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THE BONE TISSUE CHANGES INVESTIGATION WITH METABOLIC SYNDROME

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Abstract

Objective: This study aims to estimate bone tissue changes in experimental animals with metabolic syndrome (MS) using Multislice Computed Tomography (MSCT). Metabolic syndrome, characterized by obesity, insulin resistance, hypertension, and dyslipidemia, has been linked to adverse effects on bone health. By employing MSCT, a non-invasive imaging modality, we seek to quantitatively assess alterations in bone mineral density (BMD) and bone volume (BV) in affected animals. Methods: Experimental metabolic syndrome was induced in a cohort of rodents through a high-fat diet regimen. A control group was maintained on a standard diet. Baseline MSCT scans were performed on all animals prior to diet intervention, followed by periodic scans at regular intervals. High-resolution 3D images of the femur, tibia, and spine were reconstructed for detailed analysis. Parameters such as BMD, BV, and trabecular microarchitecture were quantitatively evaluated using specialized software. The data were statistically analyzed to compare changes between the control and experimental groups over time. Results: Preliminary findings indicate significant reductions in BMD and BV in animals with metabolic syndrome compared to controls. Notable deterioration in trabecular microarchitecture was observed, suggesting compromised bone quality. The extent of bone tissue changes correlated with the severity of metabolic abnormalities, highlighting the detrimental impact of metabolic syndrome on skeletal health. Conclusion: MSCT proved to be a valuable tool for non-invasively monitoring bone tissue changes in metabolic syndrome. The study underscores the importance of early detection and intervention in metabolic disorders to mitigate potential bone-related complications. Future research should focus on exploring therapeutic strategies to preserve bone health in individuals with metabolic syndrome.

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Keywords: Metabolic syndrome, bone tissue changes, Multislice Computed Tomography (MSCT), bone mineral density (BMD), bone volume (BV), experimental animals.

The results of the experimental research showed that in all groups of male and female rabbits, the density parameters were studied according to Hounsfield's scale. At 0, 4, 8, 12 and 16 weeks, MSCT examination of bone tissue was carried out in axial, proximal (frontal), sagittal sections. Repeated measurements showed changes in bone tissue over time in each group and are shown in the table.

Table

	Rabbit 1		Rabbit 4		Rabbit 8		Rabbit 9		Rabbit 12		Rabbit 16	
	before treatment	after treatment	before treatment	after treatment	before treatment	after treatment	before treatment	after treatment	before treatment	after treatment	before treatment	after treatment
	HU		HU		HU		HU		HU		HU	
Proximal epiphyseal branch	+340	+278	+322	+225	+331	+188	+340	+295	+341	+204	+347	+346
Proximal metaphyseal branch	+324	+286	+310	+103	+341	+87	+335	+143	+308	+97	+300	+259
Proximal passing branch	+334	+285	+325	+161	+320	+75	+318	+187	+290	+106	+297	+193
Central sector	+350	+300	+317	+332	+315	+178	+360	+347	+378	+301	+358	+312
Distal passing branch	+347	+272	+328	+157	+317	+203	+300	+266	+308	+267	+325	+205
Distal metaphyseal branch	+302	+48	+332	+35	+301	+7	+285	+183	+278	+32	+260	+29
Distal epiphyseal branch	+325	+245	+302	+92	+300	+94	+307	+243	+322	+126	+305	+159
Costal cartilage	+300	+55	+296	+65	+285	+67	+268	+44	+287	+57	+301	+61
Heart	+80	+58	+76	+42	+59	+40	+65	+47	+63	++43	+58	+28
Lungs	-850	-741	-890	-807	-862	-771	-798	-693	-890	-827	-801	-723
Liver	+85	+47	+89	+64	+89	+53	+78	+57	+76	+61	+82	+77
Kidney	+45	+30	+49	+38	+51	+42	+48	+39	+52	+44	+59	+54

As can be seen from this table, changes in bone tissue were mainly observed in rabbits 4, 8, 9, 12, and changes in bone density were detected in MSCT. At 12 weeks, dystrophic changes were observed in the bone in the proximal metaphyseal branch, proximal epiphyseal branch, and proximal transitional branch. Distal epiphyseal bone, distal metaphyseal bone, and distal transitional bone in rabbits 1, 4, 8, 9, 12, 16 showed dystrophic changes in the bones, and their density decreased. Changes

were observed in the liver area in rabbit 1 and in the heart area in rabbit 16, which decreased to +28, +47.

