CENTRAL ASIAN JOURNAL OF MEDICAL AND NATURAL SCIENCES
https://cajmns.centralasianstudies.org/index.php/CAJMNS
Volume: 05 Issue: 03 | July 2024 ISSN: 2660-4159

Article

Variability in Ultrasound Patterns of Osteochondral Changes in Arthropathies

Alie Servetovna Ametova[1*], Shukhrat Khudayberdievich Ziyadullaev[1], Yulduz Maratovna Khodjibekova[2]

1. Samarkand State Medical University, Samarkand, Uzbekistan
2. Tashkent State Dental Institute, Tashkent, Uzbekistan

* Correspondence author email : uzyordam@gmail.com

Abstract: The early detection and monitoring of osteochondral abnormalities associated with various arthropathies are essential for effective management. This study aimed to identify distinctive ultrasound manifestations indicative of hyaline cartilage and underlying bone alterations in different arthropathies and connective tissue disorders. A total of 540 patients with joint symptoms were examined using high-resolution ultrasound equipment. Ultrasound features of cartilage and bone changes were analyzed, with specific variations observed across rheumatoid arthritis (RA), reactive arthritis (ReA), gouty arthritis (GdA), osteoarthritis (OA), systemic lupus erythematosus (SLE), systemic scleroderma (SSc), and psoriatic arthropathy (PsA). Results revealed characteristic patterns of cartilage thinning, thickening, and erosions, as well as bone sclerosis and marginal bone growths, unique to each condition. Notably, early cartilage erosion detection occurred within approximately 2.9 months from the onset of destructive arthritis. This study underscores the high sensitivity and specificity of ultrasound diagnostics in detecting and monitoring osteochondral abnormalities, offering valuable insights for early intervention and treatment strategies in arthropathies..

Keywords: Arthropathy, Articular Cartilage, Bone Structures Of The Joint, Ultrasound Diagnostics

1. Introduction

In contemporary clinical medicine, joint pathology, which manifests across a broad spectrum of musculoskeletal and connective tissue disorders, remains a pressing medical and social concern. Its significance is underscored by its widespread prevalence, continual rise in incidence within the population, substantial socio-economic burdens resulting from the progressive nature of most joint ailments, elevated rates of temporary and permanent disability, and the substantial costs associated with the rehabilitation treatment of affected individuals.

In modern clinical practice, the diagnosis and monitoring of joint pathologies pose significant challenges due to their diverse etiologies and variable clinical presentations. Arthropathies, encompassing conditions such as rheumatoid arthritis, osteoarthritis, systemic lupus erythematosus, and others, represent a considerable burden on healthcare systems globally. Timely and accurate assessment of joint integrity is crucial for initiating appropriate treatment strategies and improving patient outcomes.

Traditionally, radiographic imaging has been a cornerstone in the evaluation of joint diseases. However, its limitations in detecting early structural changes and dynamic disease progression have led to the exploration of alternative diagnostic modalities. Ultrasound

Citation: Alie Servetovna Ametova, Shukhrat Khudayberdievich Ziyadullaev, Yulduz Maratovna Khodjibekova. Variability in Ultrasound Patterns of Osteochondral Changes in Arthropathies. Central Asian Journal of Medical and Natural Science 2024, 5(3), 307-317.
Received: 23th March 2024
Revised: 23th April 2024
Accepted: 8th May 2024
Published: 14th May 2024

Copyright: © 2024 by the authors. Submitted for open access publication under the terms and conditions of the Creative Commons Attribution (CC BY) license (https://creativecommons.org/licenses/by/4.0/)

imaging has emerged as a promising tool for assessing joint pathology, offering advantages such as real-time visualization, lack of ionizing radiation, and cost-effectiveness.

This study aims to explore the utility of ultrasound examination in identifying echographic manifestations of osteochondral changes in various arthropathies affecting medium and small joints of the extremities. By elucidating specific ultrasound findings associated with different arthropathies, we can enhance our understanding of disease pathogenesis, facilitate early diagnosis, and guide treatment decisions. Additionally, we seek to evaluate the diagnostic accuracy of ultrasound in detecting structural abnormalities, thereby contributing to the optimization of clinical management strategies for patients with joint diseases.

Through a comprehensive examination of ultrasound findings in a diverse cohort of patients with arthropathies, this study endeavors to provide valuable insights into the role of ultrasound in the assessment of joint health and disease. Ultimately, our findings aim to inform clinical practice and improve patient care in the management of arthropathies.

