

fizjoterapia polska



POLISH JOURNAL OF PHYSIOTHERAPY

OFICJALNE PISMO POLSKIEGO TOWARZYSTWA FIZJOTERAPII

THE OFFICIAL JOURNAL OF THE POLISH SOCIETY OF PHYSIOTHERAPY

NR 4/2022 (22) DWUMIESIĘCZNIK ISSN 1642-0136

**Efficacy of ultrasound in diagnosis and treatment of the shoulder –
A systematic review**

**Przydatność ultrasonografii
w fizjoterapii barku – przegląd
literatury**

**Patellar dislocation – conservative or surgical treatment
Zwichnięcie rzepki – leczenie zachowawcze czy operacyjne?**

ZAMÓW PRENUMERATE!

SUBSCRIBE!

www.fizjoterapiapolska.pl

www.djstudio.shop.pl

prenumerata@fizjoterapiapolska.pl



ULTRASONOGRAFIA W FIZJOTERAPII



Autoryzowani dystrybutorzy

Mar-Med

+48 22 853 14 11

info@mar-med.pl

Ado-Med

+48 32 770 68 29

adomed@adomed.pl



MAR-MED

OD 1995 ROKU



ADO-MED®

APARATURA MEDYCZNA



Zawód Fizjoterapeuty dobrze chroniony

Poczuj się bezpiecznie



INTER Fizjoterapeuci

Dedykowany Pakiet Ubezpieczeń

Zaufaj rozwiązaniom sprawdzonym w branży medycznej.

Wykup dedykowany pakiet ubezpieczeń INTER Fizjoterapeuci, który zapewni Ci:

- ochronę finansową na wypadek roszczeń pacjentów
— **NOWE UBEZPIECZENIE OBOWIĄZKOWE OC**
- ubezpieczenie wynajmowanego sprzętu fizjoterapeutycznego
- profesjonalną pomoc radców prawnych i zwrot kosztów obsługi prawnej
- odszkodowanie w przypadku fizycznej agresji pacjenta
- ochronę finansową związaną z naruszeniem praw pacjenta
- odszkodowanie w przypadku nieszczęśliwego wypadku

Nasza oferta była konsultowana ze stowarzyszeniami zrzeszającymi fizjoterapeutów tak, aby najskuteczniej chronić i wspierać Ciebie oraz Twoich pacjentów.

► Skontaktuj się ze swoim agentem i skorzystaj z wyjątkowej oferty!

Towarzystwo Ubezpieczeń INTER Polska S.A.

Al. Jerozolimskie 142 B

02-305 Warszawa

www.interpolska.pl

inter
UBEZPIECZENIA

SPRZEDAŻ I WYPOŻYCZALNIA ZMOTORYZOWANYCH SZYN CPM ARTROMOT®

Nowoczesna rehabilitacja **CPM** stawu kolanowego, biodrowego, łokciowego, barkowego, skokowego, nadgarstka oraz stawów palców dłoni i kciuka.



ARTROMOT-H



ARTROMOT-F



ARTROSTIM
FOCUS PLUS

ARTROMOT-K1 ARTROMOT-SP3 ARTROMOT-S3 ARTROMOT-E2

Najnowsze konstrukcje ARTROMOT zapewniają ruch bierny stawów w zgodzie z koncepcją **PNF** (Proprioceptive Neuromuscular Facilitation).

KALMED Iwona Renz
 ul. Wilczak 3
 61-623 Poznań
 www.kalmed.com.pl

tel. 61 828 06 86
 faks 61 828 06 87
 kom. 601 64 02 23, 601 647 877
 kalmed@kalmed.com.pl

Serwis i całodobowa
 pomoc techniczna:
 tel. 501 483 637
 service@kalmed.com.pl

AKTYWIZACJA OSÓB PO URAZACH RDZENIA

Po Urazie Rdzenia to ogólnopolski projekt skierowany do osób, które doznały urazu rdzenia kręgowego. Jego celem jest wielopłaszczyznowe wsparcie na drodze do odzyskania możliwie największej sprawności.

W ramach programu oferujemy pacjentom:

- Opiekę Menadżera Rehabilitacji
- Pozyskanie funduszy na rehabilitację i zakup sprzętu
- Wsparcie psychologiczne
- Konsultacje specjalistów
- Rehabilitację neurologiczną w ośrodkach na terenie kraju
- Pomoc w doborze zaopatrzenia
- Wsparcie w likwidacji barier architektonicznych
- Doradztwo zawodowe

**Skontaktuj się z nami i zapytaj
o bezpłatne egzemplarze
Poradnika dla osób
po urazie
rdzenia
do Twojej
placówki**



Masz pytanie odnośnie programu. Napisz do nas lub skontaktuj się telefonicznie z naszymi menadżerami rehabilitacji:

**+48 881 035 005
lub +48 793 003 695**

biuro@pourazierdzenia.pl
www.pourazierdzenia.pl



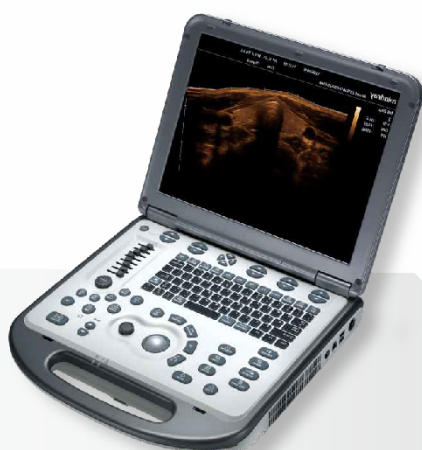
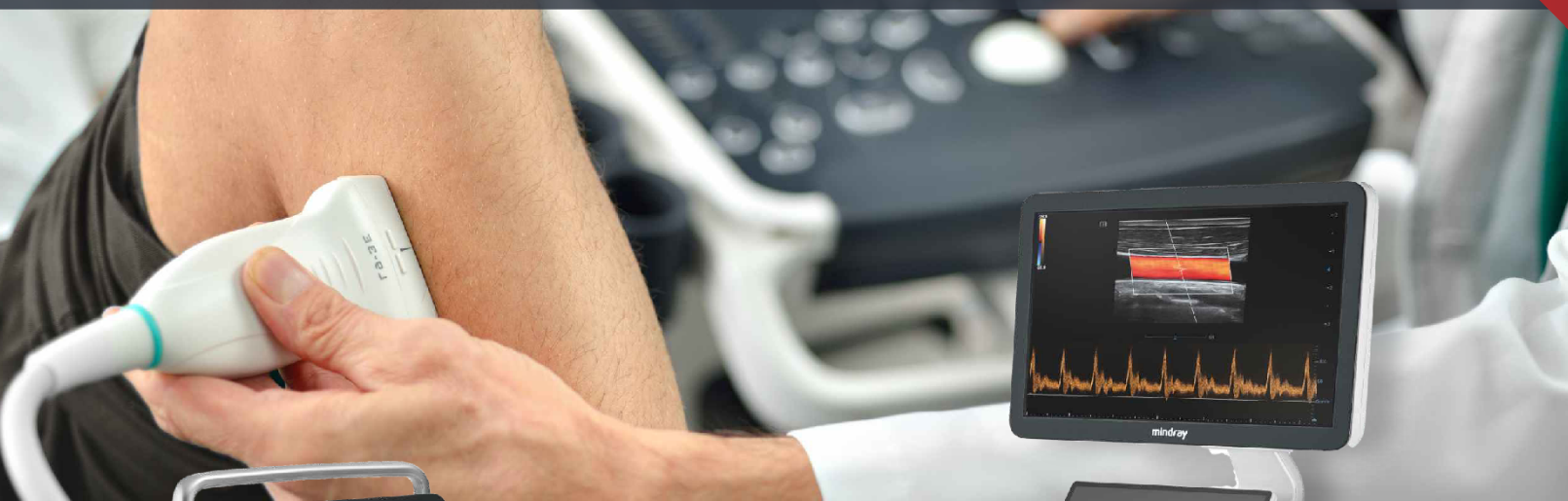
**Po Urazie
Rdzenia**

mindray

healthcare within reach

ULTRASONOGRAFIA

W FIZJOTERAPII



Autoryzowani dystrybutorzy

Mar-Med

+48 22 853 14 11

info@mar-med.pl

Ado-Med

+48 32 770 68 29

adomed@adomed.pl


MAR-MED
OD 1995 ROKU

 **ADO-MED**
APARATURA MEDYCZNA

NOWOŚĆ W OFERCIE

ASTAR.

PhysioGo.Lite SONO

**NIEWIELKIE URZĄDZENIE
EFEKTYWNA TERAPIA ULTRADŹWIĘKOWA**

Zaawansowana technologia firmy Astar to gwarancja niezawodności i precyzji parametrów. Urządzenie, dzięki gotowym programom terapeutycznym, pomaga osiągać fizjoterapeucie możliwie najlepsze efekty działania fal ultradźwiękowych.

