

**ORTHOTIC INFLUENCE OF LOCOMOTION AND VERTICALIZATION OF MYELOMENINGOCELE**

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**Abstract:** The thesis explains orthotic influence of myelomeningocele – spine bifida, which depends on age, damage level and patient’s disease. The main goal of this thesis is to evaluate the influence and effect of orthoses on patient’s image of walking. HKAFO orthosis (an orthosis influencing the hip, knee and ankle joints and the foot) is designated for patients in need of stabilization or compensation, when the lower limb is paralyzed, but the strength of hip and partially of knee extensor is kept, or when the lower limb is completely paralyzed. Correct type of RGO allows the patient to walk faster and with less energy consumption. The goal of the orthosis application is verticalization in the most possible physiological standing and locomotion.

**1 Introduction - Indication and construction of RGO**

RGO – Reciprocal Gait Orthosis (Figure 1) – helps to alternate feet while walking. It belongs among the HKAFO orthoses and is often used when patient suffers from spinal cord damage, combines flexion in one hip joint with the extension of the other hip joint; it is also used by upper lumbar spine, while the active hip flexion is kept [1].

A typical RGO consists of bilateral KAFO orthoses with the offset of the knee joint (recently, mostly crural and femoral parts of full-contact made of plastic are used, whereas in the past also the conventional unilateral femoral parts of metal were used), knee joint with a lock, hip joints, skilet part dorsally extended to waist body part and of a controlling mechanism [2].

To the contraindications of reciprocal orthosis belong deficits in upper limb movement, insufficient muscle strength in the shoulder knit, loss of body mobility in frontal and sagittal level, massive skeletal deformities – scoliosis, hip flexion contracture of the hip itself (over 20 degrees), flexion contracture of knee joint (over 15 degrees), and torsional deformities of feet. To make the skilet movement possible and to imitate the physiological rotation by walking while using the orthosis, the double-axis construction of the joint is necessary. This makes patient’s walk faster and with lower energy consumption. By use of one-axis joint construction, the image of walk is not physiological, however when using the double-axis joint construction, the feet stay turned in the way of walk [3].



Figure 1 RGO orthosis

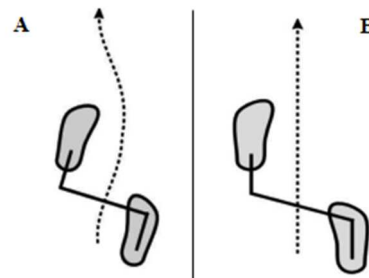


Figure 2 A – uniaxial joint B – biaxial joint

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Reciprocal orthosis ensures the connection of skilet module with the splints of lower limbs. The result of double-axis joint construction is physiological rotation of skilet at walk, while not influencing the direction of walk, minimum energy consumption and effective step cycle.

The advantage of this orthosis is a system of two axes, which allows the skilet movement by 15 degrees while using orthosis. The direction of walk is not affected at all, and the body splints can be adjusted up to 10 degrees. The wired cable system helps by non-problematic power torque transfer at walk. However, the main condition for indication of this kind of orthosis is that the patient will be psychically capable to cooperate (Figure 2).

At the starting point, the feet are parallel in the frontal position. When the heel touches the ground and the skilet is rotated, the feet stay oriented in the direction of walking (Figure 3) [1].



Figure 3 Leg positioning at the start and end positions

Because of self-supporting pipe construction, the complete stability depends on the pelvis module (Figure 4). Thanks to exchangeable parts, the orthosis can “grow” with the child.



Figure 4 Pelvis modul with control mechanism

When using orthosis at walking, the movements are done reciprocally – due to this reason the two skilet joints are interconnected by double-action movement [1].

The skilet joints consist of sciatic joint and a joint for walking (Figure 1). These joints work independently from each other. When a patient sits, the joint for walking is blocked. When a patient walks, the sciatic joint is blocked [1].



Figure 2 Sciatic joint and joint for walking

The axis of the joint for walking is positioned with inclination of 35 degrees (Figure 3), so that the internal rotation of 15 degrees and external rotation of 15 degrees is ensured while the patient walks [1].



Figure 4 Axis joint with 35 ° inclination

The reciprocal orthosis can have the hip flexion set up to 10 degrees. The body splints are straight mounted and are allowed to adjust. The flexion in the hip joint helps to keep the optimal position of the skilet and of the waist

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lordosis, by which the waist spine is stabilized and straightened (Figure 5) [1].