The improvement of early diagnostic capabilities for the most prevalent arthropathies, especially those affecting the hands and feet, is of paramount importance. Early diagnosis facilitates prompt initiation of therapy, leading to better disease prognoses.

Given the variable onset of most joint diseases, the similarity of symptoms in their early stages, and the absence of clear diagnostic criteria for various forms of arthropathy at disease onset, there is a necessity to identify specific clinical signs, laboratory markers, or imaging findings that can anticipate disease progression early on. This enables the selection of appropriate and timely therapeutic interventions, thus improving outcomes and social prognoses.

While there is an array of instrumental methods available for diagnosing joint lesions, not all are equally informative. X-ray methods, for instance, are mainly indicative in advanced disease stages, while radioisotope techniques offer insights into areas of increased blood flow but lack specificity. The integration of magnetic resonance imaging and ultrasound into clinical practice has broadened the diagnostic capabilities, facilitating more accurate nosological classifications.

Currently, ultrasound examination of joints in inflammatory diseases stands out as the most promising avenue in the advancement of radiological diagnostics. The methodology for scanning limb joints and interpreting the results continues to undergo refinement. The standards for arthrosonography are stringent, as in certain scenarios, it emerges as a viable alternative to magnetic resonance imaging.

The bulk of published literature concerning ultrasound usage in joint examination predominantly focuses on diagnosing rheumatoid arthritis. Over the years, discussions in the literature have revolved around the echographic structure of eroded articular cartilage, as well as the correlation between disease stage, activity level, and intra-articular tissue changes. Even in the early stages of the disease, articular cartilage becomes involved in the immunopathological process due to the influence of elevated concentrations of proinflammatory cytokines on chondrocytes. This leads to enzymatic resorption of the matrix, resulting in irregularities and jagged contours of the cartilage, observed in 25.7-41.6% of cases.

Destructive lesions typically form in the spaces between the synovial membrane and the hyaline cartilage covering the joint surfaces, as well as in the regions where tendons and ligaments attach. Notably, these lesions tend to increase in depth more than in width, even with minimal progression of destruction. Through long-term comparison of morphological changes and ultrasound indications of the erosive process, WW Gibbon (1996) determined the duration required for the onset of destruction using ultrasound. They observed that

older erosions are characterized by a rim of sclerosis, although no significant correlation was found between the size of resorption areas and the duration of the disease.

Sonographic manifestations of rheumatoid arthritis also encompass changes in cartilage thickness. PJ Lund et al. (1995), in their study of echograms of RA patients with knee joint damage, initially concluded that cartilage thinning coincides with the onset of the erosive process. However, subsequent research by domestic scientists has challenged this notion. It was discovered that during the early stages of destruction, cartilage initially thickens (on average by 0.1-0.6 mm) due to edema. Chronic inflammation subsequently leads to a reduction in cartilage thickness. Progressive destruction of hyaline tissue eventually culminates in its complete breakdown, starting in isolated areas and eventually affecting the entire tissue. Consequently, the subchondral layer of the epiphyses becomes involved in the pathological process, with bone erosions localizing in the epiphyseal and metaphyseal regions.

Compared to rheumatoid arthritis, there is a notable scarcity of literature dedicated to diagnosing osteoarthritis. The limited available publications primarily focus on gonarthrosis. Key criteria for identifying osteoarthritis revolve around changes in cartilage and bone structures, particularly the thinning of the hyaline layer on articular surfaces due to prevailing catabolic processes. According to findings by I.L. Terskova et al. (2005), this thinning is observed in 58.7% of cases, with uneven thickness reduction in 11.0% and negligible changes in 14.7%. E.M. Ermak (2005) provides a more detailed account of cartilage alterations, highlighting structural disruptions and changes in echogenicity, such as increased density (indicative of impaired elastic properties of hyaline tissue) and heterogeneity (attributed to collagen framework disintegration). Joint space narrowing accompanies cartilage degeneration, a feature noted by various researchers including MV Helzel (1997), U. Malzer, U. Harland, H. Sattler (1999), and D. Hans et al. (1998) during the initial exploration of this issue. Additionally, the visualization of marginal osteophytes of varying sizes serves as a hallmark feature of osteoarthritis.

There is a scarcity of literature on the echography of both extra- and intra-articular structures in systemic lupus erythematosus, systemic scleroderma, psoriatic arthropathy, and reactive arthritis. Unfortunately, no studies examining articular changes at the level of medium and small joints of the extremities in these diseases have been found in the available literature.

