

Reply

Reply to the letter to the editor by Liu and Li

B. Ganse¹, P-F. Yang^{1,2,3}, G-P. Brüggemann², L.P. Müller⁴, J. Rittweger^{1,5}, T. Koy⁴

¹Division Space Physiology, Institute of Aerospace Medicine, German Aerospace Center, Cologne, Germany;

²Institute of Biomechanics and Orthopaedics, German Sport University Cologne, Cologne, Germany;

³Key Laboratory for Space Bioscience and Biotechnology, School of Life Sciences, Northwestern Polytechnical University, Xi'an, China;

⁴Department of Orthopedic and Trauma Surgery, University of Cologne, Cologne, Germany;

⁵Institute for Biomedical Research into Human Movement and Health, Manchester Metropolitan University, Manchester, United Kingdom

We thank the colleagues Liu and Li for their interest in our work and for their commenting letter.

As to the first comment, the location of the bone screws has, of course, been a concern when planning the study. To apply the technique, it was necessary to choose locations with a cortical thickness of at least 4 mm. This was always the case in the locations we chose for screw implantation. However, 4 mm will not always be present in the locations the colleagues Liu and Li suggested. In future studies, screw positioning may be optimized, and one might consider using a surgical navigation system for exact screw positioning.

In relation to the second point of criticism, and with all due respect, we have to insist that it was the aim of the study to measure actual tibia deformation: Screws were firmly implanted into the tibia bone, and marker clusters were firmly affixed to them. Therefore, any relative displacement between marker clusters necessarily reflects tibia deformation. It should go without saying, of course, that fibula deformation, as well as interaction with tendons, muscles, ligaments and, to much lesser extent, also the skin and subcutaneous tissue will certainly occur and influence deformations of the tibia in unknown ways. Measurements of fibula deformation, however, were not a part of the present study, and we have to thank the colleagues Liu and Li for raising an excellent point whenever interpreting data obtained by the OST-approach.

As to the assessment of resonance frequencies: Room temperature and humidity were kept constant by air conditioning, which is the standard in German operating theatres. The room temperature was kept at 20°C. In addition to the air temperature, the screw's temperature is also influenced by the subject's body temperature. The body temperature should remain constant within a small range throughout the day. According to Trojanová et al¹, Young's modulus does not change to a relevant degree within the limits of normal body temperature (308-310 degrees Kelvin). Density seems not to be the crucial factor influencing the mechanical properties, as long as the elastic modulus remains constant. Accordingly, we do not see much potential for contamination of results in our study.

Finally, we are thankful to Liu and Li for mentioning saline: We have actually used saline of room temperature to reduce friction and heat development while drilling. This detail was not mentioned as it is a common procedure in orthopedic surgery.

In conclusion, we are thankful for the comments and for pointing out further research possibilities.

Keywords: Motion Capturing, Visual Analog Scale, Bone Deformation, pQCT, Three-point-bending

References

1. Trojanová Z, Maksimiyuk PA, Lukáč: Temperature Dependence of Young's Modulus of α -Titanium Polycrystals. Phys Stat sol 143, K75, 1994.