10th Joint Symposium Rostock – Riga
07 – 10 May 2009
„BIOMATERIALS AND BIOENGINEERING FOR ORAL AND MAXILLOFACIAL SURGERY"

RIGA, LATVIA

Venue:

RSU Institute of Stomatology
Reval Hotel LATVIJA
RTU Biomaterials Innovation and Development Center

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THE MECHANICAL AND STRUCTURAL PROPERTIES OF THE BONE REGENERATE IN EXPERIMENTAL MANDIBLE FRACTURE

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Aim: to study the biomechanical and structural properties of the bone regenerat depending on a degree of the bone fragments displacement.

Material and methods: 90 mature male Wistar rats were used for the experimental study Intact mandibles were taken by necropsy from 9 animals, which served as a control (I group). I 81 animals experimental mandible fracture was modeled using vertical osteotomia of the jaw i the angular area. All operated rats were divided into 3 groups (II-IV). In the II group reduction c the bone fragments was performed, followed by fixation in normal anatomic position. In the I group bone fragments were shifted on the width of the external cortical plate and fixed i dislocated position. In the IV group the dislocation consisted ½ of the mandible width. Rats were put out the experiment on 21, 28, 42 days after an operation. All cases with the macroscopic o

.c signs of the infection were excluded from the study. Original device for mechanical of the fracture zone was elaborated. Quasi-static loading was applied by a testing e, producing the combine deformation of bending and shift. Force-displacement data recorded on a PC and analyzed by software. Mechanical properties that were studied uded maximal force, ultimate stress calculated by normalizing the maximum force by the oss sectional area in the callus zone, force and deformation at lineal area, stiffness, and total energy absorbed by the specimen. After mechanical loading morphological study was performed, including SEM investigation, histological and morphometrical analysis.

Results: In all groups the diastases between bone fragments was filled with bone or bone and fibrous regenerates with different proportions of the components and levels of the bone maturity. Regenerates were more mature in II group and the less mature in the IV group. The active signs of the bone remodeling were observed up to 42 day in all groups. Cross sectional area of the callus zone increased due to the periostal regenerates, more intensively in the III and IV groups. Tree dimensional heterogeneity was more obvious in IV group and in the III group in early terms. It determined the peculiarities of the callus destruction during loading process. At late terms the structural isotropy of the regenerate became more evident in this groups due to more chaotic orientation of the trabecules and osteons in the regenerate's tissue. Mechanical properties of the bone callus depended on regenerate maturity, structure and integrity with the ends of the bone fragments. The maximal force was significantly higher in early terms after trauma ($p<0,05$) in fractures fixed in adequate anatomic position. The differences with dislocated fractures became insignificant to the 42 days. At the same times ultimate stress and stiffness were significantly lover ($p<0,05$). So the general mechanical strength was reached by increased cross sectional area of the callus zone in dislocated fractures. The ultimate stress, reflecting the strength of the regenerate tissue correlates with the volume of compact bone in the regenerate and its structural organization.

Conclusions: Dislocation of the bone fragments in experimental mandible fracture significantly influence the mechanical and structural properties of the bone regenerate. Exact reposition results in earlier renewal of the bone biomechanical properties and formation of the regenerate, which can perceive and redistribute loading stress adequately. In dislocated fractures regenerate stiffness, structural and mechanical anisotropy as well as ultimate stress in maximal load were significantly lover and the range of the non-lineal deformations increased. At the same time the differences in jaw strength after 28 day in small dislocations were insignificant.