Original Research Article: full paper

(2018), «EUREKA: Health Sciences»
Number 5

THE ROLE OF MAGNETIC RESONANCE IMAGING IN THE DIAGNOSIS OF DEFORMING ARTHROSIS OF PROFESSIONAL ETIOLOGY IN MINERS

Angela Basanets
State institution "Institute of Labor Medicine named after Yu. I. Kundiev NAMS of Ukraine"
75 Saksaganskogo str., Kyiv, Ukraine, 01033
a_basanets@meta.ua

Maria Bulavko
Lviv Regional Clinical Hospital
16 Zamkova str., Lviv, Ukraine, 79019
sofiya.nedilya@gmail.com

Abstract

The paper analyzes the effectiveness of magnetic resonance imaging with cartilage diagram in diagnosing signs of professional deforming arthrosis of knee joints in miners working in conditions of significant physical loading.

Aim of the research – to determine of diagnostic efficiency of indicators of magnetic resonance imaging of the knee joint and cartilage diagram in miners of the main occupations suffering from deforming arthrosis.

Methods. The research is conducted in 30 miners of basic occupations: 20 mining workers of breakage face (MWBF) and 10 machinists of shearer mining machines (MSMM) have been treated in the inpatient department of occupational pathology of the Lviv Regional Clinical Hospital in 2015-2017 due to deforming arthrosis. Damages of the main anatomical elements of the knee joint with arthrosis were analyzed, visualized initially with the help of MRI, and then - cartilage diagram.

Results. According to the MRI data, in miners of the main occupations with arthrosis of the knee joint the posterior cross-shaped ligament are most commonly affected (in 75.0±9.7 % MWBF and 70.0±14.5 % MSMM), damage to the medial collateral ligament are diagnosed less frequently (in 5.0±4.9 % in the MWBF and in 10.0±9.5 % in the MSMM). On average 3.8±0.4 modified elements of the knee joint are visualized in patients, whereas 4.8±0.1 affected areas are visualized on the cartilage diagram ($p<0.05$). In 86.7±6.2 % patients, in the analysis of cartilage diagram, changes in all five analyzed areas are diagnosed, indicating a higher efficiency of the diagnosis of changes in the structures of the joint with DA of the professional etiology of the method of cartilage diagram compared with MRI. According to the cartilage diagram the most significant changes are noted in the hypertrophy of the femur: among all miners 62.5±0.3 ms (medial) and 62.6±0.4 ms (lateral), in the MWBF group the average time of T2-delay is the largest in the area of the medial hypertrophy of the femur is 60.9±2.3 ms, in the MSMM group – in the area of the lateral hypertrophy of the femur: 66.7±3.3 ms, which can be linked to the peculiarities of the forced working position of miners of these professions and the kinetics of joint structures.

These results can be used to diagnose the initial lesions of joint structures with DA of professional genesis, as well as the creation of prognostic models for determining the the degree of risk of development of knee joint damage, which will allow to improve the system of personified approach to diagnostic and preventive measures in working persons in conditions of considerable physical activity and forced working position.

Keywords: deforming arthrosis, magnetic resonance imaging, cartilage diagram, miners.

DOI: 10.21303/2504-5679.2018.00730
© *Angela Basanets, Maria Bulavko*

1. Introduction

The method of magnetic resonance imaging (MRI) is a «gold standard» for non-invasive visualization and evaluation of traumatic and degenerative cartilage lesions of the knee joint, its defects and recovery [1, 2]. This is a powerful non-invasive tool for detecting this pathology and monitoring the results of pharmacological therapy and surgical intervention [3, 4]. MRI is a more sensitive method than X-ray imaging or computed tomography to visualize most changes of bone structures due to multi-dimensional tomographic capabilities [5, 6], can better visualize osteophytes, especially central ones, which are inherent in deforming arthrosis (DA) [7]. The method is used to monitor trabecular changes in the subchondral bone if osteoarthritis develops [8, 9].

Cartilage of the joint is a complex, heterogeneous and mechanically anisotropic type of tissue, consisting mainly of a three-dimensional network of collagen, proteoglycans and water; the content of cells in it is insignificant [10, 11]. In order to diagnose lesions or chronic cartilage changes, specific sequences of magnetic resonance with a special resolution and other parameters are required, of which the most effective is the cartilage diagram [12]. Extended isotropic sequences of T2-mapping of magnetic resonance have the ability to represent the joint in a three-dimensional form, in which cartilage and other structures can be evaluated in more detail [13, 14].