Głowica SnG to bezobrotowe akcesorium o dużej powierzchni czota (17,3 cm² lub 34,5 cm² w zależności od wybranego trybu działania). Znajduje zastosowanie w klasycznej terapii ultradźwiękami, fonoforezie, terapii LIPUS i zabiegach skojarzonych (w połączeniu z elektroterapią).



wsparcie merytoryczne
www.fizjotechnologia.com



ul. Świt 33
43-382 Bielsko-Biała

t +48 33 829 24 40
astarmed@astar.eu

POLSKI PRODUKT  **WYBIERASZ
I WSPIERASZ**

www.astar.pl

Dr. Comfort®

Nowy wymiar wygody.

Obuwie profilaktyczno-zdrowotne
o atrakcyjnym wzornictwie



APROBATA
AMERYKAŃSKIEGO
MEDYCZNEGO
STOWARZYSZENIA
PODIATRYCZNEGO



WYRÓB
MEDYCZNY

**Stabilny, wzmocniony
i wyściełany zapętek**
Zapewnia silniejsze
wsparcie łuku
podłużnego stopy

**Miękki, wyściełany
kołnierz cholewki**
Minimalizuje podrażnienia

Wyściełany język
Zmniejsza tarcie
i ulepsza dopasowanie

Lekka konstrukcja
Zmniejsza codzienne
zmęczenie

**Antypoślizgowa,
wytrzymała podeszwa
o lekkiej konstrukcji**
Zwiększa przyczepność,
amortyzuje i odciąża stopy

**Zwiększona
szerokość i głębokość
w obrębie palców
i przodostopia**
Minimalizuje ucisk
i zapobiega urazom

**Wysoka jakość materiałów
- oddychające siatki i naturalne skóry**
Dostosowują się do stopy,
utrzymują je w suchości
i zapobiegają przegrzewaniu

Trzy
rozmiary
szerokości

Podwyższona
tęgość

Zwiększona
przestrzeń
na palce

**Ochronna przestrzeń
na palce - brak szwów
w rejonie przodostopia**
Minimalizuje możliwość zranień

WSKAZANIA

- haluksy • wkładki specjalistyczne • palce młotkowate, szponiaste • cukrzyca (stopa cukrzycowa) • reumatoidalne zapalenie stawów
- bóle pięty i podeszwy stopy (zapalenie rozciągniętej podeszwy - ostroga piętowa) • płaskostopie (stopa poprzecznie płaska)
- bóle pleców • wysokie podbicie • praca stojąca • nerwiak Mortona • obrzęk limfatyczny • opatrunki • ortezy i bandaż • obrzęki
- modzele • protezy • odciski • urazy wpływające na ścięgna, mięśnie i kości (np. ścięgno Achillesa) • wrastające paznokcie



ul. Wilczak 3
61-623 Poznań
tel. 61 828 06 86
fax. 61 828 06 87
kom. 601 640 223, 601 647 877
e-mail: kalmed@kalmed.com.pl
www.kalmed.com.pl



www.butydlazdrowia.pl

www.dr-comfort.pl

Sukces czy porażka? Czyli jak wygląda sytuacja w zakresie szczepień ochronnych w Polsce?



Cztery uczelnie – Centrum Medyczne Kształcenia Podyplomowego, Warszawski Uniwersytet Medyczny, Akademia Leona Koźmińskiego i Uniwersytet SWPS zorganizowały konferencję naukową w ramach Projektu „Budowanie zaufania do szczepień ochronnych z wykorzystaniem najnowszych narzędzi komunikacji i wpływu społecznego”.

Podczas czterech paneli dyskusyjnych eksperci, naukowcy, lekarze, psycholodzy, przedstawiciele instytucji publicznych dyskutowali na temat szans i wyzwań stojących przed systemem szczepień w Polsce.

Nie da się zaprzeczyć faktom – szczepienia ochronne są najefektywniejszą metodą zwalczania chorób zakaźnych. Podnoszenie zaufania do szczepień, które przekłada się na poziom wyszczepienia populacji, jest więc kluczowym wyzwaniem stojącym przed wszystkim odpowiedzialnymi za zdrowie publiczne w Polsce.

Dużym sukcesem i krokiem w dobrym kierunku było wprowadzenie szczepień w aptekach – podkreślił prof. Jarosław Pinkas, Konsultant Krajowy w dziedzinie zdrowia publicznego.

Niemniej, mimo szeroko prowadzonej kampanii medialnej, Polska należy do krajów o najniższym poziomie wyszczepienia przeciw COVID-19 w Europie (niepełna 60% populacji zostało w pełni zaszczepionych). Co roku w naszym kraju przeciw wirusowi grypy szczepi się jedynie 4-6% osób. Według danych PZH-NIPZ liczba uchybień od szczepień obowiązkowych wśród dzieci w okresie od 2016 do 2020 roku wzrosła 2-krotnie z 23 tys. do 50.5 tys.

„Szczepienia przeciwko grypie u pracodawców bardzo zmniejszają absencję w pracy, ta sama prawidłowość dotyczy szczepień rotawirusowych” – mówił prof. Marcin Czech



Z danych uzyskanych przez Warszawski Uniwersytet Medyczny wynika, że postawy mieszkańców Polski wobec szczepień nie są spójne. Może to w przyszłości spowodować dalszy spadek poziomu wyszczepienia populacji, a w dalszej perspektywie wzrost zagrożenia epidemiologicznego.



W ramach panelu prowadzonego przez Uniwersytet SWPS zastanawiano się nad przyczynami postaw wobec szczepień. Pierwszym skojarzeniem, jakie większość Polaków wypowiada po hasle „szczepienia” jest „koronawirus”. I choć rzeczywiście od końca 2020 roku szczepienia przeciwko COVID-19 stały się jednym z bardzo ważnych elementów debaty publicznej, to przecież rosnąca liczba osób uchylających się od szczepień na takie choroby jak odra czy krztusiec była ważną kwestią społeczną już przed marcem 2020 roku.

Jednym z kluczowych wyzwań stojących przed systemem szczepień w Polsce jest walka z fake newsami, podkreślali eksperci Akademii Leona Koźmińskiego. Czy dezinformację naukową można interpretować w kategoriach cyberwojny? Czy jest to zagrożenie porównywalne z katastrofą klimatyczną, bądź rozwojem techniki AI? Jaką rolę odgrywają w tym procesie media społecznościowe? To pytania z którymi musimy się jak najszybciej zmierzyć.

Mimo wszystko wysoka wyszczepialność w Polsce to sukces wszystkich profesjonalistów medycznych i osób działających na rzecz zdrowia publicznego. Wciąż zdecydowana większość Polaków dokonuje właściwych wyborów zdrowotnych. To optymistyczny wniosek płynący z konferencji CMKP, WUM, SWPS i ALK. Jednak nic nie jest dane raz na zawsze – pojawiające się wyzwania powinny mobilizować lekarzy, naukowców, edukatorów, przedstawicieli administracji publicznej do szukania nowych sposobów dotarcia z komunikatem zachęcającym do szczepień i podejmowania zdecydowanych działań na rzecz walki z dezinformacją.





MATIO sp. z o.o.

to sprawdzony od 7 lat dystrybutor
urządzeń do drenażu dróg oddechowych
amerykańskiej firmy Hillrom

Hill-Rom.

The
Vest
Airway Clearance System

model 205



MetaNeb™



do drenażu i nebulizacji dla pacjentów w warunkach szpitalnych
– ze sprzętu w Polsce korzysta wiele oddziałów szpitalnych

MATIO sp. z o.o., ul. Celna 6, 30-507 Kraków, tel./fax (+4812) 296 41 47,
tel. kom. 511 832 040, e-mail: matio_med@mukowiscydoza.pl, www.matio-med.pl

Efficacy of ultrasound in diagnosis and treatment of the shoulder – A systematic review

Przydatność ultrasonografii w fizjoterapii barku – przegląd literatury

Dawid Lukoszek^{1(A,B,C,D,E,F)}, Dominik Sieroń^{2(A,C,D,E,F)}, Izabella Jabłońska^{3(A,C,D,E,F)}, Jan Szczegielniak^{4(D,E,F)}, Rafał Trąbka^{5(D,E,F)}, Karol Szyluk^{6,7(B,C,D,E,F)}

¹Dawid Lukoszek Fizjoterapia, Osteopatia, Hanusek / Dawid Lukoszek Physiotherapy Osteopathy, Hanusek, Poland

²Wydział Radiologii, Inselspital, Szpital Uniwersytecki w Bernie, Szwajcaria /
Department of Radiology, Inselspital, Bern University Hospital, University of Bern, Switzerland

³Centrum Rekreacyjno-Lecznicze GLINIK 1, Wysowa-Zdrój /
Recreation and Treatment Center GLINIK 1, Wysowa-Zdrój, Poland

⁴Wydział Wychowania Fizycznego i Fizjoterapii, Politechnika Opolska /
Faculty of Physical Education and Physiotherapy, Opole University of Technology, Opole, Poland

⁵Klinika Rehabilitacji, Wydział Nauk o Zdrowiu, Uniwersytet Jagielloński Collegium Medicum, Kraków /
Clinic of Rehabilitation, Faculty of Health and Sciences, Jagiellonian University Medical College, Cracow, Poland

⁶Katedra Fizjoterapii, Wydział Nauk o Zdrowiu w Katowicach, Śląski Uniwersytet Medyczny, Katowice /
Department of Physiotherapy, Faculty of Health Sciences in Katowice, Medical University of Silesia in Katowice, Katowice, Poland

⁷Oddział I Urazowo-Ortopedyczny, SP Wojewódzki Szpital Chirurgii Urazowej w Piekarach Śląskich /
I Department of Orthopaedic and Trauma Surgery, District Hospital of Orthopaedics and Trauma Surgery, Piekary Śląskie, Poland

Abstract

Objectives. The aim of this study was to provide an overview of the scientific evidence base on the use of ultrasonography in physiotherapy and rehabilitation of the shoulder.

