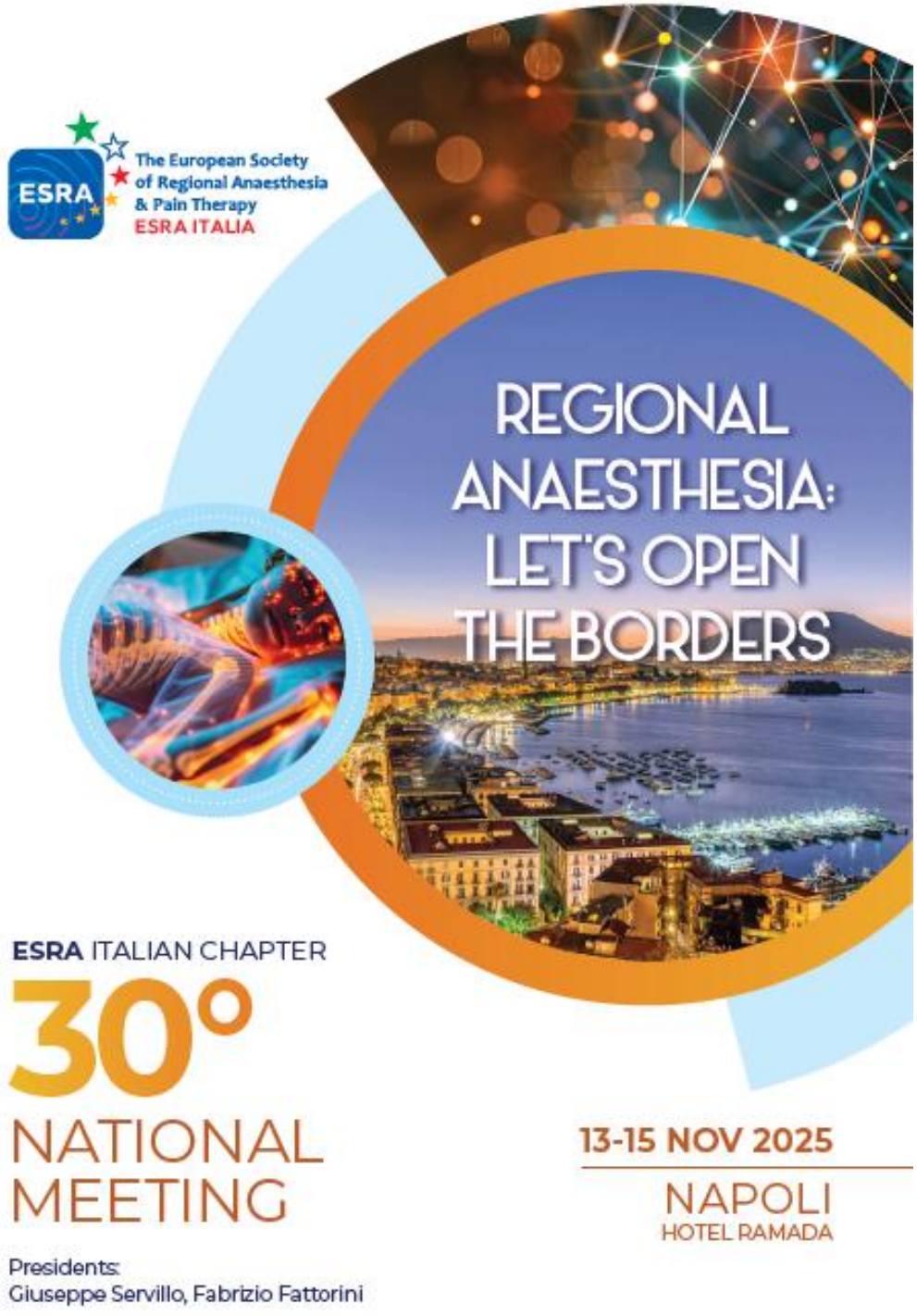
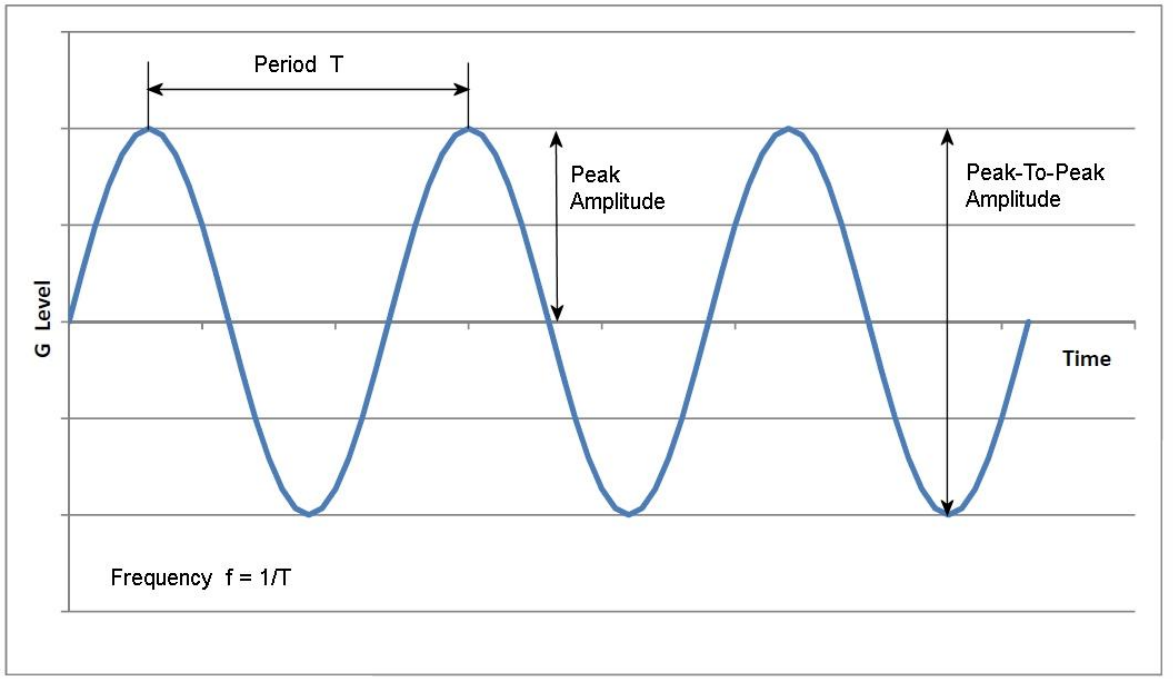
The focal microvibration role in chronic pain treatment