T2-mapping can be used to evaluate the cartilage degeneration process and reparative/regenerative processes in the knee joint with DA, in particular [15, 16]. The special application value has T2-mapping for evaluation of articular cartilage in patients with detection of early degeneration of articular cartilage is clinically significant [17, 18]. First of all it is about the category of patients with one-time injury with slaughters, fracture, dislocation and/or damage to the ligament of the joint or repeated microtraumatisation of the joint (for example, in persons with professional risk of development of degenerative changes in cartilage, including a significant share of miners) [19, 20].

At the same time, it should be noted that scientific publications concerning the application of the indicated methods of examination are limited to determine the peculiarities of pathological changes with DA associated with the effects of hazardous production factors.

2. Aim of research

Estimation of diagnostic efficiency of magnetic resonance imaging of the knee joint and cartilage diagram to determine the DA in miners of the main occupations.

3. Materials and methods

The research was conducted in 30 miners of basic occupations: 20 mining workers of breakage face (MWBF) and 10 machinist of shearer mining machines (MSMM) have been treated in the inpatient department of occupational pathology of the Lviv Regional Clinical Hospital in 2015–2017 due to deforming arthrosis. Damages of the main anatomical elements of the knee joint were analyzed, visualized initially with the help of MRI, and then – cartilage diagram (T2-mapping).

In order to standardize, all 30 patients were examined without contrast enhancement at 1.5 T MRI apparatus GE SignaHDxt 1.5 T in T2-mode. For additional evaluation of individual structures, T1 weighted images and DWI, PD FS, STIR modes were also used. For a detailed assessment of meniscus and the scan connection was also carried out in the PD FS sequence, since it was believed that the nucleus of hydrogen through the cracks was associated with macromolecules, which respectively shows a shorter T2-relaxation time.

Applying the technological and programmatic capabilities of modern MRI-apparatuses, the method of cartilage diagram was used – the protocol of research MR MapIT KNEE in sagittal cut ofT2-sequences and in several areas of each cut separately. Colour mapping of time of T2-relaxation allows detecting zones of biochemical changes in the cartilage, even with visually unchanged its structure. Five main areas of the knee joint were included for evaluation: medial hypertrophy of the femur, medial hypertrophy of the tibia, lateral hypertrophy of the femur, lateral hypertrophy of the tibia and zone of patella. The area of the measuring zone (ROI) was 2 mm^2. In each zone, the minimum and maximum delay time was determined in areas sized from 4 pixels. The signal in T2 was considered pathological if it delayed more than 40 ms in at least 2 consecutive images for all zones, except for patella, where the cut was 35 ms.

When performing the statistical processing of the data obtained, the following methods were used: calculation of relative (P) and average (M) values and their standard errors ($\pm m_p$, ±m); conducting an assessment of the probability of the results obtained in the comparable groups by χ^2 method [21].

4. Results

Narrowing of the joint crack is one of the most significant objective indicators of DA of different localization. The study reveals a slight narrowing of the joint crack in the area of the medial hypertrophy of the femur and tibia in 13 (43.33±9.05 %) miners, in particular, in half of the surveyed in the MWBF group (50.0±11.2 %, n=10), and one third of MSMM (30.0±14.5 %, n=3) (p>0.05).

The cortical layer is one of the important layers of bone tissue, which varies considerably with deforming arthrosis of stage III,and it appears in the MRI less intense, close to the image of soft tissues, the image of bone tissue.At the same time, the normal differentiation of the structure of the bones is lost, which is interconnected, and the thinning of the cortical layer of diaphysis is revealed. Among the investigated miners, changes in the cortical layer of bone were diagnosed in one third of patients (30.0±8.4 %), fuzzy contour of this layer – in 26.7±8.1 %. Comparing the frequency of occurrence changes in the cortical layer between the study groups was shown that in MWBF they occur a little less often than in MSMM (p>0.05), in particular: in 25.0±9.7 % surveyed of the MWBF group, according to data of MRI, the fuzzy contour and the changed thickness of the cortical layer of the bone are detected. In the surveyed of the MSMM group, changes in the thickness of the cortical layer were diagnosed in 40.0±15.5 % patients, fuzzy contour – in 30.0±14.5 %, (**Fig. 1**).