Methods. The PubMed / Medline database was reviewed using the following keywords: shoulder ultrasonography AND rehabilitation; shoulder ultrasound imaging AND physiotherapy; shoulder ultrasound imaging AND rehabilitation; Rehabilitative Ultrasound Imaging AND Shoulder. Only full-text, open-access studies in English published before 15 May 2022 were included in the analysis.

Results. 51 articles (out of 748 identified) were included in the analysis. Of all the studies, 3 studies were randomized, 5 were not randomized, the rest were cross-sectional or case studies. The most common study group were patients with hemiplegia (in 13 out of 51 reviewed works). 12 papers out of 51 concerned orthopedic conditions of the shoulder with varying diagnoses. Ultrasound imaging was used mainly to assess echogenicity and measure structures of the shoulder.

Conclusion. There are many studies demonstrating the utility of ultrasound in various aspects of the physiotherapist's practice, including but not limited to diagnostic purposes, assessment of treatment effectiveness, monitoring treatment progress, and referring the patient to another specialist.

Key words:

ultrasonography, ultrasound, imaging, ultrasonography, rehabilitation, physical therapy, physiotherapy, diagnosis, shoulder, pain, treatment

Streszczenie

Cel. Celem tego badania było przeprowadzenie przeglądu dowodów dotyczących wykorzystywania ultrasonografii w fizjoterapii lub rehabilitacji barku.

Metody. Do 18.05.2022 r. wykonano przegląd bazy danych PubMed/Medline, wykorzystując formy słów kluczowych: shoulder ultrasonography AND rehabilitation; shoulder ultrasound imaging AND physiotherapy; shoulder ultrasound imaging AND rehabilitation; Rehabilitative Ultrasound Imaging AND shoulder. Do przeglądu włączono jedynie prace pełnotekstowe z darmowym dostępem oraz anglojęzyczne.

Wyniki. Do analizy uwzględniono 51 artykułów (z 748 zidentyfikowanych). Ze wszystkich prac 3 prace były badaniami randomizowanymi, 5 nierandomizowanymi, reszta prac występowała w charakterze badań przekrojowych lub studium przypadku. Najczęściej spotykanymi grupami badanymi były grupy pacjentów z połowicznym porażeniem mózgu (13/51). 12 prac z 51 dotyczyło schorzeń ortopedycznych barku o różnym rozpoznaniu. USG zostało wykorzystywane głównie w celu oceny echogeniczności oraz wykonania pomiarów struktur barku.

Wnioski. Istnieje wiele prac przemawiających o wysokiej przydatności ultrasonografii w praktyce fizjoterapeuty do celów diagnostycznych, oceny postępów leczenia lub kierowania pacjenta do innego specjalisty.

Słowa kluczowe:

ultrasonografia, rehabilitacja, fizjoterapia, bark, diagnostyka

Introduction

The use of ultrasound (USG) in physiotherapy and rehabilitation is becoming more and more popular, which stems from its well-documented utility in the treatment of diseases and injuries in the shoulder area [1]. The growing number of publications since 2005 indicates a growing interest of physiotherapists in ultrasound and its use in clinical practice [2]. Ultrasound can be used with dysfunctions of the musculoskeletal system, as well as to diagnose peripheral neuropathies [1].

Rehabilitation Ultrasound Imaging (RUSI) is a framework which defines the use of ultrasound by physiotherapists for basic assessment of soft tissues (muscles, tendons, ligaments) over the course of therapy. Various measurements performed by means of ultrasound (e.g. the distance between the acromion and humeral head – AHD) allow for a more objective evaluation of the functional state of the shoulder compared to its presentation in physical examination. An additional benefit of RUSI is the ability to monitor the effects of treatment [3].

Ultrasound can be used to diagnose various shoulder conditions, in which abnormalities in the rotator cuff, the tendon of the long head of the bicep, glenohumeral joint, acromioclavicular joint and other soft tissue dysfunctions of the shoulder girdle are present [4, 5, 6].

The aim of this systematic review was to examine the current state of scientific knowledge on the use of RUSI in functional diagnostics, physiotherapy, and rehabilitation of the shoulder.

Methods

All studies were screened on an individual basis, considering a set of specific criteria and key data such as affiliation of authors, type of study, year of publication, type of tissue tested within the shoulder, study methodology, type, and cause of shoulder dysfunction. The study was designed in accordance with the standards of PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) [7].

Study search methodology

All analyzed publications were identified by 18 May 2022. To obtain the studies, the PubMed/Medline database was searched using the following keyword forms: shoulder ultrasonography AND rehabilitation; shoulder ultrasound imaging AND physiotherapy; shoulder ultrasound imaging AND rehabilitation; Rehabilitative Ultrasound Imaging AND Shoulder.

Study selection methodology

The criteria for study inclusion included: at least one author affiliated with a rehabilitation or related facility, the use of ultrasound for the purpose of diagnosis and evaluation of treatment results. Only articles with an available abstract and free access to full content were included in the study.

Exclusion criteria included: medical intervention under ultrasound guidance, use of ultrasound for purposes other than diagnosis and evaluation of the progress of shoulder

dysfunction treatment, non-English-language articles and tests on human and animal specimen. The titles and abstracts of articles obtained upon application of the outlined study strategy were checked independently by two authors (DL and KS).

Methodology of data selection and quality assessment

The full content of potentially eligible studies was independently assessed by two authors (DL and KS). Disputes over study selection were resolved through discussions with other authors. Data selection methods were used to extract relevant information from selected studies for the purpose of quality evaluation and evidence synthesis. Methods of data selection included: demographic data of the study participants, group characteristics, type of tissue assessed, method of tissue evaluation or measurement, possible physiotherapeutic interventions. Two authors (DL and KS) independently assessed the methodological quality of Randomized Control Trials (RCTs) and non-Randomized Control Trials using the PEDro scale: ≥ 7 – high quality; 6 or 5 – moderate quality, ≤ 4 – low quality [8].

Data synthesis

A narrative synthesis of the results of selected studies was prepared, focusing on the use of ultrasound in functional diagnostics and monitoring of patients with shoulder disorders, with an emphasis on the type of disorder and tissue assessed, as well as the method of assessment. A table summarizing the most relevant information from each study was assembled.

Results

Results of study selection

The study selection process for this systematic review is illustrated in Figure 1. 748 studies were identified in accordance with the literature search strategy described above. After reviewing the titles and abstracts, 609 non-full-text studies were rejected and 139 remained. 69 studies were excluded due to the failure to meet the inclusion criteria. 51 studies were qualified for further review [9–60]. Of all selected studies, 3 were RCTs and 5 were nonrandomized. The rest were cross-sectional. Table 1 summarizes studies included in our analysis. RCT studies were assessed in accordance with the PEDro scale: de Oliveira et al. – 7 [9], Stephens et al. – 6 [10], Bac et al. – 5 [11].

Due to the lack of a homogeneous research methodology among selected studies, no meta-analysis was performed. The type of tissue assessed by ultrasound and the method of assessment in selected studies included: the tendons and muscles of the rotator cuff, the tendon and the sheath of the biceps, the axillary recess, the deltoid muscle, the pectoral muscle, posterior part of the articular capsule of the shoulder joint, the subacromial bursa. Table 2 shows the most common measurements taken with an ultrasound machine. The review also included interventional methods, such as kinesiotaping, over the course of which an ultrasound examination was used to assess effectiveness (Table 3).