Prof. Pasquale Buonanno
Università degli Studi di Napoli «Federico II»

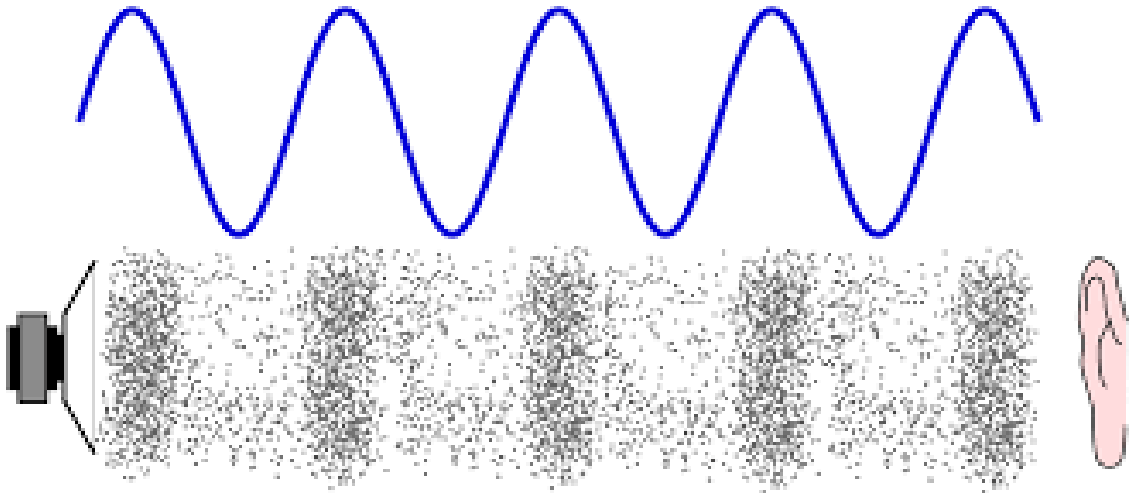


What is a mechanical vibration?