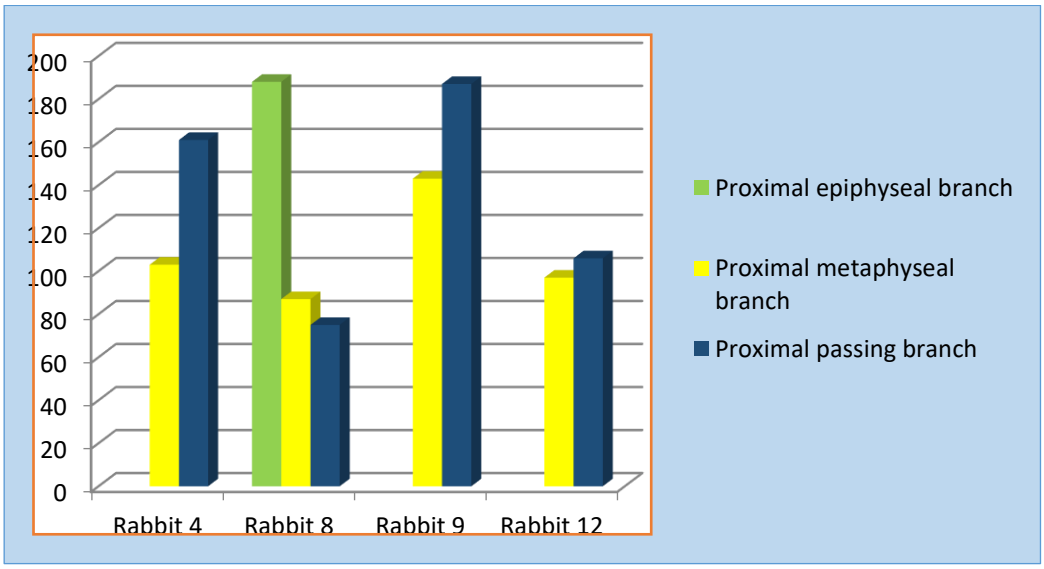


Figure 1

Changes in bone tissue in MSCT were +188 in the proximal epiphyseal area in rabbit 8, +103 in the proximal metaphyseal area in rabbit 4, +87 in rabbit 8, +143 in rabbit 9, +97 in rabbit 12, and in the proximal transitional area 4 it was found that the bone density decreased to +161 in rabbit 8, +75 in rabbit 9, +187 in rabbit 12, +106 in rabbit 12.