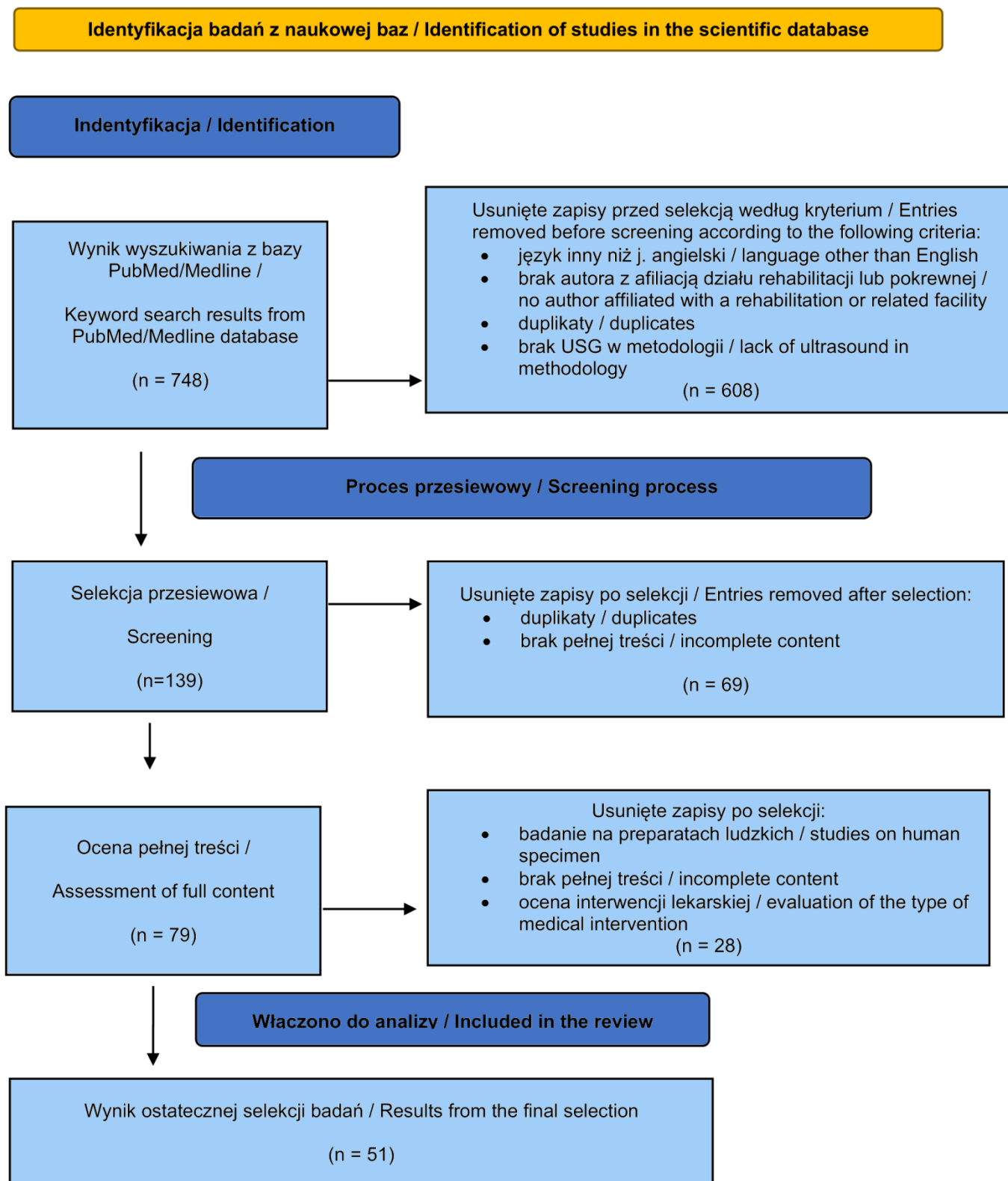


Figure 1. Flow chart – visualisation of the selection process

Table 1. Summary of studies included in the analysis

Author/Year	Type of study	Study group	Shoulder disorder	Ultrasonography application	Conclusions
Sirasaporn, Papiya et al., 2021 [12]	Cross-sectional descriptive study	91 spinal cord injury patients over 18. No history of shoulder injuries	Subacromial bursitis, biceps tendinitis, rotator cuff injury	Assessment of shoulder structures	Shoulder pain is a common problem in people with spinal cord injury. The most common injury was unilateral bursitis.
de Oliveira, Fábio Carlos Lucas et al., 2017 [9]	Randomized control trial	52 subjects aged 18-65	Rotator cuff injury	AHD measurement	Randomized trials are the most accurate way to assess the effectiveness of kinesiotyping.
Koppenhaver, Shane et al., 2015 [13]	Cross-sectional study, measurement study	52 subjects aged 18-60	Subacromial impingement syndrome	Measurement of thickness of the infraspinatus muscle in contraction and relaxation	Measurements of thickness of the infraspinatus appear reliable. Measurements vary in contraction and relaxation, and in symptomatic and asymptomatic shoulders in patients with unilateral SAIS.
Huang, Yu-Chi et al., 2010 [14]	Cross-sectional study	57 stroke patients	Biceps tendinitis, rotator cuff injury	Assessment of shoulder structures	Soft tissue injuries of the shoulder (85%) or shoulder pain (67%) occur in stroke survivors with sensory impairment, spasticity, and subluxation. Abnormalities in ultrasound results were associated with severity of shoulder pain.
Harput, Gulcan et al., 2018 [15]	Cross-sectional study	20 participants aged 22.9 ± 2.8	None	AHD measurement	No difference in AHD measurements in active scapular retraction between 0° and 90° shoulder abduction - these differences did not exceed minimally detectable change (MDC 90%).
Suzuki, Yuta et al., 2020 [16]	Cross-sectional study	60 subjects aged 33-65: 40 injured swimmers, 20 healthy subjects	Shoulder pain	Assessment of shoulder structures	High frequency of abnormalities in the rotator cuff and the tendon of the long biceps head occurs as a result of swimming and aging. The occurrence of tendinitis of the supraspinatus and the head of the biceps were associated with shoulder pain symptoms.

Author/Year	Type of study	Study group	Shoulder disorder	Ultrasonography application	Wholski Conclusions
Jiang, Li et al., 2020 [17]	Cross-sectional study	346 subjects from southern China	Shoulder pain	Assessment of shoulder structures	Ultrasound is a reliable tool for diagnosing shoulder pain and should be used widely in outpatient clinical settings.
Stephens, Gareth et al., 2021 [10]	Nested qualitative study	19 subjects: 11 patients in a streamlined rehab regimen and 8 in a standard rehabilitation regimen	Condition after arthroscopic reconstruction of rotator cuff	Assessment of rotator cuff structures	Long time use of sling resulted in pain and mobility limitations in patients. Clinicians were reluctant to remove the sling due to its role in maintenance of integrity of the surgical reconstruction performed.
Navarro-Ledesma, S. et al., 2017 [18]	Cross-sectional study	102 subjects	Chronic pain (> 3 months) of front of the shoulder	Measurement of the coracohumeral distance (CHD)	Weak relationship between CHD measurement and shoulder pain and function. Consideration should be given to treatments other than simply increasing room in the coracoid process region.
Hannah, Daniel C. et al., 2018 [19]	Descriptive laboratory study	16 volunteers aged 26.9 ± 6.8	None	Measurement of torsion of the humerus	Ultrasound is a reliable and valid alternative method of assessing the torsion of the humerus.
Huang, Shih-Wei et al., 2012 [20]	Cross-sectional study	39 stroke patients	Shoulder dislocation	Assessment of shoulder structures, AHD measurement	Ultrasound examination is a useful method of diagnosing shoulder injuries. Ultrasound is valuable in extending the diagnostic process following shoulder dislocation.
Hou, Saiyun et al., 2017 [21]	Observational study	25 healthy volunteers aged 24-50	None	Assessment of correct palpation of the tendon of the long head of the biceps	The coracoid process and the vertical line of the medial epicondyle are useful anatomical landmarks for locating the tendon groove of the long head of the biceps.
Maenhout, Annelies et al., 2015 [22]	Cross-sectional study	29 healthy athletes engaging in activities with arms above head	None	Measurement of AHD in 0°, 45°, 60° shoulder abduction	Changes in AHD in the position decompressing subacromial impingement were shown.

Author/Year	Type of study	Study group	Shoulder disorder	Ultrasonography application	Conclusions
Chang, Ke-Vin et al., 2016 [23]	Cross-sectional study	337 shoulders presenting with pain	Subacromial impingement syndrome, rotator cuff injury, adhesive capsulitis	Measurement of thickening of the tendon sheath of the long head of the biceps, dynamic assessment of subacromial conflict	Thickening of the tendon sheath of the long head of the biceps accompanies symptoms of subacromial impingement during dynamic ultrasound examination.
Park, Gi-Young et al., 2007 [24]	Retrospective clinical study, double-blinded control group	41 stroke patients aged 34-78	Shoulder dislocation	AHD measurement	Ultrasound examination and AHD measurement show a strong relationship with clinical condition of the shoulder in people with post-stroke hemiplegia.
Yang, Chengyuan et al., 2018 [25]	Prospective case control study	30 stroke patients	Shoulder dislocation	AHD measurement	Ultrasound measurements can be used as an objective basis for monitoring shoulder dislocation in stroke patients.
Huang S.W., Wang W.T., 2013 [26]	Cross-sectional study	336 subjects	Biceps tendinitis	Assessment of shoulder structures	Ultrasound is an impartial and easy tool for diagnosing tendinopathy of the tendon of the long head of the biceps.
Mascarinas, Angelie L. et al., 2014 [27]	Case study	1 subject	Condition after reverse total shoulder replacement	Measurement of pectoralis major atrophy	Ultrasound is a good tool to assess the integrity and atrophy of the pectoral muscle after reverse total shoulder replacement.
Wu, Chueh-Hung et al., 2012 [28]	Cross-sectional study	20 subjects	Complete damage to the supracomb muscle tendon	Measurement of thickness and length of the brachial ligament	Dynamic examination shows displacement of the coracoacromial ligament in people with a torn supraspinatus muscle.
Liu, Shan et al., 2022 [29]	Cross-sectional study	40 stroke patients	Shoulder dislocation	Measurement of thickness of the supraspinatus tendon in 0° and 60° shoulder abduction	The thickness and degree of change in the supraspinatus tendon are significantly smaller on the side affected with hemiplegia compared with the healthy side.