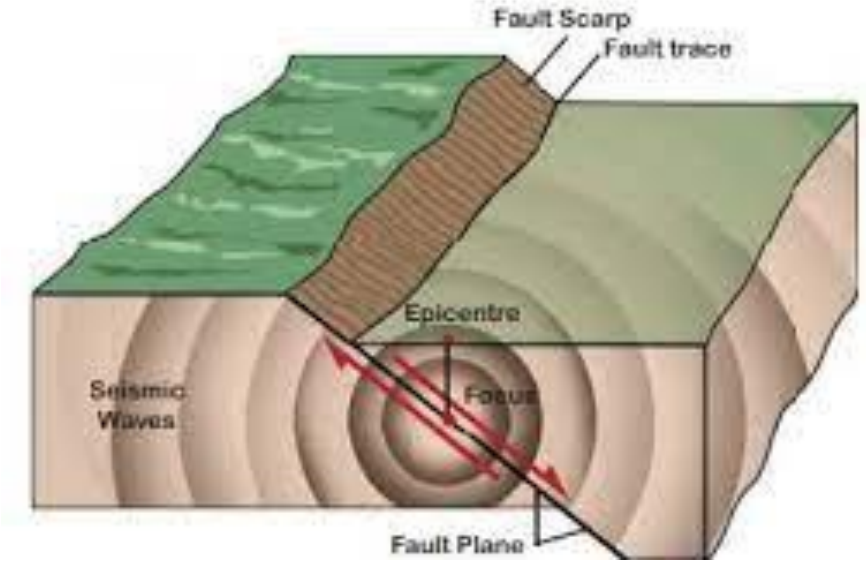
Vibration is a mechanical phenomenon whereby oscillations occur about an equilibrium point. The oscillations may be periodic, such as the motion of a pendulum, or random



