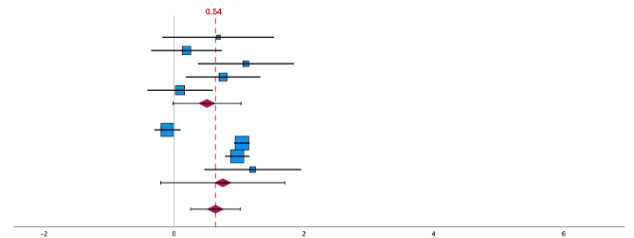


Ultrasound elastography of back muscle biomechanical properties: a systematic review and meta-analysis of current methods

ELECTRONIC SUPPLEMENTARY MATERIAL

a. Muscle Excitation Method		Study ID	pSMD	SE	95% CI	Pvalue
Body movement	Peolsson et al., 2008		0.68	0.44	(-0.18-1.54)	0.121
	Wong et al., 2016		0.19	0.28	(-0.35-0.74)	0.489
	Griefhan et al., 2017		1.11	0.38	(0.37-1.85)	0.003
	Griefhan et al., 2021		0.75	0.29	(0.15-1.33)	0.010
	Vining et al., 2022		0.09	0.26	(-0.41-0.59)	0.724
	Subgroup overall		0.51	0.19	(-0.02-1.03)	0.055
Manual compression	Yurdakul et al., 2019		-0.10	0.10	(-0.3-0.1)	0.320
	Sanchez-Infante et al., 2021		1.04	0.06	(0.93-1.16)	<0.001
	Tamaraiah et al., 2022		0.97	0.10	(0.78-1.16)	<0.001
	Wachi et al., 2022		1.21	0.38	(0.47-1.96)	0.001
	Subgroup overall		0.75	0.30	(-0.21-1.71)	0.088
Overall			0.64	0.17	(0.25-1.02)	0.005

Model: Random effects model; Tau-squared: 0.21, I-squared: 0.90; Homogeneity: Q = 109.88, df = 8, Pvalue = 0.005; Test of overall pSMD: t = 3.83, df = 8, Pvalue < 0.001. pSMD: pooled standardised mean difference; SE: standard error; CI: confidence interval.



b. Muscle Excitation Method		Study ID	pSMD	SE	95% CI	Pvalue
ARFI	Xu et al., 2018		3.00	0.55	(1.92-4.09)	<0.001
	Ding et al., 2019		2.08	0.53	(1.04-3.12)	<0.001
	Gao et al., 2020		0.86	0.33	(0.21-1.51)	0.009
	Kisilewicz et al., 2020		4.53	0.71	(3.13-5.92)	<0.001
	Bethers et al., 2021		0.47	0.09	(0.29-0.64)	<0.001
	Buran Cirak et al., 2021		1.72	0.06	(1.61-1.83)	<0.001
	Kumamoto et al., 2021		1.37	0.11	(1.16-1.57)	<0.001
	Yamaura et al., 2021		0.81	0.07	(0.68-0.94)	<0.001
	Gunaydin et al., 2022		0.37	0.07	(0.24-0.5)	<0.001
	Sasaki et al., 2022		0.86	0.28	(0.3-1.42)	0.002
	Valero-Calero et al., 2022		-0.02	0.07	(-0.15-0.12)	0.800
	Vatovec et al., 2022		0.22	0.07	(0.09-0.36)	0.001
	Subgroup overall		1.24	0.35	(0.46-2.02)	0.005
Overall			1.24	0.35	(0.46-2.02)	0.005

Model: Random effects model; Tau-squared: 1.22, I-squared: 0.99; Homogeneity: Q = 805.12, df = 11, Pvalue = 0.005; Test of overall pSMD: t = 3.50, df = 11, Pvalue < 0.001. ARFI: acoustic radiation force impulse; pSMD: pooled standardised mean difference; SE: standard error; CI: confidence interval.

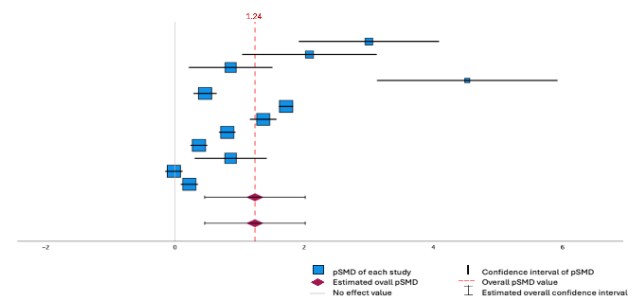
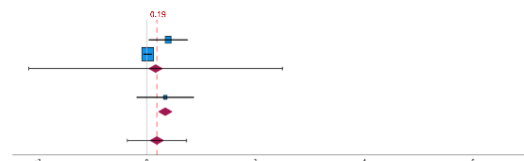


Figure S1.1 – Forest Plots of responsiveness studies. a. Within-group responsiveness studies using strain imaging. b. Within-group responsiveness studies using shear wave imaging.

a. Muscle Excitation Method		Study ID	pSMD	SE	95% CI	Pvalue
Body movement	Griefhan et al., 2021		0.39	0.18	(0.04-0.75)	0.031
	Weber et al., 2022		0.02	0.04	(-0.06-0.1)	0.657
	Subgroup overall		0.16	0.18	(-2.17-2.5)	0.536
Manual compression	Sanchez-Infante et al., 2021		0.34	0.27	(-0.19-0.87)	0.206
	Subgroup overall		0.34	0.27	(-0.19-0.87)	0.206
Overall			0.19	0.13	(-0.36-0.73)	0.278

Test of overall pSMD: t = 1.47, df = 2, Pvalue = 0.28. pSMD: pooled standardised mean difference; SE: standard error; CI: confidence interval.



b. Muscle Excitation Method		Study ID	pSMD	SE	95% CI	Pvalue
ARFI	Buran Cirak et al., 2021		0.66	0.38	(-0.09-1.41)	0.086
	Aljinovic et al., 2022		0.11	0.15	(-0.19-0.41)	0.471
	Gunaydin et al., 2022		0.27	0.12	(0.04-0.49)	0.022
	Koppenhaver et al., 2022		0.35	0.06	(0.23-0.47)	<0.001
	Valero-Calero et al., 2022		0.18	0.21	(-0.23-0.58)	0.392
	Subgroup overall		0.30	0.05	(-0.23-0.58)	0.392
Overall			0.30	0.05	(0.17-0.43)	0.003

Test of overall pSMD: t = 6.38, df = 4, Pvalue < 0.01. ARFI: acoustic radiation force impulse; pSMD: pooled standardised mean difference; SE: standard error; CI: confidence interval.

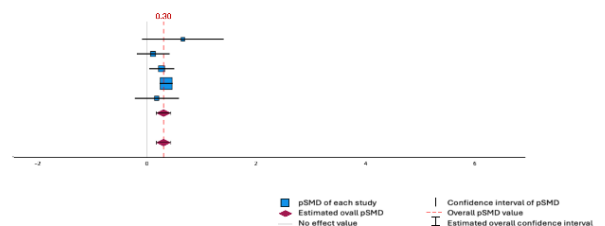


Fig S1.2 – Forest Plots of responsiveness studies. a. Between-groups responsiveness studies using strain imaging. b. Between-groups responsiveness studies using shear wave imaging.

Table S1 – Medline strategy. Ovid MEDLINE(R) ALL 1946 to February 15, 2023

1	exp back muscles/ or exp fascia/	13150
2	((back or dorsi or dorsal or vertebr* or neck or cervic* or nucha* or spina* or paraspinal* or sacrospinal* or thoracic* or thoracolumbar* or lumbar* or lumbar* or lumbosacral* or sacrococcygeal* or sacral* or coccygeal* or trapez* or levator scapulae* or rhomboid* or serratus posterior* or splenius or iliocostal* or longissimus or rotator* or multifidi* or semispinal* or interspinal* or intertransvers* or transversospinal*) adj8 (muscl* or muscul* or neuromusc* or fascia* or aponeuros*)).tw,kf.	64718
3	1 or 2	74897
4	exp ultrasonography/	482831
5	(ultrasonograph* or ultrasound* or ultrasonic* or sonograph* or sonogram* or echograph* or echogram* or echotomograph* or elastogra* or sonoelastogra* or ARFI or ((elasticity or visco* or deformation or supersonic or Nakagami or Homodynedy) adj4 imaging) or speckle or Backscatter or attenuation or "speed of sound" or "shear wave*").tw,kf.	595784
6	4 or 5	828118
7	3 and 6	3772
8	case reports.pt.	2318689
9	(case* adj2 (report* or stud*)).ti.	422378
10	(case* adj2 report*).jw.	125837
11	8 or 9 or 10	2483057
12	7 not 11	3088
13	(Animals/ or Models, animal/ or Disease models, animal/) not Humans/	5059973
14	((animal or animals or canine* or cat or cats or dog or dogs or feline or hamster* or lamb or lambs or mice or monkey or monkeys or mouse or murine or pig or pigs or piglet* or porcine or primate* or rabbit* or rats or rat or rodent* or sheep* or veterinar*) not (human* or patient* or women or men)).ti,kf,jw.	2566909
15	13 or 14	5528217
16	12 not 15	2679
17	remove duplicates from 16	2679
18	(2020042* or 2020043* or 202005* or 202006* or 202007* or 202008* or 202009* or 20201* or 2021* or 2022* or 2023*).ed,dt,ez.	5150248
19	17 and 18	947

Table S2 a – Quality rating of the included studies using the consensus-based standards for the selection of health status measurement instruments (COSMIN) subscales for reliability, validity, and responsiveness.