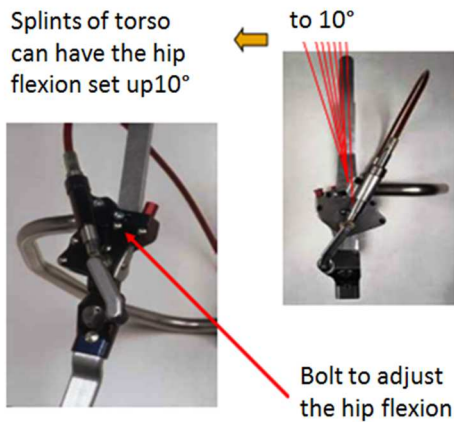


Figure 6 Splints of torso

When the release button is pressed, the seam joint closure mechanism is prepared for release and the click sounds. When the mechanism is prepared for release by a mistake it is possible to fix it back by pressing of the security button of the mechanism. Only in the neutral position, the sciatic joint can be released completely. By placing the parts of the lower joint into a parallel position, the joint for walking is locked. After that the sciatic joint can be released (Figure 7) [1].

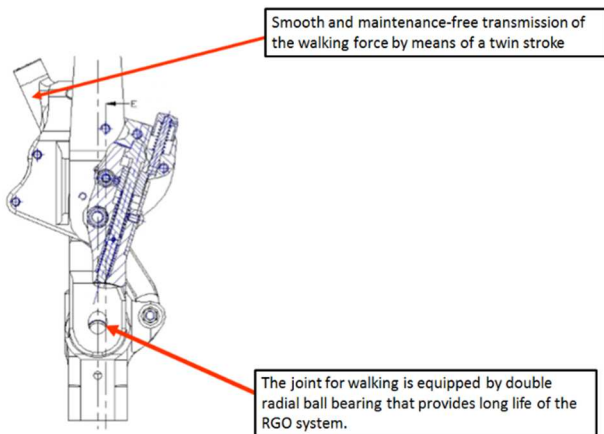


Figure 8 The function of the joint mechanism

**2 HKAFO orthosis application**

HKAFO orthosis was applied to a patient suffering from spine bifida, while the group of muscles controlling his foot was completely weakened. Muscles controlling the knee and hip joints are damaged as well. Both limbs are in extreme outer rotation. The knees turn into extreme hyperextension. The heels on both feet are in eversion, the forefoot is abducted and also the medial foot arch is lowered (Figure 9).

HKAFO orthosis is supposed to provide upright standing and allow the locomotion while using the walker. The orthosis consists of several components and modules. The feet are mounted in a laminate sandal (socket), which is interconnected with the crural socket by a modular multipurpose ankle joint. In this ankle joint the front stops are set. They prevent from ankle dorsiflexion and thus also from the knee flexion while transferring of weight in the standing position. In the back part of the ankle joint, the springs are placed to allow flexible treading on the heel and to help plantar flexion. Also the splint knee joints with the inserted rotation centre are used. These joints allow walking with a swing phase and they move in the anterior-posterior direction. They are connected with hip splint joint with free movement and in the proximal part they are mounted to body module. The hip joints are supposed to provide the movement and the stabilization in media-lateral direction. The body module is made from thermoplastics.



Figure 10 Verticalization before and after HKAFO application

**Conclusions**

The standing and walking mean maximum level of mobility and they increase the independence, thus also the self-consciousness of a child or a person dependent on a wheelchair use for a long time.

After the orthosis application, the locomotion with the help of a walker is achieved. This orthosis is particularly a rehabilitation aid, that allows verticalization and a walk to a patient using mostly the wheelchair. This verticalization is supposed to assist at better development of the skeletal muscular apparatus, and also of inner organs. Without the orthosis, the locomotion is laborious and complicated. People suffering from spine bifida have, due to their health status, different quality and versatility of their lives and this has also great influence on their personalities [4]. Therefore, the support from their direct environment, especially from the family, is very important for such patient. Also the work of the orthopaedic technician has a core value due to making of the correct aid. To help improve the quality of patients' lives, continuous development and refinement of all orthoses in particular, will be necessary.

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