The diagnostic potential of arthrosonography in gouty arthritis at the level of large joints of the extremities was investigated by T.B. Perova et al. (2004). They observed that in addition to inflammatory manifestations such as synovitis, varying degrees of destructive changes were also present in the joints. No dominance of any particular symptom was detected; all signs were visualized with equal frequency. It was noted that the ultrasound picture of gouty arthritis exhibited minor differences depending on the type of affected joint. For example, in the hip joints, predominant destruction of the articular surfaces manifested as flattening of the femoral head with irregular contours, whereas in the knee joints, nonspecific inflammatory manifestations like synovitis were more prevalent.

No publications addressing the echographic diagnosis of gouty arthritis in its early stages were found. Furthermore, researchers have not addressed issues concerning damage to small joints, the specificity of ultrasound symptoms, the accuracy of ultrasound in this type of pathology, or the potential for differential diagnosis with osteoarthritis and other arthropathies.

Purpose and objectives of the study

The objective of this study is to discern ultrasound indicators of alterations in articular cartilage and underlying bone tissue among patients afflicted with arthropathy. This

investigation aims to consider factors such as the duration of the condition, the level of activity of the pathological process, and its clinical stage.

Research objectives:

The aim of this study is to identify typical echographic osteochondral manifestations associated with various types of arthritis (rheumatoid, reactive, gouty), osteoarthritis, and articular syndromes in systemic lupus erythematosus, systemic scleroderma, and psoriatic arthropathy during the early stages of the pathological process. Furthermore, the study seeks to determine the frequency of occurrence of these manifestations.

2. Materials and Methods

In accordance with the stated goals and objectives, a total of 540 patients presenting with articular syndrome were examined, receiving treatment in the rheumatology and therapeutic departments of a multidisciplinary hospital between 2010 and 2022. Among these patients, 222 were male (42.0%) and 318 were female (58.0%). The age range spanned from 15 to 78 years, with an average age of 45.1±23.5 years, indicating a predominance of the working-age population. The duration of the disease varied from three days to four years, with an average duration of 1.2±0.85 years.

The study encompassed patients with articular syndrome stemming from various types of arthropathy, including rheumatoid arthritis (n=163), reactive arthritis (n=114), osteoarthritis (n=65), systemic scleroderma (n=50), systemic lupus erythematosus (n=33), psoriatic arthropathy (n=47), and gouty arthritis (n=30). Patients were included provided they did not exhibit pronounced multiorgan manifestations of pathology, severe concurrent diseases, or exacerbations of concurrent diseases that could influence the clinical manifestations of the articular syndrome.

Ultrasound examinations were conducted utilizing ultrasound machines equipped with linear sensors ranging from 5.0 to 7.5 MHz and 5–13 MHz for longitudinal and transverse polyaxial scanning, as well as linear sensors at 8–13 MHz and 7–15 MHz on the Ju-22 device.

The joint examination was conducted without prior patient preparation. Upon obtaining images of intra- and extra-articular tissues, a comprehensive analysis of their shape, contours, and structure was performed, with particular attention paid to echogenicity, homogeneity of elements, and the presence of pathological formations. Quantitative measurements of intra-articular elements were conducted, including the width of the joint space in static and dynamic positions, thickness of hyaline cartilage, and dimensions of existing marginal growths and free pathological fragments within the joint cavity. Ultrasound examinations of medium and small joints were performed for all patients upon admission to hospital treatment and repeated after one month of hospitalization. Repeat examinations were prescribed to clarify the progression of structural changes in patients who had undergone previous hospital treatments and had prior assessments from radiological specialists, as well as to evaluate the efficacy of pathogenetic therapy. Statistical analysis of the data was conducted using the Statistica 5.0 program. The relative frequency of detecting pathological changes was calculated, along with a 95% confidence interval, considering the number of observations. Average values were presented as $M \pm \sigma$, where M represents the arithmetic mean value of the variable, and σ represents the standard deviation.

3. Results and Discussion

Cartilage plate change syndrome

Changes in the cartilaginous plate of the joint were detected in 715 cases (75.5%). Absence of pathology in the hyaline cartilage was observed in 234 studies, including patients with acute ReA (n=71), early stages of gout (n=9), and in individuals with a short disease duration in SLE, SSc, PsA (n=19, 16, 68 respectively), as well as in young OA patients with a disease duration of no more than 2 years (n=50). In these cases, the contours, dimensions, and structure of the cartilage corresponded to normal values and characteristics.

