Energy cost of walking in transfemoral amputees: Comparison between Marlo Anatomical Socket and Ischial Containment Socket

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Abstract

Objective: To compare energy cost of walking (ECW) and prosthesis-related perceived mobility with the Marlo Anatomical Socket (MAS1) and the Ischial Containment (IC) Socket.

Method: Transfemoral (TF) amputees were enrolled in the study. ECW tests were conducted inside, in a hallway with a regular floor surface. Subjects had to walk back and forth on a 61 m linear course at their own self-selected speed. Metabolic and heart rate data were collected during the walking test using a portable gas analyzer. All measurements were made at steady state (SS). The tests were performed first using the IC socket and then after 30 days ofMAS1 use; the last test was carried out after 60 days of MAS1 use. The amputees were also administered the Prosthetic Evaluation Questionnaire Mobility Section (PEQ MS) at the first and the last test to assess perceived potential for mobility using the prosthesis.

Results: Seven long-term prosthesis users were analyzed. Their mean age was 33.9 _ 9.3 years; all were employed, active, and used IC sockets. At the third walking test, the ECW with the MAS1 was significantly lower than that with the IC socket (p = .016). PEQ MS data also improved significantly at the last evaluation (p < .018).

Conclusion

For physically active TF amputees (such as ours), a socket that allows a range of joint motion as close as possible to the physiological one, with minimal energy expenditure, should be the goal of prosthesis design. The results of the present study suggest that MAS1 can help us to reach this goal. Finally, further studies are needed to investigate ECW and prosthesis-related perceived mobility in older and/or non-active TF amputees.

Table 2
Functional data during walking tests.

Walking Test	HR rest (bpm)	SSWS (m/min)	HR ss (bpm)	%APMHR	V'O$_2$ ss (ml/kg/min)	ECW (ml/kg/m)	RER ss
I	81.9 ± 11.8	65.9 ± 4.7	124 ± 23.6	67 ± 12	17.7 ± 3.8	.26 ± .06	.82 ± .09
II	80.7 ± 8.2	68.2 ± 9	121 ± 14.8	65 ± 9	16.9 ± 2.3	.24 ± .05	.83 ± .07
III	79.9 ± 9.3	70 ± 6.5	120 ± 15.5	65 ± 8	16.3 ± 1.5	.23 ± .044*	.84 ± .05

Walking test I: fitting an Ischial Containment Socket; test II and III: fitting MAS®.
HR: heart rate; SSWS: self selected walking speed; %APMHR: percentage of age predicted maximum heart rate; V'O$_2$: oxygen consumption; ss: steady state; ECW: energy cost of walking; RER: respiratory exchange ratio; bpm: beats per minute.
* I vs III (p = .016).