BIOMECHANICS OF SIT TO STAND AND STAND TO SIT FROM HIGH AND LOW CHAIR AFTER TOTAL HIP ARTHROPLASTY IN OBESE SUBJECTS

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INTRODUCTION

The sit to stand (SitTS) movement, a prerequisite in many activities of daily living, becomes more difficult to perform with age, obesity, and after Total Hip Arthroplasty (THA), a common surgical procedure. SitTS movement has been extensively investigated but the studies on different chair heights are limited (1, 2). Using a lower seat height increases hip extensor moments in healthy normal weight subjects (3), but no studies have been done to see the effect of low chair height in THA subjects. Furthermore, most of the studies include only the sit to stand part and not the complete cycle until the subjects sit back down. Burnett (4) reported similar peak hip flexion and moments during SitTS and stand to sit (StandTS) activity in normal subjects, but no study has looked at StandTS in THA subjects.

The purpose of study is to analyze kinetics during SitTS and StandTS from high and low chair height. We hypothesize that peak hip extensor moments during SitTS will be higher for low chair height as compared to high chair and will be similar during SitTS and StandTS activity.

METHODS

Seven patients with unilateral hip replacement, aged between 50-70 years, mean BMI 34.9 kg/m² (range 30.5-40.8) were recruited for the study along with 14 age matched control obese subjects; mean BMI 37 kg/m²). The study was approved by the local institutional review board. Marker triads were placed on the pelvis, trunk and bilaterally on the thigh, leg, and foot. Three dimensional kinematic data (Optotrak) and Ground reaction force data (Kistler) were collected at 60 Hz and 300 Hz, and filtered at 6 Hz and 10 Hz, respectively.

Participants were asked to cross their arms over their chests during SitTS task. Foot position was self-selected as they stood from a standard chair (46 cm high) and a low-height chair (38 cm high) and returned to the seated position at their preferred speed. The average of five SitTS trials was used to assess kinetic data. The initiation and end of the SitTS movement was differentiated by vertical pelvic velocity.

DATA ANALYSIS

Visual 3D software (C-Motion) was used for processing and the moments were normalized to body mass. Repeated measures One Way Analysis of Variance (ANOVA) was performed to compare three dimensional peak hip moments at 6 weeks, 6 months and 1 year post operatively. Paired t-tests were used to determine significant differences. SPSS 17.0 was used for analysis with p-value <0.05.

RESULTS AND DISCUSSION

Sagittal plane peak hip extensor moments for SitTS-L (1.13 +/- 0.26) were higher during SitTS-L (1.09 +/- 0.20) for the control subjects. However the peak hip extensor moments during SitTS-H (1.13 +/- 0.16) were found to be similar to SitTS-L (1.20 +/- 0.20) for obese THA subjects at 6 months after surgery. (p-value 0.90) (Fig.1). This may be attributed to greater asymmetry in loading during SitTS-L as compared to SitTS-H. Asymmetric limb loading resulting in decreased hip moments at operated hip has been shown during SitTS in THA subjects. The heavier subjects may have less
flexibility when it comes to loading the involved side given the huge amount of weight that has to be moved.

The peak knee extensor moments were found to be greater in SitTS-L than in SitTS-H, although not significant. It can be one of the modifications in THA subjects to protect the operated hip by putting same load on hip and more on the knees to accommodate for the higher load experienced during SitTS-L.

For StandTS, the peak hip moment for obese THA subjects at 6 months for SitTS-H (1.13 +/- 0.16) was similar to StandTS-H (1.02 +/- 0.19) (p-value 0.38). following similar trend found in normal healthy subjects. (Burnett,2010). The Knee moments were also similar during SitTS and StandTS motion (See table 1).

Therefore, SitTS and StandTS motion has symmetrical hip and knee kinetics, suggesting similar joint stresses while sitting back from a standing position. Considering these findings, emphasis should also be given to StandTS activity while analyzing THA subjects.

**CONCLUSIONS**

The results of the study show that normalized peak hip extensor moments for obese THA subjects at 6 months after surgery were similar for SitTS-H and SitTS-L whereas their normal obese counterparts show greater peak moment during SitTS-L.

The SitTS and StandTS motion exert similar moments at hip and knee in obese THA population, indicating the need of analyzing the joint stresses while sitting back from a standing position in addition to the normal sit to stand activity.

**REFERENCES:**


**ACKNOWLEDGEMENTS:**

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<tr>
<th>PEAK MOMENTS IN THA (OBESE)</th>
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<td></td>
<td>HIP</td>
<td>KNEE</td>
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<tr>
<td>SitTS-H</td>
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<tr>
<td>SitTS-L</td>
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<td>0.68 (0.10)</td>
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</table>

Table 1: Peak hip and knee extensor moments during SitTS and StandTS from High and Low chair height in obese THA subjects at 6 weeks, 6 months and 1 year after THA and obese controls.