Author/Year	Type of study	Study group	Shoulder disorder	Ultrasonography application	Conclusions
Lin, Pei-Hsin., 2017 [30]	Retrospective clinical study	26 stroke patients	Shoulder pain	Assessment of shoulder structures	Changes in soft tissue of the shoulder may be independent of changes in muscle tone and nervous activity in people with post-stroke hemiplegia.
Cho, Hyong Keun et al., 2012 [31]	Cross-sectional study	51 stroke patients	Shoulder pain	Assessment of shoulder structures	Hemiplegia severity affects the spasticity of the affected and unaffected shoulder.
Do, Jong Geol et al., 2021 [32]	Retrospective cohort study	61 subjects	Adhesive capsulitis	Measurement of thickness of the coracoclavicular ligament, rotator cuff interval, axillary recess. Assessment of protrusion of the tendon sheath of the long head of the biceps	Measurements taken with ultrasound are associated with structural changes and correlate with clinical stages of adhesive capsulitis.
Guzowski, Krzysztof et al., 2019 [33]	Cross-sectional study	37 tennis players	Shoulder pain	Assessment of shoulder structures	Ultrasound is helpful in identifying pathologies of the rotator cuff. Limitation of external rotation is related to pathology of the supraspinatus tendon.
Razmjou, Helen et al., 2017 [34]	Cross-sectional study	300 subjects	Shoulder pain	Assessment of shoulder structures	Results of additional imaging tests, including ultrasound, changed the management of the physiotherapeutic regimen.
Ueda, Yasuyuki et al., 2022 [35]	Cross-sectional study	47 subjects	Rotator cuff injury	Measurement of thickness of belly of the supraspinatus	Ultrasound is a useful tool for evaluation of muscle atrophy in the rotator cuff.
Harput, Gulcan et al., 2016 [36]	Cross-sectional study	39 volleyball players aged 16.0 ± 1.4	None	AHD measurement	Teenagers playing volleyball showed less internal rotation. In the dominant upper limb, a greater total range of motion, external rotation and AHD were noted.

Author/Year	Type of study	Study group	Shoulder disorder	Ultrasonography application	Conclusions
Yi, Tae Im et al., 2012 [37]	Cross-sectional study	20 healthy volunteers, 10 shoulder hemiplegia patients after a stroke	None	Measurement of thickness of belly of the supraspinatus	Measurement of thickness of the supraspinatus belly by means of ultrasound is a reliable method.
Kim, Yang Soo et al., 2011 [38]	Cross-sectional study	11 healthy subjects	None	Measurement of circumference of belly of the supraspinatus	Measurement of volume of the supraspinatus belly is a poor or moderately reliable method of assessment evaluation in comparison with MRI.
Ishigaki, Tomonobu et al., 2015 [39]	Cross-sectional study	39 healthy baseballers	None	Measurement of stiffness in the posterior part of the articular capsule of the shoulder joint	Stiffness of the posterior part of the articular capsule affects internal rotation, while limitation of horizontal adduction may be caused by the posterior part of the deltoid muscle.
Lee, Jun-Gyu et al., 2021 [40]	Cross-sectional study	71 patients aged 58.2±9.9	Adhesive capsulitis of the shoulder joint	Measurement of the axillary recess of the shoulder joint	Measurement of the lower part of the articular capsule in neutral position by means of ultrasound has good diagnostic accuracy.
Tseng, Yu-Hsuan et al., 2020 [41]	Prospective observational study	-	Massive rotator cuff injury – before reconstructive surgery	Elastography of the supraspinatus and infraspinatus abdominals using ultrasound	Ultrasound elastography of the rotator cuff muscles seems to be a useful tool for assessing massive tears of the rotator cuff.
Nodehi Moghadam, Afsun et al., 2020 [42]	Cross-sectional study	44 women	Scapular dyskinesia	AHD measurement	No significant differences in AHD values in 0° and 90° arm abduction between healthy people and people with scapular dyskinesia.
Dehqan, Behdokht et al., 2021 [43]	Cross-sectional study	60 volunteers with shoulder protraction	None	AHD measurement	AHD values in 45° shoulder abduction are significantly lower in people with significant head protraction.

Author/Year	Type of study	Study group	Shoulder disorder	Ultrasonography application	Conclusions
Duan, Huiyu et al., 2021 [44]	Cross-sectional study	50 subjects aged 43.5±11.5	Subacromial impingement syndrome	Assessment of rotator cuff injuries	Ultrasound is a reliable method for clinical diagnosis of rotator cuff tears.
Schmidt, Simon Vadstrup et al., 2021 [45]	Preliminary study	9 badminton players	None	AHD measurement	The dominant upper limb has higher AHD values due to tendon hypertrophy caused by the type of activity undertaken, such as playing badminton.
Cesarec, Gordana et al., 2020 [46]	Cross-sectional study	51 subjects aged 20-59	Calcific tendinitis of the rotator cuff	Power Doppler Assessment	Power Doppler ultrasound assessment allows to determine the stage of calcific tendinitis of the rotator cuff and to avoid unnecessary long-term physiotherapy.
Lee, Chang Hwa et al., 2017 [47]	Cross-sectional study	77 amateur golfers	Shoulder pain	Assessment of shoulder structures	Shoulder pain in golfers was most often associated with damage to the supraspinatus and subscapular tendons.
Kim, Kyeongwon et al., 2016 [48]	Cross-sectional study	100 healthy volunteers from Korea aged 20-70	None	Measurement of thickness of the tendon of long head of the biceps, supraspinatus, subscapular head, subacromial bursa, infraspinatus, deltoid. Measurement of the acromio-clavicular joint distance	Normative reference values for dimensions of the rotator cuff of adult Koreans were suggested based on results from ultrasound imaging.
Schmidt, Malte et al., 2021 [49]	Cross-sectional study	120 subjects below 40 years of age	Acute shoulder injury	Assessment of shoulder structures	Physical examination including abduction, external rotation and muscle strength were more reliable than pain provoking tests.
Kim, Yeo Hyung et al., 2014 [50]	Observational study	94 stroke patients	Shoulder pain	Assessment of shoulder structures, measurement of thickness of the rotator cuff tendons	Stroke patients with supraspinatus injury require more attention in the rehabilitation process.

Author/Year	Type of study	Study group	Shoulder disorder	Ultrasonography application	Conclusions
Cross, Kevin M., and Michael, 2017 [51]	Case study	22-year-old gymnast	7 months after a surgical intervention in the shoulder	Assessment of thickness of belly of the infraspinatus	Ultrasound examination is a useful tool for monitoring the effects of trigger point dry needling therapy.
Pong, Ya-Ping et al., 2012 [52]	Prospective cohort study	66 shoulder hemiplegia patients following a stroke	Acute shoulder pain, chronic shoulder pain	Assessment of shoulder structures	Shoulder spasticity and abnormalities in the ultrasound image are correlated with chronic shoulder pain.
Park, Gi-Young et al., 2017 [53]	Cross-sectional study	141 subjects	Shoulder pain	Measurement of thickness of the axillary recess	Ultrasound measurements of thickness of the axillary recess show excellent internal reliability. The thickness of the axillary recess depends on gender, height, and weight.
Kim, Yong Ki et al., 2018 [54]	Prospective cohort study	34 subjects 3-4 months after a surgical intervention	Condition after rotator cuff reconstruction	Assessment of supraspinatus atrophy	The functional condition of the shoulder can be predicted by assessing supraspinatus atrophy with ultrasound. Ultrasound allows for an impartial assessment and comparison with the result on the opposite side.
Lin, Yen-Sheng et al., 2014 [55]	Cross-sectional study	23 wheelchair-bound subjects	Shoulder pain	AHD measurement	Results of the study suggest that wheelchair users should limit the use of weight-relief raises due to significant reduction of the subacromial space, which may lead to pain.
Yi, Youbin et al., 2013 [56]	Cross-sectional observational study	55 shoulder hemiplegia patients	None	Assessment of shoulder structures	Muscle weakness on the hemiplegic side and damage to the rotator cuff were more common on the paralyzed side. In contrast, weakening of the muscle force was an independent risk factor for damage to the rotator cuff.
Xie, Hualong et al., 2020 [57]	Cross-sectional study	20 stroke patients	Shoulder hemiplegia	Assessment of thickness of belly of the supraspinatus in 0°, 45° and 60° arm abduction	Ultrasound is useful for impartial assessment of the thickness of the supraspinatus muscle in patients with shoulder hemiplegia.

