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LOWER-LIMBS STRENGTH IN SYMPTOMATIC AND ASYMPTOMATIC FEMOROACETABULAR IMPINGEMENT PATIENTS

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INTRODUCTION

Cam-femoroacetabular impingement (FAI) is a chronic hip disorder characterized by hip pain and impingement of motion, and is characterized by an aspherical femoral head. It can lead to biomechanical deficiencies [1] and is believed to be one possible cause of early onset osteoarthritis [2-5].

What remains unknown is whether the deficiencies are due to the mechanical impingement or a result of pain and/or muscle disorders. Furthermore, no testing has been done on the asymptomatic FAI population, those who have similar anatomical deformities yet lack any pain or noticeable physical limitations.

Casartelli et al. [6] found that FAI patients had significantly lower strength than a control group for hip adduction (28%), flexion (26%), external rotation (18%) and abduction (11%). Another study showed similar results for a group of patient suffering from osteoarthritis: isometric adductor and abductor strength was 25% and 31% lower than controls, and hip flexion was 18% lower, but there was no difference in hip extensors strength [7].

Our study compares maximum voluntary isometric contraction (MVIC) strength three groups of individuals: asymptomatic FAI (aFAI), symptomatic FAI (sFAI) and a control group (CON). The first objective was to confirm muscle weakness in sFAI patients. The second objective was to investigate if the aFAI group suffered from similar hip weaknesses, or if the lack of pain and physical symptoms would make their performance similar to controls.

METHODS

A total of fifty-five participants were recruited into three groups, matched for age, gender and BMI (Table 1).

All participants had a pelvic CT scan. Positive diagnostic for FAI was determined as an alpha angle of over 50.5° in the axial view (3:00) or 60° in the radial view (1:30). For the CON group, we used the side with the smallest alpha angle. In cases of bilateral aFAI, we used the side with the largest alpha angle.

Table 1: Participants' groups, age and BMI.

Group	**Number**	**Age** (years)	**BMI** (kg/m^2)
CON	20 (2 females)	33 ± 7	25 ± 3
A-FAI	20 (3 females)	32 ± 7	26 ± 3
S-FAI	15 (2 females)	39 ± 9	27 ± 5

Two consecutive MVICs were performed for the following muscle groups/movements:

- *Hip flexors*: supine, straight leg raise up to 15°, resistance at the ankle;
- *Hip abductors*: supine, straight leg spreading up to 15°, resistance at the ankle;
- *Hip oblique* (combination of flexors and abductors, mostly tensor fascia lata muscle): supine, straight leg raising and abducting, and up to 15° in each plane, resistance at the ankle;
- *Hip extensors*: prone, straight leg raise up to 15°, resistance at the ankle;
- *Knee flexors*: prone, knee bent at 45°;

The MVIC strength was measured using a handheld dynamometer (Lafayette, IN). Only the highest force was used for analysis. Subject-specific anthropometric data (segment mass, inertia and center of mass) were computed according to modifications of the Zatsiorski-Seluyanov parameters by De Leva [8]. The anthropometric and force data were then combined in order to calculate the moment of force produce in each direction, which was then normalized by body mass in order to allow inter-subject comparison. Muscle weakness for the sFAI group relative to the control group is characterized by calculating the percentage differences as such:

$$100 * (MVIC_{sFAI} - MVIC_{CON}) / MVIC_{CON})$$

The same was done for the aFAI group relative to the CON group and for sFAI relative to aFAI group. A series of analysis of variance was performed on each moment of force. The confidence level was set at 95%.

RESULTS AND DISCUSSION

It was firstly observed that moments of force for females were significantly lower than males in all conditions.

