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THE EFFECT OF IMMOBILITY AND MICROGRAVITY ON CARTILAGE METABOLISM

Niehoff, A.[1], Brüggemann, G.[1], Hamann, N.[1], Zaucke, F.[2], Eckstein, F.[3], Bloch, W.[1], Mündermann, A.[4], Koo, S.[5], Mester, J.[1], Liphardt, A.[1]

[1]*German Sport University Cologne, Germany*
[2]*University of Cologne, Medical Faculty, Center for Biochemistry, Germany*
[3]*Paracelsus Medical University, Institute of Anatomy, Austria*
[4]*University Hospital Basel, Department of Orthopaedics, Switzerland*
[5]*Chung-Ang University, School of Mechanical Engineering, Seoul, Korea Republic (South)*

Introduction

Articular cartilage is an avascular, aneural, and alymphatic tissue and moderate joint loading is essential to maintain its health and function. The maintenance of cartilage is directly related to the effect of mechanical loading on chondrocytes and their surrounding extracellular matrix. To date, the impact of unloading during spaceflight on articular cartilage in healthy individuals is not well understood. One established biomarker for monitoring cartilage metabolism in relation to joint degeneration is cartilage oligomeric matrix protein (COMP)(1) which is sensitive to both physiological loading(2-4) and 14-days of immobilization(5).The objective of our studies was to analyze the effect of 21-days of HDT-BR (Head-down tilt bed rest) and 5-6 month of microgravity on serum COMP concentration.

Material & Methods

Study 1: Twelve healthy male subjects (34±8 yrs old) participated in a 21-days HDT-BR study. HDT-BR only served as the control (CON) condition. Resistive vibration exercise (RVE) alone or in combination with a nutrition intervention (NEX) was used as a countermeasure. Study 2: Astronauts subjected for 5-6 months to microgravity on the International Space Station (ISS) were included. All blood samples were taken in the morning after overnight-fast before, during and after HDT-BR as well as before and after microgravity. Serum COMP concentrations were analyzed using commercial enzyme linked immunoassays. Statistical analysis (IBM SPSS Statistics, 19.01) was performed using repeated measures ANOVA ($p<0.05$).

Results

Study 1: Twelve healthy male subjects (34±8 yrs old) participated in a 21-days HDT-BR study. HDT-BR only served as the control (CON) condition. Resistive vibration exercise (RVE) alone or in combination with a nutrition intervention (NEX) was used as a countermeasure. Study 2: Astronauts subjected for 5-6 months to microgravity on the International Space Station (ISS) were included.
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Discussion & Conclusions

These results suggest that the cartilage ECM is sensitive to unloading and that immobilization/microgravity may initiate catabolic processes in cartilage. Our study is the first one that investigates the effect of microgravity on cartilage and gives valuable insight into cartilage metabolism under these conditions.Future research will investigate the effects of exercise countermeasures on cartilage metabolism with the ultimate goal to minimize negative effects of immobilization or spaceflight on cartilage health.

References

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Author of Correspondence: niehoff@dshs-koeln.de