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QUANTIFICATION OF BONE ARCHITECTURAL CHANGES SECONDARY TO TREADMILL RUNNING EXERCISE IN ADULT OSTEOPENIC RATS

Ibrahim M.[1], El Nahass B.[2,3], Ibrahim H.[4]
[1]Cairo University, Department of Musculoskeletal Disorders, Cairo, Egypt, [2]Misr Universty for Science and Technology, Dean of College of Physical Therapy, 6th of October City, Egypt, [3]Cairo University, Faculty of Physical Therapy, Orthopaedic Physical Therapy, Giza, Egypt, [4]Cairo University, Faculty of Medicine, Histology, Cairo, Egypt

Purpose: 1. To test whether bone would react to treadmill running exercise by changes in its internal architecture. 2. To quantify the resulting architectural changes. 3. To test the effect of the exercise on the mechanical strength of distal femoral epiphysis in compression.
Relevance: The research will help to quantify the effect of treadmill running exercise on bone internal architectures as a first step in building evidence to design a specific exercise regime to induce a specific osteogenic response.
Participants: Thirty two adult (12 weeks) Wistar rats (16 males and 16 females) weighed 168.9± 18.46 gm
Methods: Rats were tail suspended for 2 weeks and then randomly divided into four groups: Group I (n=8) represented the control for osteopenic bone loss induced by tail suspension, Group II (n=8) represented the second control for normal bone recovery after 6 weeks of normal cage activities following osteopenic bone loss induced by tail suspension, Group III (n=8) was the first exercise group in which the rats were exercised 6 weeks by level surface treadmill for a speed of 12m/min for a period of 30 minutes daily at frequency of 5 days/week, Group IV (n=8) was the second exercise group in which the rats were exercised by inclined treadmill at an angle of 15°, which it was hypothesized would develop more stress on bone both by rat weight on its hind limb and by muscle tension, for the same speed, intensity and duration as group III.
Analysis: 1. Distal femurs and proximal tibiae of right hind limbs were dissected for histomorphometric analysis to measure bone architectural parameters which include cortical and trabecular thickness, trabecular separation, trabecular number and trabceular density. 2. Distal femoral epiphysis of left hind limb was dissected for mechanical testing in compression to measure peak compressive strength.
Results: Significant improvements (p=0.001) were shown in bone architecture in distal femur and proximal tibia of Group IV and in proximal tibia in Group III. There was no significant improvement in distal femur in Group III. The percentage of change was found to be 62-96% between Group IV and Group II and 72- 82% between Group IV and Group I at both distal femur and proximal tibia. Significant improvement was observed in the mechanical compressive strength, indicated by modulus of elasticity, of distal femur in Group IV but was not observed in Group III.
Conclusions: The results suggested that treadmill running exercises were effective to induce changes in bone tissue either by changing trabecular dimensions and density or by altering its mechanical properties, and that higher loading induced greater changes. The induced structural improvement was site specific and dose dependent.
Implications: The current study may be useful to prove that the exercises are capable of inducing changes in the internal architecture of bone trabeculae that in turn improves its mechanical strength resulting in a stronger structure, which could be more resistant to fractures. Furthermore, the resulting effect could be quantified because it is site specific and dose dependant to help to design an appropriate exercise protocol for a specific osteogenic response.
Key-words: 1. Architecture 2. Treadmill running exercise 3. Osteopenic rats
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Ethics approval: An approval of the protocol of Institutional Animal Care and Use Committee in accordance with Cairo University was assigned.

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