

WORLD CONGRESS
ON OSTEOPOROSIS,
OSTEOARTHRITIS AND
MUSCULOSKELETAL
DISEASES

VIRTUAL CONGRESS

March 24-26, 2022



2022 VIRTUAL



VIRTUAL.WCO-IOF-ESCEO.org

AbstractBook

P391

DEVELOPMENT OF NOVEL FULLY AUTOMATIC SEGMENTATION AND QUANTIFICATION TECHNIQUE FOR ASSESSMENT OF MUSCULOSKELETAL ORGANS

M. Imani¹, T. Ngoc Quoc Dao², E. Meijering³, G. Duque¹

¹Australian Institute for Musculoskeletal Science (AIMSS), The University of Melbourne and Western Health, Melbourne, ²Dept. of Medicine-Western Health, The University of Melbourne, Melbourne, ³School of Computer Science and Engineering, The University of New South Wales, Kensington, Australia

Objective: Quantitative measurement of the musculoskeletal (MSK) system is necessary to study conditions such as osteoporosis, sarcopenia, and osteosarcopenia. The process of analysing medical images is time-consuming and labour intensive, limiting the number of quantitative studies in this area and its clinical feasibility. Recently, we have developed and validated a novel semiautomatic image analysis software (Tissue Compass) (1). We developed a fully automatic image processing technique to segment all MSK organs in hip and thigh areas using artificial intelligence (AI).

Methods: Several AI models (U-Net deep learning models) were trained and tested for regions of interest: proximal hip and midthigh. Bone, bone marrow, muscle, intermuscular adipose tissue (IMAT), and subcutaneous fat (sub fat) in 200 CT slices were manually analysed using commercially leading software (SliceO-matic by TomoVision) for training and testing and dice coefficient (DC) which indicates the similarity between two techniques has been used to compare the AI models and manual segmentations (Table 1).

Table 1. Dice coefficient score for proximal hip and midthigh in percentage.

	Bone	Bone marrow	Muscle	IMAT	Sub fat
Hip	95.2	90	91.2	64.2	87.7
Midthigh	98	98	98	76	94

Results: The new models can automatically segment and quantify bone, bone marrow (including marrow fat), muscle, IMAT, and sub fat in two main areas of study without human intervention. Figure 1 presents an example of detected areas overlaid on the original CT scan.

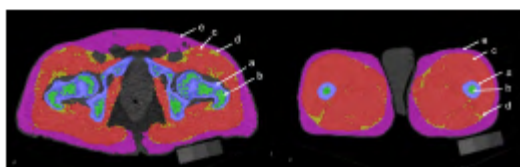


Figure 1. Segmentation results from AI models. On the left side proximal hip, on the right side midthigh. a) bone, b) bone marrow, c) muscle, d) IMAT, e) subfat

Conclusion: Presented AI models can analyse CT scan images much faster and without human intervention, significantly decreasing the cost and time needed in extensive studies that include medical images. Moreover, implementing these techniques in previously developed software (Tissue Compass) will make this robust tool accessible to researchers and clinicians in the future.

Reference: 1. Imani M, et al. Calcif Tissue Int 2021;https://doi.org/10.1007/s00223-021-00914-4

P392

EFFECT OF COMPLETE AND INCOMPLETE SPINAL CORD INJURY ON CHANGES IN THE MECHANICAL PROPERTIES OF BONE TISSUE

O. Gerasimov¹, O. Sachenkov¹, E. Sachenkova¹, K. Sharafutdinova¹, T. Baltina¹, M. Baltin¹, A. Fedianin¹, V. Smirnova¹

¹Kazan (Volga region) Federal University, Kazan, Russia

Objective: A violation of the spinal cord functioning has a significant impact on the motor function. Therefore, it is relevant to study (1) the injured condition of the patient and his individual organs and systems. The purpose of the work is to assess the effect of spinal cord injuries on the mechanical properties of rat bones.

Methods: All tests were conducted on nonlinear laboratory rats (180-200 g). The incomplete spinal cord injury (iSCI) with contusion was applied at the level Th7-Th8 so that damage to the sensory and motor axons lead to impaired hind limb function (2). A complete spinal cord injury (cSCI) with transverse spinal cord transection at the Th8-Th9 level was also reproduced (3). All experiments were performed according to bioethical standards and were approved by the local ethical committee of the Kazan Federal University. Full-scale experiments were carried out. The bone organ was subjected to a three-point bending. The analysis of the results was carried out on the tensile strength (TS) and elastic modulus (EM) values.

Results: The results were compared with the control group values. It was found that cSCI and iSCI increase the EM by 18% for femurs ($p < 0.1$) and decrease by 18% - for tibiae ($p < 0.1$). cSCI for tibiae decreases the EM by 11% ($p < 0.1$). cSCI decreases the femur TS by 37% ($p < 0.05$). The femur TS after iSCI decreased by 16% ($p < 0.1$). The tibia TS after iSCI and cSCI decreased by 17% and 10% ($p < 0.1$), respectively. cSCI and iSCI decrease the TS and EM of the femurs ($p < 0.1$).

Conclusion: The results represent that cSCI decreases the magnitude of the tibia TS ($p<0.05$). cSCI and iSCI decrease the magnitude of the TS and EM of the femurs ($p<0.1$).

