

Kinematic Analysis of Human Rolling

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Rolling is an important developmental motor skill that not only affords comfort but also injury prevention. People who cannot roll, whether due to age or disability, are at greater risk of developing bedsores. People use different techniques to roll. For example, some people use their arms to arms to roll whereas others do not. The purpose of this study was to identify which rolling technique requires less mechanical energy.

For this study, data were collected from ten healthy college-aged subjects (male to female ratio 6:4) by a video-based motion capture system (Motion Analysis Corp., Santa Rosa, CA). Subjects laid on a firm surface in the supine position and rolled to their right into a side-lying position under two conditions, i) arms uncrossed (free to move naturally) and ii) arms crossed over the chest (to mimic arms not used in rolling). Five trials were collected for each type of rolling and for each subject, resulting in 100 trials total. Data were then imported into biomechanics simulation software (OpenSim) to calculate the centers of mass (COM), linear (v), and angular velocities (ω) of the body segments. The potential and kinetic energy of the body segments were calculated to determine the mechanical energy of rolling for both techniques. A statistical analysis (two-factor repeated measures ANOVA ($\alpha = 0.05$)) was performed to identify differences in mechanical energy between the two rolling conditions.

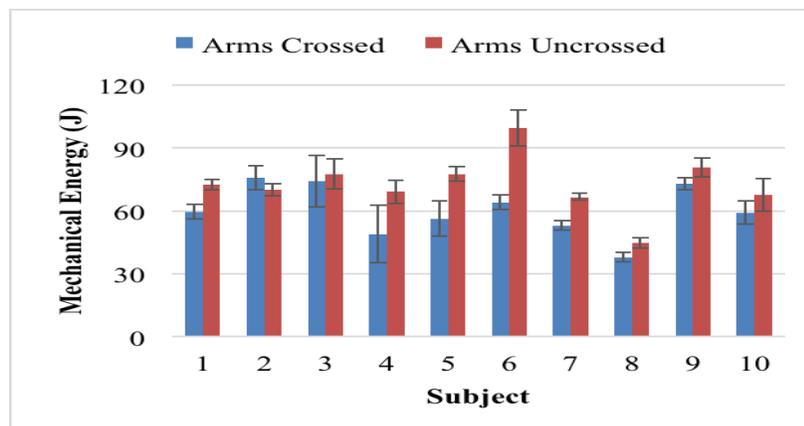


Figure 1: Mean mechanical energy for rolling with the arms crossed and uncrossed. Error bars represent ± 1 standard deviation.

The mechanical energies for rolling with the arms crossed and uncrossed were $60.1 \pm 12.1\text{J}$ and $72.6 \pm 13.8\text{J}$, respectively (Figure 1). The statistical analysis indicated that there was a significant difference ($p = 0.007$) between the mechanical energy measures for rolling with the arms crossed and uncrossed. The mechanical energy was lower for rolling with the arms crossed than with the arms uncrossed. This information could be useful to individuals and care providers for individuals who have difficulty rolling.