Articulated vs. fixed carbon-fiber prosthesis in individual with partial foot amputation: Study case

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Objective  Toe filler combined to ankle-foot orthosis (AFO) can be used to improve gait after a partial foot amputation. The AFO supports the plantar aspect of the foot, and the toe filler gives a longer lever arm that helps for pivoting over the lost metatarsals. However, the AFO type can influence gait parameters. The objective of this study case was to evaluate the effect of prosthesis with toe filler combined to:
– an articulated AFO;
– a fixed carbon-fiber AFO on gait.

Patients and methods  A gait analysis was practiced on a 20-year-old male with a partial foot amputation. Kinematic and kinetic data during walking, gait efficiency (Energy Expenditure Index), and postural control were evaluated in both conditions.

Results  An improved ankle power was observed at toe-off with the fixed carbon-fiber AFO compared to the articulated one.

Discussion/Conclusion  The fixed carbon-fiber AFO improves ankle kinematic and kinetic during walking and results in an improvement of walking efficiency in this participant with partial foot amputation.

Disclosure of interest  The authors declare that they have no competing interest.

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Modelisation of the action of compression bandages on the lower limb

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Objective  Compression bandages are commonly used in the treatment of some venous or lymphatic pathologies. The success of the treatment relies on the applied pressure, which depends on several parameters, especially the bandage properties but also patients’ morphology.

A previous experimental study showed that considering only patient’s morphology and bandage elastic properties were not sufficient to explain interface pressure distribution. However, these two parameters are the only one taken into account in Laplace’s Law, current standard method to explain interface pressure distribution. The objective of the study is to characterize and model compression bandages pressure generation mechanisms.

Material and methods  A patient-specific numerical simulation of 4 bandages application [Biflex® 16 and Biflex® 17 (Thuasne) applied with 2 and 3 layers on the leg] was developed for 5 subjects. The inputs of this simulation are the subjects’ morphology, the bandage’s and soft tissues’ elastic properties and the application technique.

The results of this simulation were then confronted to the experimental results and pressure values computed with Laplace’s Law: \( P = \frac{nT}{r} \), with \( P \) the pressure [N/mm²], \( n \) the number of layers, \( T \) the bandage tension [N/mm] and \( r \) the local radius of curvature [mm].

Results  The numerical simulation provides the complete pressure distribution over the leg but also considers the deformations of the leg, induced by bandage application. The comparison with the results given by Laplace’s law highlighted the influence of these leg geometry changes on the applied pressure.

However, the 4 parameters considered in this simulation (leg morphology and deformations, bandage elastic properties and application technique) are not sufficient to completely explain pressure generation, and differences with the experiments still persist.

Discussion/Conclusion  Numerical simulation still needs to be enriched to consider other parameters which may impact interface pressure such as bandage to bandage interaction for example.

Disclosure of interest  The authors declare that they have no competing interest.

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