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Title
Oxygen consumption and gait dynamics in transfemoral bone-anchored prosthesis users compared to socket-prosthesis users: a cross-sectional study

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Summary
Highly-active transfemoral socket-suspended prosthesis users have increased oxygen consumption and compensatory movements compared to able-bodied persons, where bone-anchored prosthesis users show intermediate results. Pistoning, centre of mass, and trunk dynamics seem important inclusion criteria.

Introduction/ basics
A transfemoral bone-anchored prosthesis (BAP) is an alternative for the conventional socket-suspended prosthesis (SSP) in persons suffering from socket-related problems [1-4]. In these persons, it has been demonstrated to improve oxygen consumption during walking [5,6]. However, it remains uncertain whether the same improved findings are found in SSP users without any socket-related problems. Accordingly the following research questions were investigated: Do oxygen consumption, centre of mass (CoM) and trunk dynamics during walking differ between satisfied transfemoral SSP and BAP users and able-bodied individuals (AB); and are CoM and trunk dynamics and pistoning potential determinants of oxygen consumption?

Material method; implementation/ process
Highly-active transfemoral SSP and BAP users (K3-K4) without prosthetic problems were sampled. Oxygen consumption was measured while participants walked on a treadmill at preferred speed, 30% slower, and 30% faster. At preferred speed, we also evaluated CoM deviation, root-mean-square values (RMS) of mediolateral (ML) CoM and trunk excursions, and pistoning. In the prosthetic users, it was evaluated whether oxygen consumption, CoM and trunk dynamics, and pistoning were associated.

Results

We included BAP users (n=10), SSP users (n=10), and AB (n=10). SSP users demonstrated higher oxygen consumption, CoM and trunk RMS ML in comparison to AB during walking. BAP users showed intermediate results between SSP users and AB, however not significantly different from either group (Figure 1 & 2). Greater CoM and trunk excursions were associated with higher oxygen consumption; in the SSP users a greater degree of pistoning, in turn, was found to associate with larger trunk RMS ML (Table 1).

Discussion/ conclusion; conclusion for the practice

The results indicate that satisfied SSP users have increased oxygen consumption compared to AB and use compensatory movements during walking. An evaluation of pistoning and CoM and trunk dynamics during walking may be considered for determining whether an individual SSP user may possibly benefit from a BAP, in addition to the currently used functional tests to evaluate eligibility. This might lead to a larger group of persons with a transfemoral SSP benefiting from this technology.

