MUSCLE ACTIVATION IN YOUNG MEN DURING A LOWER LIMB AQUATIC RESSITANCE EXERCISE WITH DIFFERENT DEVICES

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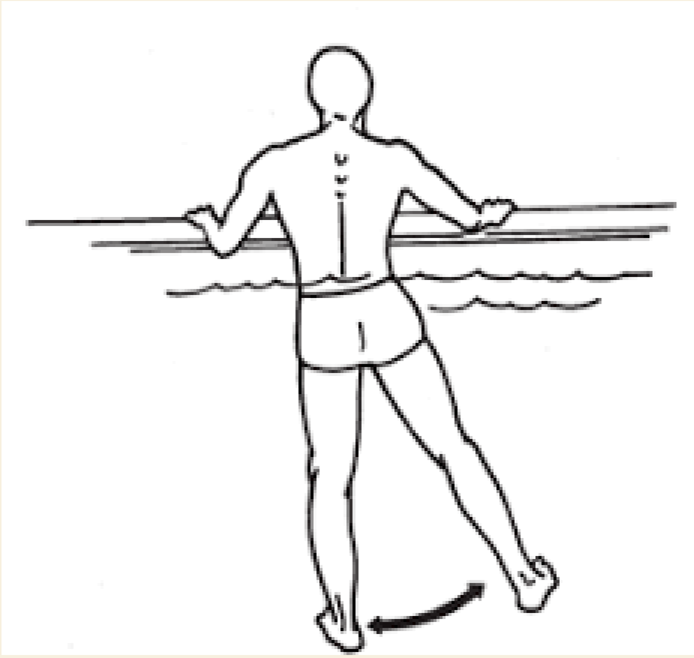
INTRODUCTION

The present study compared muscular activation of the lower extremity and core muscles in 24 young men during leg adduction performed at maximum velocity using different devices (large/small and drag/floating properties) in an aquatic environment.

It was hypothesized that the greatest lower extremity and core muscular activation would be obtained when using a larger device that increased the drag force.



WHY THIS STUDY?

- A lack of evidence exists on the use of different devices during the performance of water resistance exercises, especially at maximum velocity and involving the lower body. Because the benefits of resistance training include core muscle strengthening, and because performing exercises in a water environment have been shown to improve physical performance and health, it is important to clarify the effects of different devices used during water resistance exercises.
- Also, few studies have compared the effect of both devices on muscular activation. Thus, when performing resistance training in a water environment, deciding which device is more appropriate is difficult because of the lack of knowledge.

MATERIALS AND METHODS

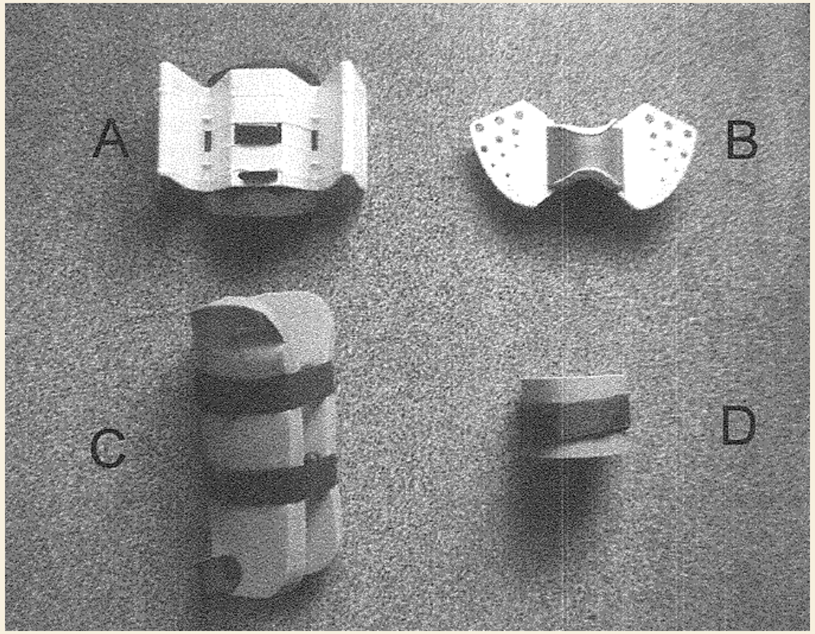
1. PARTICIPANTS

- A total of 24 young men volunteered to participate in this study.
- Participants included in the research had 1 year experience in resistance training on land, performing 2 sessions per week at moderate to vigorous intensity, and were familiar with the performance of exercises in a water environment.
- No subject included in this study presented musculoskeletal pain, neuromuscular disorders, or any form of joint or bone disease.

MATERIALS AND METHODS

2. DEVICES

A – Drag hydroboot B – Drag aquafins C – Floating boot D – Floating support



Two primary types of devices are used with two different sizes:

- Those that take advantage of the **buoyancy property** of water are often called **floating devices**. The buoyancy property is the main force that is acting against the floating devices. This force has an upward direction and is proportional to the gravity, the fluid density, and the volume of the submerged body.
- Those that take advantage of the **drag property** of water are often called **drag devices**. Drag force is the result of the high density of the water fluid. This force is the main property acting against drag devices.

MATERIALS AND METHODS

3. PROCEDURES

Participants performed 3 repetitions of leg adduction at maximum speed using 4 different devices (large/small and drag/float).

The maximum amplitude of the electromyographic root mean square of:

- Adductor longus.
- Rectus abdominis.
- External oblique on the dominant side.
- External oblique on the non-dominant side.
- Erector of the lumbar spine

The electromyographic signals were normalized to the maximum voluntary isometric contraction (MVIC). **MVIC** is an EMG normalization method that allows us to obtain a reference value and thus be able to compare muscle activation between different muscles, between exercise conditions and between athletes.

