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si Vás dovoľujú pozvať na

# **1. KONGRES BIOMEDICÍNY V OROMAXILOFACIÁLNEJ OBLASTI**

**6. TRILATERÁLNE SLOVENSKO-ČESKO-POLSKÉ SYMPÓZIUM  
SYMPÓZIUM SLOVENSKEJ STOMATOLOGICKEJ SPOLOČNOSTI  
SLOVENSKO-UKRAJINSKÉ SYMPÓZIUM**

konané v dňoch 8. – 10. 10. 2009

Pod záštitou

predsedu vlády Slovenskej republiky Róberta Fica,  
podpredsedu vlády a ministra školstva Jána Mikolaja,  
ministra zdravotníctva Richarda Rašiho,  
predsedu Košického samosprávneho kraja JUDr. Zdenka Trebul'u  
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Miesto konania:

Dom umenia, Moyzesova 66, Košice

# 1 CONGRESS

OF BIOMEDICINE  
IN ORO-MAXILLOFACIAL  
AREA



## MAIN SCIENTIFIC PROGRAMME

### ABSTRACTS

6.th TRILATERAL SLOVAK-CZECH-POLAND MEETING

SLOVAK-UKRAINE MEETING

MEETING OF THE SLOVAK SOCIETY OF DENTAL  
SURGENTS (SSS)

8. - 10. 10. 2009

Košice



*Congress is promote by the capitation grand  
Ministry of Education, Slovak Republic  
č. 027-007UPJŠ-8/2008*

# 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 the bone regenerate 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). In 81 animals experimental mandible fracture was modeled using vertical osteotomy of the jaw in the angular area. All operated rats were divided into 3 groups (II-IV). In the II group reduction of the bone fragments was performed,

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followed by fixation in normal anatomic position. In the III group bone fragments were shifted on the width of the external cortical plate and fixed in dislocated position. In the IV group the dislocation consisted  $\frac{1}{2}$  of the mandible width. Rats were put out the experiment on 21, 28, 42 days after an operation. All cases with the macroscopic or microscopic signs of the infection were excluded from the study. Original device for mechanical loading of the fracture zone was elaborated. Quasi-static loading was applied by a testing machine, producing the combine deformation of bending and shift. Force-displacement data were recorded on a PC and analyzed by software. Mechanical properties that were studied included maximal force, ultimate stress calculated by normalizing the maximum force by the cross 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 periosteal 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 lower ( $p < 0,05$ ). 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 lower and the range of the non-linear deformations increased. At the same time the differences in jaw strength after 28 day in small dislocations were insignificant.