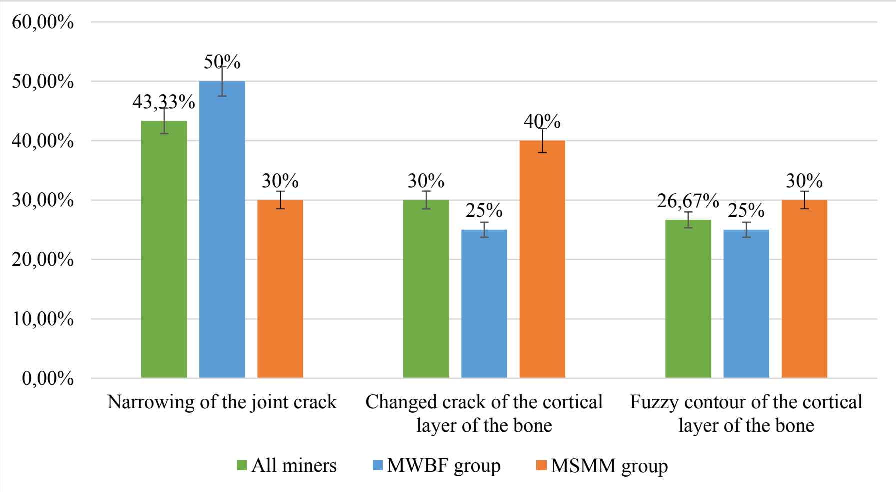


Fig. 1. Frequency of pathological changes of elements of knee joint according to data of MRI in T2-modeamong miners with DA of knee joint (%)

An important structure of the joint is its connective device, which plays a role in the kinetics. Most of the ligaments are tractions of connective tissue, fibrous beams of different widths, length and direction, allowing ligaments to relax, stretch, thereby providing an additional movement of the shin. The knee joint is represented by the anterior and posterior cross-shaped, lateral (collateral), transverse, patellaand between the fibula and tibial ligaments. The anterior cross-shaped ligament (ACSHL) stabilizes the hypertrophy of the tibia and does not allow the knee to move forward. The posterior cross-shaped ligament (PCSHL) keeps the knee from pathological shift back.The lateral ligaments – the internal and external strengthen the intra-articular capsule of the knee in places of its greatest tension and restrict superfluous movements.The transverse ligament connects and stabilizes the anterior parts of the lateral and medial meniscus.The ligament of patella involves in the extension of the knee. Thus, each ligament plays its part in the qualitative work of the knee joint. If the ligament apparatus is damaged, stretching may occur in the knee joint (without disturbing its anatomical integrity), trauma (when the individual fibers are torn) or break the ligament (with a complete break of the bundles of fibers).The causes of damage to the ligament apparatus can be: sudden sharp rotation of the knee, knee injury when falling or direct impact, inflammation and degenerative changes in tendons, caused by prolonged static loading to pose kneeling or squatting, what happens when performing work in conditions of limited space in the mine.

The study shows that in the MWBF group, violation of the integrity of the anterior cross-shaped ligament was observed in 13 patients (65.0±10.7 %), that although was 1.6 times more often than in the MSMM group (40.0±15.5 %), however, this difference was not statistically significant (p>0.05). The garnetting of the ligament was found in 11 patients of the MWBF group (55.0±11.1 %)

and in 2 patients from the MSMM group (20.0±12.7 %), which indicates the statistically significant difference ($p<0.05$) between groups. Somewhat less often occur the breaks of anterior cross-shaped ligament: in 5 patients (25.0±9.7 %) of the MWBF group and 1 patient (10.0±9.5 %) of the MSMM group ($p>0.05$).

Damages to the posterior cross-shaped ligament occurred in a large part of the miners (63.3±8.8 %), in particular among workers of the MWBF group – in 70.0±10.3 % cases, in the MSMM group – in 50.0±15.8 % ($p>0.05$). It is angulated (rejected by a certain angle from the norm) in 60.0±11.0 % investigated of the MWBF group, in the MSMM indicatoris 50.0±15.8 % ($p>0.05$). There is a ventral displacement of the shin with the increase in the angulation of PCSHL, thus, the closer PCSHL angle to 90°, the degree of the ACSHL damage is greater, which affects the general condition of the joint with DA.

In homogeneous magnetic resonance signal demonstrates in equality or fuzziness of contour of ligament and indicates deformation of the trajectory of the ligament with the loss of fibers of its structure. In the analysis of MRI-images, a heterogeneous signal from the posterior cross-shaped ligament was detected in 7 patients (35.0±10.7 %) of the MWBF group and 4 patients (40.0±15.5 %) of the MSMM group ($p>0.05$).