Study ID	Reliability		Known-groups validation	Responsiveness	
	Reliability	Measurement error		Within-group	Between-groups
Alijnovic et al., 2020	very good	-	very good	-	-
Alis et al., 2018	adequate	-	-	-	-
Alijnovic et al., 2022	-	-	doubtful	-	-
Barun et al., 2021	adequate	-	-	-	-
Bethers et al., 2021	-	-	-	adequate	-
Blain et al., 2019	adequate	-	-	-	-
Buran Cirak et al., 2021	-	-	-	very good	very good
Calvo-Lobo et al., 2017	-	-	-	-	-
Can et al., 2021	-	-	very good	-	-
Chan et al., 2012	inadequate	-	adequate	-	-
Chen et al., 2020	doubtful	-	-	-	-
Creze et al., 2017	-	-	doubtful	-	-
Dieterich et al., 2017	doubtful	adequate	-	-	-
Ding., 2019	-	-	adequate	doubtful	-
Dones et al., 2021	very good	-	very good	-	-
Ertekin et al., 2021	-	-	very good	-	very good
Gao., 2019	adequate	-	very good	-	-
Gao et al., 2020	-	-	very good	doubtful	very good
Griefahn., 2017	-	-		doubtful	-
Griefahn et al., 2021	-	-	-	very good	very good
Güler et al., 2022	-	-	-	doubtful	very good
Gunaydin et al., 2022	-	-	-	adequate	adequate
Heizelmann et al., 2017	-	-	adequate	-	-
Hvedstrup et al., 2020	-	-	very good	-	-
Ishikawa et al., 2017	-	-	very good	-	very good

Ishikawa et al.,2020	-	-	very good	-	-
Karayol et al., 2021	-	-	adequate	-	-
Kelly 2018	very good	-	-	-	-
Kisilewicz et al., 2020	-	-	-	very good	-
Koppenhaver., 2018	very good	very good	-	-	-
Koppenhaver., 2020	-	-	very good	-	-
Koppenhaver et al., 2022	-	-	-	-	very good
Kozinc et al., 2020	very good	-	-	-	-
Kumamoto et al., 2021	adequate	-	-	very good	-
Landen Ludvigsson et al., 2016	very good	very good	very good	-	very good
Langévin et al., 2011	doubtful	-	very good	-	-
Leong et al., 2013	adequate	very good	-	-	-
Leong et al., 2016	-	-	adequate	-	-
Liang et al., 2021	-	-	adequate	-	-
Ma et al., 2020	adequate	-	-	-	-
Masaki et al., 2017	-	-	very good	-	-
Masaki et al., 2019	-	-	adequate	-	-
Moreau et al., 2016	adequate	-	-	-	-
Murillo et al., 2019	very good	-	very good	-	-
Nagai et al., 2020	very good	very good	-	-	-
Peolsson et al., 2008	-	-	very good	very good	-
Peolsson et al., 2010	adequate	-	-	-	-
Peolsson et al., 2013a	-	-	very good	-	-
Peolsson et al., 2015	-	-	very good	-	-
Peterson et al., 2019	doubtful	-	-	-	-
Pimentel-Santos et al., 2021	adequate	-	-	-	-
Pinto et al., 2022	-	-	very good	-	-
Qazi et al., 2022	adequate	adequate	-	-	-
Rahnama et al., 2018	-	-	adequate	-	-
Sakaki et al., 2022	doubtful	-	-	doubtful	-
Sanchez-Infante et al., 2021	adequate	-	-	adequate	adequate

Sawada et al., 2020	very good	-	-	-	-
Shimoyama et al., 2021	very good	-	-	-	-
Takla et al., 2016	-	-	very good	-	-
Tamartash et al., 2022	-	-	-	inadequate	-
Tamartash et al., 2023	-	-	inadequate	-	-
Tas et al., 2018	-	-	adequate	-	-
Turo et al., 2015	-	adequate	-	-	-
Valero-Calero et al., 2021	-	-	very good	-	-
Valero-Calero et al., 2022	-	-	-	adequate	adequate
Vatovec et al., 2022	-	-	-	adequate	-
Wachi et al., 2022	-	-	-	adequate	-
Wada et al., 2019	Very good	-	-	-	-
Wang et al., 2020	adequate	very good	-	-	-
Weber et al., 2022	-	-	-	-	very good
Wong et al., 2016	-	-	-	very good	very good
Xie et al., 2019	very good	very good	-	-	-
Xu et al., 2018	-	-	-	very good	adequate
Yamamoto et al., 2017	very good	-	-	-	-
Yamaura et al., 2021	adequate	-	-	very good	-
Yurdakul et al., 2019	-	-	-	very good	-
Zhang et al., 2019	adequate	adequate	-	-	-

Tables S2 b–e – COSMIN Boxes used for reliability, validity, and responsiveness subscales. COSMIN methodology is a modular system that needs to be adapted according to the review purposes [3; 4; 5]. We considered reliability (boxes 6 and 7), construct validation (box 9b) and responsiveness (boxes 10c AND 10d) subscales. Boxes 1 to 5, 8, 9a, 10a and 10b were omitted.

Table S2 b. Box 6. Reliability					
Design requirements	Very good	Adequate	Doubtful	Inadequate	NA
1. If patients were implicated in the study, were patients stable in the interim period on the construct to be measured?	Evidence if patients were stable	Assumable that patients were stable	Unclear if patients were stable	Patients were NOT stable	
2. If a treatment was applied, was the time interval measurements appropriate?	Time interval appropriate		Doubtful whether time interval was appropriate or time interval was not stated	Time interval NOT appropriate	
3. Were the test conditions similar for the measurements? e.g. type of administration, environment, instructions.	Test conditions were similar (evidence provided)	Assumable that test conditions were similar	Unclear if test conditions were similar	Test conditions were NOT similar	
Statistical methods	Very good	Adequate	Doubtful	Inadequate	NA
4. Was an intraclass correlation coefficient (ICC) single measure calculated? For intra-rater reliability, was an ICC Model 3 Form 1 calculated?	ICC calculated and model or formula of the ICC is described	ICC calculated but model or form of the ICC not described.	No information of which type of ICC was used and the conditions for measurements are unclear.	No ICC single measure or ICC Model 3 Form 1 calculated	
Other	Very good	Adequate	Doubtful	Inadequate	NA
5. Were there any other important flaws in the design or statistical methods of the study?	No other important methodological flaws		Other minor methodological flaws	Other important methodological flaws	

Table S2 c. Box 7. Measurement error					
Design requirements	Very good	Adequate	Doubtful	Inadequate	NA
1. If patients were implicated in the study, were patients stable in the interim period on the construct to be measured?	Evidence if patients were stable	Assumable that patients were stable	Unclear if patients were stable	Patients were NOT stable	
2. If a treatment was applied, was the time interval between the measurements appropriate?	Time interval appropriate		Doubtful whether time interval was appropriate or time interval was not stated	Time interval NOT appropriate	
3. Were the test conditions similar for the measurements? e.g. type of administration, environment, instructions.	Test conditions were similar (evidence provided)	Assumable that test conditions were similar	Unclear if test conditions were similar	Test conditions were NOT similar	
Statistical methods	Very good	Adequate	Doubtful	Inadequate	NA
4. Was the Standard Error of Measurement (SEM), Minimum Detectable Change (MDC), Limits of Agreement (LoA) calculated?	SEM, MDC, or LoA calculated	Possible to calculate SEM, MDC or LoA from the data presented.		SEM, MDC or LoA calculated based on SD from another population	NA
Other	Very good	Adequate	Doubtful	Inadequate	NA
5. Were there any other important flaws in the design or statistical methods of the study?	No other important methodological flaws		Other minor methodological flaws	Other important methodological flaws	

Table S2 d. Box 9. Hypothesis testing for construct validity					
9b. Comparison between subgroups (discriminative or known-groups validity)					
Design requirements	Very good	Adequate	Doubtful	Inadequate	NA
1. Was an adequate description provided of important characteristics of the subgroups?	Adequate description of the important characteristics of the subgroups	Adequate description of most of the important characteristics of the subgroups	Poor or no description of the important characteristics of the subgroups		
Statistical methods	Very good	Adequate	Doubtful	Inadequate	NA
2. Were design and statistical methods adequate for the hypotheses to be tested?	Statistical methods applied appropriate	Assumable that statistical methods were appropriate	Statistical methods applied NOT optimal	Statistical methods applied NOT appropriate	
Other	Very good	Adequate	Doubtful	Inadequate	NA
3. Were there any other important flaws in the design or statistical methods of the study?	No other important methodological flaws		Other minor methodological flaws	Other important methodological flaws	

Table S2 e. Box 10. Responsiveness					
10c. Construct approach: (i.e. hypotheses testing: comparison between subgroups)					
Design requirements.	Very good	Adequate	Doubtful	Inadequate	NA
1. Was an adequate description provided of important characteristics of the subgroups?	Adequate description of the important characteristics of the subgroups	Adequate description of most of the important characteristics of the subgroups	Poor or no description of the important characteristics of the subgroups		
Statistical methods	Very good	Adequate	Doubtful	Inadequate	NA
2. Were design and statistical methods adequate for the hypotheses to be tested?	Statistical methods applied appropriate	Assumable that statistical methods were appropriate	Statistical methods applied NOT optimal	Statistical methods applied NOT appropriate	
Other	Very good	Adequate	Doubtful	Inadequate	NA
3. Were there any other important flaws in the design or statistical methods of the study?	No other important methodological flaws		Other minor methodological flaws	Other important methodological flaws	
10d. Construct approach: (i.e. hypotheses testing: before and after intervention)					
Design requirements	Very good	Adequate	Doubtful	Inadequate	NA
1. Was an adequate description provided of the intervention given?	Adequate description of the intervention	Adequate description of most of the intervention	Poor description of the intervention	NO description of the intervention	
Statistical methods	Very good	Adequate	Doubtful	Inadequate	NA
2. Were design and statistical methods adequate for the hypotheses to be tested?	Statistical methods applied appropriate	Assumable that statistical methods were appropriate	Statistical methods applied NOT optimal	Statistical methods applied NOT appropriate	
Other	Very good	Adequate	Doubtful	Inadequate	NA
3. Were there any other important flaws in the design or statistical methods of the study?	No other important methodological flaws		Other minor methodological flaws	Other important methodological flaws	

References used for the adapted COSMIN methodology.

