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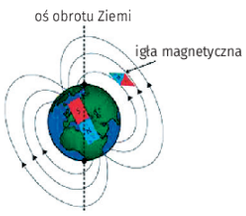

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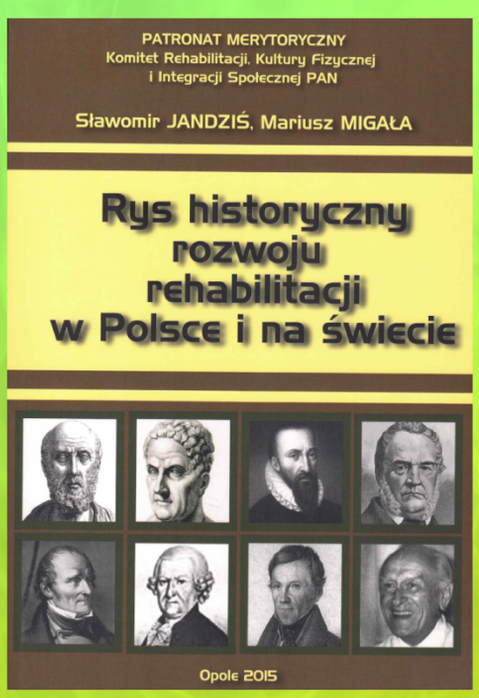

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Ultrasonography in physiotherapy and rehabilitation: A physiotherapist's curriculum introduction

Zastosowanie ultrasonografii w fizjoterapii i rehabilitacji – słowo wstępu do programu nauczania fizjoterapeutów

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Abstract

Ultrasound examination (USG) is becoming more popular among physiotherapists. The term "rehabilitative ultrasound imaging" (RUI) refers to the use of USG in the rehabilitation process. An examination (ultrasound) is used in physiotherapeutic therapy to evaluate the tissue and function of the musculoskeletal system. The real image allows for accurate observation and stimulation of the necessary muscles during kinesiotherapy, while measurements track the treatment's progress. Furthermore, the ultrasound examination aims to assist the physiotherapist in making an early diagnosis of dysfunctional aspects that may necessitate consultation with another specialty, thereby reducing medical errors. Preparing an educational program and conducting training in accordance with established standards and guidelines will allow physiotherapists to be adequately prepared to perform ultrasound examinations and dispel any doubts about a physiotherapist's competence and the possibility of performing ultrasound examinations in a medical setting.

Key words:
ultrasound, rehabilitation, physiotherapy, diagnostics

Streszczenie

Badanie ultrasonograficzne staje się coraz popularniejsze wśród fizjoterapeutów. Opracowany termin Rehabilitative Ultrasound Imaging ma za zadanie jasno określić o przydatności tego badania w procesie rehabilitacyjnym oraz niewkraczaniu w proces diagnostyki lekarskiej i kolidowaniu we współpracy między specjalnościami medycznymi. Zastosowanie badania USG w praktyce fizjoterapeutycznej znajduje miejsce w ocenie tkanki i jej funkcji układu mięśniowo-szkieletowego. Obraz rzeczywisty pozwala na dokładną komunikację i aktywację odpowiednich mięśni podczas kinezyterapii, natomiast wykonywanie pomiarów umożliwia obiektywne monitorowanie postępów leczenia. Dodatkowo, badanie USG ma na celu szybkie rozpoznanie przez fizjoterapeutę cech dysfunkcji, które mogą wymagać konsultacji innej specjalności i uniknąć błędu medycznego. Przygotowanie programu edukacyjnego i prowadzenie szkoleń według opracowanych standardów i wytycznych nada słuszności odpowiedniego przygotowania fizjoterapeutów do wykonywania badania ultrasonograficznego oraz rozwieje wątpliwości o zakresie kompetencji fizjoterapeuty i możliwości wykonywania badania USG w środowisku medycznym.