To analyze the pathological changes of the anterior cross-shaped ligament, T2-images were used, made in FSE mode with repayment of fat. The evaluation was carried out in the axial plane, and if necessary, it was supplemented by the characteristic of the ligament from T2-images in the sagittal plane. For example, in a patient I., who has been working as the MWBF for 17 years, with complaints of pronounced pain syndrome, hypersensitive signal was detected when evaluating the anterior cross-shaped ligament in the axial plane, which can indicate its thickening (**Fig. 2**). At the same time, cut in such plane visualize the position of the ligament fragmentarily and do not allow it to be evaluated throughout. In such cases, the image of the sagittal plane was used to give the more detailed assessment of all fibers of the anterior cross-shaped ligament.

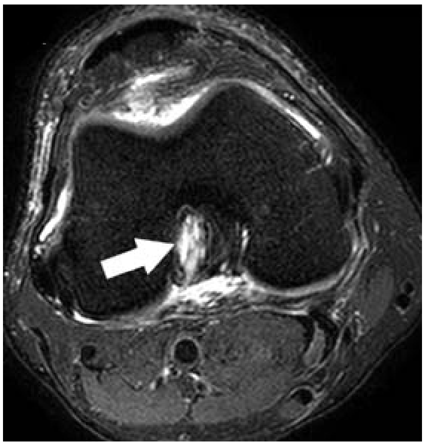


Fig. 2. Patient I., 43 years old, experience in the profession of MWBF 17 years,T2-weighted FSE image in axial plane with repayment of fat indicates an increase in the intensity of the signal from the anterior cross-shaped ligament and indicates its thickening (arrow)

The medial collateral ligament with arthrosis of the knee joint is the slightest damaged. It was damaged only in 5.0±4.9 % investigated in the MWBF group, and in 10.0±9.5 % – in the MSMM group ($p>0.05$). The lateral collateral ligament is affected 7 times more often than the medial in the MWBF group (35.0±10.7 %, $p<0.05$) and 5 times more often among patients of the MSMM group (50.0±15.8 %, $p<0.05$).

Work in forced labor position leads to the high frequency of development of such pathological symptom as winding movement of own ligament of patella in the MWBF group (55.0±11.1 %), and in the MSMM group (40.5±15.5 %) ($p>0.05$).It is worth noting that in the MWBF group there are signs of tearing of own ligament of patella in 5 %, which usually occurs as a result of a serious traumatic factor, which in this case can be dangerous working conditions.

As some of the analyzed elements of the knee joint could have double changes (for example, the ligament could be both thinned and garnetted), the study of preserved anatomical structures of the knee joint in the investigated patients was also conducted (**Table 1**).

Table1

The frequency of preserving anatomical building of structures of knee joint with DA among miners (%)

No.	Anatomical structure of the normal building	Total (n=30)	MWBF group (n=20)	MSMM group (n=10)	p between MWBF and MSMM
1	Medial meniscus of a triangular shape	83.3±6.8	85.0±8.0	80.0±12.7	>0.05
2	Lateral meniscus of triangular shape	96.7±3.3	95.0±4.9	100.0±0	>0.05
3	Anterior cross-shaped ligament is undamaged	43.3±9.1	35.0±10.7	60.0±15.5	>0.05
4	Posterior cross-shaped ligament is undamaged	26.7±8.1	25.0±9.7	30.0±14.5	>0.05
5	Medial collateral ligament is undamaged	93.3±4.6	95.0±4.9	90.0±9.5	>0.05
6	Lateral collateral ligament is undamaged	60.0±8.9	65.0±10.7	50.0±15.8	>0.05
7	Own ligament of patella is undamaged	36.7±8.8	30.0±10.3	50.0±15.8	>0.05
8	Tendon of the four-head muscle of the thigh is not damaged	53.3±9.1	55.0±11.1	50.0±15.8	>0.05
9	Hoff’s body is not enlarged	56.7±9.1	60.0±11.0	50.0±15.8	>0.05

From the above-mentioned nine structures of the knee joint with MRI, the significant difference in the frequency of undamaged elements between the professions of the MWBF and MSMM was not established.

The similar analysis was carried out, depending on the work experience of the employees. The frequency of preserving the anatomical building of the structures of the knee joint was statistically identical as evidenced by the data in **Table 2** (p>0.05 with a pairwise and simultaneous comparison of all three groups) in miners with work experience from 9 to 15 years, from 15 to 20, and more than 20 years. This may be an indication that the initial changes with DA of professional genesis occur in terms of work up to 15 years.