We are surrounded by mechanical vibrations

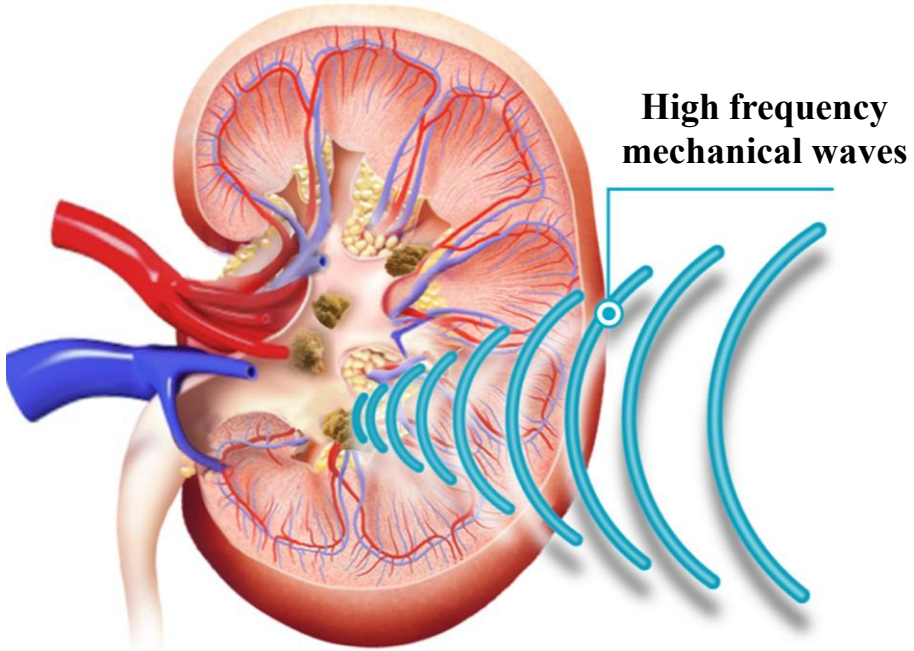


Sounds are vibrations

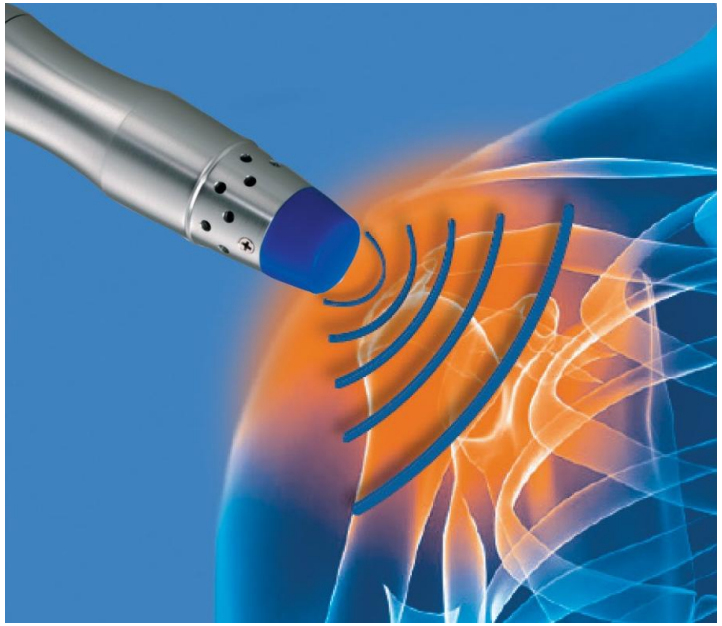


Earthquake is a vibration

Vibrations in medicine



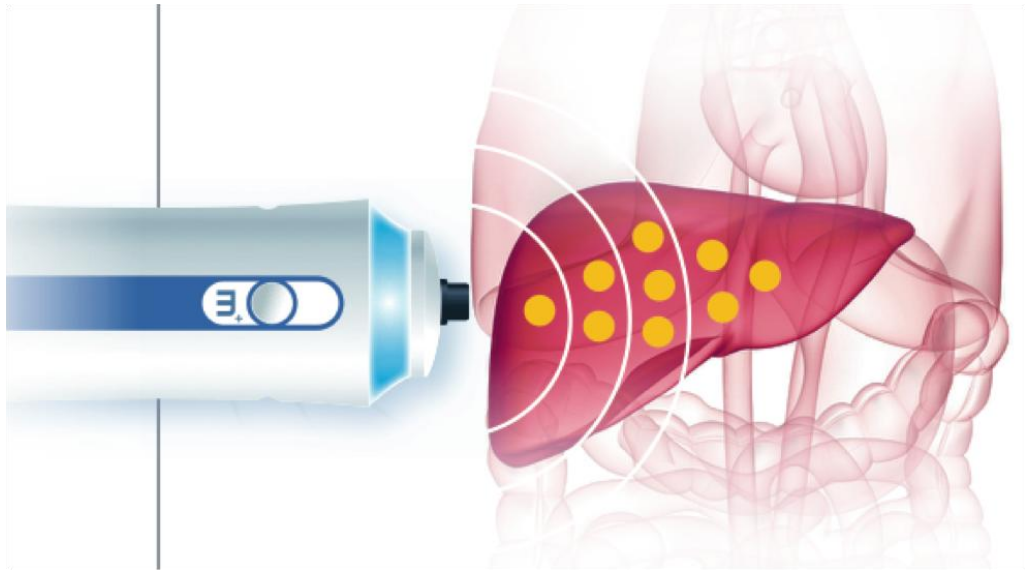
Lithotripsy



Shock waves

Vibrations in medicine

Ultrasonography



Elastosonography

I was thus led to study again the clinical aspects and the analysis of cases, and the consensus of authorities revealed the curious fact that this so-called follicular disease most frequently attacked the regions where there were the fewest hairs, such as the front of the forearms, especially near the wrist, the flanks, inner side of knees over vastus internus, and the side of the legs, especially above the ankles; to say nothing of the palms, soles, nails, and mucous membranes being occasionally involved; while only in a small minority were the backs of the forearms and hands, and other situations where the small hairs are abundant, involved, many of these cases having begun in the more usual situations, and subsequently implicated the other parts. Since these considerations were forced upon my notice I have only had the opportunity of examining two cases; one that we have seen to-day, the other a mild case in private, a man in whom there was a single patch, the size of the hand, below the knee on the inner side and back of the leg; about a finger's breadth of the patch encroached on the hairy part of the leg, the rest was on the nearly hairless part; there were a few papules also on the outer side of the leg above the ankle. In both these cases I searched carefully for papules situated round the hairs, and in neither were there well-marked instances of it. There were, comparatively speaking, a few hairs with some redness round, and some broken short, as though their nutrition had been interfered with, but among the number of well-marked papules, I could find not one with the hair in the centre, though it was quite common to find a well-developed papule with a healthy hair almost touching it.

