Neuromuscular coupling of the hamstrings and viscoelastic properties of the knee are not impaired after transient cold therapy

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Introduction
There is consensus that the ligamentous structures of the knee, especially the anterior cruciate ligament (ACL), not only act as mechanical restraints but also may play a role in neuromuscular joint stabilization ¹. Previous experiments have documented that the hamstrings musculature acting as synergists to the ACL are involved in the knee joint position sense ²,³. To date, no informations are available if transient cold therapy as applied in sports and knee rehabilitation affects the proprioceptive function in terms of reflex behaviour during a functional standing condition. The purpose of the present study was to assess quantitatively the reflex pathways of the hamstrings and the viscoelastic properties of the knee with regard to anterior tibia translation before and after knee cooling.

Methods
Fifteen healthy subjects (age: 25 y ± 3.6) without any history of neurological or orthopaedic disorders participated in this study. The experiments were approved by the ethics committee of the University of Ulm, Germany (no.192/2003). The subjects were standing upright on both legs in a 30° knee flexion with a 5° outer rotation of the foot in a testing machine. Anterior motion of the tibia was evoked by a piston with an impact force of 300 N applied 10 cm below knee joint gap. To monitor tibia motion and tibia velocity a potentiometric position transducer was localized at the tuberositas tibiae. In order to cool down the knee joint cold water (8°C) circulated in a thin-walled plastic tube which was placed around the knee joint attaching exclusively the area of the knee joint capsule. Time of cooling was 20 minutes. Hamstring reflexes were monitored by the use of surface electromyography. For analysis EMG signals were rectified, averaged and filtered by a 10 Hz high pass filter (type: Butterworth; order: 6). Paired Student’s t-test was conducted to test for differences in latency, integrated EMG activity, tibia translation distance and tibia velocity before and after cooling. For all statistical testing a level of p<0.05 was considered significant.

Results
In all subjects SLRs and MLRs of the hamstrings were observed before and after cooling (fig. 1). Before cooling the mean latencies were 21.3 ± 0.9 ms (± SD) and 38.1 ± 1.3 ms for the SLR and MLR, respectively. After cooling no significant changes were observed (SLR 20.9 ± 1.5 ms, p=0.157; MLR 38.3 ± 1.1 ms, p=0.503). Integrated EMG activity appeared to be increased in the SLR and in the MLR, but in the statistical analysis no significant differences were found (SLR p=0.220; MLR p=0.674, fig. 2). Tibia translation in posterior-anterior direction, and maximal tibia velocity were not affected by the cooling procedure. Mean tibia translation was 6.8 ± 1.1 mm before cooling and 7.1 ± 0.9 mm after cooling (p=0.541). Mean tibia velocity was 193 ± 26 mm/s before and 195 ± 34 mm/s after cooling (p=0.702, fig. 3).

Discussion/Conclusion
The present study clearly demonstrates that a 20 min cold therapy as used in rehabilitation and sports does not result in a change of the hamstrings reflex response during standing. Furthermore, our results do not support the view that this transient cooling could adversely affect knee stability as previously described ⁴. In the same line cooling during sport activities does not seem to enhance injury risk of the ACL as far as it can be judged from this neurophysiological point of view. Accordingly, our findings are relevant for rehabilitation programs after ACL reconstruction and cooling procedures in sports.

References