

Vacuum Suspension and its Effects on the Limb

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Abstract

Since its inception in 1999 (Board et al., 2001), vacuum suspension has proven to be a major innovation. Vacuum suspension provides the amputee with unmatched linkage. This linkage alters the pressures that the limb experiences, which in turn prevents daily limb volume loss and improves limb health. The purpose of this paper is to review what is known about vacuum suspension and its effects on the limb.

Conclusion

Vacuum suspension is simply the removal of air molecules from the sealed air space in a valve suspension system. The resulting vacuum has one direct physical effect; it anchors the liner to the socket. The large suspension force, ~70 kg, created by the axial components of the liner anchoring forces prevents separation between the liner and socket. This provides the amputee with unmatched linkage that improves his/her spatial awareness and control over the prosthesis. With this elimination of pistoning, limb pressures and shear forces are reduced, providing the limb with a healthier environment. Unlike all other modes of suspension, vacuum suspension prevents the limb from losing volume during the day. So, a healthier environment is maintained throughout the day. The global pumping effect of the cyclic positive and negative pressures during walking increases circulation and fluid exchange, and probably plays a role in improving limb health and wound healing.

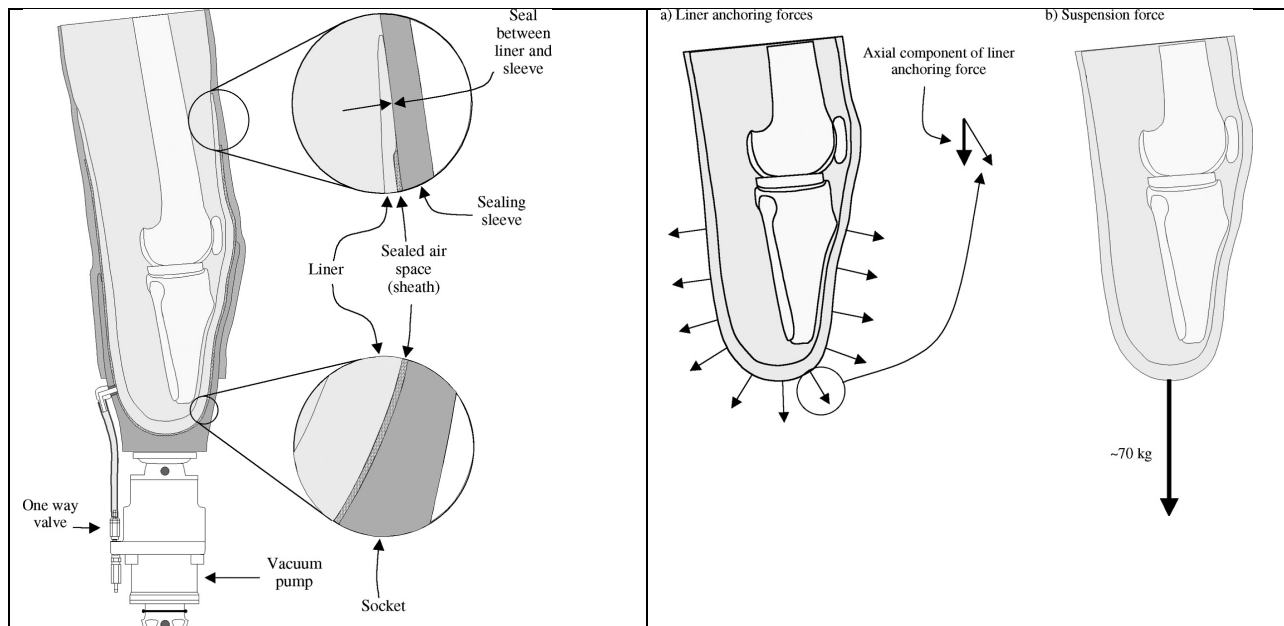


Figure 1. Cross section of vacuum suspension system showing sealed air space (sheath). Note that the sealed air space does not extend to the thigh. The seal between the top of the liner and sealing sleeve isolates the limb from the vacuum.

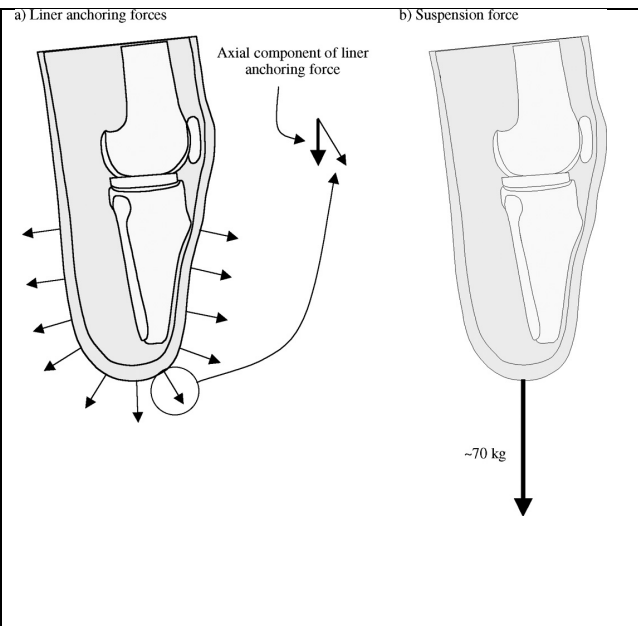


Figure 2. The vacuum creates forces that: a) anchor the liner to the socket. The sum of all the axial components of the axial forces creates a large: b) suspension force of ~70 kg. The suspension force prevents the liner/limb from extracting out of the socket.