

# POSTURAL CONTROL DURING QUIET STANDING IN PATIENTS WITH A TOTAL HIP ARTHROPLASTY OR A HIP RESURFACING

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## INTRODUCTION

Osteoarthritis (OA) is a disease affecting 15% of the American population (Issa and Sharma, 2006) with a higher prevalence for people older than 65 years (Buckwalter, 2006). In most cases, it generates an overwhelming pain. In order to relieve this pain, several prostheses are used in a surgical procedure called hip arthroplasty. The first main type of hip replacement is the total hip arthroplasty using a large femoral head (THA). Over the years, this prosthesis has proved its worthiness and is now recognized as an effective, reproducible and frequently used therapeutic option (Vendittoli, et al., 2006). The second main type is the surface replacement arthroplasty (SRA). The major advantage of this prosthesis is to keep the femoral head and neck assuring a better restoration of the patient's anatomy (Nantel et al., 2007). A lot of studies have shown results about THA or SRA but so far, only a few compared the two prostheses together. The objective of this study is to compare the postural stability of the patients after THA or SRA at six and twelve months post-surgery, during a quiet standing task with open eyes (OE) and closed eyes (CE).

## METHODS AND PROCEDURES

All patients (THA: n= 18 SRA: n=20) from the two groups were diagnosed with hip OA and had a surgical intervention using a posterior approach. A control group (n=12) was used for comparison. The characteristics of the groups are shown in Table 1. All subjects were performing a quiet standing task in two different conditions (OE and CE) while standing on a force platform (AMTI,

Advanced Mechanical Technology Inc, MA, USA). They were first asked to stand still during 2 minutes with their eyes open and secondly, with their eyes closed at 6 and 12 months post-surgery. The data relative to the center of pressure (COP) were extracted, analysed and filtered using a second-order low pass Butterworth with a cut-off frequency fixed at 10 Hz. From those data, the range (max-min), root-mean-square (RMS) amplitude and the velocity of the COP were calculated in the medio-lateral (VML) and antero-posterior (VAP) directions respectively. Moreover, the area covering 85% of the data and the total path length (TPL) of the COP, were calculated. The results were then averaged for each task and analysed with an ANOVA with repeated measures with 2 fixed factors (3 groups X 2 tasks X 2 evaluations). The results were then further analysed if necessary, with Tukey post-hoc test and paired-t-tests. All analyses were done with a level of signification set at 0.05.

## RESULTS

Table 1 demonstrates no significant differences between our groups.

Subjects	THA	SRA	Control
Age (y)	50.2 (6.4)	49.1 (6.8)	44.4 (9.2)
Gender	6 F/12 M	9 F/11 M	4 F/8 M
Mass (kg)	78.1 (13.8)	78.9 (15.0)	77.0 (13.8)
Height (m)	1.68 (0.06)	1.68 (0.07)	1.72 (0.07)
BMI(kg/m <sup>2</sup> )	27.4 (3.7)	27.7 (3.6)	26.0 (3.4)

**Table1.** Means (SD) of the group's characteristics. No significant differences were observed between the three groups.

During the quiet standing, the statistical analyses (see Tables 2, 3 and 4) revealed a main effect on the period for the range in the ML direction ( $F(1,100) = 6.238, p = 0.014$ ) and for the type of prostheses ( $F(1,100) = 3.578, p = 0.024$ ). It also revealed a main effect for the experimental conditions for the COP velocity in both directions and for TPL (VML:  $F(1,100) = 4.946, p = 0.029$ ; VAP:  $F(1,100) = 22.265, p = 0.000$ ; TPL:  $F(1,100) = 19.493, p = 0.000$ ). No interaction between the factors was found for all variables.

Period	6 months*	12 months*
Range_ML (cm)	1.47 (0.67)	1.31 (0.46)

**Table2.** Mean (SD) of the range in ML.

\*Significant difference between 6 and 12 months.

Subjects	THA	SRA*	CTRL*
Range_ML (cm)	1.40 (0.68)	1.26 (0.46)	1.59 (0.56)

**Table3.** Mean (SD) of the range in ML.

\* Significant difference between SRA and Control.

	Open Eyes*	Closed Eyes*
VML (cm/s)	0.43 (0.10)	0.45 (0.15)
VAP (cm/s)	0.69 (0.16)	0.93 (0.31)
TPL (cm)	110.5 (21.4)	139.7 (41.1)

**Table4.** Mean (SD) of COP velocity and TPL.\* Significant difference between open and closed eyes

## DISCUSSION

The presence of a significant difference between the two periods demonstrates that the patients need six additional months to complete their rehabilitation. During those six months, the muscles needed to maintain a good postural stability in the ML direction, mainly with the abductors/adductors muscle groups (Winter et al., 1996). Patients have also more time to restore their muscular force and endurance, so they may be more efficient and show a more normal postural control. In addition, a significantly improvement has been observed in the SRA group compared to the control group. For the SRA, the femoral head and neck are kept preserving better proprioception functions than the THA (Nantel et al., 2007). Moreover, the surgery used could cause less muscular damage, facilitating than a return to

a more normal activity of the affected muscles. Surprisingly, this difference is not shown when we compare the two experimental conditions. The postural control is a more complex task in lack of vision because the body needs to compensate this loss by a higher use of the other sensorial information source. In the present study, there is no difference between the period and the type of prostheses. The significantly increase of the COP velocity and TPL suggest that the patients, without visual inferences, used their proprioception functions in a similar way. In fact, they need to do more corrections of their COP to be able to keep it in the same zone.

## SUMMARY

Quiet standing is often involves in daily living activities. The range in the ML direction of the patients with hip arthroplasty needs more than 6 months to return to a more normal postural control condition. Patients with SRA prosthesis showed more improvement in their rangeML, indicating a better preservation of their proprioception. However all patients are using their proprioception functions in a similar way when they closed their eyes.

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