Increased Muscle Activity whilst cycling with the addition of Mechanical Vibration

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This is a summary of a preliminary study carried out at the Centre for Sports Science & Human Performance, University of Greenwich, UK

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Introduction:

The use of vibration within training programs continues to gain scientific credibility as an alternative method to improve muscle performance. There have been limited studies which have attempted to integrate vibration stimuli during stationary cycling to influence physiological responses, all of which used cycle frames and cranks attached directly to vibration platforms.

The Power Plate Rev™ represents a mechanical training ergometer specifically designed to apply vibration training (VT) to enhance human performance. A patented mechanism placed in the crank enables the bike to generate vibration that is transmitted to the pedals during cycling.

The aim of this preliminary study was to determine the comparative effects of cycling, with and without vibration, on activation patterns of the lower limb The aim of this preliminary study was to determine the comparative effects of cycling, with and without vibration, on activation patterns of the lower limb muscle groups.

Method:

Eight participants cycled at 60, 70, 80 and 90 RPM on the powerBIKE with and without vibration, at a fixed resistance for 3 min at each cadence. Markers were fixed to the crank in order to define top dead centre (TDC - 0°) and bottom dead centre (BDC - 180°) during the duty cycle.

Electromyography, a technique for evaluating the activity of skeletal muscles, was used to determine the level of activity in the calves, quadriceps, hamstrings and glutes, (the primary muscles used during cycling), during the duty cycles for each cadence.

Results:

Radar plots of selected muscle activities against crank position (clockwise rotation) at 90 RPM between vibration [red lines] and no vibration [blue lines] conditions are shown in Fig 1. These data show that vibration causes significant increases in the activities of the main muscle groups in cycling. The mean increases in activity were:

- Calves – 43%
- Quadriceps – 167%
- Hamstrings – 144%
- Glutes – 138%

Individual muscle activities were summated to give a 'total' lower limb muscle activation value. Comparison of total muscle activities between vibration [red lines] and no vibration [blue lines] conditions are shown in Fig 2. The relative differences between vibration and no vibration expressed as the RPM dependent vibration frequency are shown in Fig 3.

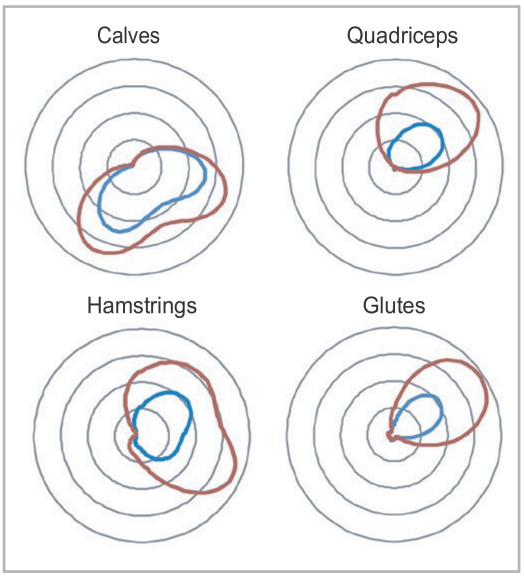

Fig 1

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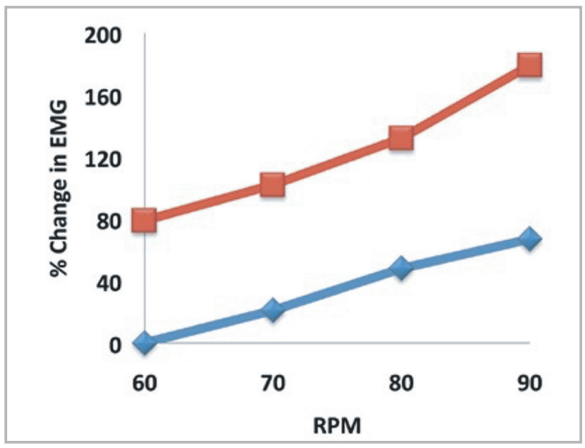

Fig 2

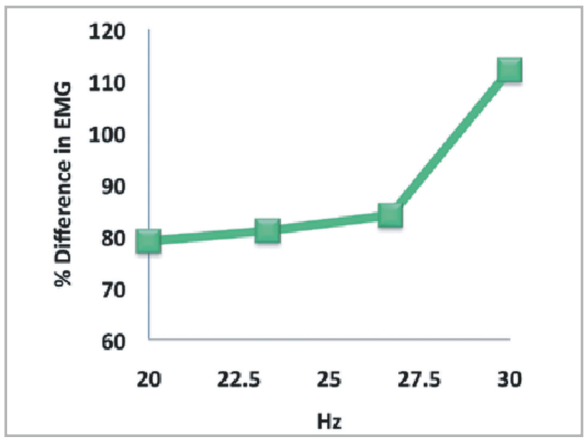

Fig 3

Conclusion:

1. The addition of mechanical vibration led to significant increases in lower limb muscle activation while cycling at 60, 70, 80 and 90 RPM at a set resistance.

2. Both the onset and duration of muscle activity also increased during the duty cycle, in response to applied vibration.

3. The mechanism providing the mechanical vibration is responsible for the increase in power output in the same way as increasing the resistance. Testing showed that, when cycling at the same cadence, level 1 with vibration was the same as cycling at level 5 without vibration.

Summary:

These preliminary data show that the addition of mechanical vibration during cycling produces significant increases in muscle activation of the major lower limb muscles. Studies have suggested that vibration training initiates changes in muscle length with concomitant muscle spindle activation, eliciting the 'tonic vibration reflex' (Cardinale & Bosco, 2003) and that during vibration, there is a increase in motor unit recruitment resulting in faster muscle activation (Rehn et al, 2007). This study suggests that vibration during cycling induces a greater training stimulus of the high-threshold fast twitch motor units.