ISB 2013 BRAZIL
XXIV CONGRESS OF THE INTERNATIONAL SOCIETY OF BIOMECHANICS
XV BRAZILIAN CONGRESS OF BIOMECHANICS

MUSCLE STRENGTH, SIZE AND QUALITY IN HIP OSTEOARTHRITIS

[1, 2] Aderson Loureiro, [1, 2] Peter Mills, [1, 2] Maria Constantinou and [1, 2] Rod Barrett

[1]Centre for Musculoskeletal Research, Griffith Health Institute, Griffith University, Australia
[2]School of Rehabilitation Sciences, Griffith University, Australia

email: a.loureiro@griffith.edu.au
http://www.griffith.edu.au/health/musculoskeletal-research

INTRODUCTION

Hip osteoarthritis (OA) is responsible for hip pain, stiffness and dysfunction during activities of daily living and is the most common reason for a total hip replacement [1]. It has been estimated that 3% of the adult population, and 8% of people older than 60 years are affected by hip OA. There is no known cure for OA and so, clinical management of hip OA largely focuses on alleviating pain and maximising function. A thorough understanding of the musculoskeletal factors underlying dysfunction in hip OA is required to effectively achieve these goals.

There is consistent evidence for quadriceps muscle weakness in knee OA [2], and the existing literature suggests unilateral hip OA is characterised by generalised muscle weakness of the affected limb [3]. However compared to the knee, there is less literature on muscle strength in hip OA compared with healthy controls. It therefore remains unclear whether muscle weakness as observed in knee OA is evident in hip OA, and if so, which muscle groups are most affected.

The force generated by a muscle is a function of the muscle's physiological cross-sectional area and the level of motor unit pool activation [4], and weakness can result from one or both of these mechanisms. Another factor with the potential to influence muscle strength is muscle density which is a measure of the amount of contractile and non-contractile material within the muscle [5]. There is some evidence for increased intra-muscular fat in persons with OA, which corresponds to lower muscle density when compared with controls. If individuals with hip OA do exhibit muscle weakness, characterisation of this weakness will help to develop management strategies for people with hip OA. The purpose of this study was to determine whether lower limb muscles of persons with hip OA were weaker, smaller and have lower muscle density than those of healthy controls.

METHODS

Twenty-one individuals with hip OA and 16 healthy controls participated in the study. All participants were between 45 and 80 years of age and currently living in the community. Participants underwent maximal isometric strength testing of the hip extensors, flexors, abductor and adductors using a Biodex (System 4 Pro, Biodex Medical Systems, Shirley, NY) isokinetic dynamometer. All tests were performed while standing with the hip in the neutral position. Muscle cross-sectional area (mm^2) and muscle density ($g.cm^{-3}$) of the thigh were measured at 25% of femoral length using peripheral quantitative computed tomography (pQCT) (Norland/Stratec XCT 3000, Pforzheim, Germany).

RESULTS AND DISCUSSION

Characteristics of the hip OA and control participants are provided in Table 1.There were no significant differences in hip strength between the hip OA and control participants however moderate effect sizes indicated a consistent trend towards less strength in hip OA than control participants (Table 2). Similarly, CSA was not significantly different between hip OA and controls however there was a moderate effect size suggesting a trend towards smaller thigh muscle size in hip OA compared with control participants (Figure 1a). Muscle density was however found to be less for hip OA compared with control participants (Figure 1b).

CONCLUSIONS

There was a significant negative effect of hip osteoarthritis on thigh muscle density indicating a greater concentration of intra-muscular fat in the thighs of individuals with hip OA than controls. No significant differences in thigh muscle cross-sectional area or strength were identified however moderate effect sizes suggested that thigh muscle size and strength within the affected leg.

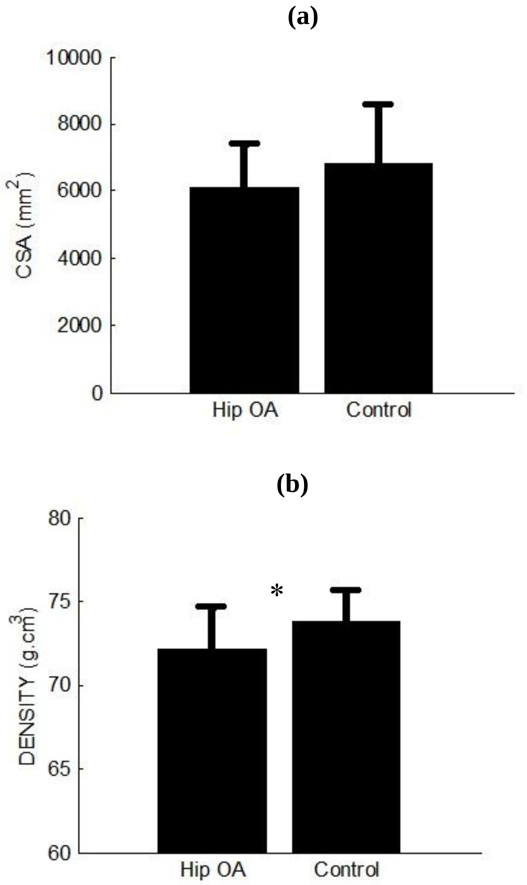

Figure 1: a) Cross-sectional area (CSA) and b) muscle density of the thigh for hip OA and control participants. * indicates $p < 0.05$.

ACKNOWLEDGEMENTS
Research funding for this study was provided by a Griffith University Postgraduate Research Scholarship, a Griffith University International Postgraduate Research Scholarship and a Griffith University Area of Strategic Investment in Chronic Disease Innovation Grant.

REFERENCES

1. Lane, NE, *New England Journal of Medicine*. **357**: 1413-21, 2007.
2. Bennell, KL, et al. *Rheumatic Diseases Clinics of North America*. **34**: 731-54, 2008.
3. Loureiro, A, et al. *Arthritis Care & Research*, **In press**, 2012.
4. Erdemir, A, et al, *Clinical Biomechanics*. **22**: 131-54, 2007.
5. Lynch, NA, et al, *Journal of Applied Physiology*. **86**:188-94. 1999.

Table 1. Anthropometric data of the hip OA and control participants.

Group	n	Age (yr)	Sex	Body mass (kg)	Height (cm)	BMI (kg/m^2)
Hip OA	21	64 (49-79)	W=17; M=4	71.1 ± 10.1	165.8 ± 8.1	26.0± 2.7
Control	16	59 (46-75)	W=10; M=6	71.6 ± 10.5	170.5 ± 8.9	24.7 ± 2.7

* Values are means ±SD (range); n, no. of subjects; W= women; M= men; BMI, body mass index.

Table 2. Isometric hip and knee strength of the hip OA and control participants.

Peak torque (Nm)	OA	Control	*p*	Effect size
Hip extension	66.9 ± 26.9	81.7 ± 31.3	0.131	0.507
Hip flexion	68.2 ± 26.4	86.7 ± 33.2	0.067	0.618
Hip adduction	47.0 ± 23.0	57.3 ± 29.3	0.237	0.393
Hip abduction	48.7 ± 20.1	61.0 ± 17.6	0.060	0.652

* Nm= Newton-metres.