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Early post-operative exercise promotes bone healing kinetics. Preclinical evaluation of non-critical sized femur defect healing

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Background/Aims: Physical exercise represents a well-known modality for maintaining healthy locomotor mechanism. On a preclinical level, studies demonstrated that treadmill training in rats is a reliable exercise protocol for in depth analysis of bone microstructural changes. Therefore, we decided to conduct a study that will investigate the early postoperative exercise effect on bone properties during the healing period of femoral defect in rats.

Method/Results: In twenty male Sprague Dawley rats a 1.6 mm bicortical defect was induced by drilling into both femoral diaphysis. Ten animals underwent continuous treadmill training (TR) over two weeks, while the other group were assigned as non-training (NT) control group. New bone formation labeling was performed by subcutaneous fluorochrome injections at day 5, 14 and week 5. In vivo µCT scans were performed after the surgery and then once a week during the 6-week postoperative period. Ten animals (five from each group) were euthanized at the 3rd week while the remaining animals were euthanized at the 6th week. Femur samples were extracted and underwent ex vivo µCT scanning and histological evaluation, while serum was used for evaluating ALP levels. In vivo µCT evaluation revealed already at one week post-surgery a significantly increased volume and surface of newly formed bone in the defect area of the TR group. BV/TV and number of osteocytes within the previous defect area were significantly increased in the TR group after 3 weeks. Fluorochrome distances demonstrated significantly increased distance between day 5 and 14 within the TR group. ALP levels were persistently increased in both groups over 3- and 6-week time points without statistical significance between TR and NT group.

Conclusion: This study demonstrated the positive effects of 2-week post-operative treadmill training in terms of increased bone healing kinetics, stimulation of new bone formation and the increase in osteocytes density.