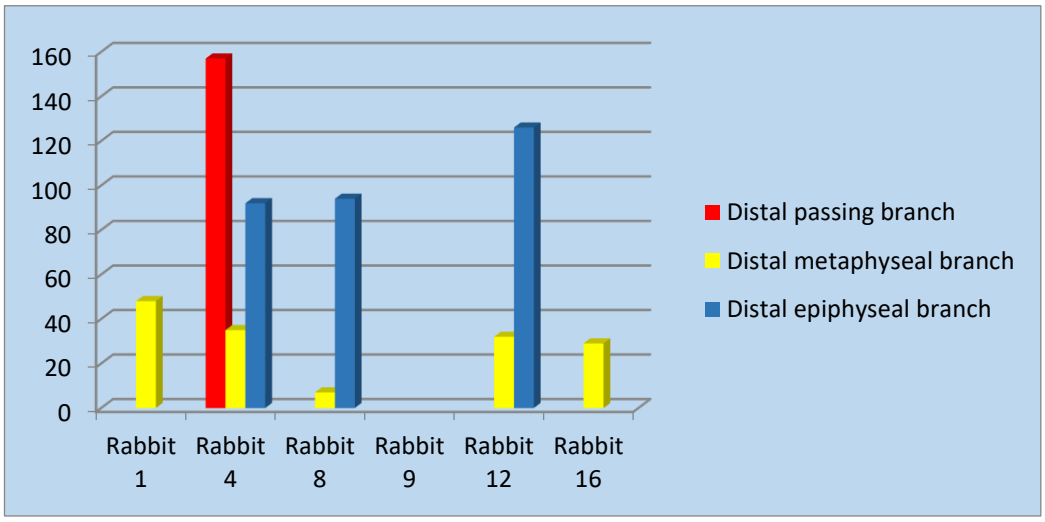
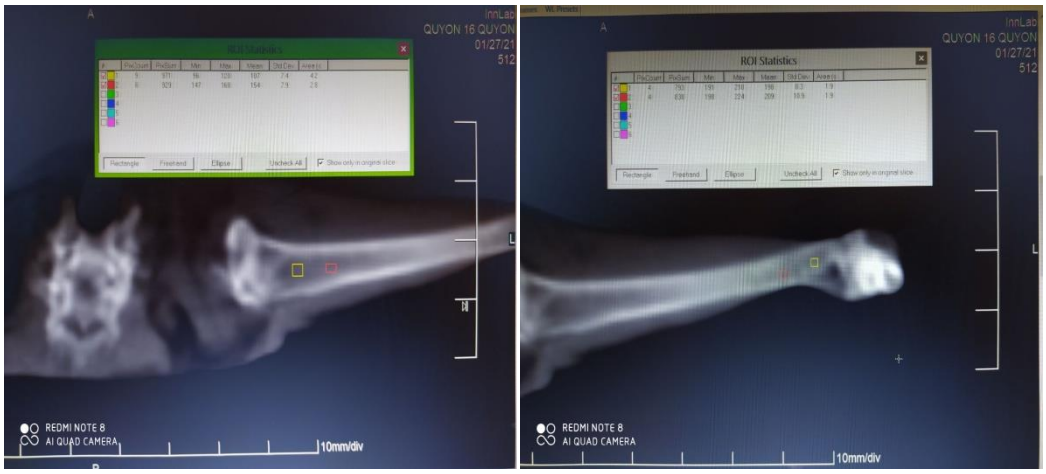


Figure 2

Bone tissue changes on MSCT were +157 in the distal transition in rabbit 4, +48 in the distal metaphyseal area in rabbit 1, +35 in rabbit 4, +7 in rabbit 8, +32 in rabbit 12, and +29 in rabbit 16 , and in the distal epiphyseal area it was found that bone density decreased to +92 in rabbit 4, +94 in rabbit 8, and +126 in rabbit 12.