Słowa kluczowe:
ultrasonografia; rehabilitacja; fizjoterapia; diagnostyka

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Introduction

Ultrasound examination is a common, safe, and cost-effective diagnostic imaging technique [1]. Furthermore, the use of an examination (USG) to evaluate the musculoskeletal system has long been used in orthopedics and rheumatology [2, 3]. Because of the rapid evolution of physiotherapy, a device (USG) is increasingly common in physiotherapy offices [4]. To that end, the term "rehabilitative ultrasound imaging" (RUSI) was adopted and defined at the World Confederation of Physical Therapy (WCPT) International Symposium "Rehabilitative Ultrasound Imaging Symposium" in 2006 in San Antonio, Texas [5]. RUSI is used by physiotherapists and physiotherapist assistants to assess the function and shape of soft tissues during exercise and to monitor physiotherapy procedures in order to improve clinical outcomes [6].

The purpose of this paper was to present previously published information on the technical data of USG devices that allow examination (RUSI), describe muscle assessment and soft tissue morphology methods, and suggest initial program assumptions for future RUSI training of physiotherapists and physiotherapist assistants.

RUSI program framework – initial assumptions

Ultrasonography in physiotherapy and rehabilitation should be aimed at people at the beginning of their specialization and beyond. The field training program (RUSI) will include a theoretical component that will include knowledge of anatomy and pathology, physics, and the legal aspect to present the consequences of error and incorrect diagnosis. The work will address the aspect of correct and complementary interaction with medical imaging diagnostics and radiology as the gold standard of imaging and imaging assessment of the patient as part of the theoretical part (RUSI). The theoretical section will include information on research standardization as well as research methodology.

The practical portion will concentrate on the actual analysis (USG) of selected anatomical areas, their assessment, and the diagnosis of basic pathologies in the osteoarticular system.

Dr. Dominik Sieroń and her team, as well as the National Chamber of Physiotherapy and the Polish Physiotherapy Society, developed the program framework for ultrasound training in physiotherapy and rehabilitation. Dominik Sieroń is a diagnostic imaging and radiology specialist and researcher at the Medical University of Bern. He is the creator of Mobile Ultrasound (MUSG) and (RUFI), as well as the author of a textbook in the field of Diagnostic Imaging in Physiotherapy and Rehabilitation published by the PZWL publishing house and Cambridge Scholars in English.

Technical data of the apparatus enabling the RUFI test

USG cameras deliver Ultra HD or Full HD images with a 64-degree gray scale. A high-frequency linear transducer (10–14–16 MHz) and shallow ultrasonic wave penetration (5–20 cm) are utilized to test musculoskeletal system structures with ultrasound. Due to the principles of physics, the higher the ultrasonic wave frequency, the shallower the penetration but the higher the resolution, hence a linear transducer is best for

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tissue assessment at 6 cm thickness. In well developed muscle tissue or deeply structured structures (e.g. hip joint), the convex transducer is employed to assess structures up to 8-10 cm thick at the expense of resolution [7, 8].

Doppler Power Doppler ultrasounds detect inflammatory changes in the synovial membrane, tendon sheaths, and tendons and identify new blood vessels in tendons due to degeneration [9]. Table 1 lists the fundamental device requirements for (RUSI).

Table 1. Technical data of devices used for the RUSI test [7]

Aparat	Głowica / Head
Full HD 64-degree grayscale Ability to save files of the DICOM type Power Doppler	Linear (4–12MHz) Convex (2–5MHz) Piezoelectric

Muscle assessment and soft tissue morphology

Ultrasound longitudinal and cross-sectional muscle measures directly assess muscle atrophy or hypertrophy [8].

Ultrasonography can accurately evaluate and compare quadriceps femoris atrophy with the opposite lower leg. The ischio-shin muscles, adductors, and adipose tissue in thigh circumference measurements may mask quadriceps femoris muscle atrophy [6].

The intraclass correlation coefficient for thickness measurements of soleus muscle was outstanding (ICC = 0.994 cm 95% CI = 0.988–0.997), multifidus muscle was good (ICC = 0.89cm 95% CI = 0.84-0.99), and trapezius muscle was good (ICC = 0.81mm 95% CI = 0.63-0.92) [11, 12, 13].

Tendon thickness can indicate tendinopathy, which requires physiotherapy. The intraclass correlation coefficient in studies on comparability of results was outstanding for the Achilles tendon (ICC = 0.98; 95% CI = 0.96–0.99), very good for the patellar ligament (ICC = 0.85; 95% CI = 0.67–0.93), good for the extensor carpi tendon, and mediocre for the plantar fascia [14].

