Effect of moutain bike spirgrips® on transmissibility of mechanical vibrations, perceived comfort, muscular activity and hand grip force

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Effect of moutain bike spirgrips® on transmissibility of mechanical vibrations, perceived comfort, muscular activity and hand grip force.

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Purpose:

Prolonged mountain biking can involve pain complain in the wrists due to the ulnar nerve compression when using traditional grips (Capitani et al., 2002; Eckman et al., 1975). This phenomenon seems to be amplified by mechanical vibrations that are largely encountered during MTB practice despite the use of damping systems located in the fork and/or the frame. Recently, SPIRGRIPS® (SG) have been designed to correct the position of the hands of the user naturally by aligning the joints of his forearms correctly which is not the case with traditional grips. The aim of this experimental study was to evaluate the effect of SG on transmissibility of mechanical vibrations, perceived comfort, muscular activity and hand grip force during a prolonged pedalling exercise.

Methods:

Sixteen trained cyclists without SG experience (age: 27 ± 10 years; height: 178 ± 6 cm; mass: 70 ± 7 kg) volunteered to participate in the study. Each participant performed a one-day laboratory cycling test on an aluminium hardtail mountain bike (Merida, Taiwan, Taiwan) equipped with a wireless SRM crank powermeter (Schoberer Rad Messtechnik, Fuchsend, Germany; accuracy ± 1%). The rear wheel of the bike was fixed onto an electromagnetic-braked ergometer (Elite, Fontaniva, Italy) while the front fork of the bike was connected to an electrical motor by a mechanical pivot. The test included two 20-minutes pedalling sessions at ~200 W that were separated by 20-minutes of passive recovery. Each pedalling session contained two pedalling periods of 9 minutes with fork vibrations interspersed by 2 min of pedalling without fork vibrations. Mechanical vibrations delivered by the motor were characterized by vertical acceleration from 12 to 53 $m.s^{-2}$ and vibration frequency from 4 to 17 Hz. Participants had to keep their hands on the traditional grips (TG) or on the ergonomic SG throughout the pedalling session. All the subjects reported their ratings of perceived comfort (RPC) on a visual numeric scale graded from 0 (very much uncomfortable) to 10 (very much comfortable) approximately 10 seconds before the end of pedalling bout. Mechanical vibrations were simultaneously measured at 1350 Hz on the mechanical pivot of the ergometer and the right wrist of the rider by two Hikob Fox inertial measurement units (HIKOB, Vileurbanne, France). Surface EMG activity of flexor carpi radialis (FCR), extensor digitorum (ED) and triceps brachii (TB) were continuously measured by Trigno sensors (Delsys, Boston, USA) which are composed of two dry bar electrodes (1 mm x 10 mm) spaced by 10 mm. Maximum voluntary grip force (MVGF) of right hand was measured by an electronic force transducer one minute before and one minute after each pedalling session. Statistical analysis was assessed by paired t-test (MVGF) and two way (grips x vibration frequency) repeated measured ANOVA (RMS of EMG and vertical acceleration data) by Statistica (Statsoft, Tulsa, USA).

Results:

While MVGF decreased by 7% after pedalling exercise with TG ($p < 0.05$), no significant change in MVGF was found with SG. Transmissibility of vertical acceleration to the wrist was higher with SG when vibration frequency exceeds 8 Hz (Figure 2), but the difference with the TG was only significant at 17 Hz. EMG activity of FCR and TB muscles was lower with SG, notably for the highest vibration frequencies (12 and 14 Hz). RPC was not significantly different between the two grips whatever the vibration frequency.

Conclusion:

This study showed that the use of MTB SPIRGRIPS® decreases fingers flexor and elbow extensor muscle activity while increasing vibration transmissibility to the wrist. In addition, maximum voluntary grip force was not altered after a prolonged pedalling exercise with vibrations. Therefore, these ergonomic grips would be interesting for mountain bikers to keep force reserve in hand and forearm for braking in steeper downhill and/or driving bike in technical sections.

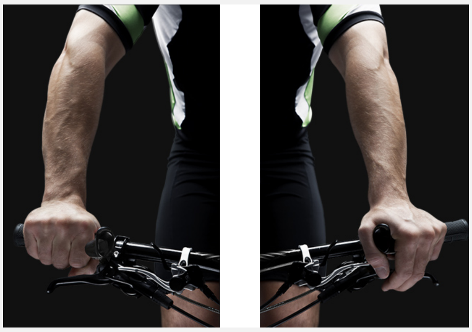

Figure 1. Traditional grips (left) and ergonomic SPIRGRIPS® (right) for MTB

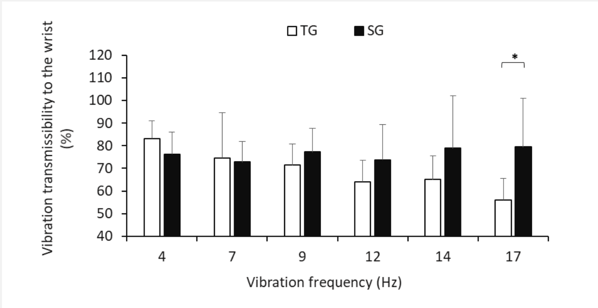

Figure 1. Comparison of transmissibility of vertical acceleration from the ergometer to the wrist with traditional grips (TG) and SPIRGRIPS® (SG)

References:
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Key words: Ergonomic grip, EMG, hand grip force, pedalling, vibrations

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