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### Effect of Vacuum-Assisted Socket and Pin Suspensions on Socket Fit

We read the article by Klute et al<sup>1</sup> with interest; however, we identified a number of issues with the article. The authors compared the socket fit, activity level, and limb volume of 2 different prosthetic suspension systems, namely a vacuum-assisted suspension system (VASS) and a pin suspension.<sup>1</sup> Because limited literature is available on the effect of vacuum-assisted suspension as a means of controlling residual limb volume and pistoning,<sup>2</sup> the article would have been more clinically helpful if some ambiguities were clarified.

Performing a reliable evaluation of pistoning in lower limb prosthetic devices is a challenging task, and several methods have been adopted for the purposes of investigating bone, soft tissue, or liner pistoning within prosthetic sockets.<sup>3-5</sup> As a result of our own extensive practical research in the field of prosthetics, and our special interest in pistoning measurement, we were extremely interested in the content of the article and the research it described. We believe that the authors did not provide sufficient information pertaining to the methodology used for the purposes of measuring the occurrence of pistoning. As such, we felt that their technique for measuring pistoning inside the socket was unclear. While their motivation to work on an important indicator of socket fit is highly honorable, no reference to the existing literature and research was provided. As studying the effect of volume loss on prosthetic fit measured by pistoning is of value, we believe that the methodology deserved more explicit clarification.

With regards to the measurement method, it seems that the authors followed the work of Board et al.<sup>3</sup> However, if gait function was simulated through the application of loads to the prosthesis, weighting and unweighting alone might not suffice, because research has revealed that the extent of pistoning is most significant during the swing phase of gait.<sup>4,5</sup> Therefore, the results might not be generalized to dynamic conditions (walking) or could underestimate the extent of pistoning during gait.

Another issue that raises concern is the authors' statement that the markers were attached to the proximal lateral aspect of the socket at the knee joint center, and on the thigh. The exact location of the thigh marker has not been explicitly explained. It is worth highlighting that, with the VASS prosthesis, patients should wear a sleeve over the socket.

This sleeve covers the leg from knee to thigh. Therefore, we are forced to speculate as to how the researchers were able to attach the markers directly to the socket. If, as it appears, the markers were adhered to the sleeve, the obtained results are questionable. Furthermore, there is no justification as to why triad markers were used. In addition to this, the number of trials used is unclear.

The Prosthesis Evaluation Questionnaire is a valid and reliable tool that is frequently used for evaluation of patients' satisfaction; however, no details were provided with regards to the validity and reliability of the methods used for measuring pistoning and limb volume.

In the Discussion section of the article, the authors compared the findings of their own research into pistoning with the findings of a study implemented by Board.<sup>3</sup> In our opinion, this comparison does not seem to be valid, because Board applied 2 different loads to the prosthesis in order to simulate the swing phase of gait. Moreover, the researchers claimed that Board found 4mm of pistoning inside the socket, while they recorded only 1mm of pistoning. It should be noted that Board remarked 1mm ( $\pm 1$ ) of pistoning for VASS in table 2 and in the Abstract, they mentioned that the limb pistoned 4mm less with the vacuum than in normal condition.<sup>3</sup>

Finally, we wish to commend the authors for their contribution to the prosthetics field, and we hope these points are of help to both their own future research and that of the others who are involved in related investigations.

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