Indeed, this has previously been established in the literature: even if normalized by body mass, female's muscle strength is reduced for any age and muscle group [9]. Moreover, because of their small number of women in the study, we did not have enough statistical power to perform an analysis of covariance. Therefore, we decided to exclude all the female participants in the three groups from the analysis. With this analysis, only the ANOVA on hip flexors was found to be significant (p=.046). However, pairwise comparisons, using a Tukey's post-hoc adjustment, revealed that the 19% reduction in muscle strength between the aFAI and sFAI groups was not significant (p=.116). The same was observed for the 19% reduction between the CON and sFAI groups (p=.051). We believed, however, that this trend does coincide with the hypothesis that sFAI patients have weaker hip flexors than healthy control, similarly shown in Casartelli et al. [6]. While the other variables did not show significant difference either, the sFAI group had smaller moments of force than both the control and asymptomatic groups. Indeed, MVICs were reduced by 9%, 14%, 10% and 8% for hip abductors, oblique, extensors and knee flexors, respectively, compared to controls, as well as by 11%, 10%, 21% and 20% compared to the aFAI group.

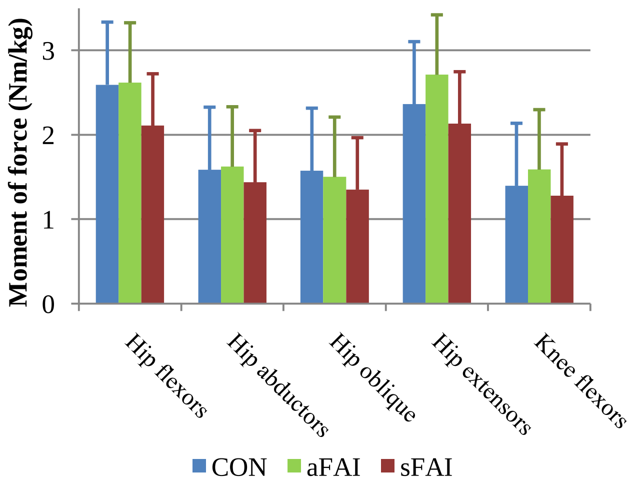

Figure 1: Moments of force in each direction for CON, aFAI and sFAI groups.

One major difference between our study and Casartelli et al. [6] is that they used an isokinetic dynamometer for measuring hip flexors. We agree that this method allows better control of the lower limb segments during the contractions, and that such a fixed resistance would provide less variability in the results that the handheld dynamometer. On the other hand, our study has better group homogeneity: all males with only unilateral cam FAI, whereas they had a mix of FAI type (of the 22 subjects, six had cam, four had pincer, and 12 had combined FAI, with eight of the subjects being bilateral). Cam-FAI usually develops in an active, young male population, and by having young strong men solely as our sFAI group, this may explain why our sFAI group had moments of force slightly closer to the controls. For the asymptomatic population, we believe that our participants might have been slightly more active and/or fit than the controls, explaining the slight increase in some muscle strengths. Indeed, FAI tends to develop more often in the more active population. However, activity level was not controlled for in this study.

We found the aFAI group was usually very close to the control group and indeed slightly higher in all but hip oblique. The absence of pain might therefore be an important element in the ability to produce higher moments of force, compared to the actual bone deformity. These subjects have essentially normal isometric hip strength as compared to healthy control. The question remains whether asymptotic FAI may or may not further develop symptoms.

In order to confirm the trends we observed as well as the data from Casartelli et al. [6], a study on muscle cross-sectional area is warranted. Indeed, it was previously found that cross-sectional area of the pelvic and thigh muscles was 6-13% less in the affected side of a population suffering from osteoarthritis [10].

A limitation of the study is that we only performed two MVIC per muscle group. It is possible that participants that are not used to produce high outputs were not able to achieve their actual maximum because of their unfamiliarity with the task. Also, the use of a handheld dynamometer could have increased variability in the results. Time restriction prevented the used of an isokinetic dynamometer, which we believe would have yielded more reliable results.

CONCLUSIONS

While our FAI patients tended to have lower hip muscle strength than both asymptomatics and controls, none of the differences achieved significance. The above-mentioned limitations could explain these results.

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