Form-Function relationship in the musculoskeletal system

Changes of Density Distribution of the Subchondral Bone Plate after Supramalleolar Osteotomy for Valgus Ankle Osteoarthritis

CT-osteoabsorptiometry (CT-OAM) has been used to visualize subchondral bone plate density distribution regarding to its mineralization. The purpose of this study was to analyze changes in density distribution of the subchondral bone plate before and after supramalleolar realignment osteotomies due to adaptational processes. We retrospectively analysed pre- and postoperative CT images of patients with post-traumatic unilateral-valgus ankle OA by means of CT-OAM. At a mean follow-up of 20 months we observed a significant pre- to postoperative decrease of the mean high-density area ratio in tibia and talus (p < 0.05) and the talus (t = 0.05). Pairwise comparison between the pre- and postoperative mineralization at the articular surface showed a significant decrease of the high-density area ratio for the tibia and the talus. The tibial and talar subchondral bone plate density, regarding to its mineralization, decreased after supramalleolar medial closing wedge osteotomy in patients with valgus ankle OA correlating with an improvement of pain symptoms (VAS) decreased from 6.2±0.9 pre- to 2.8±0.9 postoperatively (p = 0.027). The results of this study suggest that realignment surgery may lead to a better load distribution.

Selected Publications

Insight into the 3D-trabecular architecture of the human patella

The subchondral bone plate (SBP), a dynamic component of the osteochondral unit, shows functional adaptation to long-term loading by distribution of the mineral content in a manner best serving the mechanical demands. Since the received joint load is transmitted into the trabecular system, the spongiosa should also exhibit topographical differences. To evaluate the regional variations in trabecular architecture, ten physiologic patellae were analysed for defined parameters of bone structure by means of micro-computed tomography (Fig.2). The obtained architectural parameter varied within the trabecular system and showed regular distribution patterns (Fig.3). It proved to be distinctive with maxima of material and stability situated below areas of the highest long-term load intake. With increasing depth, the pattern of distribution was consistent but lessened in intensity. The parameters significantly correlated with the density distribution of the SBP. The trabecular network adapts to its mechanical needs and is therefore not homogeneously built. Dependent upon the long-term load intake, the trabecular model optimizes the support with significant correlation to the density distribution of the SBP.