Of course, there are plenty of cases where the hairs are more implicated than in these two; but even then I am inclined to think that it will be found that follicular papules will be far outnumbered by the papillary ones. Even if in some cases this were not so, and the follicular inflammation predominated, I still contend that the disease stands in relation to the hair follicles very much in the same position as eczema, in which, though usually a disease of the flexor surfaces involving all the skin structures, it sometimes picks out the hair follicles as the seat of the inflammatory process. These cases were formerly reckoned among the lichens, but are now recognised as mere varieties of eczema. I have pointed out to you that a sweat duct can generally be traced in the centre of the papule, and two or three may be involved in it, and that the apex of the cone of the corneous layer coincides with the orifice of the sweat duct. Is this an accident of situation, so to speak, or has the sweat gland or its duct anything to do with the production of the papule? With regard to the sweat gland, I regret to say that the skin was not removed sufficiently deeply to speak with absolute certainty about many of them; all that I observed were healthy, but I am inclined to think, from the frequency of its central position, that it constitutes a determining point for the formation of the papule round it, just as the hair undoubtedly does in some cases, though, I contend, not so frequently as general opinion would ascribe to it. There is another fact which tends in this direction. Mr. Hutchinson, with his usual accuracy of observation, has noticed that wherever the clothes are fastened in close contact with the skin, such as the waist, the site of the garters, the pad of the truss when a hernia exists, &c., there the papules are most thickly distributed. In the case before you this is very noticeable below the knees, where the garters are fastened. Mr. Hutchinson ascribes this to pressure. May it not be, however, that the increased heat produced by close contact is the real agent? The general conclusions I would draw, therefore, are—

1. That the process at its commencement is entirely superficial.
2. That it consists of an inflammatory effusion from the superficial plexus of vessels, the cells in the horizontal vessels coming only from the upper wall.
3. That all the vessels of this plexus are notably dilated and the papillæ enlarged by down-growth of the interpapillary processes.
4. That all the epithelial layers undergo proliferation, those in the rete mucosum taking the most prominent part in the formation of the papule.
5. That the involvement of the hair follicles is not an essential nor the main feature of the process in most cases; but—
6. That the sweat ducts have more often an influence in determining the position of the papule.

"TREATMENT OF PAIN BY MECHANICAL VIBRATIONS."

BY J. MORTIMER GRANVILLE, M.D.

THE publication of certain results obtained in an investigation which I have been pursuing for some years past having been to a large extent anticipated by a paper which appeared in *Le Progrès Médical* of the 5th inst., from the pen of M. Boudet de Paris, ancien interne des hôpitaux de Paris, I have no alternative but to bring my researches, together with such *facts*, real or imaginary, as I have succeeded in eliciting, under the notice of the profession here and on the Continent. Indeed, I owe some explanation to many friends in England and in Paris for having so long delayed to report the progress of my experiments. Nevertheless I break silence thus early with the greatest reluctance, and only under the pressure of circumstances. As regards the accident of "forestalling," if I am not mistaken M. Boudet de Paris will have greater cause than I have to regret what I cannot but feel is the premature announcement of a discovery. On the 5th of August, 1878, Professor Brown-Séquard wrote me as follows:—"If it (the instrument employed in these experiments) has the power you state, you have certainly made a very important discovery." I could not but feel that there was a virtue in that "if" to enforce reserve until other judgments besides my own were fully satisfied. Such grave responsibility attaches to every member of the profession who ventures to suggest a new, or seemingly new, method of treatment, and who dares to hold out a hope of remedy or relief for the miseries of mankind, that I, for one, must confess to a great shrinking from the hazard of rushing into print prematurely. This feeling alone has induced me to keep silence during the last three or four years, and I am convinced the same motive has influenced the several physicians who have kindly tried my method and employed my Percuteur, to wait until convinced of their validity and value before giving to either the sanction of their authority. Among the gentlemen to whom I have submitted my speculations, and shown my instrument, I may mention Professor Brown-Séquard, Professor Ball, and Dr. Oscar Jennings of Paris, and Drs. Ringer and Gowers of London. These names are in themselves sufficient to guarantee that if the results obtained by experiment had been such as to establish my conclusions they would long since have been announced, and unless I am greatly mistaken the results recorded by M. Boudet de Paris cannot, in any therapeutical sense, be more trustworthy than my own. I will now tell the story of my investigations, and thus mark the point reached in the search for a new remedy.

