3D WRIST KINETICS DURING JAR AND BOTTLE OPENING IN OLDER ADULTS

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INTRODUCTION

Jar and bottle opening remain a significant problem for many members of society, particularly older adults, despite research effort in this area [1,2]. Recent work has characterised kinematic jar opening [3], along with static kinetic force measurement [4]. While this work is valuable, it does not provide detailed information about the precise hand postures used by the subjects, nor the subsequent loading experienced at key anatomical joints.

This study recorded both force and motion data during dynamic jar and bottle opening to allow quantification of wrist joint kinetics in young and older adult populations.

METHODS

A control group of 8 young healthy adults (5M, 3F; mean age 26.2),and a group of 11 older adults (6M, 5F; mean age 76.4), completed two hand functionality tests; power grip (Jamar® Hand Dynamometer, Lafayette Instruments, Lafayette, IN) and manual dexterity (Purdue Pegboard Test, Lafayette Instruments, Lafayette, IN). This was followed by the completion of 3 jar and 3 bottle opening activities, with jar opening shown in Figure 1. During these activities the force data was measured by a custom-made jar/bottle device which, in addition to being dimensionally similar to a jar/bottle, also provided a realistic torque resistance and opened when the subject had applied sufficient torque. Two Nano 25 F/T transducers (ATI Industrial Automation, Apex, NC) measured the forces and moments applied by the two separate grip components; the thumb and the opposing fingers combination. Motion data was simultaneously captured using an 8-camera Vicon motion analysis system (0xford Metrics, UK) and 50 reflective hand markers (25 per hand). The biomechanical model of the hand and wrist used was adapted from previous work [5].

External hand loading and kinematics were combined to calculate resultant wrist joint moments and forces (inertial and gravitational effects considered negligible) about a forearm embedded axes system (Figure 1).

RESULTS AND DISCUSSION

As the results in Table 1 show, despite older adults having less grip strength and poorer dexterity, there was no clear difference in the group average external moments and forces at the wrist. However, within both groups there was considerable variation in the wrist moment as defined in a forearm axis system, suggesting that technique and/or kinematics have a key influence on external kinetics.

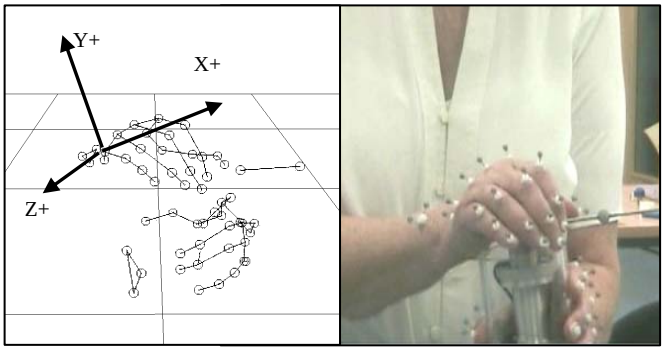

Figure 1: Subject opening custom-made jar and corresponding motion analysis output, with right forearm embedded axes system shown.

CONCLUSIONS

No significant age related differences were found in wrist kinetics although there were large variations within groups. Further examination of hand functionality and hand posture may provide more insight into the cause of variation in external kinetics recorded.

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Table 1: Jar opening external kinetics at point of opening (right hand on lid). See Figure 1 for forearm axes. Mean (S.D.)

Subject Group	Power Grip (N)	Manual Dexterity Score	Wrist Moments (Nm)			Wrist Forces (N)		
			Flex./Ext. (-Mz/+Mz)	Rad./Uln. (+My/-My)	Sup./Pro. (+Mx/-Mx)	F_x	F_y	F_z
Young Adults	358.7 (59.8)	43.6 (4.2)	1.2 (0.9)	-2.9 (2.1)	1.1 (1.8)	-13.2 (14.9)	30.3 (17.8)	16.4 (12.6)
Older Adults	244.4 (110.3)	30.6 (6.5)	-0.3 (0.8)	-3.0 (1.8)	2.3 (1.3)	-7.5 (12.2)	44.5 (15.1)	2.1 (26.5)