The frequency of detecting pathological changes in cartilage tissue, as per ultrasound data, varied depending on the underlying condition, as outlined in Table 1.

Isolated changes in one joint were identified in 210 echographs, while polyarthropathy was observed in 503 cases. Overall, pathology of cartilaginous structures was detected in 986 joints, with the most common sites being a combined lesion of the intercarpal, carpometacarpal (12.5%), II–V metacarpophalangeal joints of the hand (11.6%), and interphalangeal connections of the hand and I, II, IV toes (4.3%). Symmetrical articular involvement was characteristic of RA, ReA, SSD, OA, PsA, while asymmetric involvement was observed in SLE and PdA (58.5% and 16.9%, respectively).

Table 1. presents the frequency of changes in the cartilage plate categorized by nosology and joint type.

Affected joints	Nosology/number of ultrasounds that revealed changes in joints in %						
	RA	SLE	SSD	ReA	PsA	OA	PdA
Ankle	12.1	0.7	0.12	3.4	0.4	2.5	0.3
Radiocarpal	10.5	0.9	-	0.5	-	1.6	-
Metacarpophalangeal	1.3	0.6	-	0.3	-	0.4	-
Metatarsophalangeal	0.7	-	-	0.2	0.4	0.3	0.5
Interphalangeal brushes	14.5	0.6	1.3	-	-	2.5	-
Interphalangeal feet	4.1	-	0.2	1.1	0.3	3.2	1.5
Total:	43.3	3.5	1.52	5.5	1.1	10.5	2.0

The echographic depiction of pathology included alterations in the thickness of the cartilaginous plate, its echogenicity, structure, contours, and the presence or absence of additional formations in the area of hyaline tissue.

Among the primary metric abnormalities in the thickness of cartilage in its non-mineralized part, thinning was notable in 86.3% of cases. This thinning manifested as diffuse (uniform or uneven, frequently observed on the lateral aspect of the joint) or localized thinning. The former was commonly observed in patients with SSc, RA, ReA, PdA, and OA with a disease duration exceeding two years. On the other hand, localized thinning of the cartilaginous plate was characteristic of SLE and PsA in marginal regions, and for OA along

the axis of maximum load. On average, the thinning of hyaline tissue across all joints amounted to 0.6±0.32 mm. No correlation was observed between the degree of thinning of the articular cartilage and the specific nosological forms of pathology (r=+0.003). The areas most affected by thinning are outlined in Table 2.

Table 2. Presents the predominant localization and parameters of thinning of the cartilaginous plate.

Localization of thinning of articular cartilage	Thickness of the cartilage plate in mm
Scaphoid	0.8±0.22
Lunate	0.75±0.45
Talus	0.4±0.4
level of the distal epiphysis of the radius	0.7±0.18
heads of middle phalanges of fingers II–IV	0.29±0.12
heads of the middle phalanges of the II–IV toes	0.32±0.5

Thickening of the cartilaginous plate was identified in 0.8% of cases. This thickening was observed either uniformly throughout the entire cartilage or in a single (often central) area, with an average thickness of 0.7 ± 0.18 mm. This phenomenon was noted in cases of OA at stage 0, as well as in SLE. This condition may be attributed to collagen fragmentation and the saturation of its surface with synovial fluid, resulting in the "swelling" of the cartilage matrix and an increase in its volume. No change in the thickness of the cartilaginous component was observed in 13.9% of patients, most of whom presented with initial disease manifestations or had a short duration of the pathological process (up to six months).

