DYNAMOMETRIC ANALYSIS OF THE ANTEROPOSTERIOR FORCE APPLIED IN AQUATIC HUMAN GAIT

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INTRODUCTION

Walking in water is a major rehabilitation therapy for patients with orthopedic disorders. However, data about kinetic variables while walking in water is still unclear [1]. It is important to the professionals who work with rehabilitation to know informations as the gound reaction force components during gait in water. Acccording to Brito et al[2], few works exist about the subject, and also there aren´t knew studies about the behavior of the anteroposterior component during walking in water. This work had the objective to analyze the anteroposterior component of the ground reaction force (GRF) during the aquatic gait and the influence of the speed and the upper limb position on the GRF anteroposterior component values.

METHODS

This study took place at the swimming pool and Aquatic Biomechanics Research Laboratory of Santa Catarina State University.

The sample was composed by 60 individuals that possessed stature from 1,6 to 1,85m and no gait disorders. The water depth was 1,30m. One opted for dividing the sample in three groups, according to their levels of immersion: (1) manubrium sterni, (2) medial point between the manubrium sterni and xiphoid process sterni distance (3) Xiphoid process sterni.

Two underwater force platforms [3] were set on the bottom of a thermal swimming pool (30±1oC), in a footbridge of 6,15 m of length. One acquired the GRF in the anteroposterior component in a rate of sample of 600hz. One has also used the acquisition system SAD 32 version 3.0 [4]. The subjects were supposed to walk along the footbridge in two speeds (Slow and Quick) and two different upper limb positions (Inside and Outside the water). The four situations imposed for the three groups in this study are described on Table 1.

Table 1: Aquatic Gait Situations

	Gait Situation	Speed
ISG	Slow gait with the upper member inside the water beside the body slow gait with the upper member inside the water beside the body - named inside slow gait	0,42 m/s
OSG	Slow gait with the upper member outside the water - outside slow gait	0,42 m/s
IQG	Gait with the upper member inside the water the fastest speed the subject obtained - inside quick gait	0,55 m/s
OQG	Gait outside the water the fastest speed the subject obtained - outside quick gait	0,66 m/s

RESULTS AND DISCUSSION

The GRF anteroposterior maximum force reduction for aquatic gait compared to the reference values for land gait [5](Table 2).

Table 2: Maximum force reduction of the GRF anteroposterior component for aquatic gait compared to the reference values for land gait (%).

	Group 1	Group 2	Group 3
ISG	55	55	55
OSG	50	50	50
IQG	45	35	15
OQG	30	20	5

Comparing each group separately in different speed situations (slow and quick), one can realize that the values raise as the speed raises, with statistic significance for all the three groups. Comparing the upper limb inside and outside the water gait situation, the values do not raise significantly.

In the slow situations the values had been cut off to half the values outside the water. Indeed, in the quick situations, there wasn’t such a significant reduction, specially when it comes to group 3 OQG, where the values are very close to land gait values, despite of a slower speed in the water. The alteration of immersion level does not increase the maximum force in this component.

The Fx curve has a negative peak in land gait, related to the movement breakdown, and a positive peak, due to acceleration [5]. For the positive peak, one can observe that the maximum force increases significantly with the aquatic gait speed upgrade.

CONCLUSIONS

This work values point out that an increase in the gait speed results an increase in the anteroposterior component. This is very important for underwater exercise prescription. For instance, if the treatment goal is to train gait of a subject not so functionally injured, the aquatic gait that most approximates to land gait is in the xiphoid process immersion level, upper limb outside the water and the fastest speed the subject can carry out. An alteration in the curve pattern also can be confirmed: it looks like a triangle.

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