- 1 Portney LG, Watkins MP (2009) Foundations of clinical research: applications to practice. Pearson/Prentice Hall Upper Saddle River, NJ
- 2 Doi SA, Williams GM (2013) Methods of clinical epidemiology. Springer
- 3 Mokkink LB, de Vet HCW, Prinsen CAC et al (2018) COSMIN Risk of Bias checklist for systematic reviews of Patient-Reported Outcome Measures. Qual Life Res 27:1171-1179
- 4 Prinsen CAC, Mokkink LB, Bouter LM et al (2018) COSMIN guideline for systematic reviews of patient-reported outcome measures. Qual Life Res 27:1147-1157
- 5 Terwee CB, Prinsen CAC, Chiarotto A et al (2018) COSMIN methodology for evaluating the content validity of patient-reported outcome measures: a Delphi study. Qual Life Res 27:1159-1170

Table S3 – Characteristics of studies included in the meta-analysis.

First author, year	Ultrasound method Excitation method Measured physical quantity (and units) US model, company, country Type of probe, position, and frequency Clinical/research device	Participants' condition N/group Age (mean, SD) Sex (male: female)	Muscle assessed (and spinal level, if specified)	Patient's position (and muscle state)
Alis et al., 2018	Shear wave imaging ARFI Shear modulus (kPa) Aplio Platin. 500, Toshiba, CA Convex, parallel, 1-6 MHz Clinical	Patients with unilateral lumbar disk herniation (LDH) 33 47.30 ± 11.22 years 17:16	Lumbar multifidus, slightly below the level of herniation (varies from L3 to L5).	Prone at rest.
Aljinovic et al., 2020	Shear wave imaging ARFI Shear modulus (kPa) Aixplorer, SuperSonic, France Linear, parallel, 2-10 MHz Clinical	Patients who were involved in a car accident and suffered a whiplash Injury/asymptomatic control. 75 (whiplash)/75 (controls) 43.1±13.5 (whiplash)/46.5±16.3 (controls) 32:43 (whiplash)/34:41 (controls)	Upper trapezius (mid-way between shoulder and head).	Seated at rest.
Aljinovic et al., 2022	Shear wave imaging ARFI unclear Aixplorer, Supersonic, France Linear, parallel, 2–10MHz Clinical	Whiplash associated disorders (WAD)/asymptomatic controls. 99(WAD)/75(controls) 41.9 ±13/46.5 ± 16.3 unclear/45:55	Upper trapezius.	Seated at rest.
Barun et al., 2021	Shear wave imaging ARFI Shear modulus (kPa) Aixplorer, Supersonic, France Linear, parallel, 2–10MHz Clinical	Whiplash associated disorders (WAD). 22 (WAD) 38.6 ±11 10:12	Upper trapezius.	Seated at rest.
Bethers et al., 2021	Shear wave imaging ARFI Young modulus (kPa) GE LOGIC S8, GE Healthcare Linear, parallel, 2.4-10MHz Clinical	Asymptomatic participants. 60 27.1 ± 8.8 36:24	Upper trapezius.	Prone at rest.

First author, year	Ultrasound method Excitation method Measured physical quantity (and units) US model, company, country Type of probe, position, and frequency Clinical/research device	Participants' condition N/group Age (mean, SD) Sex (male: female)	Muscle assessed (and spinal level, if specified)	Patient's position (and muscle state)
Blain et al., 2019	Shear wave imaging ARFI Young modulus (kPa) Aixplorer, SuperSonic, France Convex, parallel, unclear Clinical	Asymptomatic participants. 15 24 ± 4 09:06	Erector spinae (L4), multifidus (L4).	Prone at rest (task 1), Prone + passive arm elevation (task 2), seated at rest (task 3), seated + passive arm elevation (task 4), seated + passive thigh elevation (task 5).
Buran Cirak et al., 2020	Shear wave imaging ARFI Shear modulus (kPa) unclear, unclear Linear, parallel, 2–10MHz Clinical	LBP having real sustained natural apophyseal glides treatment (SNAG)/LBP having Sham SNAG. 15 (LBP + SNAG)/15 (LBP + Sham SNAG) 21 ± 1.7/20.4 ± 0.5 05:10/04:11	Erector spinae (L4) and multifidus (L3).	Prone at rest.
Calvo-Lobo et al., 2017	Strain imaging Strain ratio (no units) Manual compression LOGIQ P9, GE Healthcare Linear, unclear, 6-15 MHz Clinical	Patients with nonspecific lumbopelvic Pain (LPP). 10 26.50 ± 7.00 09:01	Active and latent myofascial trigger point (A-MTrPs and L-MTrPs) with regards to control points in the lumbar erector spinae of subjects with LPP.	Prone at rest.
Can et al., 2021	Shear wave imaging ARFI Young modulus (kPa) MyLab 9, Esaote, unclear Linear, parallel, 4-15 MHz. Clinical	LBP having a lumbar unilateral disc herniation. 22 (hernia side)/22 (non-hernia side) 44.23 ± 5.49 10:12	Multifidus (lumbar hernia level varying from L3 to S1).	Prone at rest.
Chan et al., 2012	Strain imaging TUPS Young modulus (kPa) HDI-5000, Philips, USA Cylindrical, unclear, 5 MHz Research	low back pain (LBP)/asymptomatic controls 12 (LBP)/12 (controls) 36.6 ± 2.9 (LBP)/25.2 ± 1.1 (No-LBP) 24:00:00	Lumbar multifidus (L4).	Prone at rest, upright at rest, 25° forward stooping, 45° forward stooping.

First author, year	Ultrasound method Excitation method Measured physical quantity (and units) US model, company, country Type of probe, position, and frequency Clinical/research device	Participants' condition N/group Age (mean, SD) Sex (male: female)	Muscle assessed (and spinal level, if specified)	Patient's position (and muscle state)
Chen et al., 2020	Shear wave imaging ARFI Shear modulus (kPa) Aixplorer, SuperSonic, France Linear, parallel, 2–10MHz Clinical	Asymptomatic male participants. 20 18.4 ± 0.7 20:00	Thoracolumbar fascia (L3-L4).	Seated at rest.
Creze et al. 2017	Shear Wave Imaging ARFI Shear modulus (kPa) Aixplorer, SuperSonic, France Supercurved, parallel, 6-10 MHz Clinical	Cadavers/asymptomatic participants 23 (16 healthy adults, 7 cadavers) 23 7:9	Multifidus (MF), longissimus (L), iliocostalis (IC) (L3)	Prone at rest.
Dieterich et al., 2017	Shear wave imaging ARFI Shear modulus (kPa) Aixplorer, SuperSonic, France Linear, parallel, 2-10 MHz Clinical	Asymptomatic participants 11 21.7 ± 3.2 07:04	Trapezius, splenius capitis, semispinalis capitis, semispinalis cervicis and multifidus (all at C4).	Prone in resting state (task 1), performing a lift of 1/3 of the head's weight (task 2), a lift of 2/3 of the head's weight (task 3), a lift of full head weight (task 4).
Ding et al., 2019	Shear wave imaging ARFI Young modulus (kPa) Aixplorer, SuperSonic, France Linear, parallel, 4-15 MHz Clinical	Inpatients having an arthroscopic surgery/inpatient having upper limbs surgery. 22 (arthroplasty)/12 (controls) 61.91 ± 8.93 6:22 (patients) / 3:12 (controls)	Splenius capitis (C4), upper trapezius (mid-point of a line between the C7 and the middle of the acromion).	Seated at rest.
Dones et al., 2021	Strain imaging Body movement Displacement (mm) HS1, Konica Minolta, Tokyo, Japan. Linear, parallel, 5-13 MHz Research	Myofascial pain syndrom/asymptomatic controls 5 (MFP)/ 5 (controls) 37 ± 6 02:08	Trapezius deep fascia (C7).	Seated performing cervical flexion, extension, right lateral flexion, left lateral flexion, right rotation, left rotation.

First author, year	Ultrasound method Excitation method Measured physical quantity (and units) US model, company, country Type of probe, position, and frequency Clinical/research device	Participants' condition N/group Age (mean, SD) Sex (male: female)	Muscle assessed (and spinal level, if specified)	Patient's position (and muscle state)
Ertekin et al., 2021a	Shear wave imaging ARFI Young modulus (kPa) RS 80, Samsung, Korea. Linear, parallel, 9-12 MHz Clinical	Women with trigger points in the upper part of the trapezius muscle (myofascial pain; MFP) / asymptomatic women. 30 (MFP)/ 30 (controls) 20.3 ± 1.7/20.9 ± 2.2 00:60	Trapezius (1/2 of the length between the spinous process of C7 and acromion).	Seated at rest.
Gao et al., 2019	Shear wave imaging ARFI Young modulus (m/s) ACUSON S3000, SIEMENS, CA Linear, parallel, 4-9 MHz Clinical	Patients with low back somatic dysfunction/asymptomatic controls. 20 (som. dysfunction)/9 (controls) 28, no SD (som. dysfunction) /26, no SD (controls) 15:14	Iliocostalis lumborum (ICL) (L1–L5) with somatic dysfunction and ICL without somatic dysfunction (in patients), healthy ICL (in controls).	Prone at rest (task 1), prone performing Superman spine extension (contraction) (task 2). In patients with somatic dysfunction measures were also done immediately before and after osteopathic manipulative treatment.
Gao et al., 2020	Shear wave imaging ARFI Shear wave speed (m/s) ACUSON S3000, Siemens Medical Solutions, USA linear, parallel, 4-9 MHz. Clinical	Adults with asymmetric lumbar somatic dysfunction (som. dysfunction). 20 (som. dysfunction) 28 ± unclear 10:10	Iliocostalis lumborum (L1–L5)	Prone at rest.
Griefahn et al., 2021	Strain imaging Body movement Strain and displacement (% and mm) MyLabOne, Esaote, Germany. Linear, parallel, 13 MHz. Research	Asymptomatic 45 26.31 ± 3.92 23:22	thoracolumbar fascia (L 2-L3)	Prone lying on a motorized articulated table that passively moved the trunk.