Author/Year	Type of study	Study group	Shoulder disorder	Ultrasonography application	Conclusions
Bac, Aneta et al., 2020 [11]	Randomized control trial	60 subjects	Shoulder pain	AHD measurement, measurement of thickness of the subacromial bursa, the subacromial bursa in internal rotation, the rotator cuff, assessment of structures in terms of tendinopathy	Ultrasound allowed for assessing effectiveness of kinesiотaping used with a standard rehabilitation regimen.
Ishigaki, Tomonobu et al., 2022 [58]	Cross-sectional study	18 subjects aged 21-24 and 27 subjects aged 45-80 lat	None	AHD measurement, measurement of thickness of the supraspinatus tendon	Results show a thicker supraspinatus tendon in the elderly without reducing the AHD dimension.
Liu, Shan et al., 2022 [59]	Cross-sectional study	40 stroke patients aged 57.4 ± 11.9	Shoulder hemiplegia	Measure of thickness of the deltoid muscle in 0°, 30° and 60° arm abduction, AHD measurement	Ultrasound measurement of thickness of the deltoid shows excellent diagnostic reliability and can be used in patients who have suffered a stroke.

Types of shoulder dysfunctions and assessed tissue

The most common group studied with ultrasound in physiotherapy literature are patients with hemiplegia ($n = 13/52$). Subsequent studies included athletes from various disciplines ($n = 6$). Clinical observations also included patients after shoulder surgery ($n = 3$) or with orthopedic diseases ($n = 12$), such as: subacromial impingement syndrome, obliterative bursitis, bursitis, tendinopathy of the long head of the biceps and the rotator cuff, tears of the rotator cuff and shoulder dislocation. Observational studies also included asymptomatic groups, in which research amounted to observing shoulder function.

Echogenicity ($n = 12$) was assessed mainly in structures of the shoulder such as the rotator cuff tendons, belly of the supraspinatus and infraspinatus, the tendon sheath, and the tendon of the long head of the biceps.

Measurements mainly focused on the distance between the acromion and humeral head (AHD). The belly of the supraspinal and subcapsular muscles was also considered. The differences lied in the method of measurement: whether thickness, circumference of the muscle, or ratio of muscle to fat infiltration of the muscle (muscle atrophy) were considered.

Methods of measuring internal structures with ultrasound

Table 2 shows the ultrasound measurements taken in the studies in relation to the diagnosis of the shoulder structure. In most studies, methodology for using an ultrasound machine for shoulder measurements differed. Measurements of distance, thickness or perimeter of a given structure were prevalent. In the study by Kim et al. a protocol recommended by the European Society of Musculoskeletal Radiology was used [48].

Table 2. Characteristics of the ultrasound measurements used in reviewed studies

Diagnosis	Structures	Method of assessment/measurement
Shoulder / subacromial impingement syndrome / rotator cuff injury / shoulder dislocation	Subacromial space	AHD: distance from lower edge of the acromion to the top of the humeral head ALT: distance between the lower edge of the shoulder process and the greater tubercle of the humerus AHD 0°, 60°, 90° abduction: distance from lower edge of the acromion to the top of the humeral head in 0°, 60° or 90° abduction
Shoulder / rotator cuff injury / dislocated shoulder	Tendons of rotator cuff muscles	Measurement of the subscapular, supraspinatus and infraspinatus tendons in the long and short axis

Diagnoza / Diagnosis	Struktura / Structures	Sposób oceny/pomiaru / Method of assessment/measurement
Shoulder / subacromial impingement syndrome / dislocated shoulder / condition after surgical intervention/ rotator cuff injury	Belly of rotator cuff muscles	Measurement of the belly of the supraspinatus and infraspinatus in the long axis and at half of scapular length in 90 ° abduction of the upper arm in contraction and relaxation of the muscle. The circumference of the supraspinatus in the short axis at the level of the scapular notch. Measurement of the supraspinatus, infraspinatus, and teres minor - methodology shown in Figure 2.
Frozen shoulder / shoulder pain	Axillary recess	Measurement in the axillary region at the height of the humeral head in the long axis of the axillary recess with arm abducted up to 90°
Shoulder pain	Coracoid process region	Measurement in coracoid process region, the smallest distance from the coracoid process to the humeral head in resting position and 60° abduction

Some studies used the "Power Doppler" and "B" - elastography modes [41, 46]. In addition, other studies included measurements of thickness of the deltoid and pectoral muscles, as well as the coracoacromial ligament and the rotator cuff interval [27, 33, 39, 48]. Figure 1 shows the most common measurements from studies featured in this review.

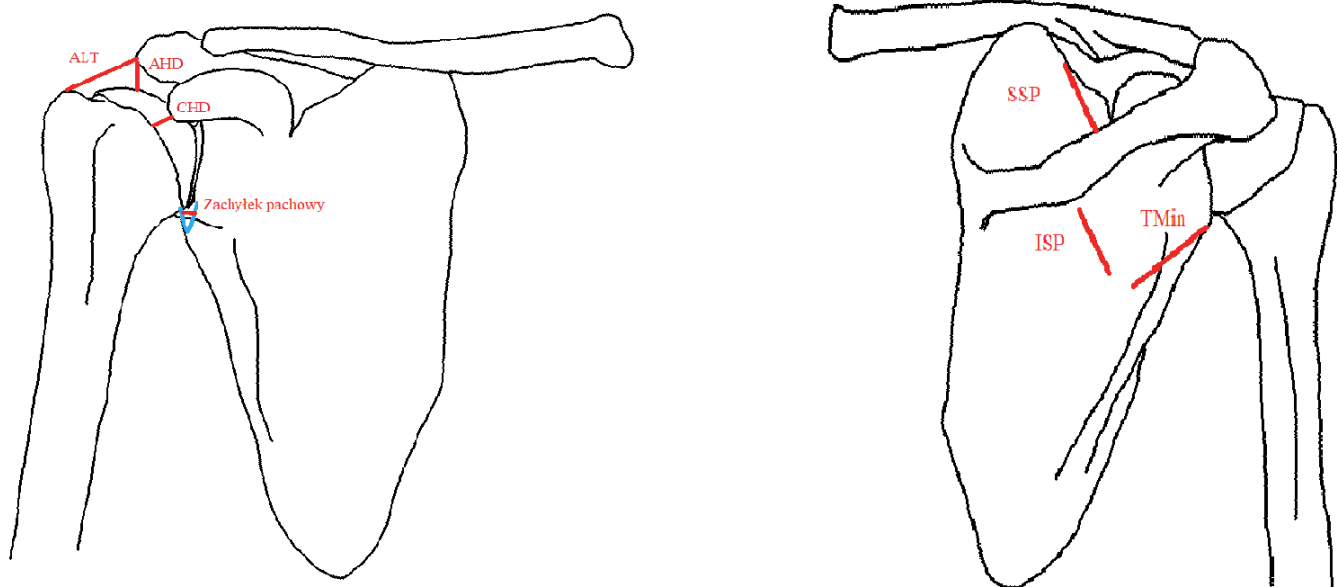


Figure 2. Shoulder structures evaluated by means of ultrasound; on the left measurements of: AHD, CHD, axillary recess; on the right, the position of the head during measurement of muscle thickness: SSP, ISP, TMin

Types of physiotherapeutic interventions in which ultrasound was used to monitor progress and results

Out of all reviewed articles, only two studies aimed to test the effectiveness of a physiotherapeutic intervention with ultrasound. In the study by Bac et al. to monitor the effects of kinesiotaping, ultrasound measurements of the AHD, the thickness of subacromial bursa and the thickness of the subacromial bursa in internal rotation of the arm were used. In the de Oliveira study, ultrasound was used to measure AHD in resting position of the shoulder joint and in 60 °abduction - but the results have not yet been published [9, 11].

Table 3. Application of ultrasound to monitor effectiveness of physiotherapeutic interventions

Diagnosis			
Bac, Aneta et al. [10]			
AHD	11.86 mm ± 3.75	11.09 ± 1.86	p = 0.380
Shoulder bursa	1.06 mm ± 0.82	1.14 ± 0.64	
Shoulder bursa with arm in internal rotation	1.27 mm ± 0.87	1.39 ± 0.64	
de Oliveira, Fábio Carlos Lucas et al. [8]			
Results not yet published			

Summary

- Presented studies differ in research design.
- The dominant study group were people without shoulder pain or with shoulder hemiplegia and the associated dislocation of the shoulder. Orthopedic disorders in presented studies had varying etiologies.
- Most studies used ultrasound technology to assess echogenicity and morphological changes in the structures of the shoulder.
- The most common measure to examine the shoulder was the distance between the acromion and humeral head (AHD).

Discussion

This review clearly demonstrates the widespread use of ultrasound in shoulder conditions by physiotherapists. The multitude of ways in which ultrasound was used indicates that various methods of measuring can be used to assess a given shoulder dysfunction.

In the case of studies in which the study group consisted of patients with hemiplegia due to stroke, ultrasonographic assessment of shoulder structures allows for an analysis of shoulder pain with paresis, and redirection to another specialist or modification of the treatment at the same time [30, 34].

The use of RUSI in the field of musculoskeletal disorders allows for an analysis of shoulder diseases in terms of morphological damage to structures and functions, enabling the correct clinical decision to be made [13, 14, 17, 22, 23, 36, 39, 54]. Control of integrity of the re-

constructed tendons and of trophic functions of the rotator cuff muscles allows for a safe patient guidance during recuperation period [54]. Additionally, ultrasound examination can be used to educate physiotherapists to accurately palpate structures and to objectively evaluate various methods in physiotherapy, such as strengthening exercises, manual therapy, kinesiotaping and others [9, 11, 39, 51, 61].