References

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Image: Figure 1_152_152.jpg

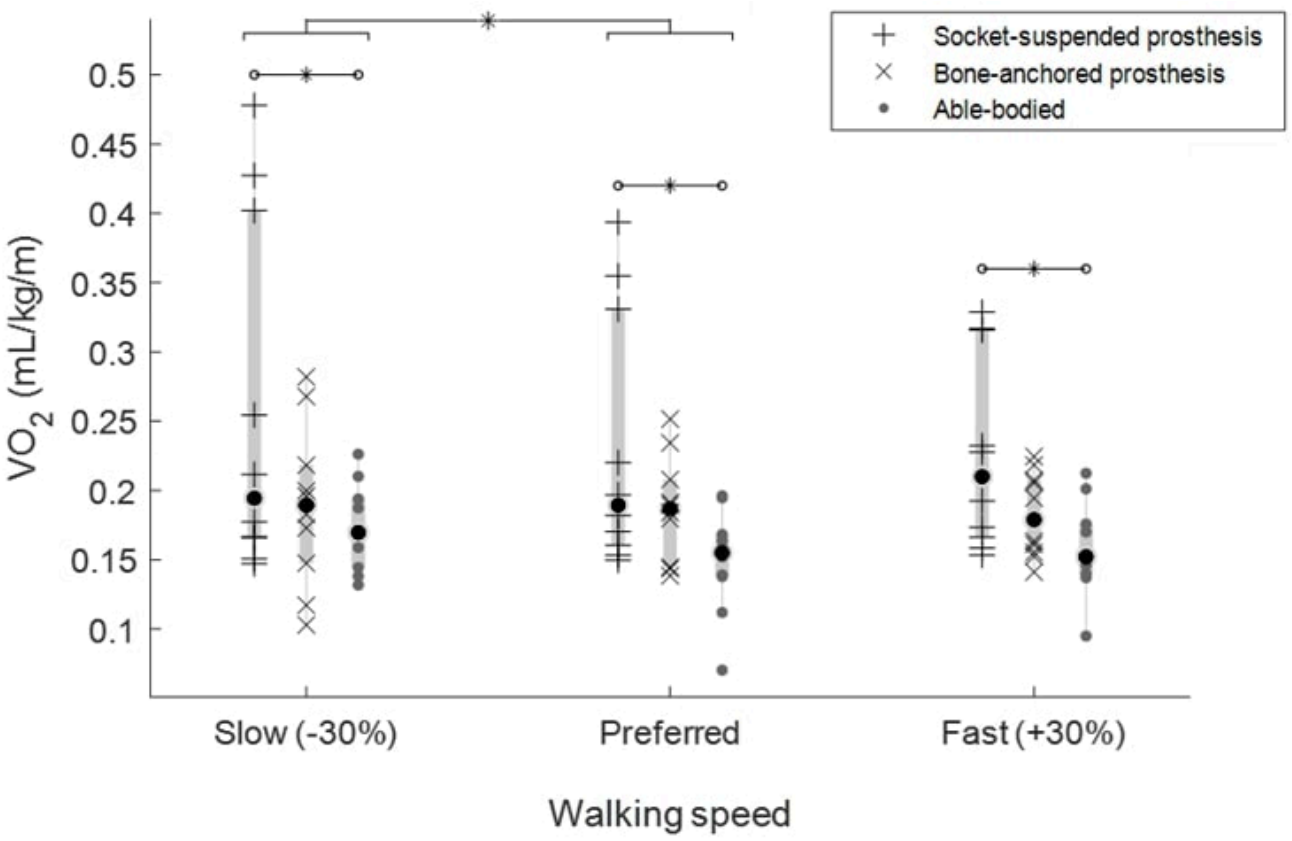

*Figure 1: The results of the metabolic cost measurements presented in a boxplot over three speed levels for all three groups. Grey boxplots present the data distribution from the 25th to the 75th percentiles, and the black circle indicates the median. Each individual data point represents one participant. SSP: Socket-suspended prosthesis; BAP: Bone-anchored prosthesis; AB: Able-bodied individuals; * indicates significant difference (p < .05);*