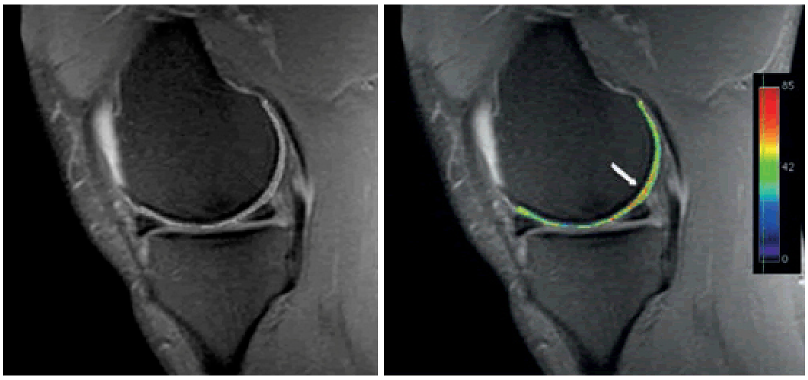
Table 2

Frequency of preserving the anatomical building of the structures of the knee joint with DA depending on the work experience (%)

Anatomical structure of the normal building	Work experience ≤ 15 years (n=7)	Work experience 15–20 years (n=18)	Work experience >20 years (n=5)	p
Medial meniscus of a triangular shape	71.4±17.1	88.9±7.4	80.0±17.9	>0.05
Lateral meniscus of triangular shape	100.0±0	100.0±0	80.0±17.9	>0.05
Anterior cross-shaped ligament is undamaged	28.6±17.1	50.0±11.8	40.0±21.9	>0.05
Posterior cross-shaped ligament is undamaged	28.6±17.1	44.4±11.7	20.0±17.9	>0.05
Medial collateral ligament is undamaged	71.4±17.1	100.0±0	100.0±0	>0.05
Lateral collateral ligament is undamaged	57.1±18.7	55.6±11.7	80.0±17.9	>0.05
Own ligament of patella is undamaged	28.6±17.1	44.4±11.7	20.0±17.9	>0.05
Tendon of the four-head muscle of the thigh is not damaged	42.9±18.7	55.6±11.7	60.0±21.9	>0.05
Hoff’s body is not enlarged	42.9±18.7	55.6±11.7	80.0±17.9	>0.05

The analysis of the anatomical building of the structures of the knee joint does not reveal the significant difference in their macrostructure and MR-characteristics among the groups compared by profession, work experience and X-ray image (with the exception of damaged medial meniscus).This may indicate a lack of diagnostic effectiveness of the MRI technique, and indicates the need to use more accurate methods to detect changes in the initial stages of DA, for example, cartilage diagram (**Fig. 3**).

It is found that in all of the investigated patients time of T2-delay exceeded the limit norm: at least in two analyzed areas simultaneously in 26 patients (86.7±6.2 %) changes are diagnosed in all five studied zones.



a *b*

Fig. 3. T2-weighted image of the jointcartilageof medial hypertrophy of femoral bone in the sagittal plane in the patient M., miner, 34 years old, work experience in the MSMM profession is 16 years, with osteoarthrosis of the knee joint: a – of the Ist stage with standard image; *b* – using the method of the cartilage diagram (the initial damage ofcartilage surface of the joint is detected only on the cartilage diagram – increase of relaxation time (red dots))

In the analysis of the received MRI cuts in T2 mode the signal of pathological intensity from the bone marrow of the hypertrophy of the femur and tibia met only in one-fifth of the miners (20.0±7.3 %, n=6), equally in both studied groups: 20.0±8.94 % in the MWBF group and 20.0±12.7 % in the MSMM group.

In both groups, it was determined that the highest average indicator of time delay of T2-relaxation was observed in the zone of hypertrophy of the femur. In particular, in the medial hypertrophy of the femur in the MWBF group the average time of T2-delay was 60.9±2.3 ms, which was 1.2 more ($p<0.05$), than in the areas of the hypertrophy of the tibia. This indicates the presence of more significant superficial, transmural and deep linear changes of hypertrophy of the femur compared to the tibia with DA of professional etiology. Similarly, the highest average indicator of time delay of T2-relaxationin the MSMM group was recorded in the area of the lateral hypertrophy of the femur – 66.7±3.3 ms.At the same time, there is no statistically significant difference between the respective indicators in the two investigated groups of miners ($p>0.05$). The detailed characteristics time delay of T2 in cartilage tissue, measured in patients with DA of the knee joint, are presented in the **Table 3**.

