioception.

The importance of additional use of somatosensory cues in maintenance of balance is emphasized in many studies. Only a small touch of the index finger in a stationary surface can decrease postural sways in health subjects and peripheral neuropathy. With this in mind we can say that with the provision of somatosensorial cues person can provide better control during gait and posture [1].

There are many studies in the literature that supports the improvement in proprioception or joint position sense with orthoses. They suggest that “the effectiveness of orthotic intervention might also be as a result of proprioceptive mechanism” [2]. Effect of foot sensory feedback alteration on plantar pressure distribution during walking is established and stated that peak pressure and muscle patterns were changed when sensory feedback was altered [3].

The main possible explanation of improvement is reported as proprioception might be increased due to this larger skin-contact area with the orthoses which allowing additional cutaneous stimulation and an increase of the afferent inflow of cutaneous receptors [4-6]. Influence the tactile and proprioceptive mechanisms in the lower legs, results in improvements to the sense of position and balance and a reduced risk for falling [7].

It is hypothesized that Foot Orthoses (FO) influence muscular activity by FO’s position. The foot with an FO is in a mechanically advantageous position so as to optimize lever arm length(s) and thus muscular force production, and/or through enhanced proprioception via enhanced afferent signals to the CNS [8]. It is also hypothesized that “subtle changes of alignment achieved by foot orthoses may affect joint position such that mechanoreceptor function is improved, which in turn improves proprioception and postural control” [9]. Rothbart insole is an example of this type of proprioceptive insoles. This insole elevates the first ray and this elevation in each step enhances the tactile stimulation of the foot plantar surface [10]. Another hypothesis is “by reducing strain or load on the supportive ligaments, tendons and muscles of the lower leg foot orthoses may facilitate proprioception and postural control mechanisms” [11].

Both tactile and proprioceptive mechanisms showed to be influenced by the use of Insoles [5]. Prefabricated orthotics improved postural stability in participants with functional ankle
instability. One hypothesis is that “Orthotics have the potential to improve postural stability because (1) a neutral orthotic can control the subtalar joint, subsequently providing a more stable foundation of support, and (2) by supporting the medial longitudinal arch, the orthotic stimulates afferent cutaneous receptors, subsequently stimulating the somatosensory system” [12].

Full contact orthoses apply more evenly dispersed pressure across the bottom of the foot. Because with full contact orthoses, pressure is better distributed to the entire surface and increase tactile stimulation to the skin of the foot [7-9]. To have more receptive field causes to reach more feedback signals regarding the state of the foot from the skin to brain. These mechanisms can improve proprioceptive feedback and create a more stable base of support [10,11]. With the proprioceptive insole, it is considered that “forces in medial midfoot area were reduced and insoles with sensory stimulation may alter sensory feedback of plantar surface of the foot and may lead to some changes in plantar pressure parameters in flexible flatfoot” [15].

On the other hand it is reported in the literature that some new techniques like randomly vibrating insoles or magnetic insoles could improve tactile and proprioceptive feedback and so balance [13]. Three vibrating elements were embedded in each insole to be able to create vibrations to the plantar foot surface. The underlying mechanism called stochastic resonance explained as “The mechanical noise, applied by the vibrating insoles to the soles of the feet can improve the detection of a change in pressure distribution under the soles. Earlier detection results in earlier reaction on a change in upright position, hence in a better control of balance [14].” Significant reductions in total sway area and lateral sway scores is also defined in the literature by using magnetic insoles [13].

Postural perturbation induced by a localized fatigue of the ankle muscles during bipedal quiet standing could be limited by the use of Ankle Foot Orthoses (AFO). The mechanism of improved postural control is described as “by the application AFO proprioception at the ankle joint might have been facilitated through the increased cutaneous feedback at the foot and ankle supplied by the AFO” [4]. Balance improves by the application of an AFO. Underlying mechanism could be explained as an extra proprioceptive input by increasing afferent feedback from cutaneous receptors in skin of the ankle due to the application of an AFO may have a positive effect on balance [5,6].

Orthoses can produce kinematic, kinetic and muscle activity changes [15]. Biomechanical effects of orthoses are due to mechanical and/or proprioceptive mechanisms [3]. Orthotic effects may depend on their surface texture to stimulate the sensory feedback (proprioceptive orthosis). By sensory feedback which can be enhanced with orthoses muscle activity and gait patterns could be modified [3].

There are a few studies in the literature that assess the effects of the Lumbo Sacral Orthoses (LSO) on proprioception. There is a positive effect of wearing LSO on proprioception in the lumbar spine. But this effect can change over time due to sensorimotor adaptation [16].

There is very little information in the literature with regard to the effect of knee bracing on proprioception of subjects with Anterior Cruciate Ligament (ACL) injury and reconstruction. Some studies reported that knee bracing can improve the proprioception of the knee joint where as some claimed that brace did not improve proprioceptive function [17,18]. With the subjects has ACL-deficient limb application of a functional brace reported no to improve detection of passive knee motion but on the other hand using an elastic bandage can improve joint position sense. With the subject has ACL reconstruction use of a brace reported not to has an effect of proprioception [19].

It still remains unclear whether an orthoses improves joint proprioception or not. Future research has to focus on short term and long term effects of using different kind of orthoses and splints on proprioception.
References