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Griefhan et al., 2017	Strain imaging Body movement Displacement (mm) MyLab One, Esaote, Germany Linear, parallel, 6-13 MHz Research	Healthy sportive participants. Foam Roll Group (13)/placebo group (12)/control group (13) 23.34 ± 2.58 13:25	Thoracolumbar fascia (L 2-L3).	Seated, performing a thoracolumbar flexion of 30° before and 10 minutes after a foam roll (or placebo) treatment. Controls had no treatment.
Gunaydin et al., 2022	Shear wave imaging ARFI Shear modulus (kPa) RS80, Samsung, Korea. Linear, parallel, 9 MHz. Clinical	Participants with rounded shoulders performing a home exercise physiotherapy program for 4 weeks with performance taping (PT) treatment, classic taping (CT) treatment and without taping (controls). 15(PT)/14(CT)/10(controls) 23.3 ± 3.6/22.5 ± 4.1/23.3 ± 5.4 unclear	Upper trapezius (unclear).	Seated at rest.
Heizelmann et al., 2017	Shear wave imaging ARFI Shear wave speed (m/s) ACUSON S3000, SIEMENS, Germany Linear, parallel, 4-9 MHz Clinical	Participants over 60 years/ under 60 years > 60 years (24)/≤ 60 years (254) 35.51 ± 14.93 110:168	Erector spinae (level of iliac crest), trapezius (level of the midclavicular line).	Prone at rest.
Hvedstrup et al., 2020	Shear wave imaging ARFI Shear wave speed (m/s) Logic E9, GE Healthcare, UK Linear, parallel, 9 MHz Clinical	Migraine patients with ictal neck pain/ migraine patients without ictal neck pain/ asymptomatic controls. 52 (migraine with ictal)/ 48 (migraine without ictal)/46 (controls) median (25–75 percentiles): 44 (29–53) (migraine with ictal)/ 42 (32–52) (migraine without ictal)/42 (31–52) (controls) 89%/91%/93%	Trapezius (1/3 of the length between the spinous process of C7 and acromion), splenius capitis (C5) and semispinalis capitis (C5).	Seated at rest.

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Ishikawa et al., 2017	Strain imaging Manual compression Strain ratio (no units) HI VISION Avius, Hitachi, Japan Linear, unclear, 6-14 MHz, acoustic coupler (Hitachi, Japan) Research	Patients with neck and shoulders complaints/ asymptomatic controls. 18 (complaints)/ 10 (controls) 25.7 ± 2.9/24.5 ± 3.9 9:9/8:4	Trapezius (2 cm distal midpoint C7- acromion), levator scapulae (LS) (2 cm distal to scapula sup. angle - midpoint C1 - C4), rhomboid (midpoint scapula inf. angle - T3).	Seated at rest, before and after the typing task.
Ishikawa et al., 2020	Strain imaging Manual compression Strain ratio (no units) HI VISION Avius, Hitachi, Japan Linear, unclear, 6-14 MHz, acoustic coupler (Hitachi, Japan) Research	Patients with symptomatic tears/patients with asymptomatic tears/healthy controls. 13 (symptomatic)/10 (asymptomatic)/9 (controls) 66 ± 7/72 ± 8/62 ± 8 10:3/3:7/5:7	Trapezius (2 cm distal midpoint C7- acromion), levator scapulae (2 cm distal to scapula sup. angle - midpoint C1 - C4), rhomboid (midpoint scapula inf. angle - T3).	Seated with 0°, 60°, 90° and 120° arm elevation.
Karayol et al., 2021	Shear wave imaging ARFI Shear wave speed (m/s) ACUSON S3000, Siemens Medical Solutions, USA. Linear, parallel, 4-9 MHz. Clinical	Participants with fibromyalgia (FM)/asymptomatic controls 53 (FM)/ 47 (controls) 39 (range, 23–60 years) / 37 (range, 21–58 years). 0:53/0:47	Rhomboid major (unclear).	Prone at rest.
Kelly et al., 2018	Shear wave imaging ARFI Young modulus (kPa) Aixplorer, SuperSonic, France Linear, parallel, 4-15 MHz Clinical	Asymptomatic participants 17 (males)/13 (females) 27.87 ± 5.76 17:13	Erector spinae (L4).	Prone at rest (task 1), 40% of maximum voluntary contraction (MVC) (task 2) and 80 % MVC (task 3).
Kisilewicz et al., 2020	Shear wave imaging ARFI Shear modulus (kPa) LOGIQ S8, GE Healthcare, USA. Linear, parallel, 9 MHz. Clinical	Asymptomatic participants performing eccentric exercises (ECC). 14 23.2 ± 3.0 11:3	Upper trapezius (C7).	Seated at rest.

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Kitamura et al. 2020	Shear Wave Imaging ARFI Shear modulus (kPa) Aixplorer, SuperSonic, France Superlinear, parallel, 2-10 MHz Clinical	College swimmers with LBP/college swimmers without LBP 11 (LBP)/21 (controls) 21.1 ± 1.5 (LBP)/20.6 ± 1.5 (controls) 32:0	Latissimus dorsi (LD) (10 cm below the acromion).	Seated at rest.
Koppenhaver et al., 2018	Shear wave imaging ARFI shear modulus (kPa) Aixplorer, Supersonic, WA Linear, parallel, 2-10 MHz Clinical	Asymptomatic participants 36 30.4 ± 5.5 50%:50%	Erector spinae (ES) (iliocostalis and longissimus muscles) (L4) and multifidus (MF) (L4/L5).	Prone at rest (MF and ES) and at minimal and moderate contraction levels (MF only).
Koppenhaver et al., 2020	Shear wave imaging ARFI Shear modulus (kPa) Aixplorer, Supersonic, France Linear, parallel, 2-10 MHz Clinical	LBP/asymptomatic controls 60 (LBP)/60 (controls) 32.2 ± 7.3/31 ± 8 40%:60%/57%:43%	Erector spinae (ES) (iliocostalis and longissimus muscles) and multifidus (MF) on the most symptomatic side (right or left) at the most symptomatic level (L3, L4, or L5) for LBP patients and on the right side at the L4 spinal level for controls and patients with bilateral symptoms.	Prone at rest (task 1; ES and MF assessment) and during submaximal contractions (task 2; MF only).
Koppenhaver et al., 2022	Shear wave imaging ARFI Shear modulus (kPa) Aixplorer, SuperSonic, France Linear, parallel, 2–10MHz Clinical	Participants with low back pain having dry needling treatment (LBP + DN)/participants with low back pain having SHAM dry needling treatment (LBP + SHAM DN). 30 (LBP + DN) / 30 (LBP + SHAM DN) 32.2 ± 8.2 / 32.2 ± 6.6 16:14/ 20:10	Erector spinae and multifidus (L3-L5)	Prone at rest (ES and multifidus) and during a submaximal contraction (multifidus only).

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Kozinc et al., 2020	Shear wave imaging ARFI Shear modulus (kPa) Resona 7, Mindray, China linear, parallel, and perpendicular, 3-11 MHz Clinical	Asymptomatic participants. 20 31.4 ± 9.8 8:12	Trapezius (1/2 of the length between the spinous process of C7 and acromion).	Seated at rest (task 1) and performing shoulder abduction at 40° (task 2) and 60° (task 3).
Kumamoto et al., 2021	Shear wave imaging ARFI Shear modulus (kPa) Aixplorer, SuperSonic, France Linear, parallel, 2–10MHz Clinical	Fatigue-exercise (F-Ex) group: asymptomatic participants that exercised standing back extension exercises (SBEE) after completing a muscle fatigue-task (Biering Sorensen). Fatigue-non-exercise (F-nEx) group remained standing for the same duration as the F-Ex group without doing SBEE after the muscle fatigue-task. Non-fatigue-exercise (nF-Ex) group exercised five sets without performing the muscle fatigue-task. 11 (F-Ex)/11(nF-Ex)/11(F-nEx) 26.8 ± 8.6/21.2 ± 3.7/22.5 ± 5.6 11:0/11:0/11:0	Multifidus (L5)	Upright at rest.
Kuo et al. 2013	Shear Wave Imaging ARFI Shear wave speed (m/s) Acuson S2000, Siemens, Germany linear, unclear, 7–9-MHz Clinical	Chronic neck pain/asymptomatic controls 3 (neck pain)/17 (controls) 30.8 ± 4.0 9:11	Trapezius (TP) (midpoint of occipital protuberance and acromial tip).	Seated at rest.
Landen Ludvigsson et al., 2016	Strain imaging Body movement Strain (%) Vivid I, GE Healthcare, Norway Linear, parallel, 12 MHz Research	Whiplash associated disorders (WAD)/asymptomatic controls. 36 (WAD)/ 36 (controls) 38 ±11 /38 ± 11 10:26/10:26	Superior, mid, and deep portions of the upper trapezius (halfway between the acromion and C7).	Upright, performing a scapular elevation task (concentric and eccentric contraction) before and following

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				loaded arm abduction.
Langévin et al., 2011	Strain imaging Body movement Strain (%) T3000, Terason, USA Linear, parallel, 10 MHz Research	LBP/asymptomatic controls 71 (LBP)/50 (controls) 44.6 ± 1.8/41.8 ± 2.3 38:33/24:26	Thoracolumbar fascia (L 2-L3).	Prone lying on a motorized articulated table that passively moved the trunk.
Leong et al., 2013	Shear wave imaging ARFI Shear modulus (kPa) Aixplorer, SuperSonic, France Linear, parallel, 4-15 MHz Clinical	Asymptomatic participants 15(males)/13 (females) 29.6 ± 13.5 15:13	Upper trapezius (mid-way between the angle of acromion and C7).	Seated, in resting position (task 1) and holding a static 30° abduction (task 2).
Leong et al., 2016	Shear wave imaging ARFI Shear modulus (kPa) Aixplorer, Supersonic, France Linear, parallel, 4-15 MHz Clinical	Athletes with rotator cuff tendinopathy (RCT)/athletes without RCT. 26 with RCT/17 without RCT 23.6 ± 3.3/21.7 ± 3.5 43:00:00	Upper trapezius (vertebral level unclear).	Seated during active arm holding at 30° (task 1) and 60° (task 2) of shoulder abduction (active tasks) and with the arm passively positioned at 0° (task 3), 30° (task 4) and 60° (task 5) of shoulder abduction (passive tasks).