Table 3

The indicators of average maximum time of T2-relaxation of cartilages of the knee joint with DA (M±m, ms)

Anatomic area of the cartilage of the knee joint	Norm	Total (n=30)	MWBF (n=20)	MSMM (n=10)
Medial hypertrophy of the femur	Up to 40	62.5±0.3	60.9±2.3	65.7±1.1
Medial hypertrophy of the tibia	Up to 40	54.5±0.6	51.1±2.4	61.3±9.3
Lateral hypertrophy of the femur	Up to 40	62.6±0.4	60.5±2.5	66.7±3.3
Lateral hypertrophy of the tibia	Up to 40	53.1±0.3	50.1±1.9	59.2±2.9
Zone of patella	Up to 35	54.3±0.5	55.7±3.2	51.4±4.4

Thus, when comparing the data of the study, it was found that according to MRI data in patients with AD, on average 3.8±0.4 modified elements of the knee joint were visualized, whereas 4.8±0.1 damaged areas were visualized (p<0.05) during the analysis of the cartilage diagram. Since the 12 structural elements were provided by the characteristics for the MRI-examination, during the cartilage diagram – five, then changes were observed in 31.7 % visible parameters for MRI and in 95.3 % – for the cartilage diagram. The above-mentioned indicates the higher diagnostic effectiveness of the cartilage diagram method compared with MRI for the detection of the damage of joint structures with DA of professional genesis.

5. Discussion

According to MRI data, in miners of the main occupations with arthrosis of the knee joint the posterior cross-shaped ligament was most often affected (63.3±8.8 % investigated), in 75.0±9.7 % MWBF and 70.0±14.5 % MSMM. Damage to this joint structure occurs in long-term physical labor with excessive force loading kneeling or squatting, which was a typical forced posture of miners.

The ligament apparatus is an important structure of the joint, which plays a role in the kinetics [1, 2]. The knee joint is represented by anterior and posterior cross-shaped, lateral (collateral), transverse, patella and between the fibula and tibial ligaments. The anterior cross-shaped ligament stabilizes the hypertrophy of the tibia and does not allow the knee to move forward, whereas the posterior - keeps the knee from pathological shift back, the lateral ligaments – the internal and external strengthen the intra-articular capsule of the knee in places of its greatest tension and restrict superfluous movements [13, 17]. If the ligament apparatus is damaged, stretching may occur in the knee joint (without disturbing its anatomical integrity), trauma (when the individual fibers are torn) or break of the ligaments (with a complete break of the bundles of fibers). The causes of damage to the ligament apparatus can be: sudden sharp rotation of the knee, knee injury when falling or directhit, inflammation and degenerative changes in tendons, caused by the prolonged static loading to pose kneeling or squatting, what happens when performing work in conditions of limited space in the mine [18, 19].

According to MRI, on average 3.8±0.4 modified knee joint elements were visualized in patients, whereas by the cartilage diagram 4.8±0.1 damaged areas were visualized (p<0.05). In 86.7±6.2 % patients in the analysis of the cartilage diagram, changes in all five analyzed areas were diagnosed. The above-mentioned indicates the higher diagnostic effectiveness of the cartilage diagram method compared with MRI for the detection of the damage of joint structures with DA of professional genesis. The obtained results were similar to the results of research by the foreign scientists [7, 11].

According to the cartilage diagram the most pronounced changes with DA of professional etiology were noted in the zone of hypertrophy of the femur, as indicated by the indicator of the average time of T2-delay among all miners up to 62.5±0.3 ms (medial) and 62.6±0.4 ms (lateral). In MWBF group the average time of T2-delay was the largest in the zone of medial hypertrophy of the femur and was 60.9±2.3 ms, in the MSMM group – in the zone of lateral hypertrophy of the femur was 66.7±3.3 ms.

These data can be used in the clinic to monitor trabecular changes in the subchondral bone when osteoarthritis develops.

6. Conclusions

1. Miners of the main occupations with arthrosis of the knee joint are most often affected the posterior cross-shaped ligament.

2. Miners have more significant superficial, transmural and deep linear changes of hypertrophy of the femur compared to the tibia with DA of professional etiology.

3. It was proven that the higher diagnostic effectiveness of the cartilage diagram method compared with MRI for the detection of the damage of joint structures with DA of professional genesis.

4. These results can be used to diagnose initial damages of the joint structures with DA of professional genesis, as well as the creation of prognostic models for determining the risk degree of developing of knee joint damage, which will allow to improve the system of personified approach to diagnostic and preventive measures among working persons in conditions of considerable physical loading and forced labor posture.