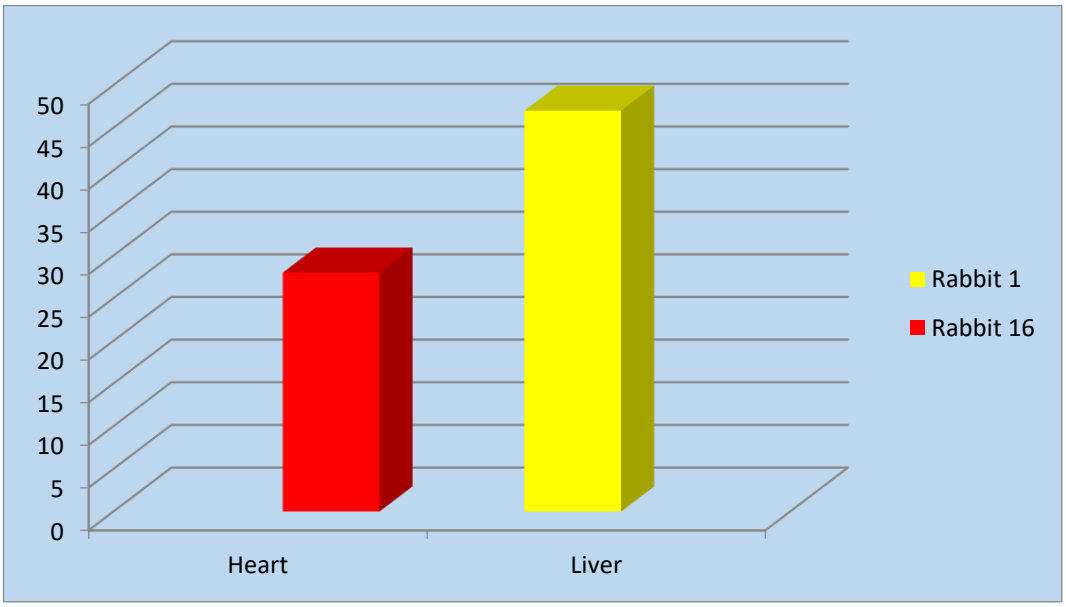


Figure 3

In MSCT, changes in the liver and heart were mainly observed in rabbit 1 and rabbit 16, that is, it decreased to +47 in the liver in rabbit 1 and +28 in the heart in rabbit 16.