The main limitation of this review is the inability to verify the person performing the ultrasound in individual examinations (a radiologist or a physiotherapist). In subsequent reviews, studies that include assessment of physiotherapeutic intervention using ultrasound should be distinguished. Results of randomized studies, non-randomized studies and individual study groups should be compared. Separating neurological and orthopedic patients from the analysis could further outline the circumstances of the use of ultrasound in the physiotherapist's practice in given specialties.

Further scientific work should focus on creating standards and guidelines for the use of ultrasound in the physiotherapist's practice for the purpose of diagnosis and monitoring of physiotherapeutic procedures. Additionally, testing to what extent an ultrasound examination enables selection of proper and accurate treatment and what percentage of patients are referred for further medical consultation by physiotherapists after initial ultrasound assessment of the shoulder would answer the question whether performing ultrasound examination is an additional skill or a requirement in the physiotherapist's practice.

Conclusions

Ultrasound examination in physiotherapy allows for an impartial and effective assessment of shoulder structures. The ability to determine various measurements warrants an accurate assessment of the effects of physiotherapy or rehabilitation. Conducting randomized clinical trials to evaluate the effectiveness of physiotherapeutic or rehabilitation interventions with the use of an ultrasound machine is considered appropriate and necessary. Ultrasound usage by physiotherapists seems reasonable due to the possibility of achieving an objective functional diagnosis, monitoring the effects of treatment, its possible modifications and redirection to another specialist.

Adres do korespondencji / Corresponding author

Maciej Śliwiński

e-mail: sliwinskim@gumed.edu.pl

Piśmiennictwo/ References

1. Amoo-Achampong, Kelms et al., "An orthopedist's guide to shoulder ultrasound: a systematic review of examination protocols". *The Physician and sportsmedicine* vol. 44,4 (2016): 407-416. doi:10.1080/00913847.2016.1222224
2. Özçakar, Levent MD; Kara, Murat MD; Chang, Ke-Vin MD, PhD; Lew, Henry L.MD, PhD; Franchignoni, Franco MD *Musculoskeletal Ultrasound Liberating Physical and Rehabilitation Medicine, American Journal of Physical Medicine & Rehabilitation: August 2018 - Volume 97 - Issue 8 - p e73-e74* doi: 10.1097/PHM.0000000000000888
3. Teyhen, 2006, D. Teyhen, J. *Orthop. Sports Phys. Ther.*, 36 (2006), pp. A1-A3.
4. Backhaus M., Burmester G.R., Gerber T. et al., *Guidelines for musculoskeletal ultrasound in rheumatology. Ann. Rheum. Dis.* 2001; 60: 641-649.
5. Grassi W., *Clinical evaluation versus ultrasonography: Who is the winner? J. Rheumatol.* 2003; 30: 908-909.
6. Bianchi S., Martinoli C., *Shoulder*. In: *Ultrasound of the Musculoskeletal System*. Springer, Berlin Heidelberg, 2007; 189-293.
7. Page M. J., McKenzie J. E., Bossuyt P. M., Boutron I., Hoffmann T. C., Mulrow C. D. et al., *The PRISMA 2020 statement: an updated guideline for reporting systematic reviews BMJ* 2021; 372 :n71 doi:10.1136/bmj.n71

8. de Morton, Natalie A., "The PEDro scale is a valid measure of the methodological quality of clinical trials: a demographic study". *The Australian journal of physiotherapy* vol. 55,2 (2009): 129-33. doi:10.1016/s0004-9514(09)70043-1
9. de Oliveira F.C.L., Pairot de Fontenay B., Bouyer L.J., Desmeules F., Roy J.S., Effects of kinesiotaping added to a rehabilitation programme for patients with rotator cuff tendinopathy: protocol for a single-blind, randomised controlled trial addressing symptoms, functional limitations and underlying deficits. *B.M.J. Open.* 2017 Sep. 24; 7 (9): e017951. doi: 10.1136/bmjopen-2017-017951. PMID: 28947462; PMCID: PMC5623568.
10. Stephens G., Littlewood C., Foster N.E., Dikomitis L., Rehabilitation following rotator cuff repair: A nested qualitative study exploring the perceptions and experiences of participants in a randomised controlled trial. *Clin. Rehabil.* 2021 Jun; 35 (6): 911-919. doi: 10.1177/0269215520984025. Epub 2020 Dec 27. PMID: 33356517; PMCID: PMC8191163.
11. Bac, Aneta et al., "The influence of the Kinesio Taping on selected ultrasonography measurements, and quality of life in patients with rotator cuff lesions". *Scientific reports* vol. 10,1 18539. 29 Oct. 2020, doi:10.1038/s41598-020-75701-6
12. Sirasaporn, Patpiya et al., "Ultrasonographic findings of shoulders in individuals with spinal cord injury". *The journal of spinal cord medicine* vol. 44,3 (2021): 357-363. doi:10.1080/10790268.2019.1673547
13. Kopenhagen, Shane et al., "The reliability of rehabilitative ultrasound imaging in the measurement of infraspinatus muscle function in the symptomatic and asymptomatic shoulders of patients with unilateral shoulder impingement syndrome." *International journal of sports physical therapy* vol. 10,2 (2015): 128-35.
14. Tseng, Yu-Hsuan et al., "Use sonoelastography to predict the reparability of large-to-massive rotator cuff tears". *Medicine* vol. 99,27 (2020): e21139. doi:10.1097/MD.00000000000021139
15. Harput, Gulcan et al., "Active Scapular Retraction and Acromiohumeral Distance at Various Degrees of Shoulder Abduction". *Journal of athletic training* vol. 53,6 (2018): 584-589. doi:10.4085/1062-6050-318-17
16. Suzuki, Yuta et al., "Ultrasonographic Evaluation of the Shoulders and Its Associations with Shoulder Pain, Age, and Swim Training in Masters Swimmers." *Medicina (Kaunas, Lithuania)* vol. 57,1 29. 31 Dec. 2020, doi:10.3390/medicina57010029
17. Jiang, Li et al., "The Ultrasonographic Features of Shoulder Pain Patients in a Tertiary Hospital in South China". *BioMed research international* vol. 2020 3024793. 25 Aug. 2020, doi:10.1155/2020/3024793
18. Navarro-Ledesma, S. et al., "Is coracohumeral distance associated with pain-function, and shoulder range of movement, in chronic anterior shoulder pain?" *BMC musculoskeletal disorders* vol. 18,1 136. 4 Apr. 2017, doi:10.1186/s12891-017-1498-0
19. Hannah, Daniel C. et al., "Reliability and Validity of a 1-Person Technique to Measure Humeral Torsion Using Ultrasound". *Journal of athletic training* vol. 53,6 (2018): 590-596. doi:10.4085/1062-6050-213-17
20. Huang, Shih-Wei et al., "Relationship between severity of shoulder subluxation and soft-tissue injury in hemiplegic stroke patients". *Journal of rehabilitation medicine* vol. 44,9 (2012): 733-9. doi:10.2340/16501977-1026
21. Hou, Saiyun et al., "Ultrasonographic Validation of Anatomical Landmarks for Localization of the Tendon of the Long Head of Biceps Brachii". *BioMed research international* vol. 2017 (2017): 1925104. doi:10.1155/2017/1925104
22. Maenhout, Annelies et al., "Acromiohumeral distance and 3-dimensional scapular position change after overhead muscle fatigue". *Journal of athletic training* vol. 50,3 (2015): 281-8. doi:10.4085/1062-6050-49.3.92
23. Chang, Ke-Vin et al., "Association of Bicipital Peritendinous Effusion with Subacromial Impingement: A Dynamic Ultrasonographic Study of 337 Shoulders". *Scientific reports* vol. 6 38943. 12 Dec. 2016, doi:10.1038/srep38943
24. Park, Gi-Young et al., "Ultrasonographic measurement of shoulder subluxation in patients with post-stroke hemiplegia". *Journal of rehabilitation medicine* vol. 39,7 (2007): 526-30. doi:10.2340/16501977-0099
25. Yang, Chengyuan et al., "Musculoskeletal Ultrasonography Assessment of Functional Magnetic Stimulation on the Effect of Glenohumeral Subluxation in Acute Poststroke Hemiplegic Patients". *BioMed research international* vol. 2018 6085961. 3 Jul. 2018, doi:10.1155/2018/6085961
26. Huang, Shih-Wei, and Wei-Te Wang, "Quantitative diagnostic method for biceps long head tendinitis by using ultrasound". *TheScientificWorldJournal* vol. 2013 948323. 7 Dec. 2013, doi:10.1155/2013/948323
27. Mascarinas, Angelie L. et al., "Ultrasound of the pectoralis major muscle after reverse shoulder arthroplasty: a case report". *American journal of physical medicine & rehabilitation* vol. 93,12 (2014): e9-e14. doi:10.1097/PHM.0000000000000197
28. Wu, Chueh-Hung et al., "Dynamic ultrasonography to evaluate coracoacromial ligament displacement during motion in shoulders with supraspinatus tendon tears". *Journal of orthopaedic research : official publication of the Orthopaedic Research Society* vol. 30,9 (2012): 1430-4. doi:10.1002/jor.22084
29. Liu, Shan et al., "Evaluation of supraspinatus muscle changes in the shoulder joint of stroke patients with hemiplegic and shoulder subluxation using ultrasonography: comparison between affected and unaffected sides". *Journal of physical therapy science* vol. 34,1 (2022): 44-48. doi:10.1589/jpts.34.44
30. Lin, Pei-Hsin, "Sonographic findings of painful hemiplegic shoulder after stroke". *Journal of the Chinese Medical Association : JCMA* vol. 81,7 (2018): 657-661. doi:10.1016/j.jcma.2017.07.018
31. Cho, Hyong Keun et al., "Sonography of affected and unaffected shoulders in hemiplegic patients: analysis of the relationship between sonographic imaging data and clinical variables". *Annals of rehabilitation medicine* vol. 36,6 (2012): 828-35. doi:10.5535/arm.2012.36.6.828
32. Do, Jong Geol et al., "Correlation of Ultrasound Findings With Clinical Stages and Impairment in Adhesive Capsulitis of the Shoulder". *Orthopaedic journal of sports medicine* vol. 9,5 23259671211003675. 10 May. 2021, doi:10.1177/23259671211003675
33. Guzowski, Krzysztof et al., "Assessment of ultrasonography as a diagnostic tool in shoulder pain and alterations in glenohumeral range of motion in tennis players". *Wideochirurgia i inne techniki maloinwazyjne = Videosurgery and other minimally invasive techniques* vol. 14,1 (2019): 114-125. doi:10.5114/wiitm.2018.81183