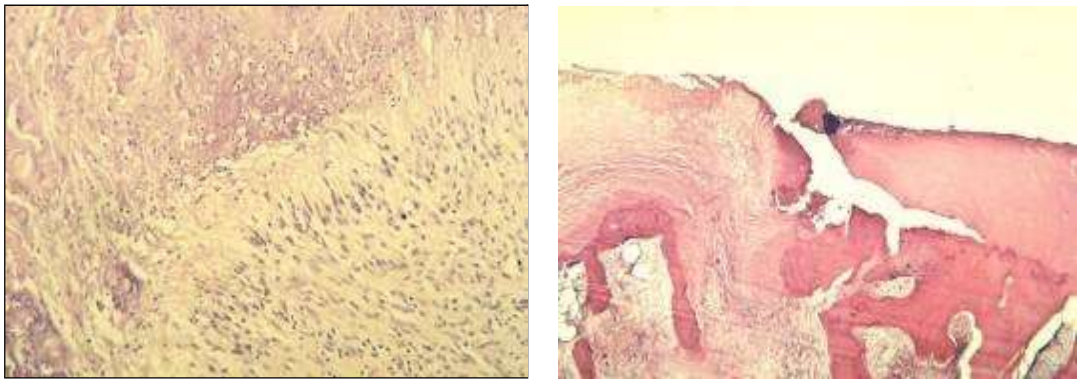

Figure 1. Histological preparations of hyaline cartilage taken at the level of the metacarpophalangeal joint of the second finger of the right hand revealed the following:

a) Fragmentation of collagen fibers, characterized by their splitting, accompanied by initial signs of destruction.
b) Destruction of collagen fibers, saturation of hyaline cartilage with transudate, replacement of hyaline tissue with fibrous tissue, and indications of restructuring of cancellous bone.

The echogenicity of cartilage exhibited impairment in the direction of its increase across all nosologies without exception (observed in 75.5% of cases). During echography, it

displayed low or medium echo density, along with a granular structure. An unchanged ultrasound picture of the hyaline plate was observed in 24.8% of cases.

The absence of an increase in the echogenicity of cartilage tissue was typical for patients with RA exhibiting minimal disease activity and a disease duration of no more than 1 year, as well as for those with SLE, SSc, and PsA with a disease duration of 1,5–2 years.

Evaluation of the contours of the articular cartilage revealed changes in both its external and internal borders. The outer section (cartilage - synovial fluid) exhibited either smooth (230 studies) or uneven contours (480 cases). The latter were differentiated as a result of degenerative or erosive defects of cartilage tissue in 470 observations. Blurriness was attributed to the total or subtotal development of pannus in some patients, presenting on echography as an avascular formation with reduced echogenicity, adjacent to the articular capsule on one side and the cartilaginous plate on the other. This condition in CDK was accompanied by moderate vascularization in areas of chondrosynovial contacts.

The internal contour of the cartilage was predominantly clear and even (96.6% of cases), although in 3.4% of patients, there was a violation of the differentiation of the contact point between the non-mineralized part of hyaline tissue and the calcified cartilage-subchondral bone complex. This sign was visualized in RA (from complete resorption of cartilage) and OA of stage III.

The external contour of the cartilaginous plate exhibited some variations depending on the nosology. In RA, SLE, and PsA, areas of softening in the cartilage tissue led to corroded scalloped contours, manifesting as crater-like areas with torn edges. Cartilaginous erosions appeared approximately 0.7±0.3 years from the onset of RA and PsA, and 1.1±0.9 years in SLE.

In OA, defects in the triangular-shaped plate resulted in uneven contours, extending to the mineralized part of the cartilage and the underlying bone tissue. Disruption of the cartilage structure was indicated by the appearance of an additional interface between media in its non-mineralized part, loss of homogeneity of outer layers, and the appearance of hyperechoic linear inclusions parallel to the articular surface in some cases.

In PdA, vertically oriented hyperechoic inclusions resembling a "picket fence" were visualized in the projection of the cartilage in 2.7% of studies.

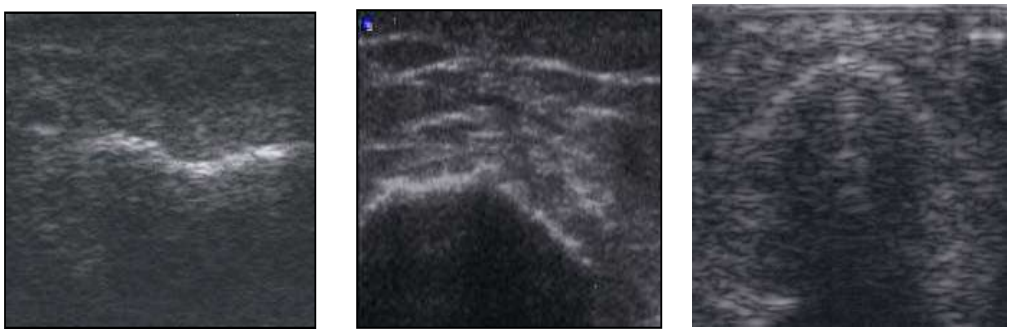

Figure 2. a) The ultrasound image of the external contour of the hyaline plate during transverse scanning of the third metatarsophalangeal joint displays scalloped contours of the articular cartilage due to erosions in RA during the acute phase of the process. b) The image reveals a large erosion of cartilage, indicated by an arrow, which extends to the subchondral layer. c) A histological specimen of hyaline cartilage in RA displays foci of fibrinoid necrosis of collagen surrounded by palisade-located histiocytes. d) The presence of a hyperechoic zone at the base of the erosion is indicated by red arrows. e) Triangular-shaped defects of the cartilage plate in OA are highlighted by curly arrows. f) A pathological additional interface between the media of hyaline cartilage in the initial manifestations of OA is circled in an oval.

