CHOOSING BEST COMPONENTS FOR AN AMPUTEE. 
A Methodology For The Best Decision-making

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Summary

The objective of this study is to verify and confirm the process of decision-making for four different trans-tibial prostheses with suspension systems: Hypobaric(A), PIN(B), Classic Suction(C) and Vacuum Active –VASS(D) according data provided by gait efficiency (mLO₂/kg/m) imagiology (pistonning) and amputee perception.

Introduction

The harmony between the stump and the prosthesis is critical to allow it to fulfill its function enabling an efficient gait. A well fitted socket, with an efficient and comfortable suspension, allows the amputee to continue their daily living activities, maintaining the stump functional, making this correlation between socket and suspension very important in the functionality of the prosthesis, mobility and overall satisfaction with the device¹,². Of our knowledge, the quantitative correlation between all of these factors as not yet been assessed.
Methodology

For this case-study, with a 23 years old individual, the functional performance that each different suspension system allows was assessed with physiological data provided by:

- Gait efficiency \( (\text{mLO}_2/\text{kg/m}) \) from a breath-by-breath analyzer - Quark PFT Ergo-COSMED in a treadmill H/P/Cosmos \( (R) \) Mercury according Lin-Chan (2003)\(^3\) in which a lower value is a better value.

![Fig. 1 – Breath-by-breath analysis in a treadmill during Lin-Chan protocol.](image1)

- The pistonning measure (image of axial displacement of the stump in mm, was measured by indirect conversion of image acquisition system model MultixPro/Top Siemens according Narita (1997)\(^4\).

![Fig. 2 - Image of the prosthesis with suspension Pin; a) in the standing position; b) with traction 5kg](image2)

- Perception data was provided by Prosthesis Evaluation Questionnaire(PEQ)\(^5\). This will analyze the perception of the subject, as well as the functionality and the quality of life provided by each of the prostheses (component) tested.

![Fig. 4 – PEQ – Prosthesis Evaluation Questionnaire](image4)
Results

Results showed that for this patient, the Vacuum Active Suspension System (VASS), presented the best results with the total walking distance of 1102 meters in 15’30” (maximum speed of 93,87 m/min in last stage of four minutes). Gait efficiency was the lowest value (0.20 ml/kg/m) with highest VO₂ in last stage of 18,47 ml/min/kg.

Pistonning, showed better results for VASS with 47,91 mm. According amputee perception by the PEQ, the VASS presented the best scores in all the 9 validated scales.

Table 1 – Comparison between O₂ consumption, efficiency and walked distance

Table 2 – Results of the Pistonning in the various suspension systems

Table 3 – Results of application variables of the PEQ

According amputee perception by the PEQ, the VASS presented the best scores in all the 9 validated scales.

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Conclusion

The use of this protocol with several objective and subjective data as proven the best evidence for analyzing differences in results of various suspension systems, and it seems that this is a viable tool in the evaluation and decision-making process within a rehabilitation with a prosthesis. Also through the analysis of results was clear that the VASS suspension system is, for this case-study, the one that provides greater functionality and satisfaction.

References


