Consequences of Car Driving on Foot and Ankle Mobility and Reflexes

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Abstract

Car driving could induce fatigue and an altered sensorimotor control of foot muscles. Also, the use of a cruise controller (CC) or an adaptive cruise controller (ACC) could delay the brake reaction time when an emergency braking response is needed. The literature brings very few information on fatigue of the leg muscles during prolonged car driving and no data was found on any lengthened brake reaction time in CC/ACC condition. We recently showed that 1 hour driving at constant speed (120 or 60 km/hour) induced fatigue of the tibialis anterior (TA) muscle. TA fatigue was associated with a reduced myotatic reflex, a situation which reduced the sensorimotor control of muscles maintaining the foot on the accelerator pedal. Driving in CC/ACC condition increased the amplitude of leg displacement during emergency braking and markedly lengthened the brake reaction time, increasing the braking distance. The brake reaction time increased with age in the CC/ACC condition. Thus, car driving modifies the sensorimotor control of foot muscles and the use of new tools to control the speed of a motor vehicle significantly lengthens the brake reaction time. This could result from an increased amplitude of leg motion and/or an age-related decrease in reflex control.

Keywords: Foot muscles; Car driving; Brake reaction time

Introduction

Car driving could be the source of foot and ankle problems. First, fatigue of the leg muscles participating to the driving task could occur during prolonged driving for occupational activities. T e plantar fexor muscles (gastrocnemius and soleus muscles) play a key role to adjusting the force exerted by the foot on the accelerator pedal. In addition, the dorsifexor muscles (tibialis anterior or TA, and tibialis posterior muscles) maintain the foot position on the accelerator pedal. Second, the braking reaction behaviour to an oncoming car collision could be afected when using a cruise controller (CC) or an adaptive cruise controller (ACC). In these two driving conditions, the right foot stays on the foor of the vehicle and is not in the close proximity of the braking pedal. When an emergency braking response is needed in a CC/ACC condition one could suppose that the amplitude of the leg displacement should increase and this could delay the brake reaction time.

Systematic Review

Very few data are found on the occurrence of leg muscle fatigue during prolonged car driving. Some studies have shown that prolonged (1hour) simulated driving on the trapezius, deltoid, and vertebral muscles [1-4] but not on the leg muscles. In a recent study [5], we measured before and afer a 1 hour driving trials at 120 km/hour or 60 kS]ő ! ti" ɹn4 t`ş Ƀ

behaviour to an oncoming car collision, including the measurement of brake reaction time (BRT) and muscle activation of the lower extremity muscles at the collision moment, has been well documented when using the accelerator pedal (Control condition) [7-12]. Some of these studies [9,11,12] clearly showed that the time to collision at brake application was signifcantly higher in females [12] and old subjects [9]. Also, Loeb et al. [11] showed strong diferences between the experienced and novice drivers in the brake pressure applied. On the other hand, the literature brings very few data on the braking response to collision when using a cruise controller (CC) or an adaptive cruise controller (ACC). One study [13] has examined the capacity of the driver to brake pulses in ACC condition but no comparative data were reported in the absence of ACC. Some studies report that ACC results