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*High resolution ultrasonography for imaging
metacarpophalangeal joints*

Ultrasonography as an effective diagnostic method is widely used for imaging soft tissues. Initially, the ultrasound diagnostic procedures of the motor system were not appreciated. The first studies describing the application of this method in the knee joint examinations were published in the 70's (4,5). Since the 80's, when the equipment was improved and resolution abilities increased, USG could be used for imaging smaller joints, such as the hand joints. Thanks to new US heads providing better resolution of images, smaller and smaller structures may be visualized.

The purpose of the study was to examine the possibilities of high resolution US to visualize and diagnose the changes within the fissures of hand metacarpophalangeal joints. The specific aim was to assess the dimensions of metacarpophalangeal joints in healthy people and selected diseases.

MATERIAL AND METHOD

The study involved 44 individuals subjected to ultrasound examinations of the hands in the 1st Department of Medical Radiology, Medical University of Lublin between June and October 2002. The group included 35 healthy right-handed persons (22 women and 13 men), aged 21–53 (average – 33), 7 right-handed patients with rheumatoid arthritis (RA) (5 women and 2 men), aged 41–73 (average – 54) and 2 right-handed men treated for acromegaly, aged 43 and 58.

The Logic 500 ultrasonograph (GE) was used. The images of metacarpophalangeal joints of both hands in the dorsal transverse and longitudinal projections were performed using the broad-band linear head with the frequency of 8.5–11 MHz according to the earlier accepted standards (2,4,6). The patients were examined in the sitting position with the hand in pronation placed on the basis. The examination consisted of two stages. In the first stage, after the initial evaluation of the surface structures of both hands, the metacarpophalangeal joints were examined in the longitudinal projection. On imaging the second to fifth fingers, the patients had a cloth roll, 3.5cm in diameter, squeezed in their hand. The examination of the first finger was performed in flexion and adduction without the roll. The hand was placed at the level of the head of the metacarpal bones and moved along the extensor tendon. Having optimally visualized the head of metacarpals and the basis of the proximal phalanx, the joint fissure was measured.

The second stage involved the measurement of the metacarpophalangeal joints in the transverse projection. The hand was placed on the flat surface with the metacarpophalangeal joints – from the first to the fifth one - in the zero position (the first metacarpal bone and the basic phalanx formed the straight line).

Due to the thin layer of soft parts various anatomical structures were difficult to distinguish. To improve their imaging the distancing attachment in the form of gel dressing ("Aqua-gel") was used. The typical USG gel was placed under and on the attachment.

RESULTS

Each patient was subjected to 10 measurements in the longitudinal projection and another 10 in the transverse projection. Totally, the analysis included 880 measurements of the metacarpophalangeal joints. The results were presented using the metacarpophalangeal joints of the 1st and 3rd fingers. The analysis consisted of 2 stages. The first stage dealt with the comparison of sex-dependent variables in healthy persons (Fig.1a, b). In the transverse projection, the average dimension of metacarpophalangeal joints of the first finger was $13.21\text{mm} \pm 0.63$ in men and $12.09\text{mm} \pm 0.97$ in women and of the third finger- $12.1\text{mm} \pm 0.45$ and $10.91\text{mm} \pm 1.09$, respectively. In the longitudinal projection, the differences were insignificant. The above results are presented in Table 1.

Table 1. Dimension of the metacarpophalangeal joints of healthy men and women in US examination

Metacarpophalangeal joint		Dimension (mm)		
		men	woman	mean
Finger I	transverse projection	13.21 ± 0.63	12.09 ± 0.97	12.52 ± 0.97
	longitudinal projection	1.42 ± 0.25	1.26 ± 0.21	1.26 ± 0.24
Finger III	transverse projection	12.1 ± 0.45	10.91 ± 1.09	11.35 ± 1.28
	longitudinal projection	1.28 ± 0.14	1.15 ± 0.17	1.15 ± 0.17