3. PROCEDURES

Each subject participated in 2 sessions:

- **Familiarization:** In the first session, participants were familiarized with the leg abduction and adduction exercise, movement amplitude, intensities, and devices that would later be used during data collection.
- **Experimental session:** The aquatic protocol started with the preparation of participants' skin, followed by MVIC* collection and exercise performance.

*The MVIC for all muscle groups analyzed was performed on land. The MVIC executed on land can be used for normalization of the EMG activity of dynamic exercises in water.

3. PROCEDURES

EXPERIMENTAL SESSION:

The participants started the exercise in the standing position with their hands on the iliac crest. Each subject performed 3 repetitions with the dominant leg in all conditions.

- The first phase of the movement consisted of a leg abduction from 0° to 45° at a very slow velocity.
- The second phase consisted of a leg adduction at maximum velocity. Visual feedback was given to the participants to maintain the range of movement during data collection.

The exercise was performed under the following 4 conditions at xiphoid process depth.

3. PROCEDURES

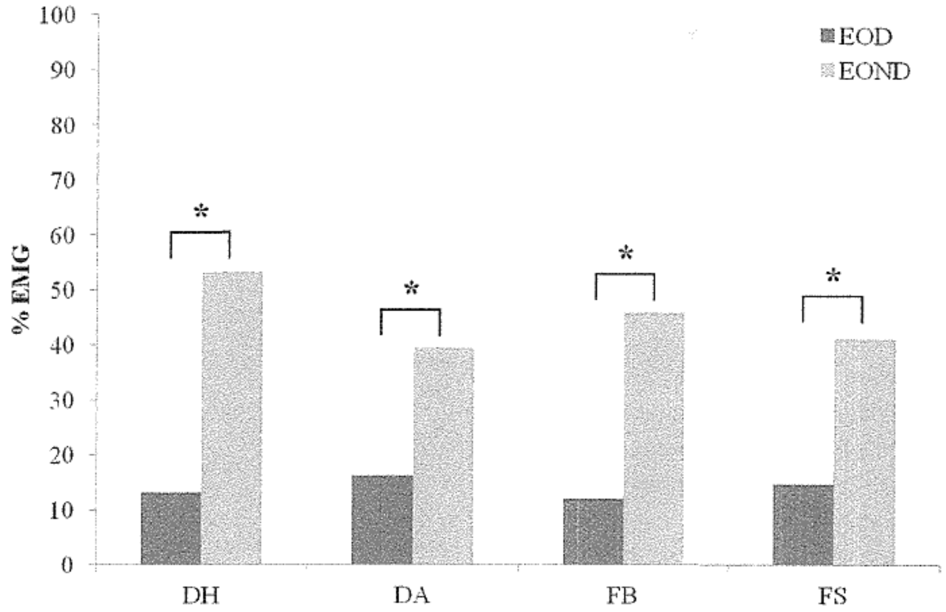
CONDITIONS:

- The different devices were located in the distal part of the leg and were fixed with their own Velcro straps around the ankle joint.
- Verbal encouragement was provided to motivate all participants to achieve maximum velocity in the leg adduction phase.
- Throughout the experiment, both air and water were maintained at thermoneutral temperatures at 24°C and 30°C, respectively.
- Several restrictions were imposed on the volunteers: no food, drinks, or stimulants (eg, caffeine) could be consumed 3 to 4 hours before the sessions and no physical activity more intense than daily living activities could be perfouned 12 hours before. Subjects were encouraged to sleep > 8 hours the night before data collection.

RESULTS

- The data were expressed as a percentage of the maximum EMG.
- For all muscles analyzed in the present study, no significant differences were found between performance of the aquatic exercise under the 4 conditions.
- Subjects' EOND (external oblique on the non-dominant side) showed significantly higher activation than EOD (external oblique on the dominant side) during the performance of the exercise under each condition.

Figure 2. Muscle activation (%EMG) of EOD and EOND during the performance of the exercise in the 4 conditions.



*Significant differences ($P \leq 0.05$).
Abbreviations: %EMG, percentage of maximum electromyography regarding the maximum voluntary isometric contraction; EOD, external oblique on the dominant side; EOND, external oblique on the nondominant side; DA, drag aquafins; DH, drag hydroboot; FB, floating boot; FS, floating support.

DISCUSSION

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The present data contradict the hypothesis because they demonstrate that similar muscle activation is achieved during the performance of resistance exercises using different devices (ie, large/small and drag/floating) for lower extremity and core muscles.

DISCUSSION

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- ❖In the same vein, the property of the floating devices does not seem to be an influential factor.
- ❖Regarding the comparison of core muscles, it was found that different devices did not modify the activation. Studies have also shown that the forces generated by the extremities directly affect the activation of core muscles. Therefore, the greater the force generated by the extremity, the greater the activation of the core muscles.
- ❖Interestingly, EOND activation is much higher than EOD activation in each condition. This result is in accordance with those of previous studies, which showed that core muscle activation is asymmetrical when exercises are performed unilaterally. Greater core muscle activation was found in the contralateral side during dynamic unilateral upper limb exercises.

DISCUSSION

Limitations:

- Subjects are physically active men with low body fat and therefore the results could not be extrapolated to other populations.
- Lack of adjacent measurements (eg, rate of perceived exertion, blood lactate).

CONCLUSION

- There is similar muscle activation using different sizes and types (drag and floating) of devicies when training in a water environment when the movement is performed at maximum velocity.
- Thus, the choice of using one or another device in a maximum velocity training should be based on economic factors.

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THANKS FOR YOUR ATTENTION

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