Preliminary Methods for Correct Alignment of Residual Limb in Sagittal and Frontal Planes during the Gait of Persons with Transfemoral Amputation

Vera Kornilova-Filusina [1], ***Andris Vikmanis*** [2], ***Zane Pavare*** [1], ***Eriks Svede*** [1], ***Aleksejs Smolovs*** [1], ***Tatjana Ananjeva*** [1], ***Katie Leatherwood*** [3], ***Jelena Dzene*** [4]

[1] *National Rehabilitation Centre "Vaivari", Latvia*
[2] *Riga East Clinical University Hospital, Clinic of Traumatology and Orthopaedics, Latvia*
[3] *Bridge Builders International, Latvia*
[4] *Riga East Clinical University Hospital, Clinic of Physical and Rehabilitation Medicine, Latvia*

Introduction. The level of activities of daily living contributes to self-care, depressive syndrome and quality of life in persons with transfemoral amputation. Residual limb muscle strength and prosthetic socket design affect alignment in different planes during the gait cycle. Electromyography, using surface electrodes attached to the residual limb while wearing the prosthesis, demonstrates the ability of the residual limb muscles to compensate the absence of the distal lower-limb structures and to maintain the prosthetic stability during the gait cycle.

Aim, Material and Methods. 28 peer-reviewed articles were examined to determine current methods of surgical treatment, physical therapy, and prosthetic design for stabilising the residual limb in different planes to achieve optimal gait performance in transfemoral amputees. The result of gait analysis was assessed in our transfemoral amputee patient with very good midterm functional outcome. The aim of this study was to suggest other possible methods for improvement of residual limb alignment during the gait cycle.

Results. Our patient is unrestricted outdoor walker with especially rigorous demands. His residual limb strength after rehabilitation course was 5 points according to the Kendall grading system. Increase amplitude of m. semitendinosus dxt. and m. adductor longus contraction was observed with electromyography. This suggests that the hypertrophy of these muscles is a result of a compensatory mechanism due to the absence of the distal lower-limb anatomy. The groups of adductor muscles and hamstrings are most weakened because of the loss of their distal insertion points to the bone after transfemoral amputation. Myoplasty alone allows femur to move more freely within the soft tissue envelope. The myodesis of m. adductor magnus and hamstrings at the distal femur provides improved adduction and extension of the thigh. This leads to proper alignment of the prosthesis with the residual limb, optimal load transfer and gait performance. Proper prosthetic alignment combined with ischial containment socket design aims to put the femur into adduction position, thus decreasing the loss of adduction moment during gait. The hypertrophy of theoretically weakened muscle groups suggests positive compensatory mechanisms for gait pattern. Electromyostimulation has been found to achieve muscle hypertrophy and provides faster return to normal walking pattern in patients with muscle atrophy after a long period of immobilisation. There is, however, a lack of research about the efficiency of electromyostimulation in patients after trans-femoral amputation with weakened strength of residual limb musculature.

Conclusions. Electromyostimulation of residual limb muscles can positively contribute to optimal gait pattern, resulting in increased level of activities of daily living and quality of life in transfermoral amputees with performance of myodesis to the residual limb muscles and application of ischial containment prosthetic socket design. Further studies are needed to determine the confidence of this hypothesis.