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Liang et al., 2021	Shear wave imaging ARFI Shear modulus (kPa) Aplio 500, Toshiba Medical Systems, Japan. Linear, parallel, 5-14 MHz. Clinical	Participants with back pain presenting myofascial trigger points (MTrPs) on one spinal side and no MTrPs on the other side (controls). 30 (MTrPs) 47.67 ± 5.79 unclear	Trapezius (unclear)	Prone at rest.
Ma et al., 2020	Strain imaging and shear wave imaging TUPS and ARFI Young modulus (kPa) Unclear (for TUPS) and Aixplorer (for ARFI), Unclear (for TUPS) and SuperSonic Imaging (for ARFI). 128-elements ultrasound transducer with a 20 N in-series load cell (for TUPS); Convex, parallel, 1-6 MHz (for ARFI). Research	Asymptomatic male participants. 14 23.5 ± 2.9 14:0	Unclear (T7 and L1)	Prone at rest.
Masaki et al., 2017	Shear wave imaging ARFI Shear modulus (kPa) Aixplorer, SuperSonic, France Linear, parallel, 2-10 MHz Clinical	Medical workers with LBP/asymptomatic medical workers. 9 (LBP)/23 (asymptomatic) 44.3 ± 13.0/34.7 ± 10.2 1:8/8:15	Erector spinae (L3) and multifidus (L4).	Prone at rest.
Masaki et al., 2019a	Shear wave imaging ARFI Shear modulus (kPa) Aixplorer, SuperSonic, France Linear, parallel, 2-10 MHz Clinical	Middle-aged and elderly women with LBP/middle-aged and elderly women with LBP history (LBPH)/asymptomatic middle-aged and elderly women. 23 (LBP)/ 16 (LBPH)/ 19 (asymptomatic) 74.3±6.4/70.3±6.5/72.4±5.4 00:23/0:16/0:19	Erector spinae (L3) and multifidus (L4).	Prone at rest.
Moreau et al., 2016	Shear wave imaging ARFI Shear modulus (kPa) Aixplorer, SuperSonic, France Linear, parallel, 8 MHz Research	Asymptomatic participants 10 25.5 ± 2.2 06:04	Multifidus (L3-L4) and (L4-L5).	Prone at rest (task 1) and seated on a massage chair with the multifidus in passive stretching (task 2).

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Murillo et al., 2019	Shear wave imaging ARFI Shear modulus (kPa) LOGIQ S8, GE Healthcare, USA Linear, parallel, 9 MHz Clinical	LBP/asymptomatic controls 15 (LBP)/15 (asymptomatic) 29.4 ± 10.80/26.71 ± 5.40 46.7 % males/53.30 % males	Superficial and deep multifidus (L3-L4).	Prone at rest (superficial and deep MF assessment) (task 1) and prone with 15° steady trunk extension (superficial MF only) (task 2).
Nagai et al., 2020	Shear wave imaging ARFI Shear modulus (kPa) Aixplorer, Supersonic, WA Linear, parallel, 5-18 MHz Clinical	Physical active young adult males and females 11 males/13 females 25.6 ± 4.9/ 23.7 ± 1.9 11:13	Upper trapezius, at the distance between C7 and the most lateral part of the acromion process (1) and at 2/3 of the distance from the acromion process (2).	Prone at rest.
Peolsson et al. 2008	Strain Imaging Body movement Strain (%) and strain rate (%/s) Vivid 7 Dimension GE Healthcare, Norway. linear, parrallel, 12 MHz. Research	female patients with trapezius myalgia and asymptomatic controls 14 (TM)/13 (asymptomatic) 38 (range:24-48)/43 (range:36-55) 0:27	Trapezius (mid-distance on a line from C7 to the edge of acromion).	Seated, performing a 3-cm concentric shoulder elevation before and after pain provocation/ exercise.
Peolsson et al., 2010	Strain imaging Body movement (no units) Strain (%) and strain rate (%/s) Vivid 7 Dimension, GE Healthcare, Norway Linear, parallel, 14 MHz Research	University student volunteers. 15 25 ± 3.8 06:09	Trapezius, splenius, semispinalis capitis, semispinalis cervicis, and multifidus (all at C4).	Seated, performing a sub-maximal isometric head extension against manual resistance ("initial contraction phase"), maintaining the position ("plateau phase") and letting go of the external handheld resistance

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				("end phase").
Peolsson et al., 2013a	Strain imaging Body movement Strain (%) and strain rate (%/s) Vivid 9 Dimension, GE Healthcare, Norway Linear, parallel, 14 MHz Research	Individuals with residual disability 10 years after anterior cervical decompression and fusion (ACDF) for cervical disc disease/10 asymptomatic controls 10 (ACDF) / 10 (asymptomatic) 60±7.1/60 ±6.5 7:3/7:3	Trapezius, splenius, semispinalis capitis, semispinalis cervicis, and multifidus (all at C4).	Upright, performing a single loaded arm lift to 120° while holding a standardized weight in the hand (1 kg females, 2 kg males) (task 1) and 10 repeated loaded arm lift to 90° while holding a standardized weight in the hand (0.5 kg females, 1 kg males). (task 2).
Peolsson et al., 2015	Strain imaging Body movement Strain (%) and strain rate (%/s) Vivid 9 Dimension, GE Healthcare, Norway Linear, parallel, 14 MHz Research	Individuals with residual disability 10 years after ACDF for cervical disc disease/10 asymptomatic controls 10 (ACDF) / 10 (asymptomatic) 60±7.1/60 ±6.5 7:3/7:3	Trapezius, splenius, semispinalis capitis, semispinalis cervicis, and multifidus (all at C4).	Seated, performing a 20° head extension against resistance (2 kg males, 1 kg females).
Peterson et al., 2019	Strain imaging Body movement Strain (%) Vivid Dimension, GE Healthcare, Norway Linear, parallel, 12 MHz Research	Asymptomatic participants 20 24 ± 5.3 12:08	Trapezius, splenius, semispinalis capitis, semispinalis cervicis, and multifidus (all at C4).	Upright, performing a head extension against a resistance of 10%, 20%, 40%, 60%, and 80% of MVC.

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Pimentel Santos et al., 2021	Shear wave imaging ARFI Shear modulus (kPa) Aixplorer v 10, SuperSonic, France. unclear, unclear, unclear Clinical	Asymptomatic participants. 17 26.5 (23.5 - 32.5) (mean (range)) 8:9	Multifidus (L3-L4)	Prone at rest.
Pinto et al., 2022	Shear wave imaging ARFI Shear modulus (kPa) Aixplorer, SuperSonic, France. Convex, parallel, 1-6 MHz Clinical	Participants with low back pain /asymptomatic controls 78 (LBP) / 73 (controls) 46.0 (35.8 - 54) / 48 (30 - 54.5) 16:14/ 20:10	Multifidus (L4-L5 and L5-S1)	Prone at rest.
Qazi et al., 2022	Shear wave imaging ARFI Strain ratio (no units) Aixplorer, SuperSonic, France., SuperSonic, France. Linear, parallel, 5-14 MHz Clinical	Participants with unilateral lumbar radicular pain/asymptomatic controls. 15 (radicular pain)/10 (controls) 38.53 ± 8.13 unclear/unclear	Multifidus (unclear)	Prone at rest.
Rhanama et al., 2018	Strain imaging Body movement Strain (%) and strain rate (%/s) Vivid-I, GE Healthcare, Norway Linear, parallel, 12 MHz Research	36 (including two drop-outs) (WAD)/36 (asymptomatic) 37 ± 10.78/37 ± 10.54 26:10/26:10 26:10/26:10	Trapezius, splenius, semispinalis capitis, semispinalis cervicis, and multifidus (all at C4).	Prone on a table performing a head extension with a load (4 kg males, 2 kg females) applied around the head.
Sakaki et al., 2022	Shear wave imaging ARFI Shear modulus (kPa) unclear, Unclear Unclear, parallel, unclear Clinical	Participants that underwent arthroscopic rotator cuff repair (ARCR). 8 61.5 ± 9.4 8:0	Trapezius (unclear).	Seated performing a 30° maximum voluntary isometric shoulder abduction in the scapular plane.

