A comparison of trans-tibial amputee suction and vacuum socket conditions

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Abstract

Daily volume loss of the stump leads to a poor fit of the prosthetic socket. A method of preventing this volume loss and maintaining a good fit was developed. A vacuum (-78 kPa) was drawn on the expulsion port of a total surface-bearing suction socket to hold the liner tightly against the socket. Stump volume of 10 trans-tibial amputees was measured prior to and immediately after a 30 minute walk with normal and vacuum socket conditions. Under the normal condition, the limb lost an average of 6.5% of its volume during the walk. In contrast, with the liner held tightly by vacuum, the limb gained an average of 3.7% in volume. It is believed that the difference observed between conditions resulted from a greater negative pressure developed during the swing phase of gait with the vacuum condition. X-rays revealed that the limb and tibia pistoned 4mm and 7mm less, respectively, under the vacuum condition. The combination of reduced pistoning and maintenance of volume is thought to account for the more symmetrical gait observed with the vacuum.

Conclusions

Proper socket fit is crucial for the comfort of the amputee, health of the skin, and performance of the prosthesis. Maintaining a good fit is difficult with the total surface bearing suction socket because the pressure that provides a good fit causes daily volume loss in the stump. As volume is lost and the fit deteriorates, the skin is thought to be subjected to higher pressure and shear forces, and possible ulceration. Drawing a high vacuum on the interface space prevents volume loss or, in some cases, causes a gain in volume. A vacuum also reduces pistoning of the stump and tibia within the socket when statically loaded. Therefore, a vacuum condition maintains a better fit and may reduce irritation of the skin. In addition, a vacuum improves gait symmetry.

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