References

[1] Angeretti, G., Ferraro, S., De Falco, G., Genovese, E., Cherubino, P., Ronga, M. (2014). Imaging of articular cartilage: current concepts. Joints, 2 (3), 137–140. doi: http://doi.org/10.11138/jts/2014.2.3.137

[2] De Windt, T. S., Welsch, G. H., Brittberg, M., Vonk, L. A., Marlovits, S., Trattnig, S., Saris, D. B. F. (2013). Is Magnetic Resonance Imaging Reliable in Predicting Clinical Outcome After Articular Cartilage Repair of the Knee? The American Journal of Sports Medicine, 41 (7), 1695–1702. doi: http://doi.org/10.1177/0363546512473258

[3] Eckstein, F., Burstein, D., Link, T. M. (2006). Quantitative MRI of cartilage and bone: degenerative changes in osteoarthritis. NMR in Biomedicine, 19 (7), 822–854. doi: http://doi.org/10.1002/nbm.1063

[4] Crema, M. D., Roemer, F. W., Marra, M. D., Burstein, D., Gold, G. E., Eckstein, F. et. al. (2011). Articular Cartilage in the Knee: Current MR Imaging Techniques and Applications in Clinical Practice and Research. RadioGraphics, 31 (1), 37–61. doi: http://doi.org/10.1148/rg.311105084

[5] Alizai, H., Roemer, F. W., Hayashi, D., Crema, M. D., Felson, D. T., Guermazi, A. (2015). An update on risk factors for cartilage loss in knee osteoarthritis assessed using MRI-based semiquantitative grading methods. European Radiology, 25 (3), 883–893. doi: http://doi.org/10.1007/s00330-014-3464-7

[6] Crespo Rodriguez, A. M., de Lucas Villarrubia, J. C., Pastrana Ledesma, M. A., Millan Santos, I., Padron, M. (2015). Diagnosis of lesions of the acetabular labrum, of the labral–chondral transition zone, and of the cartilage in femoroacetabular impingement: Correlation between direct magnetic resonance arthrography and hip arthroscopy. Radiología, 57 (2), 131–141. doi: http://doi.org/10.1016/j.rxeng.2013.11.001

[7] Kovalenko, V. M., Bortkevich, O. P., Protsenko, G. O., Povoroznyuk, V. V. (2011). Instrumental visualization in rheumatology. Part I. Radioisotope scintigraphy, thermography, positron emission tomography, magnetic resonance imaging. Pain Joints Spine, 2 (2). Available at: http://www.mif-ua.com/archive/article/18651

[8] Binks, D. A., Hodgson, R. J., Ries, M. E., Foster, R. J., Smye, S. W., McGonagle, D., Radjenovic, A. (2013). Quantitative parametric MRI of articular cartilage: a review of progress and open challenges. The British Journal of Radiology, 86 (1023), 20120163. doi: http://doi.org/10.1259/bjr.20120163

[9] Blackman, A. J., Smith, M. V., Flanigan, D. C., Matava, M. J., Wright, R. W., Brophy, R. H. (2013). Correlation Between Magnetic Resonance Imaging and Clinical Outcomes After Cartilage Repair Surgery in the Knee. The American Journal of Sports Medicine, 41 (6), 1426–1434. doi: http://doi.org/10.1177/0363546513485931

[10] Wyatt, C., Guha, A., Venkatachari, A., Li, X., Krug, R., Kelley, D. E. et. al. (2015). Improved differentiation between knees with cartilage lesions and controls using 7T relaxation time mapping. Journal of Orthopaedic Translation, 3 (4), 197–204. doi: http://doi.org/10.1016/j.jot.2015.05.003

[11] Eckstein, F., Cicuttini, F., Raynauld, J.-P., Waterton, J. C., Peterfy, C. (2006). Magnetic resonance imaging (MRI) of articular cartilage in knee osteoarthritis (OA): morphological assessment. Osteoarthritis and Cartilage, 14, 46–75. doi: http://doi.org/10.1016/j.joca.2006.02.026

[12] Welsch, G. H., Juras, V., Szomolanyi, P., Mamisch, T. C., Baer, P., Kronnerwetter, C. et. al. (2012). Magnetic resonance imaging of the knee at 3 and 7 Tesla: a comparison using dedicated multi-channel coils and optimised 2D and 3D protocols. European Radiology, 22 (9), 1852–1859. doi: http://doi.org/10.1007/s00330-012-2450-1

[13] Teichtahl, A. J., Smith, S., Wang, Y., Wluka, A. E., O'Sullivan, R., Giles, G. G., Cicuttini, F. M. (2015). Occupational risk factors for hip osteoarthritis are associated with early hip structural abnormalities: a 3.0 T magnetic resonance imaging study of community-based adults. Arthritis Research & Therapy, 17 (1), 19. doi: http://doi.org/10.1186/s13075-015-0535-3