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Sanchez-Infant et al., 2021	Strain imaging and shear wave imaging Manual compression and ARFI Strain ratio (no units) and shear modulus (kPa) LOGIC S8 (for TUPS) and unclear (for ARFI), GE, USA (for TUPS) and SIEMENS, unclear (for ARFI) linear, parallel, 4-15 MHz (for TUPS) and linear, parallel, 4-9 MHz (for ARFI). Clinical	Healthy young people with latent trigger points on their upper trapezius (dominant side) having one session of dry needling (DN) or one session of SHAM DN treatment. 19 (DN)/ 24 (Sham DN) 23.68 ± 3.41/ 24.45 ± 3.48 19:8/18:6	Upper trapezius (middle third).	Seated at rest.
Sawada et al., 2020	Strain imaging Manual compression Strain ratio (no units) HIVISION Preirus, Hitachi, Japan. linear, parallel, 5-18 MHz, acoustic coupler (Hitachi, Tokyo, Japan). Clinical	Asymptomatic male participants. 20 20.3 ± 0.6 20:0	Trapezius (1/2 of the length between the spinous process of C7 and acromion).	Seated at rest.
Shimoyama et al., 2021	Strain imaging Manual compression Strain ratio (no units) EUB-7500, Hitachi, Japan. linear, parallel, 6-14 MHz, acoustic coupler (Hitachi, Tokyo, Japan). Clinical	Asymptomatic male participants. 22 27.6 ± 6.69 22:0	Trapezius (1/3 of the distance between the spine and the acromion, midway between C7 and the superior medial scapular angle).	Seated at rest.
Takla et al., 2016	Vibration elastography Controlled external vibration Strain ratio (no units) EUB-7500, Hitachi, Japan Linear, unclear, unclear Research	Participants with active myofascial trigger points (A-MTrPs) or passive myofascial trigger points (P-MTrPs). 50 participants (compiling 153 A-MTrPs and 159 P-MTrPs). 34.28 ± 6.17/ 35.8 ± 5.91 unclear	A-MTPs and P-MTPs in the longissimus thoracis (T10-T11 and L1) with regards to normal surrounding tissue of the longissimus thoracis.	Rest lying on its side.
Tamartash et al., 2022	Strain imaging Manual compression Elastic modulus coefficient (Pa) Sonix TOUCH, Ultrasonic, Canada. linear, parallel, 5 - 14 MHz Research	Participants with low back pain having myofascial release treatment (LBP + MFR)/participants with low back pain having electrotherapy treatment (LBP + ET). 16 (LBP + MFR) / 16 (LBP + ET) 40.31 ± 5.45/ 42.19 ± 5.03 unclear/unclear	Thoracolumbar fascia (L 2-L3 and L4-L5)	Prone at rest.

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Tamartash et al., 2023	Strain imaging Manual compression Elastic modulus coefficient (kPa) SONON, Guro-dong, South Korea linear, parallel, 5 - 14 MHz. Research	Participants with low back (LBP)/asymptomatic controls (controls). 68 (LBP) / 63 (controls) 40.2 ± 5.3/ 41.7 ± 4.9 33:35/32:31	Thoracolumbar fascia (L 2-L3 and L4-L5)	Prone at rest.
Tas et al., 2018	Shear wave imaging ARFI Shear wave speed (m/s) ACUSON S3000, SIEMENS, CA Linear, parallel, 4-9 MHz Clinical	Patients with chronic neck pain/ asymptomatic participants. 35 (neck pain)/35 (asymptomatic) 35.7 ± 8.3/35.2 ± 9.0 unclear	Upper trapezius (2 cm lateral to C7) and splenius capitis (2 cm lateral to C4), levator spinae.	Prone at rest.
Turo et al., 2015	Vibration sonoelastography Controlled external vibration Mechanical heterogeneity index (no units) Sonix RP, Ultrasonix Corp, CA Unclear, unclear, 10 MHz Research	Patients with chronic myofascial pain and at least one palpable active myofascial trigger point (A-MTrP). 48 35 ± 13 18:30	In the upper trapezius approximately midway between the cervical vertebrae and the acromion process: (1) A-MTPs that changed from active to latent or palpably normal tissue after treatment (defined as "responded"). (2) A-MTPs that changed from active to palpably normal tissue after treatment (defined as "resolved"). (3) A-MTPs that responded but did not resolve ("active to latent").	unclear
Valera-Calero et al., 2021	Shear wave imaging ARFI Shear wave speed (m/s) APLIO A, CANON linear, parallel, 5 - 14 MHz. Clinical	Participants with chronic neck pain/ asymptomatic participants. 19 (neck pain)/ 34 (asymptomatic) 21.5 ± 3.2/ 21.9 ± 5.9 unclear/unclear	Upper trapezius (unclear).	Prone at rest.

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Valera-Calero et al., 2022	Shear wave imaging ARFI Shear wave speed (m/s) APLIO A, CANON linear, parallel, 5 - 14 MHz. Clinical	Participants with chronic neck pain having dry needling (DN) / asymptomatic participants having SHAM DN 32 (DN)/ 28 (SHAM DN) 22.3 ± 7.9/ 21.4 ± 2.3 unclear/unclear	Upper trapezius (unclear).	Prone at rest.
Vatovec et al., 2022	Shear wave imaging ARFI Shear modulus (kPa) Resona 7, Mindray, China. Unclear, parallel, unclear. Clinical	Asymptomatic participants. 22 22.5 ± 3.0 11:11	Superficial and deep multifidus, deep erector spinae (L4).	Prone at rest (superficial MF and ES, deep MF) (task 1), prone at rest after isometric trunk contraction (fatigue exercise) (task 2), prone during low level (task 3) and high level of contractions (task 4) (superficial MF and ES only).
Vining et al., 2022	Strain Imaging t3000 Terason, Burlington, USA. Linear, parallel, 10 MHz Research	LBP having chiropractic care for 8 weeks. 20 41.1 ± 12.6 9:11	Thoracolumbar fascia (L2-L3)	Prone-lying on a motorized articulated table that passively moved the trunk.
Wachi et al., 2022	Strain imaging manual compression Strain ratio (no units) SSD-3500SV, FujiFilm, Tokyo. Linear, parallel, 7.5 MHz, acoustic coupler (FujiFilm, Tokyo). Clinical	Participants with low back pain (LBP) having capacitive and resistive electric transfer therapy (CRet)/ LBP participants having SHAM CRet. 12 (CRet) / 12 (SHAM CRet) 34.3 ± 8.7 / 32.5 ± 7.5 12:0/12:0	Multifidus (unclear).	unclear

First author, year	Ultrasound method Excitation method Measured physical quantity (and units) US model, company, country Type of probe, position, and frequency Clinical/research device	Participants' condition N/group Age (mean, SD) Sex (male: female)	Muscle assessed (and spinal level, if specified)	Patient's position (and muscle state)
Wada et al. 2019	Shear Wave Imaging ARFI Unclear (kPa) Aixplorer, SuperSonic, France Linear, parallel, 2-10 MHz Clinical	Patients with frozen shoulder being in the freezing (phase 1) or frozen phase (phase 2). 15 (freezing) /17 (frozen) 54.9 ± 9.8/63.4 ± 8.1 5:9/8:9	Middle trapezius (vertebrae level unclear).	Seated at rest.
Wang et al., 2020	Shear wave imaging ARFI Shear wave speed (m/s) Aixplorer, SuperSonic, France. Linear, parallel, 4-15 MHz. Clinical	Asymptomatic participants. 20 unclear unclear	Trapezius (1/2 between the spinous process of C7 and acromion).	Seated, in resting position (task 1) and in 90° passive abduction (task 2).
Weber et al., 2022	Strain imaging Body movement Displacement and relative displacement (mm) SonoSmart Plus, Zimmer Medizin System, Germany. Linear, parallel, 16 MHz. Clinical	Female soccer athletes. 23 (IAMT) / 22 (CG) / 22 (PG) 21.2 ± 4.1 / 20.9 ± 3.6 / 20.8 ± 4.1 0:23/ 0:22/0:22	Erector spinae (ES), superficial fascia (SF), superior (SL) and deep (DL) lamina of the thoracolumbar fascia (TLF), (all at L 2-L3).	Prone lying on a motorized articulated table that passively moved the trunk.
Wong et al., 2016	Strain imaging Body movement Stiffness index (mm, N/mm and no units) T3000, Terason, USA Linear, parallel, 5-12 MHz Research	Asymptomatic male participants. 10 22.8 ± 2.0 10:00	Junction of the latissimus dorsi muscle and the thoracolumbar fascia.	Prone, performing a "press-down" task from resting (0%) to MVC (100%) followed by a ramped relaxation before and after myofascial release treatment.
Xie et al., 2019	Shear wave imaging ARFI Shear modulus (kPa) Aixplorer, SuperSonic, France Linear, parallel, 2-10 MHz Research	Asymptomatic participants. 16 29.3 ± 9.8 08:08	Upper trapezius, anterior upper trapezius, posterior upper trapezius, spinalis capitis, semispinalis capitis and cervicis, multifidus, middle and lower	Seated at rest.

First author, year	Ultrasound method Excitation method Measured physical quantity (and units) US model, company, country Type of probe, position, and frequency Clinical/research device	Participants' condition N/group Age (mean, SD) Sex (male: female)	Muscle assessed (and spinal level, if specified)	Patient's position (and muscle state)
			trapezius, levator scapular.	
Xu et al., 2018	Shear wave imaging ARFI Young modulus (kPa) Aixplorer, SuperSonic, France Linear, parallel, 2-10 MHz Clinical	LBP with primary osteoporosis (POP) having calcium treatment + moxibustion treatment for 3 days a week for 4 weeks/LBP with POP having only calcium treatment for 4 weeks. 32 (including 3 dropouts) (moxhi + Ca)/31 (including 4 dropouts) (Ca only) 65.16 ± 6.82/63.90 ± 7.59 3:29/2:29	Right and left multifidus (L4).	Prone at rest.
Yamamoto et al., 2017	Vibration sonoelastography Controlled external vibration Shear wave speed (m/s) EUB-8500, Hitachi Linear, parallel, 6.5 MHz Research	Asymptomatic male participants. 23 28.8 (range: 21- 42) 23:00	Trapezius (1/3 of the length between the spinous process of C7 and acromion).	Seated at rest.
Yamaura et al., 2021	Shear wave imaging ARFI Shear modulus (kPa) Aplio 500, Toshiba Medical Systems, Japan. Linear, parallel, 4-13 MHz Clinical	Baseball players' throwing shoulder at 3 time points: before, immediately after, and 24 hours after a throwing session of 100 pitches. 14 26.6 (24-33) (mean (range)) unclear	Middle trapezius and rhomboideus (midway of T2-T4 and scapula), lower trapezius (5 cm below the root of the scapular spine).	Seated at rest.
Yurdakul et al. 2019	Strain Imaging Manual compression Strain ratio (no units) Aplio 500, Toshiba, Japan. Unclear Clinical	Patients with low back pain treated for a period of 3 weeks with hot pack and TENS (H+T, group 1), HP, TENS and therapeutic ultrasounds (H+T+U, group 2), and asymptomatic controls (group 3). 23 (H+T)/23 (H+T+U)/23 (controls) 51.7±10.7/48.6±11.0/46.3 ±10.7 11:12/11:12/11:12	Multifidus (L4).	Prone at rest.

