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EFFECT OF GRIPPING IN A TRIGGER POSTURE ON APPARENT MASS OF THE HAND-ARM SYSTEM

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Introduction

Exposure to hand-arm vibration can induce hand-arm vibration syndrome (HAVS), one aspect of which is vibration white finger (VWF). The risk of developing HAVS is related to exposure duration, and the frequency and magnitude of the vibration. As the hand-arm system is not rigid, the extent to which forces are transmitted to the hand is a function of frequency and can be measured using the apparent mass, where a high apparent mass corresponds to higher forces being transmitted when compared to frequencies with a lower apparent mass. The apparent mass is affected by the direction of the vibration and the gripping conditions[1, 2].

When workers are exposed to hand-arm vibration from power tools, they often need to control a trigger. On most construction tools triggers are operated with the first and second finger whilst the thumb, third and fourth finger provide the primary grip for the tool in that hand. This paper reports an experiment to compare the biomechanical response of the hand-arm system when gripping with a 'full' grip and with a 'trigger' grip.

Methods

8 male subjects were exposed to tri-axial random (10 – 1000 Hz) vibration. The vibration had a magnitude of 18 m/s² r.m.s. in each direction and was presented through a 40 mm handle containing accelerometers and force cells. Subjects gripped the handle at 30N and pushed at 50N. Tests were conducted with a straight (elbow 180˚) and bent arm (elbow 90˚). In the 'full' grip condition all fingers were used; in the 'trigger' grip there was no contact of the first two fingers with the handle (Figure 1). Apparent mass was measured separately for finger and palm sides of the hand.

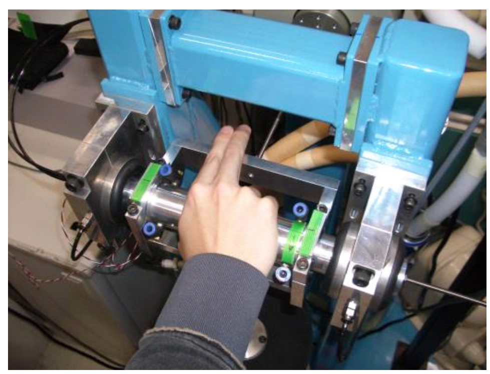

Figure 1. 'Trigger' grip posture.

Results and Discussion

Results for the 'full' grip showed similar trends to those in the literature[1,2] (Figure 2). In the x- and y-axes, the apparent mass in the 'trigger' grip posture was increased for the palm side at low frequencies. On the finger side apparent mass reduced, as expected,

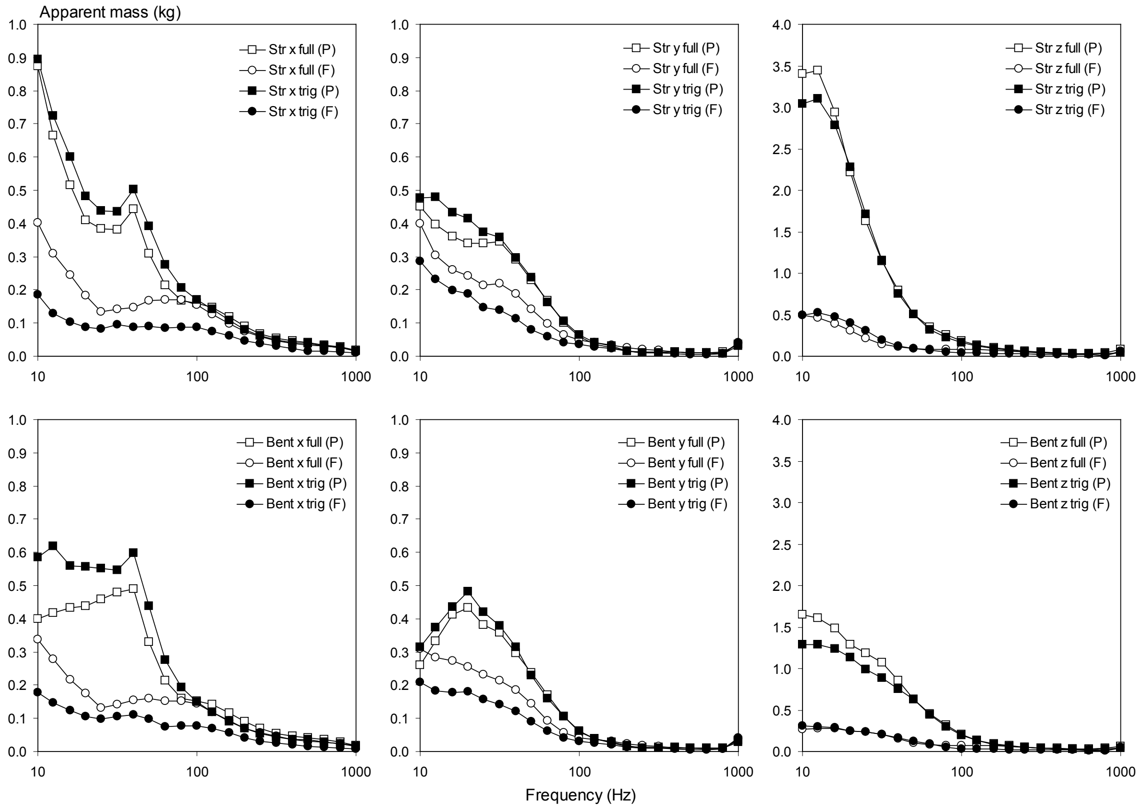

Figure 2. Mean apparent mass of the hand-arm system with straight ('str') and bent arm, with full and trigger ('trig') grip, for the finger (F) and palm (P) side of the hand. Note change of scale for z-axis vibration data.

as there was less finger loading. For z-axis vibration the apparent mass was about 400g lower for the trigger posture (palm side) at low frequencies. For the palm side with bent arm, differences were significant at 12.5 Hz ($p < 0.05$, Wilcoxon) but not for the straight arm. For the finger side, differences at 12.5 Hz were significant in the x- and y-axes for both arm postures.

These results show that although slight differences occur in the apparent mass of the hand-arm system when gripping with a full and trigger posture, changes are relatively small in comparison with inter-subject variability.

Acknowledgement

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