When pathology is not obvious in static assessment, real-time ultrasound monitoring provides a major benefit. Dynamic examinations increase the diagnosis of subacromial impingement syndrome, instability of the long head of the biceps arm, snapping hip syndrome, and others [15, 16, 17, 18].

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The patient's education can also include using USG to activate the right muscles and choose the right vocal command [19, 20].

Clinical decisions in the practice of a physiotherapist supported by imaging diagnostics

The form of exercise therapy that will be most effective is supported by the RUSI study's findings on the connection between motor control and function. As a result of being able to provide empirical evidence of the benefits of specific therapeutic procedures, ultrasonic examination also enhances the efficacy of treatment. The (RUSI) research appears to be a useful tool for doing both quantitative and qualitative analyses of structure and function [21].

On the topic of incorporating imaging test results into clinical practice, Little and Lazaro polled British physiotherapists in 2006. Seventy percent of the physiotherapists surveyed said they value the information provided by imaging tests, 83.4% say they use this information in their practice, 77.3% say they have the basic knowledge to interpret imaging results, 84.2% say they support physiotherapeutic diagnostics, 85 percent say they help them better understand their patients' dysfunctions, and 90 percent say it helps them communicate with other specialists. [22].

Exemplifying techniques for visualizing muscles and other soft tissues

Multifidus muscle

By examining a cross-sectional ultrasound (USG) imaging of the multifidus muscle, one can determine the muscle thickness from the dorsal side of the L_4–L_5 or L_5–S_1 intervertebral joint to the upper edge of the multifidus muscle (Figure 1).

Figure 1. Ultrasound image of the multifidus muscle

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Transverse abdominal muscle

The three muscular layers of the abdominal wall can be seen during an ultrasound examination (in the transverse plane) thanks to the presence of hyperechoic lines (white lines) that demarcate the fascial layers (superficial to deep). Figure 2 [23] shows how the skin, subcutaneous tissue, external and internal obliques, transverse abdominis, and abdominal contents are all demarcated by lines.