First author, year	Ultrasound method Excitation method Measured physical quantity (and units) US model, company, country Type of probe, position, and frequency Clinical/research device	Participants' condition N/group Age (mean, SD) Sex (male: female)	Muscle assessed (and spinal level, if specified)	Patient's position (and muscle state)
Zhang et al., 2019	Shear wave imaging ARFI Shear modulus (kPa) Aixplorer, SuperSonic, France Linear, parallel, 2-10 MHz Clinical	Asymptomatic male participants. 20 23.1 ± 2.7 20:00	Upper trapezius (mid-way between the angle of acromion and C7).	Seated performing 0° (task 1) and 50° (task 2) cervical flexion.

Table S4 a – Pooled intraclass correlation coefficient (ICC) by study included in the meta-analysis.

TABLE S4 a. RELIABILITY			
Test-retest for strain imaging			
ID	Pooled ICC	Pooled 95 Upper CI	Pooled 95 Lower CI
Landen Ludvigsson, 2016	0.81	0.24	0.96
Peollson, 2010	0.96	0.87	0.99
Test-retest for shear wave imaging			
ID	Pooled ICC	Pooled 95 Upper CI	Pooled 95 Lower CI
Dieterich, 2017	0.98	0.94	0.99
Koppenhaver, 2018	0.58	0.47	0.67
Kozinc et al., 2020	0.69	0.52	0.81
Leong, 2013	0.81	0.53	0.93
Qazi et al., 2022	0.92	0.8	0.97
Sanchez-Infante et al., 2021	0.76	-0.74	0.99
Xie, 2019	0.78	0.70	0.84
Zhang, 2019	0.86	0.78	0.91
Test-retest for vibration sonoelastography			
ID	Pooled ICC	Pooled 95 Upper CI	Pooled 95 Lower CI
Turo, 2015	0.98	0.96	0.99
Intra-rater reliability for strain imaging			
ID	Pooled ICC	Pooled 95 Upper CI	Pooled 95 Lower CI
Chan, 2012	0.88	-	-
Dones, 2021	0.86	0.71	0.94
Langévin, 2011	0.98	-	-
Ma et al., 2020	0.87	0.81	0.92
Peterson, 2019	0.64	0.47	0.76
Sawada et al., 2020	0.94	0.80	0.98
Shimoyama et al., 2021	0.60	-0.71	0.98
Intra-rater reliability for shear wave imaging			
ID	Pooled ICC	Pooled 95 Upper CI	Pooled 95 Lower CI
Alijnovic, 2020	0.96	0.90	0.98
Barun, 2021	0.86	0.78	0.91
Blain, 2019	0.71	0.65	0.77
Chen, 2020	0.91	-0.84	1.00
Gao, 2019	0.97	0.91	0.99
Kelly, 2018	0.61	0.32	0.80

Kitamura et al., 2020	0.76	-	-
Koppenhaver, 2018	0.71	0.55	0.82
Kozinc et al., 2020	0.86	0.67	0.95
Leong, 2013	0.95	-0.71	1.00
Moreau, 2016	0.91	0.69	0.97
Murillo, 2019	0.88	0.66	0.96
Nagai, 2020	0.73	0.36	0.89
Pimentel-Santos et al., 2021	0.90	-0.92	1.00
Qazi et al., 2022	0.95	0.49	1.00
Sanchez-Infante et al., 2021	0.80	-0.87	1.00
Sasaki et al., 2022	0.99	0.99	1.00
Wang et al., 2020	0.95	0.81	0.99
Xie, 2019	0.77	0.72	0.82
Yamaura et al., 2021	0.84	0.80	0.87
Intra-rater reliability for vibration sonoelastography			
Yamamoto, 2017	0.91	0.76	0.96
Inter-rater reliability for Strain imaging			
ID	Pooled ICC	Pooled 95 Upper CI	Pooled 95 Lower CI
Ma et al., 2020	1.00	0.99	1.00
Shimoyama et al., 2021	0.62	0.27	0.83
Inter-rater reliability for shear wave imaging			
ID	Pooled ICC	Pooled 95 Upper CI	Pooled 95 Lower CI
Alis, 2018	0.94	0.9	0.96
Barun, 2021	0.81	0.72	0.88
Gao, 2019	0.8	0.62	0.89
Kozinc et al., 2020	0.74	0.45	0.89
Kumamoto et al., 2021	0.93	0.82	0.97
Leong, 2013	0.81	0.69	0.88
Moreau, 2016	0.91	0.69	0.97
Wang et al., 2020	0.94	0.85	0.98
Yamaura et al., 2021	0.77	0.68	0.83
Zhang, 2019	0.97	-0.91	1.00
Inter-rater reliability for vibration sonoelastography			
ID	Pooled ICC	Pooled 95 Upper CI	Pooled 95 Lower CI
Yamamoto, 2017	0.83	0.56	0.94
ID: study identification; ICC: intraclass correlation coefficient; CI: confidence interval.			

Table S4 b – Pooled standardized mean differences (pSMD) by known-group validation study included in the meta-analysis.

TABLE S4 b. KNOWN – GROUP VALIDATION						
Strain imaging						
ID	pSMD	SE ^a	t	Sig. (2-tailed)	Pooled CI Lower	Pooled CI Upper
Calvo-Lobo et al., 2017^b	1.863	0.5355	3.478	0.001	0.813	2.912
Chan et al., 2012	1.620	0.3464	4.676	0.000	0.941	2.298
Dones et al., 2021	-0.470	0.0544	-8.638	0.000	-0.576	-0.363
Ishikawa et al., 2017	1.017	0.3951	2.573	0.010	0.242	1.791
Ishikawa et al., 2020	1.689	0.3098	5.453	0.000	1.082	2.297
Landen Ludvigsson et al., 2016	0.053	0.0712	0.739	0.460	-0.087	0.192
Langévin et al., 2011^b	0.535	0.1878	2.851	0.004	0.167	0.903
Peolsson et al. 2008	0.286	0.1619	1.766	0.077	-0.031	0.603
Peolsson et al., 2013a	-0.186	0.0768	-2.426	0.015	-0.337	-0.036
Peolsson et al., 2015	0.217	0.1294	1.677	0.094	-0.037	0.471
Rhanama et al., 2018	0.343	0.0619	5.539	0.000	0.221	0.464
Tamartash et al., 2023	0.931	0.0382	24.337	0.000	0.856	1.006
Shear wave imaging						
ID	pSMD	SE ^a	t	Sig. (2-tailed)	Pooled CI Lower	Pooled CI Upper
Alijnovic et al., 2020	0.903	0.1777	5.081	0.000	0.554	1.251
Alijnovic et al., 2022^b	1.589	0.1873	8.483	0.000	1.222	1.956
Can et al., 2021	0.590	0.2611	2.260	0.024	0.078	1.102
Creze et al. 2017	0.480	0.4654	1.032	0.302	-0.432	1.393
Ding et al. 2019	2.751	0.7292	3.772	0.000	1.322	4.180
Ertekin et al., 2021	1.370	0.0521	26.279	0.000	1.268	1.472
Gao et al., 2019^b	0.722	0.4124	1.750	0.080	-0.087	1.530
Gao, 2020^b	0.708	0.3260	2.172	0.030	0.069	1.347
Heizelmann et al., 2017	0.346	0.0908	3.811	0.000	0.168	0.524
Hvedstrup et al., 2020	0.191	0.1521	1.257	0.209	-0.107	0.489
Karayol et al., 2021^b	0.437	0.2039	2.146	0.032	0.038	0.837
Koppenhaver et al., 2020	0.313	0.2591	1.210	0.226	-0.194	0.821
Kuo et al., 2013^b	1.209	0.6547	1.846	0.065	-0.075	2.492
Leong et al., 2016	0.926	0.3054	3.033	0.002	0.328	1.525

Liang et al., 2021.	0.379	0.1650	2.298	0.022	0.056	0.703
Masaki et al., 2017	0.532	0.3585	1.484	0.138	-0.171	1.234
Masaki et al., 2019a	0.412	0.2933	1.406	0.160	-0.163	0.987
Murillo et al., 2019	0.327	0.6995	0.467	0.640	-1.044	1.698
Pinto et al. 2022	0.090	0.0111	8.083	0.000	0.068	0.112
Tas et al., 2018	0.432	0.2547	1.695	0.090	-0.068	0.931
Valero-Calero et al., 2021	0.157	0.1428	1.099	0.272	-0.123	0.437
Wada et al. 2019	0.063	0.1741	0.364	0.716	-0.278	0.405

Vibration sonoelastography

ID	pSMD	SE ^a	t	Sig. (2-tailed)	Pooled CI Lower	Pooled CI Upper
Takla et al., 2016	1.957	1.0192	1.920	0.055	-0.041	3.954

a. Knapp-Hartung method is used for standard error adjustment. b. Some statistics cannot be computed because this subgroup contains a single record. pSMD: pooled standardized mean difference; ID: study identification; SE: standard error of the pooled effect size. CI: confidence interval; t: t statistic of the pooled effect size; Sig.: P value associated to the t statistic.

Table S4 c – Pooled standardized mean difference (pSMD) by responsiveness study included in the meta-analysis.