[14] Kohl, S., Meier, S., Ahmad, S. S., Bonel, H., Exadaktylos, A. K., Krismer, A., Evangelopoulos, D. S. (2015). Accuracy of cartilage-specific 3-Tesla 3D-DESS magnetic resonance imaging in the diagnosis of chondral lesions: comparison with knee arthroscopy. Journal of Orthopaedic Surgery and Research, 10 (1). doi: http://doi.org/10.1186/s13018-015-0326-1

[15] Horng, A., Raya, J. G., Stockinger, M., Notohamiprodjo, M., Pietschmann, M., Hoehne-Hueckstaedt, U. et. al. (2015). Topographic deformation patterns of knee cartilage after exercises with high knee flexion: an in vivo 3D MRI study using voxel-based analysis at 3T. European Radiology, 25 (6), 1731–1741. doi: http://doi.org/10.1007/s00330-014-3545-7

[16] Zink, J., Souteyrand, P., Guis, S., Chagnaud, C., Le Fur, Y., Militianu, D. et. al. (2015). Standardized quantitative measurements of wrist cartilage in healthy humans using 3T magnetic resonance imaging. World Journal of Orthopedics, 6 (8), 641–648. doi: http://doi.org/10.5312/wjo.v6.i8.641

[17] Vrezas, I., Elsner, G., Bolm-Audorff, U., Abolmaali, N., Seidler, A. (2009). Case–control study of knee osteoarthritis and lifestyle factors considering their interaction with physical workload. International Archives of Occupational and Environmental Health, 83 (3), 291–300. doi: http://doi.org/10.1007/s00420-009-0486-6

[18] Vincent, T. L., Watt, F. E. (2014). Osteoarthritis. Medicine, 42 (4), 213–219. doi: http://doi.org/10.1016/j.mpmed.2014.01.010

[19] Hong, E., Kraft, M. C. (2014). Evaluating Anterior Knee Pain. Medical Clinics of North America, 98 (4), 697–717. doi: http://doi.org/10.1016/j.mcna.2014.03.001

[20] Madan, I., Grime, P. R. (2015). The management of musculoskeletal disorders in the workplace. Best Practice & Research Clinical Rheumatology, 29 (3), 345–355. doi: http://doi.org/10.1016/j.berh.2015.03.002

[21] Shevaga, V. M., Painok, A. V., Beloshitsky, V. V., Zadorozhna, B. V., Netlukh, A. M., Kobyletsky, O. Ya. et. al. (2016). Mathematical modeling of the influence of risk factors on the probability of an adverse result in severe craniocerebral trauma. Bulletin of scientific research, 4, 46–48.

ESTIMATION OF THE EFFECT OF PLATELET RICH PLASMA PRODUCTS IN THE INTEGRATION OF POLYPROPYLENE MESH IMPLANT IN BIOLOGICAL TISSUES. EXPERIMENTAL MODEL IN RATS

Dmitro Atanasov
Surgery department № 4 with oncology course
Odessa National Medical University
2 Valichovskiy lane, Odessa, Ukraine, 65082
dmitriyatanasov@gmail.com

Abstract

The aim of the research is to determine morphological changes in the area of implantation of the polypropylene mesh implant and to determine the effect on the integration of the prosthesis of locally introduced adipose tissue and platelet rich plasma.

Materials and methods. The experiment was performed on 36 sexually mature males of the Wistar line rats. The experiment simulated, studied and quantified local morphological responses and changes in developing in biological tissues that are in contact with implanted highly porous lightweight (80 g/m2) mesh implant in isolation and also in conditions of local administration of fatty graft and platelet rich plasma.

Results: Assuming introduction of adipose tissue and platelet rich plasma in the zone of integration of mesh alloprosthesis under the influence of introduced regenerative cytokines as well as stromal stem cells activated by them there is an earlier activation of regenerative processes, enhanced angiogenesis which determines the optimal nature of the integration of the prosthesis with the formation of thin collagen fibers in more early terms minimizing excess peri-prosthetic fibrosis. Isolated introduction into the implantation zone of fatty suspension determines similar changes that have a slightly less pronounced character. These changes are quantitatively studied and the results obtained are statistically significant.

Conclusions: Applying a fatty graft together with platelet rich plasma in the area of implantation of the lung polypropylene prosthesis, there was an accelerated tissue reaction from the integration of the prosthesis.

Mesenchymal stem cells of adipose tissue that is a target for plasma cytokines enriched with thrombocytes have a more pronounced effect in stimulating reparative processes provided that they are simultaneously administered with PRP compared with isolated administration without PRP. The use of platelet rich plasma and adipose tissue design has a significant positive effect on local