Bone change syndrome

All clearly visualized bone changes can be categorized into two primary types: sclerosis of the subchondral layer of bone and marginal bone growths. Direct changes in the bone structure of the epiphyses, as detected by other radiological methods, were not reliably identified and therefore were not considered in this study.

The symptom of sclerosis of the subchondral layer of bone was observed in 94 ultrasound scans (9.9%) among patients with RA (n=50), OA (n=22), SLE (n=4), SSc (n=7), and ReA in individuals older than 52 years (n=14). The affected joints included the ankle (11.5%), metatarsophalangeal joints (12.3%), bones of the distal row of the wrist (6.4%), such as the trapezoid (2.9%), capitate (2.5%), and right hamate (1.6%), as well as interphalangeal joints of the arms and legs (2.2%). Echographically, this symptom presented as either local (15.2%) or diffuse (30.0%) thickening of the calcified cartilage-subchondral bone complex. In 23.5% of cases, it was accompanied by diffuse small-focal fragmentation, while in 6.3% of cases, it involved the formation of crater-like defects filled with hyperechoic coarse fibrous substrate showing signs of vascularization, with the most severe manifestations observed in the areas of chondrosynovial contacts and entheses.

Single erosions of the subchondral layer, ranging from 1.5 to 3.0 mm in diameter, were found in seven patients with RA. These erosions exhibited a clearly visible rim of sclerosis with an average thickness of 0.6±0.15 mm, bordering the entire area of the defect. On average, the thickness of the underlying hyperechoic subchondral layer measured 1.5±0.3 mm.

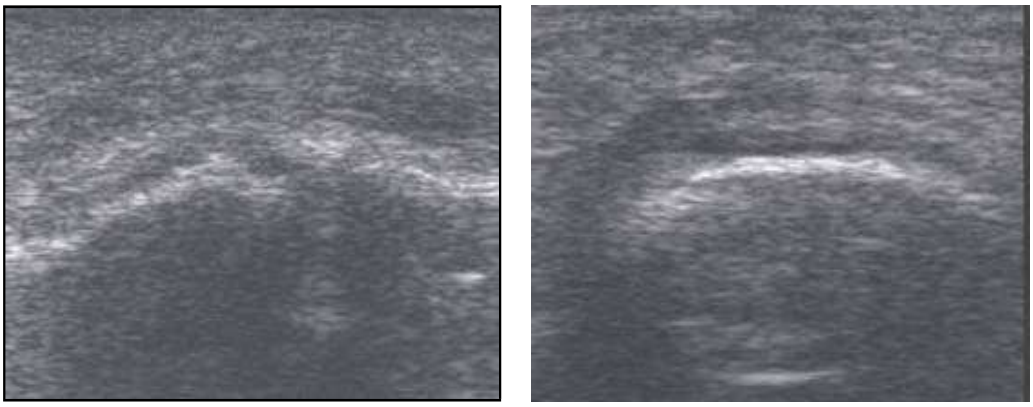

Figure 3. Echograms of the base of the proximal phalanx of the second finger of the hand during transverse scanning: a) The image displays erosion of the subchondral layer with a rim of sclerosis along the periphery of the defect in RA, as indicated by a curly a

Proliferative changes along the periphery of the articular cartilage were characterized by the formation of chondroid regenerates (chondrophytes), followed by the resumption of perichondral ossification and the development of osteophytes. These alterations were detected in 49 cases (5.2%) among patients with OA, ReA, RA, PdA in individuals over 51 years old due to secondary OA, and PsA with a disease duration exceeding 3 years. However, no additional bone structures were identified in SLE cases.

The localization of marginal hyperechoic growths varied depending on the anatomical characteristics of the joint structure: in the middle diarthroses of the hand and foot, they were situated along the outer edge of the articulating surfaces (such as the anterior-outer edge of the epiphysis of the tibia, radius, and lateral surface of the talus), while in the finger joints, they were found along the lateral and dorsal surfaces of the phalanges.

