POSTURAL BALANCE DURING ONE LEG STANDING IN PATIENTS WITH TOTAL HIP ARTHROPLASTY AND SURFACE REPLACEMENT ARTHROPLASTY

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INTRODUCTION

Osteoarthritis (OA) is the world most common joint condition, affecting over 20 millions people in USA (Garstang and Stitik, 2006). Of these, the hip is the second most common site of OA after the knee, causing the patient to experiment pain in their activities of daily living. One way to relieve this pain is to make a hip arthroplasty. Traditionally performed, the total hip arthroplasty (THA) with a large head using metal on metal bearing surface is a frequent and successful procedure that requires the resection of the whole femoral head and part of the neck. Consequently, THA does not always allow a precise reconstitution of the normal hip biomechanics, particularly for the abd/adductor muscles. In opposition, the surface replacement arthroplasty (SRA) does not present these draw-backs. Considering that balance control in medio-lateral (ML) is mostly regulated by the abd/adductor muscles (Winter, 1995), the objective of this study was to examine if the SRA would be more advantageous than THA to maintain postural control in a challenging task like one leg stance. In addition, we wanted to determine whether a difference persists between the affected and the sound side.

METHODS AND PROCEDURES

Two groups of patients with unilateral hip OA who underwent THA or SRA were evaluated at six and twelve months post-surgery while a control group was evaluated once. Characteristics of the groups are presented in Table 1. Each surgery was performed using a posterior surgical approach. All subjects performed two 10-sec.-one leg standing trials for each side on a force platform (AMTI, Advanced Mechanical Technology Inc, MA, USA) recording at 120 Hz the position of their center of pressure (COP). The data were then filtered and analysed to extract the range (maximum-minimum), root-mean-square amplitude (RMS) and the velocity of the COP (V_{COP}), in both the ML and antero-posterior (AP) directions . In addition, the total path length (TPL) of the COP was measured. The results were then averaged for each side and analysed by means of a repeated measures ANOVA (3 groups X 2 sides X 2 evaluations). If necessary, the results were analyse with Tukey post-hoc tests and paired-t tests. Statistical threshold was set at 0.05.

RESULTS

Table 1 shows the characteristics of the groups. No significant differences were observed between the groups ($p<0.05$).

Subjects	THA	SRA	Control
Age (y)	50.3 (6.6)	49.1 (6.8)	44.4 (8.5)
Gender	6 F/11 M	9 F/11 M	6 F/8 M
Weight (kg)	76.3 (11.9)	78.9 (15.0)	75.2 (13.4)
Height (m)	1.68 (0.05)	1.68 (0.07)	1.70 (0.07)
BMI(kg/m^2)	27.0 (3.5)	27.7 (3.6)	25.8 (3.3)

Table 1. Means (SD) of the group's characteristics.

The statistical analysis revealed only a main group effect for the V_{COP} in both ML ($p=0.045$) and AP ($p=0.010$) directions and for the TPL variable ($p=0.040$). No main effect of evaluation time or side was found. In addition, no interaction was found between the three factors for all variables. Table 2 presents the Tukey post-hoc tests used for the significant main group effect. The results show no difference between THA and SRA for these biomechanical variables but they present significant difference with the control group.

Subjects	THA	SRA	Control
Range ML	3.4 (1.0)	3.4 (1.0)	3.3 (1.0)
Range AP	4.0 (1.2)	4.1 (2.0)	3.9 (0.8)
RMS ML	0.8 (0.2)	0.8 (0.3)	0.7 (0.2)
RMS AP	0.8 (0.3)	0.8 (0.3)	0.8 (0.2)
V_{COP} ML	4.1 (1.4)*	3.9 (1.3)	3.4 (0.9)*
V_{COP} AP	3.8 (1.4)*	3.9 (2.3)λ	2.8 (1.0)* λ
TPL	60.8(18.4)*	60.7 (27.6)λ	49.0 (15.1)*λ

Table 2. Means (SD) of COP range, RMS, TPL (cm) and velocity (cm/s) for the main group effect, independently of evaluation time and side. *: Significant difference between THA and Control, λ: Significant difference between SRA and Control.

DISCUSSION

The absence of significant effect of side or evaluation time indicate that both legs performed the task similarly as soon as 6 months, which is consistent with an improvement of the hip function three to six months post-surgery (Laupacis et al., 2002). However, this improvement is not sufficient to reach the performance of the control group even at 12 months post-surgery. In fact, even if the amplitude of displacement of the COP is similar between our 3 groups (range, RMS); the velocity of the displacement made by the two patient groups is higher than for the control group (V_{COP}, TPL). This reflects an increased neuromuscular activity needed for maintaining their postural stability not only in ML, but also in AP for the same displacement of the COP. Finally, even if no significant group difference where found between SRA and THA for the V_{COP} in ML, the former seems to better performs between 6 and 12 months. These results could be linked to a better recovery of the abd/adductors muscles which, combined with a more natural hip biomechanics (femoral head and neck), may improve their postural control by means of a better proprioceptive function and stronger muscles strength (Nantel et al., 2007).

SUMMARY

One leg standing is a challenging task for control participants. It is even more for patients undergoing arthroplasty because of the muscles affected during the surgery. Even at 12 months post-surgery, these patients did not reach the performance showed by control participants. However, as soon as 6 months post-surgery, no difference subsists between the two supporting legs. Finally, even if no significant group difference between THA and SRA was found, the latter seems to better performs between 6 and 12 months.

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