TABLE S4 c. RESPONSIVENESS						
WITHIN RESPONSIVENESS FOR STRAIN IMAGING						
ID	pSMD	SE ^a	t	Sig. (2-tailed)	Pooled CI Lower	Pooled CI Upper
Griefhan et al. 2017 ^b	1.107	0.3772	2.935	0.003	0.368	1.846
Griefhan et al. 2021	0.754	0.2927	2.575	0.010	0.180	1.327
Peolsson et al. 2008	0.680	0.4385	1.550	0.121	-0.180	1.539
Sanchez-Infante et al., 2021	1.045	0.0606	17.228	0.000	0.926	1.163
Tamartash et al. 2022	0.973	0.0976	9.963	0.000	0.781	1.164
Vining et al., 2022	0.091	0.2568	0.353	0.724	-0.413	0.594
Wachi et al., 2022	1.212	0.3809	3.182	0.001	0.465	1.958
Wong et al. 2016	0.192	0.2775	0.693	0.489	-0.352	0.736
Yurdakul et al., 2019	-0.103	0.1032	-0.994	0.320	-0.305	0.100
WITHIN RESPONSIVENESS FOR SHEAR WAVE SPEED IMAGING						
ID	pSMD	SE ^a	t	Sig. (2-tailed)	Pooled CI Lower	Pooled CI Upper
Bethers et al. 2021	0.466	0.0912	5.110	0.000	0.287	0.644
Buran Cirak et al. 2021	1.719	0.0568	30.278	0.000	1.608	1.830
Ding et al. 2019	2.082	0.5320	3.913	0.000	1.039	3.124
Gao, 2020	0.862	0.3306	2.606	0.009	0.214	1.509
Gunaydin et al., 2022	0.370	0.0665	5.557	0.000	0.239	0.500
Kisilewicz et al., 2020 ^b	4.525	0.7131	6.346	0.000	3.128	5.923
Kumamoto et al., 2021	1.365	0.1051	12.989	0.000	1.159	1.571
Sasaki et al., 2022	0.861	0.2845	3.028	0.002	0.304	1.419
Valero-Calero et al., 2022	-0.017	0.0685	-0.254	0.800	-0.152	0.117
Vatovec et al., 2022	0.221	0.0683	3.240	0.001	0.087	0.355
Xu et al. 2018	3.003	0.5543	5.418	0.000	1.917	4.089
Yamaura et al., 2021	0.808	0.0651	12.407	0.000	0.681	0.936
BETWEEN RESPONSIVENESS FOR STRAIN IMAGING						
ID	pSMD	SE ^a	t	Sig. (2-tailed)	Pooled CI Lower	Pooled CI Upper
Griefhan et al. 2021	0.394	0.1832	2.153	0.031	0.035	0.753

Sanchez-Infante et al., 2021	0.341	0.2693	1.265	0.206	-0.187	0.868
Weber et al., 2022	0.018	0.0400	0.444	0.657	-0.061	0.096
BETWEEN RESPONSIVENESS FOR SHEAR WAVE SPEED IMAGING						
ID	pSMD	SE ^a	t	Sig. (2-tailed)	Pooled CI Lower	Pooled CI Upper
Alijnovic et al., 2022	0.110	0.1532	0.720	0.471	-0.190	0.411
Buran Cirak et al. 2021	0.657	0.3825	1.717	0.086	-0.093	1.406
Gunaydin et al., 2022	0.266	0.1165	2.283	0.022	0.038	0.494
Koppenhaver et al., 2022	0.351	0.0626	5.602	0.000	0.228	0.474
Valero-Calero et al., 2022	0.177	0.2066	0.857	0.392	-0.228	0.582

a. Knapp-Hartung method is used for standard error adjustment. b. Some statistics cannot be computed because this subgroup contains a single record. pSMD: pooled standardized mean difference; ID: study identification; SE: standard error of the pooled effect size. CI: confidence interval; t: t statistic of the pooled effect size; Sig.: P value associated to the t statistic.

Table S5 a – Results of heterogeneity analysis and meta-regression for strain imaging studies.

Heterogeneity and meta-regression: strain imaging						
Known-groups validation.	F²	df 1	df 2	Sig.	R²	M
M = 12, N = 569						
Tau ² = 0.463, I ² = 98.3, Q = 569.191, df = 11 (P < 0.001)						
Univariate meta-regression						
Excitation method (body movement x manual compression)	27.575	1	10	< 0.001	76	12
Research x clinical device	Number of records is insufficient for meta-analysis. All studies but one used research devices.					
Medical condition (LBP x neck or shoulder pain)	2.569	1	8	0.141	17.3	10
Mean age	0.008	1	10	0.929	0	12
BMI	1.107	1	3	0.370	23.2	5
% of females	3.156	1	10	0.106	14.8	12
Extrinsic x intrinsic	0.254	1	10	0.625	0	12
Position (prone x seated x upright)	0.597	2	9	0.571	0	12
Muscle state (contracted x rest)	4.464	1	8	0.068	34.0	10
Vertebral level (cervical x lumbar)	4.287	1	10	0.065	28.1	12
Within-group responsiveness.	F²	df 1	df 2	Sig.	R²	M
M = 9, N = 302						
Tau ² = 0.206, I ² = 90.0, Q = 109.884, df = 8 (P < 0.001)						
Univariate meta-regression						
Excitation method (body movement x manual compression)	0.370	1	7	0.562	0	9
Research x clinical device	0.006	1	7	0.939	0	9
Medical condition (LBP x asymptomatic)	0.180	1	6	0.686	0	8
Mean age	2.947	1	7	0.130	26.3	9
BMI	3.183	1	4	0.149	41.2	6
% of females	0.272	1	6	0.621	0	8
Extrinsic x intrinsic	0.022	1	7	0.887	0	9
Position (prone x seated)	3.532	1	6	0.109	25.5	8
Muscle state (contracted x rest)	0.060	1	5	0.816	0	7
Vertebral level (cervical x lumbar)	0.803	1	7	0.400	0	9
Time of measurements after baseline (immediate x not immediate)	0.485	1	7	0.508	0	9
Time of measurements after baseline (within 48 h x after 48 h)	2.469	1	7	0.160	13.5	9
Time of measurements after baseline (immediate x after more than one week)	1.491	1	6	0.268	0.4	8
Treatment (manual therapy x others)	0.013	1	7	0.913	0	9
Between-groups responsiveness.	F²	df 1	df 2	Sig.	R²	k
M = 3, number of records is insufficient for meta-analysis.						

Tau-squared: variance of the standardized mean difference across studies; **I-squared:** proportion of total variance between studies that is attributed to heterogeneity; **Q:** heterogeneity statistic; **M:** number of cohorts; **N:** number of participants; **df:** degree of freedom; **F-squared:** F statistic of the meta-regression. **Sig.:** P value associated with the F statistic; **R²:** proportion of total variance that is explained by the variable under interest.

Table S5 b – Results of Heterogeneity analysis and meta-regression for shear wave imaging.

Heterogeneity and meta-regression: shear wave imaging						
Known-groups validation.	F²	df 1	df 2	Sig.	R²	M
M= 22, N = 1578 Tau ² = 0.182, I ² = 93.2, Q= 695.162, df = 21 (P < 0.001)						
Univariate meta-regression						
Research x clinical device	Number of records is insufficient for meta-analysis. All studies used clinical devices.					
Medical condition (LBP x neck or shoulder pain)	1.489	1	15	0.241	3.0	17
Mean age	0.175	1	18	0.681	0	20
BMI	0.000	1	9	0.989	0	11
% of females	0.042	1	17	0.840	0	19
Extrinsic x intrinsic	1.289	1	18	0.271	0	20
Position (prone x seated)	3.951	1	20	0.061	12	20
Muscle state (contracted x rest x other)	Number of records is insufficient for meta-analysis. Studies were conducted only at rest.					
Vertebral level (cervical x lumbar)	3.473	1	16	0.081	12.9	18
Within-group responsiveness.	F²	df 1	df 2	Sig.	R²	M
M = 12, N = 390 Tau ² = 1.219, I ² = 99.3 Q= 605.118, df = 11 (P < 0.001)						
Univariate meta-regression						
Research x clinical device	Number of records is insufficient for meta-analysis. All studies used clinical devices.					
Medical condition (neck or shoulder pain x asymptomatic)	0.945	1	5	0.376	0	7
Mean age	0.801	1	9	0.394	0.5	11
BMI	0.300	1	3	0.622	0	5
% of females	0.072	1	7	0.796	0	9
Extrinsic x intrinsic	0.097	1	10	0.762	0	12
Position (prone x seated)	0.520	1	9	0.489	0	11
Muscle state (contracted x rest)	Number of records is insufficient for meta-analysis. Studies were conducted only at rest.					
Vertebral level (cervical x lumbar)	1.687	2	9	0.239	9.5	12
Time of measurements after baseline (immediate x not immediate)	0.442	1	10	0.521	0	12
Time of measurements after baseline (within 24 h x after 24 h)	0.089	1	10	0.772	0	12
Time of measurements after baseline (within 48 h x after 48 h)	0.011	1	10	0.917	0	12
Time of measurements after baseline (immediate x within 1 month)	0.624	1	9	0.450	0	11
Treatment (manual therapy x other)	0.134	1	10	0.722	0	12
Treatment (active physical exercise x other)	0.288	1	10	0.603	0	12
Between-groups responsiveness.	F²	df 1	df 2	Sig.	R²	M
M = 5, number of records is insufficient for meta-analysis.						

Tau-squared: variance of the standardized mean difference across studies; **I-squared:** proportion of total variance between studies that is attributed to heterogeneity; **Q:** heterogeneity statistic; **M:** number of cohorts; **N:** number of participants; **df:** degree of freedom; **F-squared:** F statistic of the meta-regression **Sig.:** P value associated with the F statistic; **R²:** proportion of total variance that is explained by the ultrasound excitation method used.