Discussion-Conclusion: Our results suggest that (i) presynaptic inhibition of Ia terminals does not modulate the FN stimulation-induced TA or SOL facilitation (ii) RI could contribute to selection of the appropriate synergism in various motor tasks. Inhibition of Renshaw cells might result from a supraspinal control exerted either directly onto Renshaw cells and/or through group-II pathways [2].

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11.13 Distal joint limitation induces conservation of temporal kinematics invariant

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Introduction: Earlier stage of Rheumatoid Arthritis (RA) induces synovitis, erosion, distal joint limitations and induces modification of the locomotor pattern which could affect the limb endpoint trajectory. Investigations in healthy humans revealed a strong invariance of distal part of the lower limbs during locomotion whatever mechanical context, speed of walking, and contact force at foot level. These studies suggest that the limb endpoint might be centrally encoded for simplifying locomotor control. We tested the robustness of this invariant with RA patients with distal joint limitations in order to corroborate the stability of this parameter.

Methods: Kinematics of lower-limb was analyzed in nine RA outpatients (P) and seven healthy subjects (S). Locomotor performances of P and S were compared at the same range of velocity. We calculated malleolus linear parameters: HL and TA defined as ratio of path height to path length, and acceleration time to movement duration, respectively.

Results: TA was not significantly different. HL_P was significantly bigger than HL_S. Reduction of HL ratio in P was the consequence of path length reduction.

Discussion: It was surprising that arthritis and consecutive joint limitations at foot level did not affect the timing of foot trajectory. Indeed one can expect that pain and joint limitation will drastically modified foot trajectory.

Conclusion: One hypothesis could be that the CNS encodes movement timing rather than spatial trajectory. Hence, this possibility is supported by previous studies, showing that temporal characteristic of limb endpoint appears to be related to motor planification and might be centrally encoded.

11.14 Phase resetting of uni- and bi-manual rhythmic arm movements due to perturbation

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Introduction: Rhythmical arm movements may be produced in a pendulum-like manner by central destabilization of the system at one equilibrium position. Alternatively, they may result from transitions between two equilibrium positions that define the spatial boundaries of movement.

Methods: Standing subjects swung one or both arms from the shoulder joints, in-phase at ~0.8 Hz. In randomly selected cycles, one arm was transiently arrested by an electromagnetic device while the arm was moving forward or backward.

Results: When perturbed, the oscillations of the arm or arms were reset around the extreme forward or backward arm position. This was especially evident in the case of bi-manual movements when the non-perturbed arm stopped moving at this position. When oscillations were renewed, the phase shifted randomly with respect to the pre-perturbation period. Such phase resetting occurred in both uni- and bi-manual movements, regardless of when or which arm was perturbed.

Conclusion: Results support the hypothesis that the central nervous system produces transitions between two stable equilibrium positions of the arm(s), rather than elicits pendulum-like oscillations about a single position. The frequency and spatial boundaries of arm oscillations may be controlled by changing the rate of transitions and by adjusting the equilibrium positions, respectively. In response to perturbations, the generator may arrive at one of the equilibrium states and resume oscillations at a new phase, as observed in the present study. Our findings are relevant to locomotion and suggest that walking may also be generated by transitions between several equilibrium states of the body.

11.15 Paradoxical muscle movements in human standing

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Introduction: In human standing the calf muscles soleus and gastrocnemius actively prevent forward toppling about the ankles. It has been assumed that these postural muscles behave like springs with stiffness reflecting their mechanical properties, reflex gain and central control. Here we test the muscle-spring hypothesis that contractile element length increases during forward sway of the body.

Methods: We used an ultrasound scanner and automated image analysis to record the tiny muscular movements occurring in normal standing and during large voluntary sways. This new, non-invasive technique resolves changes in muscle length as small as 10 microns without disturbing the standing process [1].

Results: The contractile elements are longest when the subject is closest to the vertical and shorten as the subject sways forwards (paradoxical movements). In quiet standing, muscle length fluctuates at approximately three times the frequency of body sway: on average, shortening during forward sway and lengthening during backwards sway.

Discussion: This counter-intuitive result is consistent with the fact that calf muscles generate tension through a series elastic component (Achilles tendon and foot) which limits maximal ankle stiffness to 92±20% (±S.D.) of that required to balance the body.

Conclusion: The intrinsic length-tension relationship of the calf muscles partially stabilizes the human body in quiet standing while leaving the body mechanically unstable. Stability and balance is achieved by an impulsive process that is poorly correlated with CoM angle.

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11.16 Somatosensory graviception inhibits soleus H-reflex gain during walking in humans revealed by reduced gravity condition

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Introduction: The purpose of this study was to investigate how gravity related somatosensory information affects the excitability of the soleus muscle (SOL) motoneuron pool in humans while walking in water compared with on land.

Methods: SOL H-reflexes were elicited in ten healthy males walking at 2.0 km/h on a treadmill both on land and in water. To