34. Razmjou, Helen et al., "Impact of Radiographic Imaging of the Shoulder Joint on Patient Management: An Advanced-Practice Physical Therapist's Approach". *Physiotherapy Canada. Physiotherapie Canada* vol. 69,4 (2017): 351-360. doi:10.3138/ptc.2016-41PC
35. Ueda, Yasuyuki et al., "Agreement in rotator cuff muscles measurement between ultrasonography and magnetic resonance imaging". *Asia-Pacific journal of sports medicine, arthroscopy, rehabilitation and technology* vol. 28 13-20. 31 Mar. 2022, doi:10.1016/j.asmart.2022.03.005
36. Harput, Gulcan et al., "Shoulder-Rotator Strength, Range of Motion, and Acromiohumeral Distance in Asymptomatic Adolescent Volleyball Attackers". *Journal of athletic training* vol. 51,9 (2016): 733-738. doi:10.4085/1062-6050-51.12.04
37. Yi, Tae Im et al., "Reliability of the supraspinatus muscle thickness measurement by ultrasonography". *Annals of rehabilitation medicine* vol. 36,4 (2012): 488-95. doi:10.5535/arm.2012.36.4.488
38. Kim, Yang Soo et al., "The test-retest reliability of supraspinatus cross-sectional area measurement by sonography". *Annals of rehabilitation medicine* vol. 35,4 (2011): 524-8. doi:10.5535/arm.2011.35.4.524
39. Ishigaki, Tomonobu et al., "Does restriction of glenohumeral horizontal adduction reflect posterior capsule thickening of the throwing shoulder?" *Journal of physical therapy science* vol. 27,5 (2015): 1299-302. doi:10.1589/jpts.27.1299
40. Lee, Jun-Gyu et al., "Dynamic Ultrasonographic Measurement of Inferior Joint Capsule Thickness in Patients with Unilateral Frozen Shoulder". *Diagnostics (Basel, Switzerland)* vol. 11,5 898. 18 May. 2021, doi:10.3390/diagnostics11050898
41. Tseng, Yu-Hsuan et al., "Use sonoelastography to predict the reparability of large-to-massive rotator cuff tears". *Medicine* vol. 99,27 (2020): e21139. doi:10.1097/MD.00000000000021139
42. Nodehi Moghadam, Afsun et al., "The comparison of acromiohumeral distance and scapular dyskinesis prevalence in females with and without rounded shoulder posture". *Medical journal of the Islamic Republic of Iran* vol. 34 19. 11 Mar. 2020, doi:10.34171/mjiri.34.19
43. Dehqan, Behdokht et al., "Does forward head posture change subacromial space in active or passive arm elevation?". *The Journal of manual & manipulative therapy* vol. 29,4 (2021): 227-234. doi:10.1080/10669817.2020.1854010
44. Duan, Huiyu et al., "Application of Ultrasound Diagnosis Technology Based on Statistical Analysis in Rehabilitation Treatment of Shoulder Sports Injuries". *Journal of healthcare engineering* vol. 2021 4867850. 22 Dec. 2021, doi:10.1155/2021/4867850
45. Schmidt, Simon Vadstrup et al., "Acromio-Humeral Distance Is Associated with Shoulder External Strength in National Elite Badminton Players-A Preliminary Study". *Sports (Basel, Switzerland)* vol. 9,4 48. 31 Mar. 2021, doi:10.3390/sports9040048
46. Cesarec, Gordana et al., "Calcific tendinopathy: calcium deposit morphology directly affects pain and function of the shoulder". *Acta clinica Croatica* vol. 59, 2 (2020): 270-276. doi:10.20471/acc.2020.59.02.10
47. Lee, Chang Hwa et al., "Features of Golf-Related Shoulder Pain in Korean Amateur Golfers". *Annals of rehabilitation medicine* vol. 41,3 (2017): 394-401. doi:10.5535/arm.2017.41.3.394
48. Kim, Kyeongwon et al., "Ultrasound Dimensions of the Rotator Cuff and Other Associated Structures in Korean Healthy Adults". *Journal of Korean medical science* vol. 31,9 (2016): 1472-8. doi:10.3346/jkms.2016.31.9.1472
49. Schmidt, Malte et al., "Interrater reliability of physical examination tests in the acute phase of shoulder injuries". *BMC musculoskeletal disorders* vol. 22,1 770. 9 Sep. 2021, doi:10.1186/s12891-021-04659-x
50. Kim, Yeo Hyung et al., "Clinical and sonographic risk factors for hemiplegic shoulder pain: A longitudinal observational study". *Journal of rehabilitation medicine* vol. 46,1 (2014): 81-7. doi:10.2340/16501977-1238
51. Kim, Yeo Hyung et al., "Clinical and sonographic risk factors for hemiplegic shoulder pain: A longitudinal observational study". *Journal of rehabilitation medicine* vol. 46,1 (2014): 81-7. doi:10.2340/16501977-1238
52. Pong, Ya-Ping et al., "Sonography and physical findings in stroke patients with hemiplegic shoulders: a longitudinal study". *Journal of rehabilitation medicine* vol. 44,7 (2012): 553-7. doi:10.2340/16501977-0987
53. Park, Gi-Young et al., "Ultrasonographic measurement of the axillary recess thickness in an asymptomatic shoulder". *Ultrasonography (Seoul, Korea)* vol. 36,2 (2017): 139-143. doi:10.14366/usg.16032
54. Kim, Yong Ki et al., "Quantitative Measurement of Muscle Atrophy and Fat Infiltration of the Supraspinatus Muscle Using Ultrasonography After Arthroscopic Rotator Cuff Repair". *Annals of rehabilitation medicine* vol. 42,2 (2018): 260-269. doi:10.5535/arm.2018.42.2.260
55. Lin, Yen-Sheng et al., "Effects of repetitive shoulder activity on the subacromial space in manual wheelchair users". *BioMed research international* vol. 2014 (2014): 583951. doi:10.1155/2014/583951
56. Yi, Youbin et al., "Prevalence of the rotator cuff tear increases with weakness in hemiplegic shoulder". *Annals of rehabilitation medicine* vol. 37,4 (2013): 471-8. doi:10.5535/arm.2013.37.4.471
57. Joseph, Leonard H et al., "Clinical evaluation of the anterior translation of glenohumeral joint using ultrasonography: an intra- and inter-rater reliability study". *Acta orthopaedica et traumatologica turcica* vol. 48,2 (2014): 169-74. doi:10.3944/AOTT.2014.3184
58. Xie, Hualong et al., "Reliability of ultrasonographic measurement of the supraspinatus thickness at different angles of shoulder abduction in patients with stroke". *Journal of physical therapy science* vol. 32,3 (2020): 257-259. doi:10.1589/jpts.32.257
59. Ishigaki, Tomonobu et al., "Supraspinatus tendon thickness and subacromial impingement characteristics in younger and older adults". *BMC musculoskeletal disorders* vol. 23,1 234. 11 Mar. 2022, doi:10.1186/s12891-022-05179-y
60. Liu, Shan et al., "The reliability and effectiveness of shoulder joint evaluation by ultrasonography in stroke patients: deltoid muscle thickness, acromion-humeral distance, acromion-lesser tuberosity distance". *Journal of physical therapy science* vol. 34,1 (2022): 31-35. doi:10.1589/jpts.34.31
61. Kitagawa T., Aoki Y., Sugimoto H., Ozaki N., Randomised controlled trial for evaluation of an ultrasound-guided palpation intervention for palpation skill training. *Sci. Rep.* 2022 Jan 24; 12 (1): 1189. doi: 10.1038/s41598-022-05290-z. PMID: 35075225; PMCID: PMC8786950.