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Histological and Histomorphometrical Evaluation of local Application of Melatonin and Beta-Tricalcium Phosphate on Bone Healing in Rats

A Thesis

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By

Muhanad Tareq Jehad

B.D.S.; M.Sc.

Supervised by:

Prof. Dr. Ban A. Ghani Jamil

B.D.S., M.Sc., PhD. (Oral Histology and Biology)

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Abstract

Background:

Bone defects and well-made disorder of osseous tissues have become a universal health care struggle. Bone defect healing is a procedure of renovation of the bone tissue, which normally undertakes a multidimensional technique with a coinciding timeline.

Regeneration comprises the differentiation of new cells and the construction of new bone tissue that grades in whole increase in bulk of new skeletal tissues. Managements of bone defects have been basically concentrated on substituting the lost bone with allogeneic or autogenously bone grafts materials.

Melatonin affects the release of growth hormone and stimulates bone development by suppressing osteoclast actions; exciting the foundation and propagation of a mineralized matrix and Type I collagen and stimulates osteoblast alkaline phosphatase actions over the increased genetic manifestation of Type I collagen, osteopontin, bone sialoprotein and osteocalcin.

Beta-tricalcium phosphate (ß-TCP) is an artificial bone substitute has high porosity and firm resorption. It has an osteoconductive influence presently subsequently implantation, bioresorption happens over the osteoclastic action creating a new bone tissue, consequently illustrating the process of osteotransductivity.

Beta-tricalcium phosphate (β-TCP), is a ceramic alloplast, has an organized system of micropores. The size and geometry of biomaterial granules are measured critical parameters to favor bone formation and appropriate for restoration of bone defects.

Aims of study:

To evaluate the effect of local application of melatonin and / or β-tricalcium phosphate and both on healing of experimentally induced bone defect by histological analysis and assessment of bone response to the applied materials by analysis of histomorphometric parameters (trabecular area, trabecular number, bone marrow area and bone cells)

Materials and methods:

Twenty four adult male rats (*Rattus Rattus norvegicus*) weighing (250-350 g) , age (7-8 months) were used in this study . The animals were randomly divided into control and experimental groups , 8 animals for each healing periods (1, 2, and 4 weeks). Four standardized defects were prepared in both femurs of all animals of about 2.5 mm in depth and diameter (two holes in right and two in left femur bones) .The application of materials was done as follows

Control group(C): where bone defect was left unfilled for spontaneous healing.

Experimental groups:

Group (M): where local application of melatonin (0.5 mg/gm /body weight) dissolved in 0.1 ml propylene glycol (inert solvent) was performed.

Group (T): where the local application of beta-TCP material(0.5 mg/gm/body weight) septodont (ready-made syringe) was performed.

Group (MT): application of both melatonin and beta-TCP materials was done . MT (0.5 mg/gm/body weight): (Melatonin 0.25 mg/gm + beta-TCP 0.25 mg/gm).

Sacrification of all animals was completed for the above mentioned healing periods . Histologic sections were arranged and examined microscopically and histomorphometric analysis was performed .

Results:

Histological findings indicated bone deposition in studied groups ,new bone trabeculae seen at two weeks with progressing mineralization and maturation with time and it was more enhanced in experimental groups (M,T and MT)as compared to control ones(C). Descriptive statistical analysis displayed increase in mean values of trabecular area, trabecular number, more prominent in MT group at four weeks duration. Bone marrow area exhibited decreased mean values with time where lowest values were distinguished with MT group after four weeks. Highly significant difference was observed with trabecular area (TA), trabecular number (TN) and bone marrow area BMA during group assessment. Moreover the bone marrow area was the only studied parameter that revealed high significant difference between all studied groups in different periods .Mean values of osteoblasts and osteocytes were higher in experimental than in control groups .While osteoclasts exhibited increased values during two weeks healing period, lowest values noticed in four weeks durations among all groups. Group comparison of bone cells showed high significant difference in (1,2 and 4weeks)durations.

High significant difference was noticed with osteoblasts only between 1 and 4 weeks duration among all groups, concerning osteoclasts and osteocytes variant in significant detected in different durations.

Conclusion:

The study revealed that application of melatonin and β-TCP could be effective in the enhancement of bone regeneration but the combination of (melatonin + β-TCP) appeared to be more effective in the acceleration of bone healing process.