DYNAMIC ASSESSMENT OF SUBJECTS WITH BAYLEY-WALKER REVERSE ANATOMY IMPLANTS PERFORMING ACTIVITIES OF DAILY LIVING

Milad Masjedi, Sian E.M. Lawson and Garth R. Johnson
Centre for Rehabilitation and Engineering Studies (CREST), Newcastle University, UK
Email: milad.masjedi@ncl.ac.uk web: http://www.ncl.ac.uk/crest/

INTRODUCTION

Restoring the function of normal anatomy is one of the ultimate aims of any joint replacement. Evaluation of these replacements is possible by kinematic and dynamic comparison of the implanted subjects with normal subjects. A full kinematic analysis was previously performed [1] on, 12 subjects who had a Bayley-Walker reverse shoulder implant (B-W-S), and 12 normal subjects (mean mass of 63.7 kg and 76.5 kg respectively). High variability between normal subjects made distinction between patients and normal subjects' kinematics difficult. A dynamic analysis was therefore performed to evaluate the influence of post-implant kinematics on the net joint forces and moments.

METHODS

The tasks for which kinematic data was obtained and analyzed [1] are shown in Table 1. Additionally the body segment parameters (BSP) were determined from regression equations [2]. The Recursive Newton Euler method was used to obtain the net forces and moments across the shoulder joint for each activity (**actual**). Although the normal and B-W-S subjects did not have significantly different mass (P=0.067, two sample t-test with 95% CI) the average mass was about 12 kg greater in normal subjects. Therefore, in order to isolate the effects of alteration of motion between the patients and normal subjects on dynamics, the resultant forces and moments calculated were presented as a percentage of the total body mass (**%TBM**).

1. Mug to mouth (drinking)	7. Pouring from kettle standing (5 N)
2. Reach to opposite axilla	8. Lift shopping bag (2 kg)
3. Wash lower back	9. Lift tray (0.5 kg) use both hands
4. Brush opposite side of head	10. Sitting position lift to shoulder height (0.5 kg)
5. Answer telephone	11. Reach to as far as you can
6. Pouring from kettle sitting (5 N)	12. Sitting position lift to head height (0.5 kg)

Table 1: Tasks that were analyzed in this study.

RESULTS AND DISCUSSION

The greatest actual forces and moments were observed in task eight which has the external mass of 2 kg acting on the hand. The results indicated that the actual (unnormalized) forces and moments were smaller for B-W-S subjects than for normal subjects. For the drinking task although the actual force magnitude were greater for normal subjects, the actual moment was slightly smaller. This was caused by higher flexion moment for B-W-S. The greatest difference for the actual force between the two groups was observed when a task involved elevation of the arm (i.e. hair brushing, Task Four) where the average actual total force 23% greater for normal subjects. This difference decreased after presenting the data as %TBM (to 4 %). For Task Two the actual moment was greater for normal subjects but after normalization, the B-W-S had greater moment with 19% difference (Figure 1). This shows the strong influence of BSP on dynamic calculations. The highest moments were seen in task lifting bag, where the highest difference also occurred between the two groups. For this task the actual moment for normal subjects was around 23% greater than for B-W-S which reduced to 7.6% when the moment was presented %TBM. Although representing the data as %TBM can isolate the effect of kinematics, it was identified that it can also influence the effect of external forces.

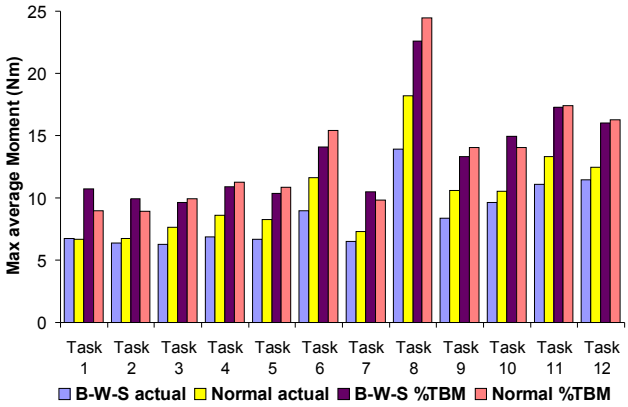

Figure 1: Total moment for normal and B-W-S.

CONCLUSIONS

The actual joint forces and moments for the B-W-S were smaller than those for normal subjects in nearly all cases. Using the normalized data can show the influence of the movement on the forces and moments across the shoulder joint. Following normalization of mass, it was observed that although changes in kinematics did not substantially influence the net force it affected the total moment. Since the BSP parameters have a significant effect on dynamic analysis, in order to focus on effect of variation in movement in dynamic study it is necessary to normalize the data with respect to the mass. Furthermore it is recommended to present BSP parameters for any dynamic studies to make the results comparable across the studies.

REFERENCE

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2. de Leva, P., *J Biomech*, **29**(9):1223-30, 1996.