Disruption of the configuration of the articular surface of pathologically altered joints was observed in 8.6% of studies, while it remained unchanged in 12.5%. Osteophytes

exhibited a range of sizes from 1.3 to 6.0 mm, with an average size of 3.2±0.4 mm. They varied in shape, including spinous (13.5%) and mushroom-shaped (7.7%). The number of marginal bone growths was either single (17.3%) or multiple (3.9%). Osteophytes showed different degrees of mineralization, appearing as hyperechoic formations that either did not exhibit an acoustic shadow (in the initial stage of calcification) or produced an acoustic shadow during echography.

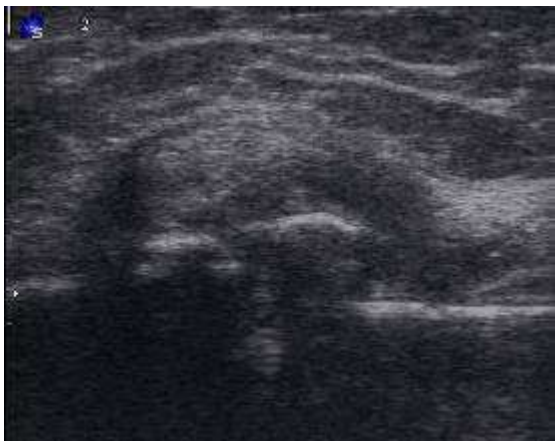

Figure 4. The ultrasound image depicts numerous marginal bone growths observed during longitudinal scanning of the first metatarsophalangeal joint.

Additionally, **Table 3. outlines the diagnostic precision of echographic syndromes.**

Sonographic syndromes	The information content of ultrasound in identifying syndrome in %, n=940		
	Se	Sp	Ac
Changes in the cartilage plate	72.0	82.5	77.6
Change in bone tissue	96.6	84.8	90.4

4. Conclusion

At the initial stages of rheumatoid arthritis, SLE, psoriatic arthropathy, and severe reactive arthritis, damage to the hyaline tissue is observed. As the diseases progress, erosions tend to spread both in terms of area and depth of the cartilaginous plate, particularly evident in rheumatoid arthritis. In psoriatic arthropathy, elements of tissue degeneration appear alongside destruction. Systemic lupus erythematosus and systemic scleroderma exhibit minimal changes in ultrasound manifestations over time. Gouty arthritis at its initial stage typically shows no disruption in the structure of the cartilaginous plate. In osteoarthritis, there's a continual increase in degenerative processes within the hyaline tissue. Osteochondral tissue damage is observed in arthropathy cases in 90.9% of instances. Overall, the sensitivity of ultrasound diagnostics was 84.2%, specificity was 83.5%, and accuracy was 83.5%. Detection of cartilage erosion can occur within approximately 2.9 months from the onset of destructive arthritis, while degenerative changes and microcrystalline inclusions within cartilage tissue can be identified after around 6.5 months.

In summary, the ultrasound examination of various arthropathies reveals distinct patterns of hyaline tissue damage and associated changes. Rheumatoid arthritis, SLE, psoriatic arthropathy, and severe reactive arthritis typically exhibit initial destruction of the hyaline tissue, with tendencies for erosions to spread in rheumatoid arthritis and

degenerative changes in psoriatic arthropathy. Conversely, systemic lupus erythematosus and systemic scleroderma show minimal changes over time. Gouty arthritis often lacks disruptions in the cartilaginous plate initially, while osteoarthritis is characterized by ongoing degenerative processes. Overall, ultrasound diagnosis demonstrates high sensitivity and specificity, allowing for the detection of cartilage erosion and degenerative changes within a few months from the onset of destructive arthritis..

REFERENCES

[1.] Algorithms in Radiation Diagnostics and Programs for Radiation and Complex Treatment of Patients. Moscow, 2001, pp. 76-77.

[2.] M. V. Babaev and G. P. Volkov, "Comparative Assessment of Radiographic and Ultrasound Diagnostics of Degenerative Lesions of the Knee Joint," in Collection of Scientific Works of the III Russian Scientific Forum "Radiation Diagnostics and Radiation Therapy in the Clinic of the 21st Century. Radiology 2002". Moscow, 2002, pp. 17-18.