As far back as 1862–3 I was, in the course of certain clinical studies of mental and sensory phenomena, induced to believe that many forms of the sensation we call "pain" were, in fact, unnecessary, and might be *interrupted* by appropriate mental and physical methods and appliances. My first observations were made in connexion with the paroxysmal, or recurrent, pains accompanying the uterine contractions in the natural process of parturition. On the 4th of May, 1864, Dr. Graily Hewitt was good enough to communicate the results of my experiments and to show certain apparatus, to the Obstetrical Society of London. In a paper "On the Application of Extreme Cold as an Anodyne in the Pain attendant on Parturition," a short abstract of which will be found in THE LANCET of July 9th, 1864, I contended that the sensations of pain experienced by the parturient woman were *not* invariably synchronous with what, for want of a better name, we term the pains of labour; and from this and other premisses—for example, the circumstance that they are commonly "referred" to regions more or less remote from the contracting uterus, or the dilating external passages, in which the real seat of the pain might have been supposed to be located—I deduced that the pain attendant on labour is *neuralgic* in character. I had constructed small boxes or chambers of such sizes and shapes as to admit of their being applied to the *supposed* seats of

I was thus led to study again the clinical aspects and the analysis of cases, and the consensus of authorities revealed the curious fact that this so-called follicular disease most frequently attacked the regions where there were the fewest hairs, such as the front of the forearms, especially near the wrist, the flanks, inner side of knees over vastus internus, and the side of the legs, especially above the ankles; to say nothing of the palms, soles, nails, and mucous membranes being occasionally involved: while only in a

"TREATMENT OF PAIN BY MECHANICAL VIBRATIONS."

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THE publication of certain results obtained in an investigation which I have been pursuing for some years past

NERVE-VIBRATION AND EXCITATION

AS

AGENTS IN THE TREATMENT OF FUNCTIONAL DISORDER AND ORGANIC DISEASE.

BY

J. MORTIMER GRANVILLE, M.D.

LONDON:
J. & A. CHURCHILL,
NEW BURLINGTON STREET.
1883.

FIG. 2.

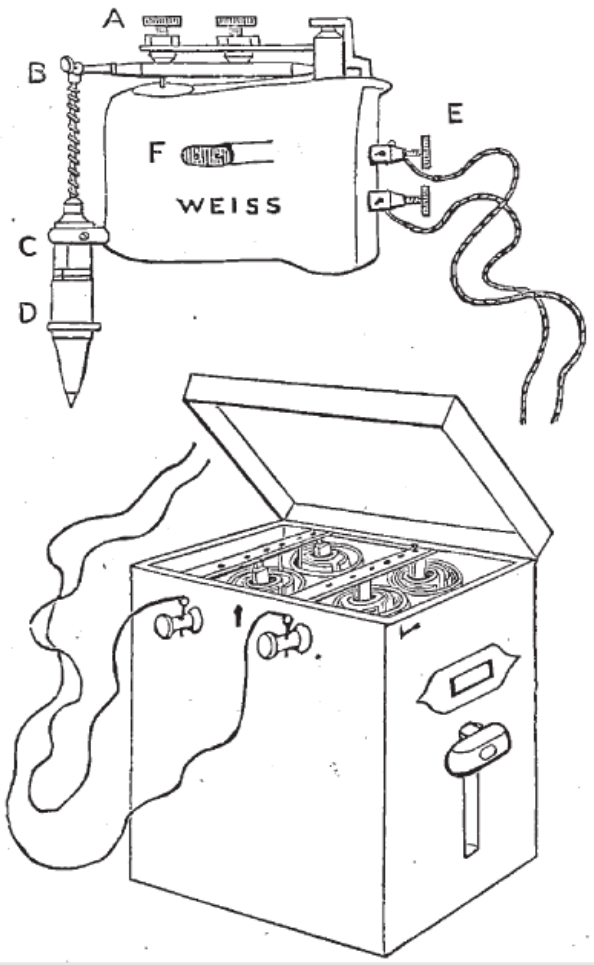


FIG. 3.

