

## HIGH RANGE OF MOTION ACTIVITIES OF DAILY LIVING: DIFFERENCES IN THE KINEMATICS BETWEEN HONG KONG AND CHENNAI, INDIA SUBJECTS

<sup>1</sup>Urs Wyss, <sup>1</sup>Heather Brown, <sup>1</sup>Andrea Hemmerich, <sup>2</sup>Tanya Packer, <sup>1</sup>Stacey Smith  
<sup>1</sup>Queen's University, Kingston, Ontario, Canada; e-mail: [wyss@me.queensu.ca](mailto:wyss@me.queensu.ca)  
<sup>2</sup>Curtin University, Perth, Western Australia

### INTRODUCTION

There are regions in the world where for cultural or religious reasons high range of motion (ROM) activities of daily living (ADL), such as squatting, kneeling and cross-legged sitting are common. When patients in these regions suffer from joint disease, it is more difficult for them to be treated with joint replacements, as not many of the current designs allow for a high ROM. Kinematic and kinetic data is limited (3), which is why it is necessary to study high ROM ADL. It was not known if high ROM activities would be following the same kinematic and kinetic patterns in different regions, which is why data was collected from more than one specific group. This study discusses data from subjects from Hong Kong and Chennai in India, and looks at differences between the two populations.

### METHODS

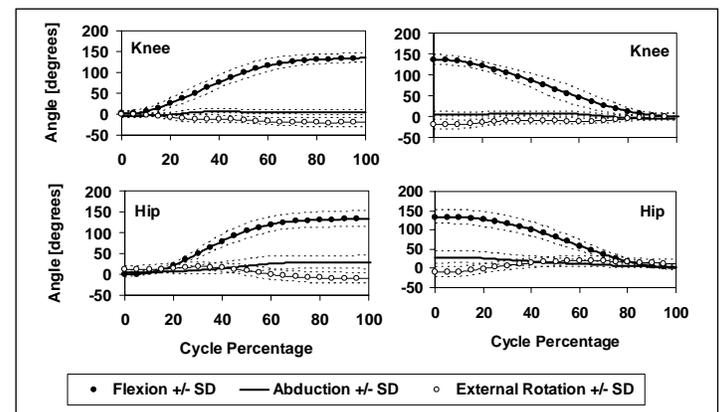
In Hong Kong there were 8 female and 3 male subjects assessed. Their mean age was 50.2 years (SD 7.8), the mean mass was 59.3kg (SD 9.9), and the mean height 158.4cm (SD 10.3). In Chennai there were 10 female and 20 male subjects. Their mean age was 48.1 years (SD 7.6), the mean mass was 57.1kg (SD 10.2), and the mean height 158.6cm (SD 7.3). The kinematics were recorded with a Fastrak system (Polhemus), and the ground reaction forces with a non-magnetic force platform (AMTI). The trials were split into a phase going with gravity into the posture, and against gravity out of the posture. Each phase was then normalized to 100%, so that the data can be compared (1).

### RESULTS AND DISCUSSION

The mean curves with the standard deviations (+/- 1SD) for the hip and knee angles of the squatting with heels down activity, is shown in Figure 1 for the Hong Kong subjects. It shows the flexion/ extension, abduction/ adduction and external-/ internal-rotation curves. The differences between the Hong Kong and Chennai subjects are mainly in the flexion/ extension movement, which is why only those are summarized in Table 1 for other activities. The kneeling data is not added here, since both groups indicated that it is not an activity that they would do frequently. This, of course would be a very important ADL in Muslim populations. The data in Table 1 shows that the Hong Kong subjects had a higher flexion maximum at the hip as compared to the Chennai subjects. There was, however, a large standard deviation, indicating big differences between subjects. It is interesting to see in Table 1 that the larger hip angles in the Hong Kong subjects are compensated somewhat by smaller maximum knee angles. Furthermore, the standard deviations at the knee of the Chennai subjects are smaller than for the hip angles, indicating much less variation between subjects.

### CONCLUSIONS

The kinematics of how the subjects in Hong Kong perform high ROM ADL are different from subjects in Chennai, India. Some of these differences are over 30 degrees. The Hong Kong subjects use less knee flexion, but more hip flexion. Reviewing the position of the sacral marker showed that the compensation of the lower hip angles is mostly taking place in the lower region of the back (2). It is important to be aware of the differences how high ROM ADL are performed in populations with different cultural and religious backgrounds when artificial joints are developed for these persons, so that the technical ROM of the implant is sufficiently large.



**Figure 1:** Hip and knee rotations for squatting heels down of Hong Kong subjects.

**Table 1:** Maximum hip and knee flexion angles for three ADL of the Hong Kong and Chennai subjects.

	Maximum Hip Flexion [degrees]		Maximum Knee Flexion [degrees]	
	Hong Kong	Chennai	Hong Kong	Chennai
<b>Squatting Heels Down</b>	133 (21)	95 (26)	135 (20)	152 (11)
<b>Squatting Heels Up</b>	108 (22)	91 (17)	142 (15)	155 (7)
<b>Sitting Cross-Legged</b>	128 (29)	85 (34)	126 (32)	149 (8)

### REFERENCES

1. Brown, H. *M.Sc. Thesis*, Mech. and Mat. Eng., Queen's University, Canada, 2004.
2. Hemmerich, A, et al. *Proceedings of ORS*, 2005.
3. Mulholland, SJ and Wyss, UP. *Int. J. Rehab. Res.*, **24**, 191-198, 2001.
4. Noble, P and Weiss, GM. *Proceedings of ORS*, 2001.

### ACKNOWLEDGEMENTS

The study was partially supported by Zimmer, Inc. Switzerland and NSERC.