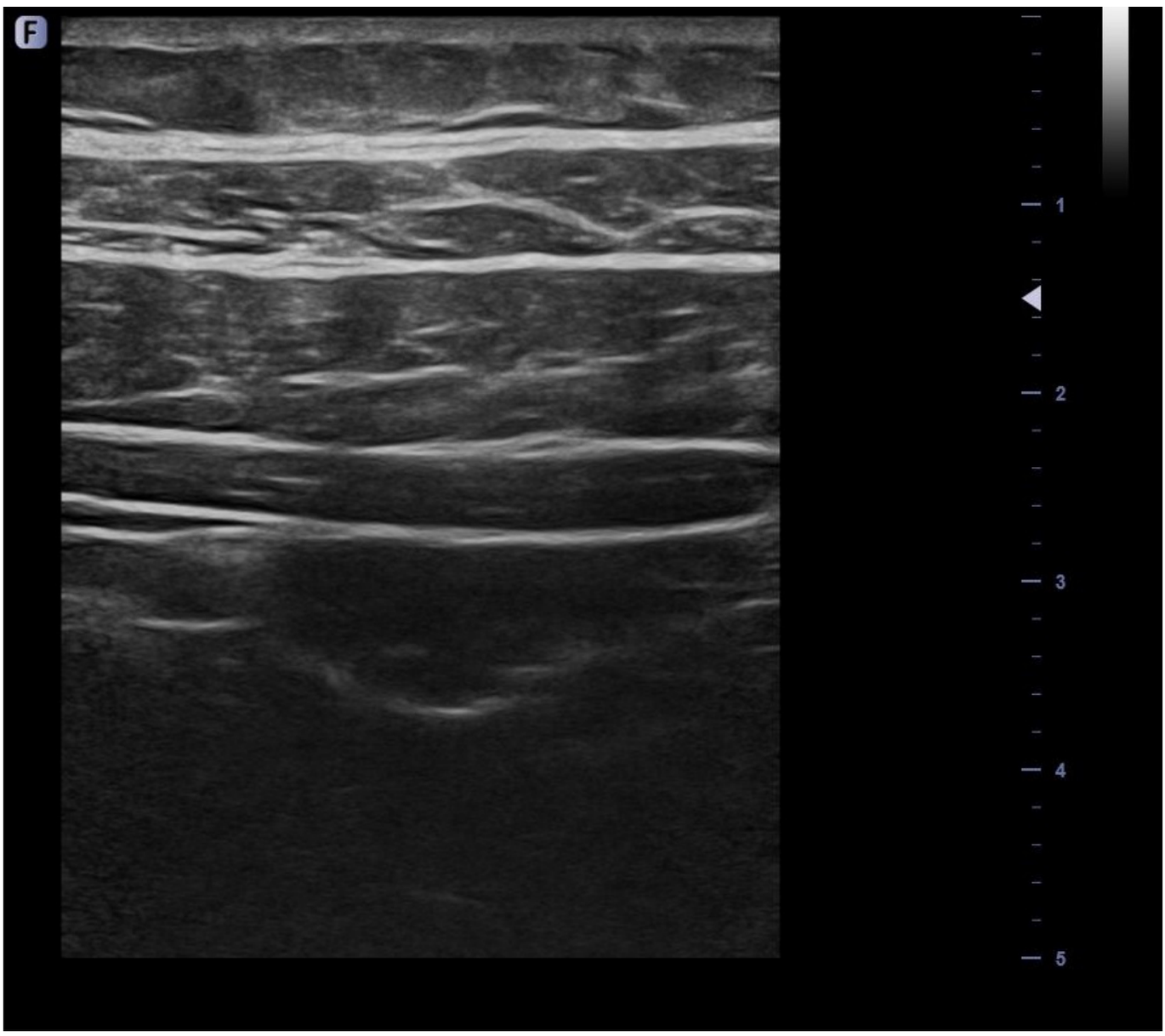

Figure 2. Ultrasound image of the lateral abdominal wall

Achilles tendon

Patients are examined for Achilles tendon problems while lying on their backs with their ankles at rest. Examination (ultrasound) permits determination of Achilles tendon thickness in longitudinal and transverse axes, 3 cm proximally from the tendon attachment to the calcaneus (Figure 3) [14].

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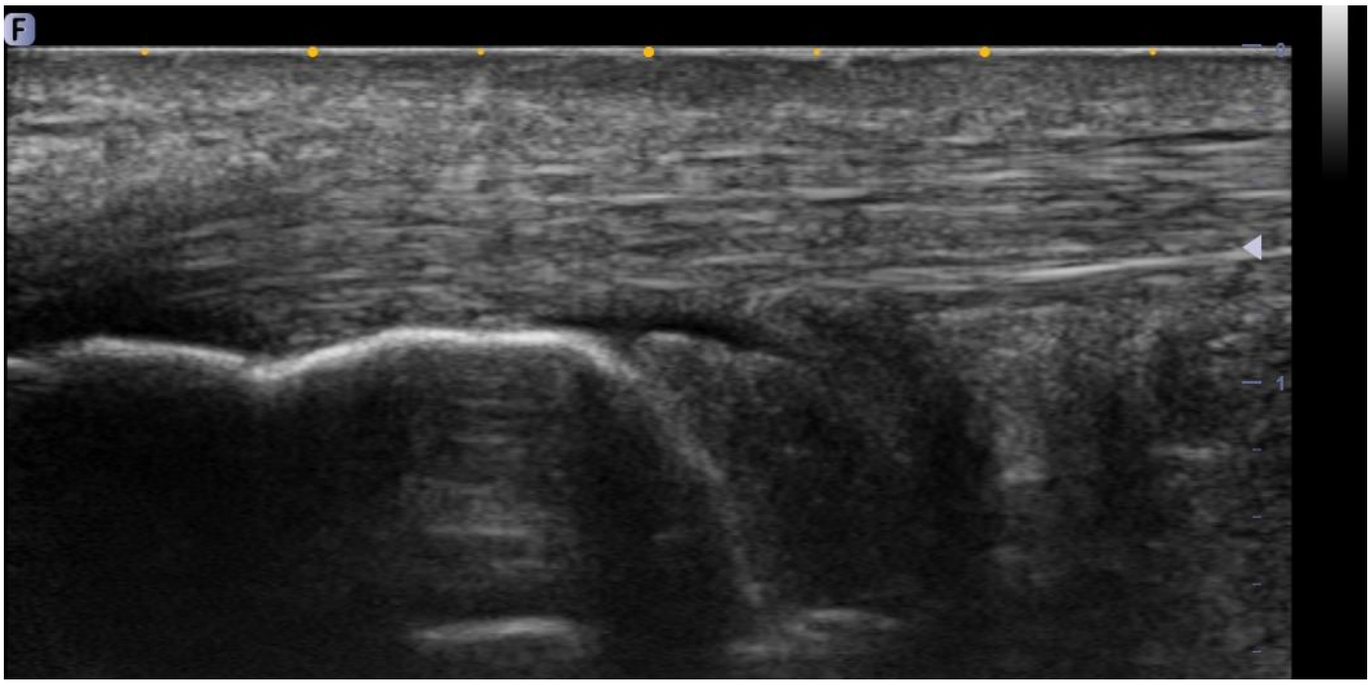