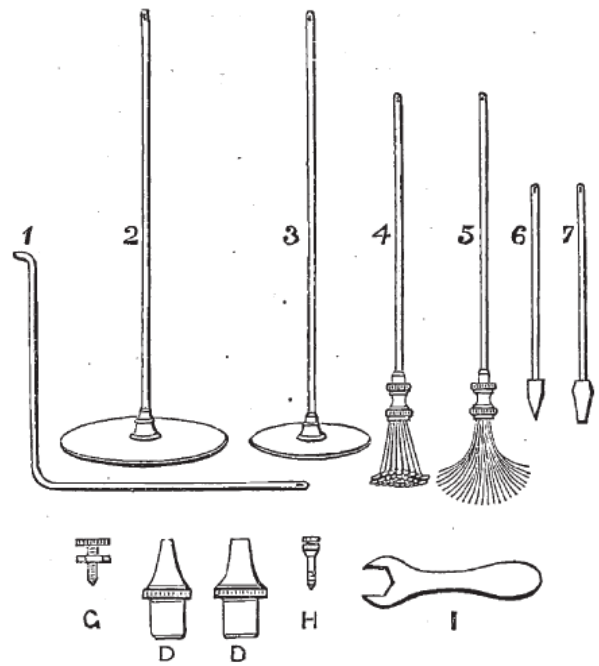
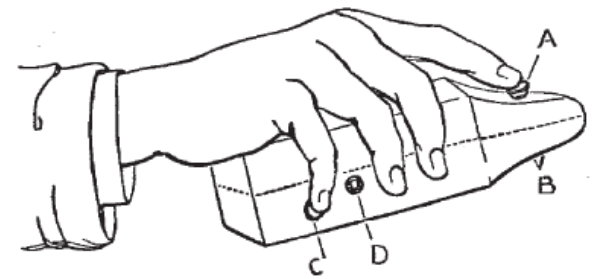


FIG. 1.



Whole body vibration

DISABILITY AND REHABILITATION, 2017
http://dx.doi.org/10.1080/09638288.2017.1282989

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REVIEW ARTICLE

Efficacy of the whole-body vibration for pain, fatigue and quality of life in women with fibromyalgia: a systematic review

Eduarda Moretti, Angélica Tenório, Laís Holanda, Adriana Campos and Andrea Lemos

Department of Physical Therapy, Federal University of Pernambuco, Recife, Brazil

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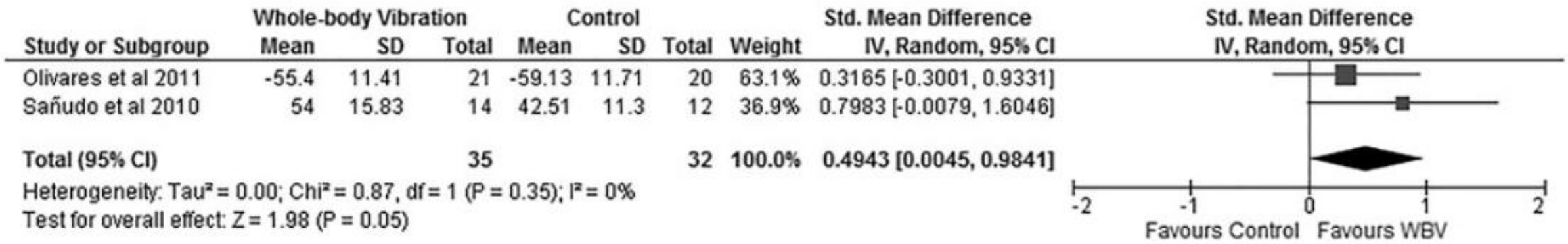

Figure 3. Forest plot for whole-body vibration (WBV) *versus* control for quality of life in women with Fibromyalgia.

