EVIDENCE FOR THE INVOLMENT OF MUSCULAR PRE-ACTIVATION IN IMPACT LOADING AND IN SHOCK WAVE TRANSMISSION

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INTRODUCTION

Biomechanical studies of human beings in a seated position to mimic the driver attitude have increased our knowledge of the effect of the shock on the body structure [1] for accidentology perspective. Potential injuries are generally indirectly estimated from dummies or PMHS paradigms. By consequence, resulting numerical models are limited due to the absence of consideration of potential modifications of functional response of the musculo-skeletal system [3]. This study was conducted to establish the influence of muscular activation of the lower limb prior the impact (pre-activation) on impact loading and on the resulting shock wave.

METHODS

Ten young male adults volunteered in this study. The experimental protocol was approved by the human ethics committee of the University.

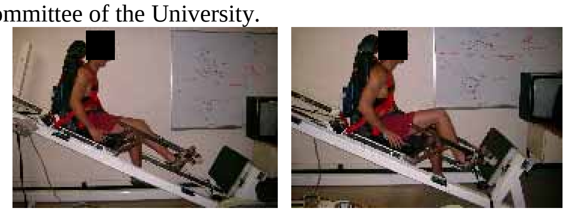

Figure 1. Experimental set : sledge ergometer [2].

The sledge ergometer (Figure 1) was associated to a lower limb guiding device (strain gauge sensor based) which allow the measurement of the overall force exerted by the impacting lower limb before the contact with the force plate. EMG activity of 4 lower limb muscles were monitored and 2 miniature accelerometer measured shank and thigh accelerations of the impacting leg. Three conditions, 25%, 50% and 75% of the maximal force input exerted on the guiding device, were tested in blocks of 3 consecutive trials. Each seated volunteer was dropped from a distance corresponding to 200% of maximal rebound off the force plate he could performed. EMGs, reaction force, displacement of the seat and force before impact were simultaneously recorded at a 2 kHz frequency. ANOVAs tests were run on the averaged measured parameters.

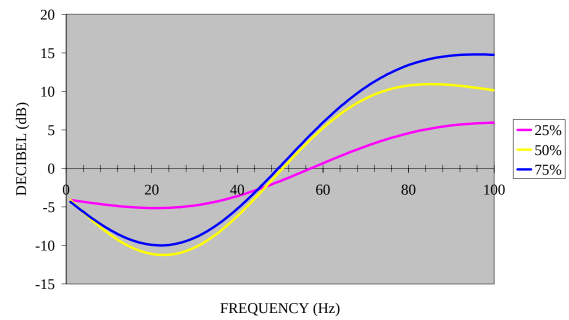

Figure 2. Gain/Attenuation profiles.

RESULTS AND DISCUSSION

On average (Table 1), the lowest pre-activation condition generated highest acceleration peak associated with highest shock transmission ratio and lowest peak force. At the opposite highest condition revealed lowest amplitude peak associated with lowest shock transmission ratio and highest peak force. The computation of gain/ attenuation (Figure 2) showed that attenuation was realized by the human system for the frequency content below 50-60 Hz. The best attenuation was provided for the highest pre-activation conditions.

CONCLUSION

In accordance with recent studies [4] our results showed significant positive relationships between myoelectric input and shock cushioning. Additionally, increasing preactivation would play a role in the damping of the soft tissues.

REFERENCES

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Table 1: Peak force (PF), peak shank (PS) and peak thigh (PT) accelerations, and calculated acceleration ratio (PS-PT) are reported for the 3 experimental conditions i.e. 25 %, 50% and 75% of maximum force pre-impact.

% maximum force	25%	50%	75%
PF (N/kg)	46 ± 3.7	48 ± 9.3	50 ± 7.3
PS (g)	13 ± 3.45	6.4 ± 4.70	6.4 ± 4.03
PT (g)	8.9 ± 1.10	4.5 ± 1.56	4.8 ± 1.63
PS/PT ratio (a.u)	1.46	1.42	1.33