In the second stage the results in healthy and ill individuals were compared. In patients with rheumatoid arthritis – RA (Fig.2a,b) compared to healthy persons significant differences were observed in the longitudinal projection: the average value for the first finger in healthy individuals was $1.26\text{mm} \pm 0.24$, in RA patients – $0.5\text{mm} \pm 0.42$; for the third finger – $1.15\text{mm} \pm 0.17$ and $0.43\text{mm} \pm 0.31$, respectively. In the transverse projection, the differences were statistically insignificant (the average value for the first finger – $12.52\text{mm} \pm 0.97$ in healthy persons and $13.05\text{mm} \pm 0.41$ in RA patients; for the third finger – 11.35 ± 1.28 and $12.28\text{mm} \pm 0.78$, respectively). The differences between healthy and acromegaly patients (Fig.3a,b) were observed in both projections. In the longitudinal projection, the average value of the first finger in acromegaly patients was $1.75\text{mm} \pm 0.07$, in the transverse projection – $17.0\text{mm} \pm 0.85$ compared to $12.52\text{mm} \pm 0.97$ in healthy individuals. The average value for the third finger in acromegaly patients was $1.65\text{mm} \pm 0.35$ in the longitudinal projection and $13.9\text{mm} \pm 0.28$ in the transverse projection compared to $11.35\text{mm} \pm 1.28$ in healthy individuals. The above data are listed in Table 2.

The morphological changes within the metacarpophalangeal joints in RA patients – exudates, reduced thickness of the articular capsule, bone deformities are worth noting.



a)



b)

Fig. 1. US examination of metacarpophalangeal finger joint in the healthy patient; a) transverse projection view, b) longitudinal projection view



a)



b)

Fig.2. US examination of metacarpophalangeal finger joint in the patient with rheumatoid arthritis; a) transverse projection view, b) longitudinal projection view

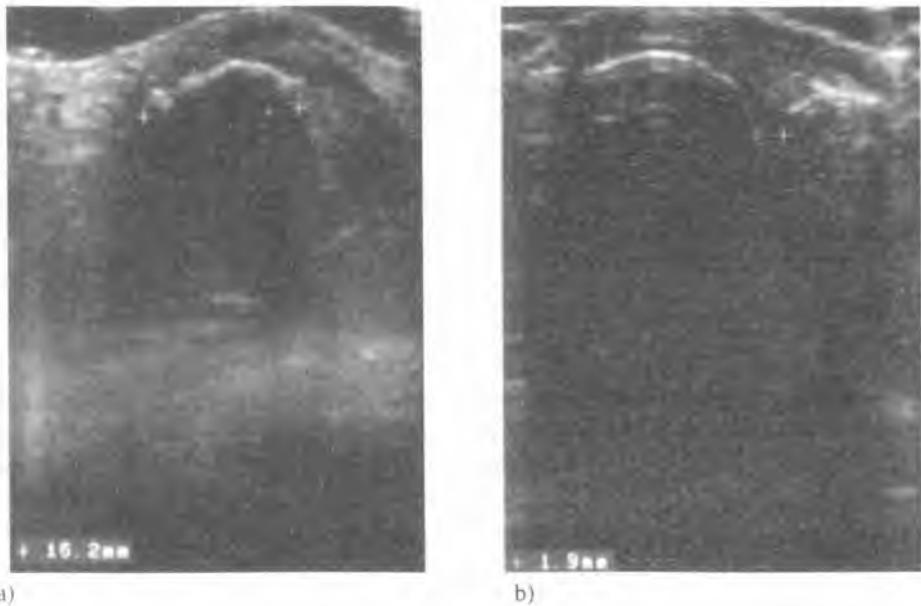


Fig.3. US examination of metacarpophalangeal finger joint in the patient with acromegaly; a) transverse projection view, b) longitudinal projection view

Table 2. Comparison of the US results of the metacarpophalangeal joints dimensions of healthy people, patients with RA and acromegaly

Metacarpophalangeal joint		Dimension (mm)		
		healthy	RA	acromegaly
Finger I	transverse projection	12.52 ± 0.97	13.05 ± 1.40	17.0 ± 0.85
	longitudinal projection	1.26 ± 0.24	0.5 ± 0.42	1.75 ± 0.07
Finger III	transverse projection	11.35 ± 1.28	12.28 ± 0.78	13.9 ± 0.28
	longitudinal projection	1.15 ± 0.17	0.43 ± 0.31	1.65 ± 0.35

DISCUSSION

The examinations conducted by the authors measuring the sizes of joint structures within fine hand joints showed the differences between men and women, which seem to result from their different constitution. The changes in the sizes of fissures and transverse sections of the metacarpophalangeal joints appear to be more relevant in RA and acromegaly patients compared to healthy individuals.