Figure 3. Ultrasound image of the Achilles tendon

Discussion

There is currently no basic education at universities or certified diploma courses in the field of ultrasound diagnostics in Poland or Europe, and there are also no regulated, uniform standards regarding the key criteria for training physiotherapists and physiotherapists in the field of ultrasonography. Training in the field of ultrasonography is now provided by individuals who lack the requisite credentials, and as a result, many unaccredited courses do not adhere to radiological standards. Reasons for this could include the novelty of ultrasonography in physiotherapy and the fact that it is now a relatively inexpensive and widely available instrument. Authors argue that unifying training is essential since it will pave the way for the implementation of well-defined program frameworks (among others, on certified courses).

These days, almost everyone can afford to buy a device like this because of the abundance of both brand-new and refurbished options available.

Sonography is used for imaging diagnostics, however ultrasonography is also commonly used in conjunction with other imaging diagnostics and radiology procedures, such as X-rays, CT scans, and MRIs. Keep in mind that an ultrasound is a very active diagnostic tool. X-ray examination has an advantage over magnetic resonance imaging, but ultrasonography has physical restrictions that prevent it from providing information about bone and other hard tissue outside of the superficial layers. Knowledge of both imaging diagnostics and radiology, which are necessary for doing such an examination, is at a bare minimum. Possessing a foundational understanding of anatomy is essential, as is an understanding of the pathologies involved in imaging diagnoses of the musculoskeletal system. Physiotherapists face both an opportunity and a threat in the form of increased specialization in the field of ultrasound imaging diagnosis. The danger that a physiotherapist or physiotherapist, like a radiologist who specializes in imaging and intervention (e.g., under ultrasound control), may neglect

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other areas of their education and training. Therefore, standardization (RUSI) is absolute to ensure both fundamental and expanded knowledge that would permit assessment of the osteoarticular system to the level necessary for the physiotherapist and physiotherapist. Participants in training and courses should have a strong foundation in algorithmic thinking and an emphasis on knowledge of specific topics.

Ultrasonography is used for imaging diagnostics throughout the entire human body, not just the musculoskeletal system. We also need to keep in mind that many surgical operations can be carried out with the aid of ultrasonography guidance. It's important to think about whether physiotherapists may provide these services, and if so, under what circumstances; if not, it's important to understand why that isn't the case, as well as the arguments against it. Work is currently being done to standardize and define guidelines for (RUSI) so that trained people can have complete knowledge of their field, make a preliminary diagnosis, and know how to possibly extend the diagnosis, for example with an examination (MRI, CT, or X-ray), and to which doctor specialist to send the patient. Thus, it is important to develop a curriculum for teaching the basics of ultrasound imaging diagnostics.

Summary

The use of ultrasonic examination in a physiotherapist's practice is supported by research [24, 25, 26, 27, 28, 29]. Because of ultrasonography's rapid growth in the field of physiotherapy, PTs are being pushed to learn more about it and incorporate it into their practice [30, 31]. In addition, it seems prudent to begin preliminary work on regulating physiotherapists' rights to do ultrasound examinations in Poland. Determining the range of usefulness (RUSI) and developing a training program for physiotherapists to use the device are important subjects for future research (USG). Physiotherapists should be encouraged to adopt ultrasound as a diagnostic and monitoring tool due to its potential to enhance patient care and objectively document the efficacy of physiotherapeutic interventions for publication; however, this should be done in accordance with established standards that aim to support the physician rather than undermine him.

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