



Diurnal changes in plantar flexion torque and measures of cortical and spinal excitability: influence of chronotype

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Introduction

Diurnal patterns in human force production have been found in a variety of muscles; however there is disagreement as to the direction and origins of the rhythm.

Even amongst studies examining the same muscle group, the trend of force fluctuations throughout the day is variable. Currently the majority of studies have observed maximal isometric torque production in the evening (1,2). These differences may in part be explained by methodological variations such as differences in activity levels of participants throughout the day of testing, differences in the level of familiarity in achieving a maximal voluntary contraction and differences in the muscles studied.

Most importantly however, differences in chronotype (morning type or evening type) of the subjects has seldom been addressed. For this reason, our study was designed to examine diurnal variations in: maximal voluntary isometric contractions (MVICs), and measures of cortical, spinal and peripheral excitability in persons having morning and evening chronotypes.

Purpose

To evaluate cortical, spinal and peripheral excitability in persons of different chronotypes to determine the mechanisms underlying diurnal fluctuations in torque amongst humans.

Hypothesis

Torque will increase throughout the day more for evening than morning types. Spinal excitability will peak at 21:00 for evening types and 9:00 for morning types.

Methods

Fourteen participants (3 female 11 male) aged 19-54 years completed a self-assessment questionnaire (3) to determine their chronotype. Subjects were split into morning types (n=7) and evening types (n=7).

- Measurements were made at 9:00, 13:00, 17:00 and 21:00
- Plantar flexion MVICs and interpolated twitches
- Soleus H-reflex recruitment curves
- Soleus threshold motor evoked potentials (MEP)
- Soleus MEP recruitment curves
- Below threshold TMS conditioned Soleus H-reflex

Results

Torque

Evening types showed a significant increase in torque between 9:00 and 17:00 as well as 9:00 and 21:00

Morning types show no change in torque throughout the day

TMS conditioned H-reflex

Evening types show increased cortical excitability at 21:00

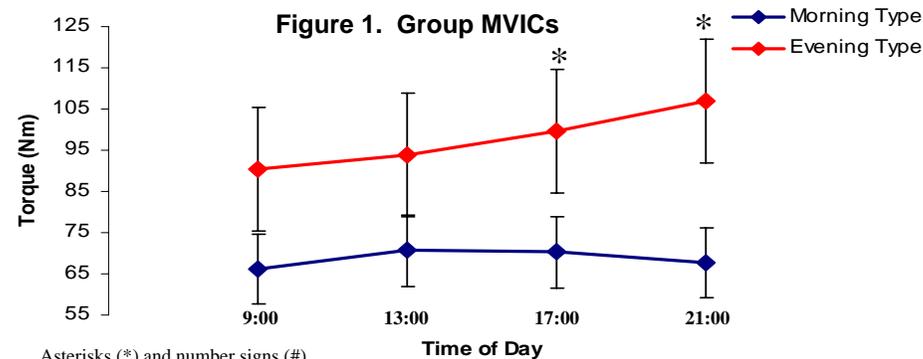
Morning types show increased cortical excitability at 9:00

Ascending limb of H-reflex recruitment

Evening types showed increased H-reflex values at 17:00 and 21:00

Post Activation Potentiation (PAP)

Evening types showed increased values at 21:00



Asterisks (*) and number signs (#) indicate significant differences with respect to 9:00 amongst the evening and morning groups respectively.

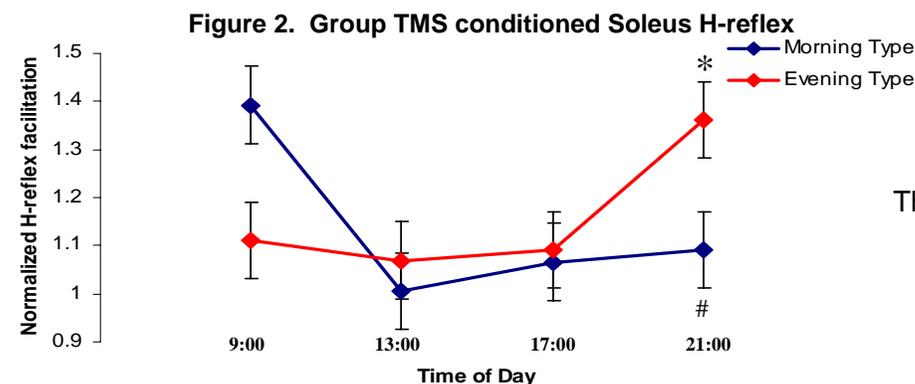


Figure 3. Group Soleus H-reflex values with an accompanied 5% of max Mwave

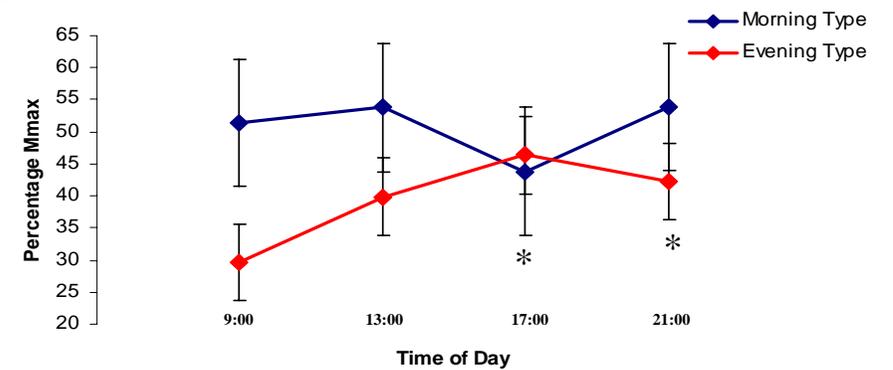
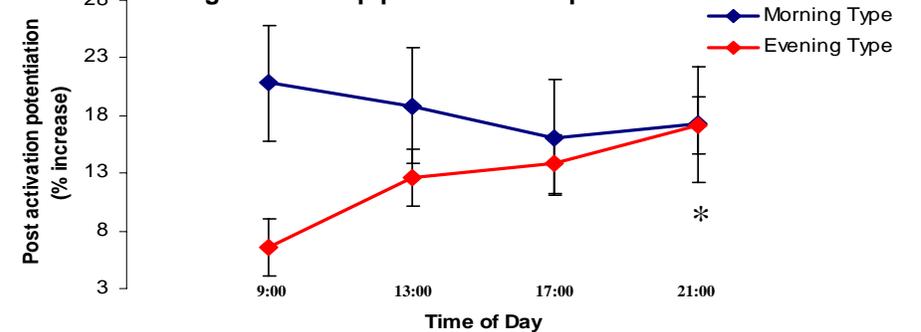


Figure 4. Group post activation potentiation



Conclusion

Evening types display greater diurnal variation in torque, H-reflexes, TMS conditioned H-reflexes and PAP. Morning types showed changes in TMS conditioned H-reflex measurements only. Our data suggest that spinal mechanisms underlie diurnal fluctuation in force production. In addition, chronotype of the subjects should be addressed when making diurnal measurements in humans.

References

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Acknowledgements

The authors would like to thank Zoltan Kenwell for his outstanding technical support.