The imaging technique used in the study visualizes precisely the anatomical structures and morphological changes in degenerative diseases. The changes observed in soft tissues are similar to those described in literature (3,7). Our attention was particularly attracted to the changes in the fissure width and joint contour sizes. The measurement of these parameters may be a useful additional tool in the diagnosis of morphological changes in fine hand joints in

degenerative diseases. The characteristic, shortened to the non-measurable values, longitudinal dimension of the joint fissure in RA may help to determine the degree of degeneration. This method is not routinely used to visualize the joint changes in acromegaly although its typical symptoms seem to be widened fissures and transverse sections of fine hand joints (1). Weidekamm et al. reported high effectiveness of US methods in imaging the morphological changes in inflammatory diseases of the hand joint structures, stressing additional diagnostic possibilities connected with the use of Color-Doppler option (8). The diagnostic value of joint US results from its competitiveness with modern tomography methods – CT and MRI. Its advantages include lack of exposure to ionizing radiation, availability and relatively low costs.

CONCLUSION

High resolution US is a valuable method of imaging the anatomical structures of metacarpophalangeal joints, which may be used to evaluate morphological changes and to estimate the degree of joint destruction in some diseases.

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SUMMARY

The purpose of the study was to examine the possibilities of high resolution US to visualize and diagnose the changes within the fissures of hand metacarpophalangeal joints and to assess the dimensions of metacarpophalangeal joints in healthy people and selected diseases. The study involved 44 individuals subjected to ultrasound examinations of the hands. The group included 35 healthy right-handed persons (22 women and 13 men), aged 21–53 (average – 33), 7 right-handed patients with rheumatoid arthritis (RA) (5 women and 2 men), aged 41–73 (average – 54) and 2 right-handed men treated for acromegaly, aged 43 and 58. The Logic 500 ultrasonograph (GE) was used. The images of metacarpophalangeal joints of both hands in the dorsal transverse and longitudinal projections were performed using the broad-band linear head with the frequency of 8.5–11 MHz. The analysis included 880 measurements of the metacarpophalangeal joints. The

results were presented using the metacarpophalangeal joints of the 1st and 3rd fingers. The results in men and women, healthy and ill individuals were compared. In the authors' opinion high resolution US is a valuable method of imaging the anatomical structures of metacarpophalangeal joints, which may be used to evaluate morphological changes and to estimate the degree of joint destruction in some diseases.

Wykorzystywanie ultrasonografii wysokiej rozdzielczości w obrazowaniu stawów śródrečno-paliczkowych

Celem pracy było zbadanie możliwości wykorzystania ultrasonografii wysokiej częstotliwości do obrazowania i diagnostyki zmian w obrębie szczelin stawów śródrečno-paliczkowych dłoni z oceną ich wymiarów u osób zdrowych i w wybranych jednostkach chorobowych. Badana grupa obejmowała 44 osoby, u których wykonano badanie ultrasonograficzne dłoni. Wykonano badania w projekcji poprzecznej i podłużnej przy użyciu liniowej sondy szerokopasmowej o częstotliwości 8,5–11 MHz. Materiał obejmował 35 zdrowych, praworęcznych osób (kobiety - 22, mężczyźni - 13) w wieku 21-53 lat (średnia 33), 7 chorych na reumatoidalne zapalenie stawów (kobiety - 5, mężczyźni - 2) w wieku 41-73 lat i dwóch mężczyzn leczonych z powodu akromegalii. Analiza obejmowała 880 pomiarów, a wyniki podano na przykładzie stawów śródrečno-paliczkowych palca I i III. Porównano wyniki pomiarów u kobiet i mężczyzn oraz u osób zdrowych i chorych. Autorzy uważają, że ultrasonografia wysokiej rozdzielczości, jako metoda nieinwazyjna i powszechnie dostępna, może okazać się przydatna do obrazowania zmian morfologicznych w zakresie drobnych stawów dłoni.