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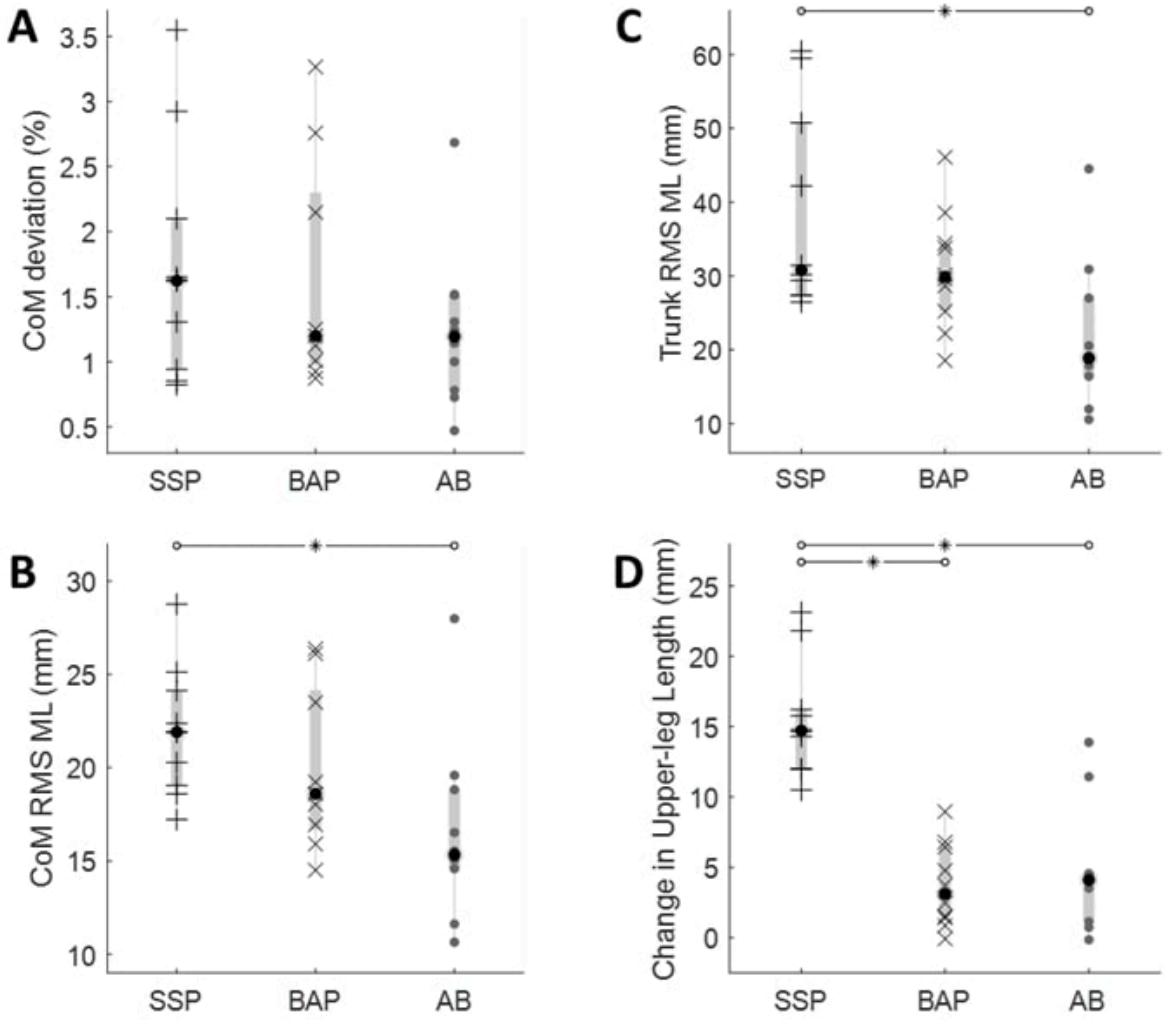

*Figure 2: The results of the gait measurements including CoM deviation (A), CoM RMS ML (B), trunk RMS ML (C), and CULL (D) for all three groups. Grey boxplots present the data distribution from the 25th to the 75th percentiles, and the black circle indicates the median. Each individual data point represents one participant. CoM: Centre of mass; RMS ML: Root-mean-square mediolateral; CULL: Change in upper-leg length; SSP: Socket-suspended prosthesis; BAP: Bone-anchored prosthesis; AB: Able-bodied individuals; * indicates significant difference ($p < .05$);*

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*Table 1: Spearman correlations between oxygen consumption, CoM deviation, CoM RMS ML, and trunk RMS ML for SSP and BAP combined, and with CULL for SSP. CoM: Centre of mass; RMS ML: Root-mean-square mediolateral; CULL: Change in upper-leg length; SSP: Socket-suspended prosthesis; BAP: Bone-anchored prosthesis; * indicates significance*

	SSP+BAP			SSP
	CoM deviation	*CoM RMS ML*	*Trunk RMS ML*	*CULL*
Oxygen consumption	$r_s(19) = .756^*$	$r_s(19) = .625^*$	$r_s(20) = .740^*$	$r_s(10) = .418$
CoM deviation		$r_s(19) = .828^*$	$r_s(19) = .693^*$	$r_s(10) = .564$
CoM RMS ML			$r_s(19) = .782^*$	$r_s(10) = .455$
Trunk RMS ML				$r_s(10) = .697^*$