[3.] A. V. Bryukhanov, V. V. Fedorov, and D. F. Mikhalkov, "Magnetic Resonance Imaging in the Diagnosis of Osteoarthritis of Large Joints," Siberian Medical Journal, vol. 13, no. 1-2, pp. 28-30, 1998.

[4.] E. M. Ermak and A. Yu. Kinzersky, "Diagnosis of the Early Stages of Destruction of Articular Cartilage and a Number of Prearthrosis Factors," Ultrasound and Functional Diagnostics, no. 2, pp. 297-298, 2002.

[5.] N. K. Erov and S. N. Mairansaeva, "Issues in the Diagnosis of Mono- and Oligoarthritis of Various Etiologies," Issues of Rheumatism, no. 1, pp. 41-44, 2002.

[6.] A. A. Godzenko, "Undifferentiated Forms of Spondyloarthritis: Problems of Diagnosis and Classification," Rheumatology, vol. 8, no. 2, pp. 3-11, 2006.

[7.] N. G. Goncharov, "Social and Hygienic Aspects of Disability, Clinical and Functional Features, Medical and Social Examination and Rehabilitation for Diseases of the Musculoskeletal System," Ph.D. dissertation, Center for Research Institute for Examination of Working Capacity and Labor Organization of Disabled People, Moscow, 2001.

[8.] O. N. Ivanova, Yu. A. Sobolev, E. A. Pyadova et al., "Comparative Analysis of Arthrosonographic and Radiological Changes in Joints in Rheumatic Diseases," Scientific and Practical Rheumatology, no. 4, p. 11, 2004.

[9.] D. E. Karateev, E. N. Aleksandrova, N. V. Demidova et al., "Anticitrullinated Antibodies and Magnetic Resonance Imaging Data of Hand Joints in Patients with Early Arthritis," Therapeutic Archive, vol. 80, no. 10, pp. 72-77, 2008.

[10.] D. E. Karateev and E. L. Luchikhina, "Early Diagnosis of Rheumatoid Arthritis: Problems and Solutions," Russian Medical News, no. 4, pp. 24-27, 2007.

[11.] Z. S. Khudayberdiyevich et al., "Possibilities and Prospects of Ultrasound Diagnostics in Rheumatology," Central Asian Journal of Medical and Natural Science, vol. 3, no. 5, pp. 570-582, 2022.

[12.] E. S. Mach, O. V. Pushkova, "Ultrasound Characteristics of Knee Arthritis in Rheumatic Diseases," Visualization in the Clinic, no. 19, pp. 18-22, 2001.

[13.] E. S. Mach, O. V. Pushkova, and M. V. Severinova, "Joint Damage due to Gout (According to Arthrosonography)," in Collection of Materials of the IV Congress of the Russian Association of Ultrasound Diagnostics in Medicine. Moscow, 2003, p. 275.

[14.] E. L. Nasonov, "Introduction of High Medical Technologies in Rheumatology: Problems and Solutions," Scientific and Practical Rheumatology, no. 2, pp. 4-5, 2008.

[15.] T. B. Perova, V. D. Zavadovskaya, and L. S. Ekimova, "Sonographic Signs of Rheumatoid Lesions of the Knee Joints," in Collection of Materials from the Nevsky Radiological Forum "From the Future to the Present". Saint Petersburg, 2003, pp. 104-105.

[16.] T. B. Perova, V. D. Zavadovskaya, N. L. Klimentenko et al., "Ultrasound Examination of Joints in Psoriatic Arthritis," in Collection of Materials of the IV Congress of the Russian Association of Ultrasound Diagnostics in Medicine. Moscow, 2003, p. 278.

[17.] M. S. Rusakova, N. N. Gritsman, A. I. Speransky, and S. M. Mirzoeva, "Data from an Immunomorphological Study of Articular Cartilage in Rheumatoid Arthritis," Collection of Scientific Papers: "Modern Problems of Pathogenesis and Therapy of Rheumatic Diseases." Riga, 1985, no. 15, pp. 62-65.
[18.] V. D. Zavadovskaya, T. B. Perova, and A. V. Khodashinskaya et al., "The Role of Ultrasound in Assessing the Activity of Rheumatoid Arthritis," Visualization in the Clinic, no. 17, pp. 33-36, 2000.
[19.] V. D. Zavadovskaya, T. B. Perova, V. Yu. Usov et al., "Ultrasound Diagnostics of the Activity of Rheumatoid Arthritis of the Knee Joints," in Abstracts of Reports of the VIII All-Russian Congress of Radiologists and Radiologists..