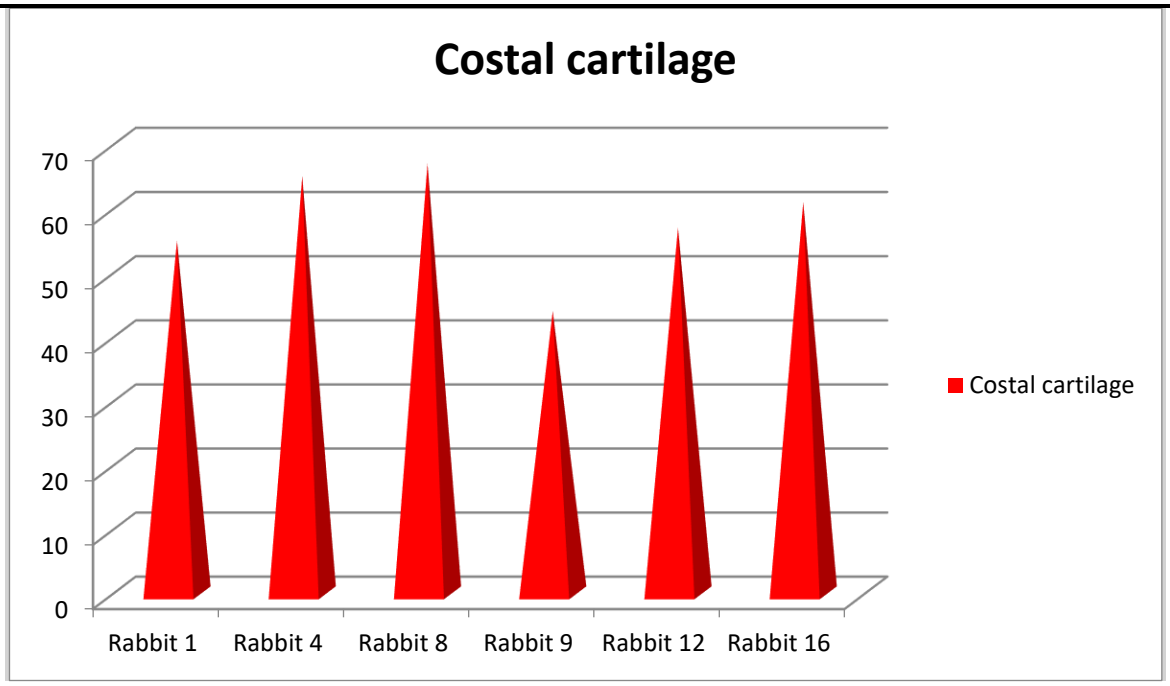
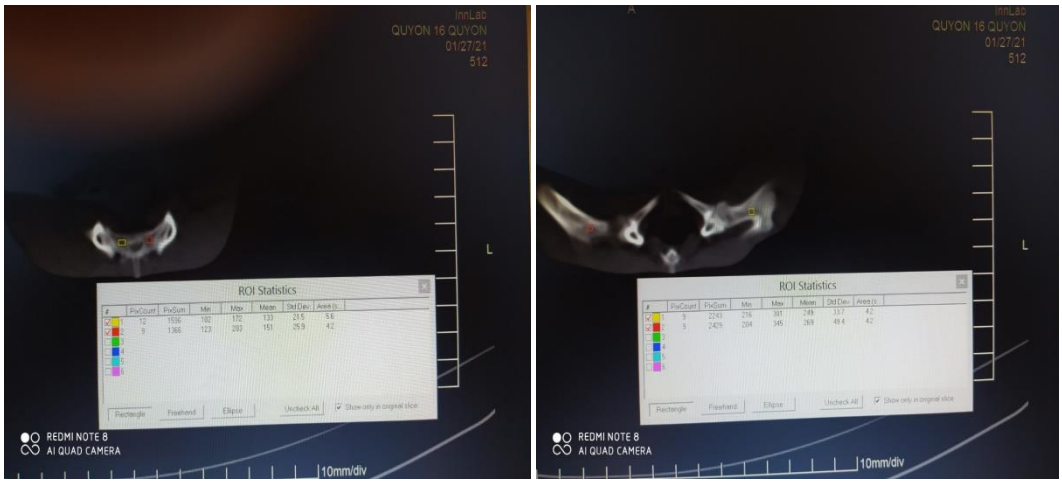
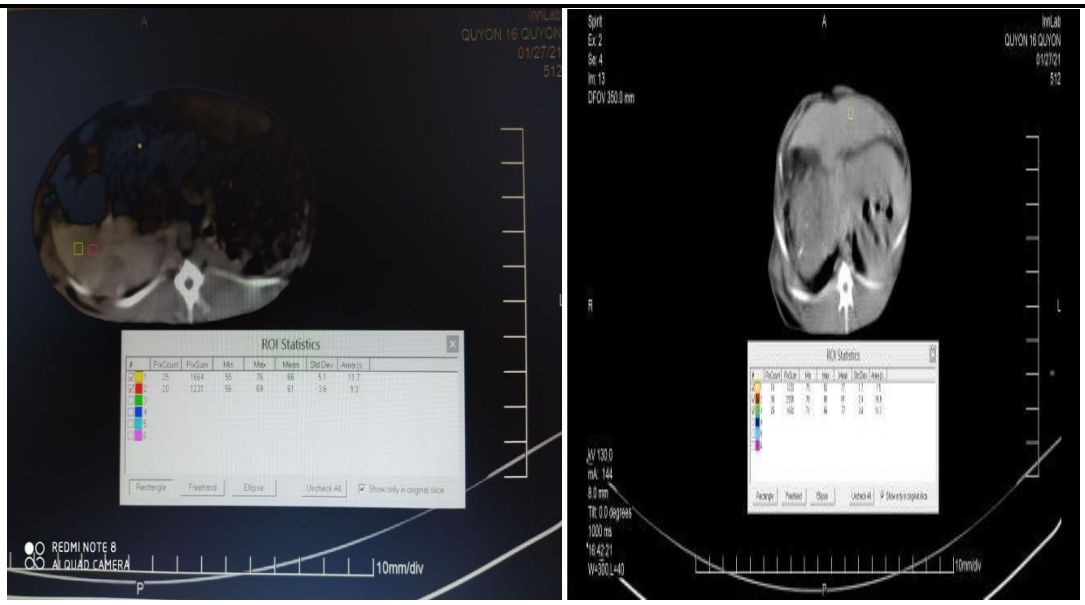


Figure 4

The results of the experiment showed that the changes in the rib cage in MSCT increased to +55 in rabbit 1, +65 in rabbit 4, +67 in rabbit 8, +44 in rabbit 9, +57 in rabbit 12, +61 in rabbit 16 and bone density decreased.





In conclusion, it can be said that in all groups of male and female rabbits, density parameters were studied according to the Hounsfield scale at 0, 4, 8, 12, and 16 weeks, when axial, proximal (frontal), sagittal sections of bone tissue were examined by MSCT, changes in MSCT in comparison to other groups in male and female rabbits modeled with osteoporosis and metabolic syndrome showed that mainly changes were observed in the proximal and distal parts of the bone, in the rib cage, heart and liver area, and it was determined that it was associated with an increase in body weight and hypertension.

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