References:

1. Baltina T, et al. *BioNanoScience* 2018;8:864
2. Baltin ME, et al. *Exp Brain Res* 2021;239:627
3. Eremeev A, et al. *BioNanoScience* 2019;9:433

Acknowledgment: This research was funded by RFBR, grant number 20-01-00535.

P393

RELATIONSHIPS BETWEEN OSTEOPOROSIS AND ANEMIA IN LONG-LIVING PATIENTS WITH CORONARY ARTERY DISEASE

S. Topolyanskaya¹, T. Eliseeva², A. Sanina², O. Vakulenko², L. Dvoretzki¹

¹First Moscow State Medical University (Sechenov University), Hospital Therapy Dept. N2, ²War Veterans Hospital N3, Moscow, Russia

Objective: Limited and controversial data are available on relationships between osteoporosis and anemia; therefore, we evaluated BMD and its relationship with erythropoiesis in patients with coronary artery disease (CAD) over 90 years of age (long-livers).

Methods: This work was cross-sectional study performed in the War Veterans Hospital. The study enrolled 197 patients (138 women and 59 men) aged 90-106 y (mean age 92.4±2.3 y) hospitalized with CAD. BMD was analyzed by DXA.

Results: Patients with osteoporosis had lower hemoglobin and erythrocyte counts compared to patients with normal BMD: hemoglobin - 117.3 and 125.9 g/l, respectively ($p=0.003$), erythrocytes - $3.8 \times 10^{12}/l$ and $4.1 \times 10^{12}/l$ ($p=0.04$), MCV - 88.7 and 93.5 fl ($p=0.02$), MCH - 30.6 and 31.0 pg ($p=0.07$). Patients with anemia had lower total BMD (973 and 1036 mg/cm³, $p=0.001$), BMD of upper (772 and 845 mg/cm³, $p=0.001$) and lower (956 and 1059 mg/cm³, $p=0.0003$) extremities, BMD of trunk (805 and 851 mg/cm³, $p=0.004$), ribs (607 and 642 mg/cm³, $p=0.005$), pelvis (889 and 935 mg/cm³, $p=0.03$) and spine (973 and 1034 mg/cm³, $p=0.02$). Correlation analysis revealed significant direct relationships between hemoglobin level and all BMD parameters ($r=0.3$; $p=0.00003$). Significant correlations were also established between all BMD parameters and erythrocytes MCV ($r=0.27$; $p=0.0001$) as well as MCH ($r=0.22$; $p=0.002$). Significant direct relationships between blood iron concentration and all BMD parameters were found ($r=0.28$; $p=0.003$).

Conclusion: The study results indicate presence of relationships between BMD and erythropoiesis in centenarians.

P394

MMP-3 AND MPO IN SERUM AND SYNOVIAL FLUID OF PATIENTS WITH IN RHEUMATIC DISEASES

S. T. Popova-Belova¹, M. G. Geneva-Popova¹, K. R. Kraev², V. Popova², A. N. Batalov²

¹Medical University – Plovdiv, Faculty of Medicine, Propedeutics of Internal Diseases, UMHAT "Sveti Georgi" Plovdiv, Rheumatology, ²Medical University – Plovdiv, Faculty of Medicine, Propedeutics of Internal Diseases, UMHAT "Kaspela" Plovdiv, Rheumatology, Plovdiv, Bulgaria

Objective: The study of biomarkers in synovial fluid in patients with rheumatic diseases is a challenge. The aim of the study was to investigate the levels of MMP-3 and MPO in serum and synovial fluid of patients with rheumatic diseases.

Methods: In the study for the period 2018-2021, 156 patients with CASPAR criteria for Psoriatic arthritis (PsA) age of 59.00±13.18 (range 29-82 y), 50 patients with activated gonarthrosis (GoA) age of 61.48±11.01 (range 49-81 y) and 15 patients with rheumatoid arthritis age of 55.22±7.21 (range 29-73 y) were analyzed. Serum and synovial fluid samples were examined by human matrix metalloproteinase-3 (MMP-3) ELISA Kit, Elabscience Biotechnology Inc., USA, and human myeloperoxidase (MPO) ELISA Kit, Wuhan Fine Biotech Co., Ltd., China. Descriptive statistics, parametric and nonparametric tests, linear regression, and binary logistic analysis using computer statistical program SPSS, Vers 26 were used for statistical data processing, with $p<0.05$.

Results: Serum levels of MMP-3 and MPO correlate with the age of the patients and the duration of the disease in all patients. A strong significant relationship were found between the concentration of MMP-3 and MPO in the synovial fluid and the concentrations of circulating MMP-3 and MPO in the patients with PsA ($R_s=0.704$; $p=0.001$) and with RA ($R_s=0.854$; $p=0.01$). The mean values of MMP-3 and MPO in synovial fluid were significantly lower than in the serum of patients with PsA. The higher level of MMP-3 and MRO strongly correlate with the indices for disease activity in patients with PsA, RA and GoA.

Conclusion: MMP-3 and MPO can be used as biomarkers for a severe and aggressive course of the disease in patients with GoA, PsA, RA. Their higher level strongly correlates with the indices for disease activity in patients with PsA, RA and GoA.