DISABILITY AND REHABILITATION, 2017
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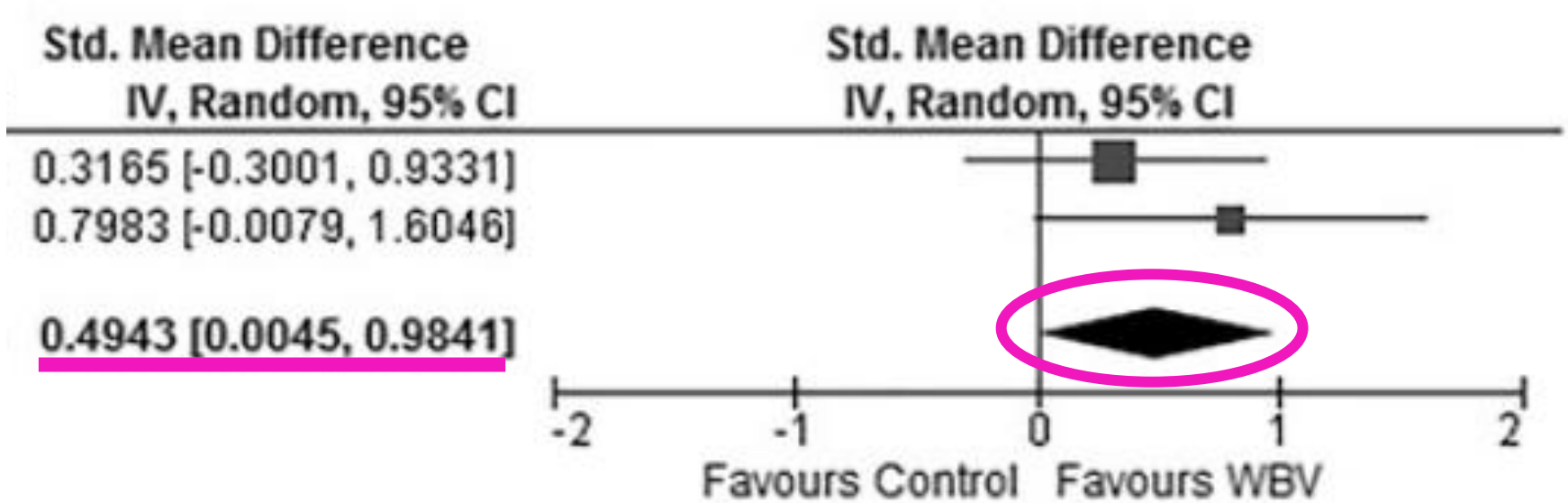
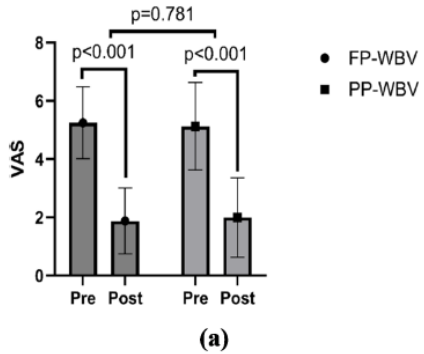


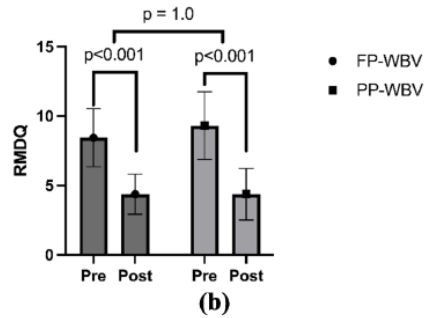
Effects of progessive *vs.* constant protocol whole-body vibration on muscle activation, pain, disability and functional performance in non-specific chronic low back pain patients: a randomized clinical trial

Tasneem Zafar[1], Saima Zaki[1], Md Farhan Alam[1], Saurabh Sharma[1], Reem Abdullah Babkair[2] and Shibili Nuhmani[3]

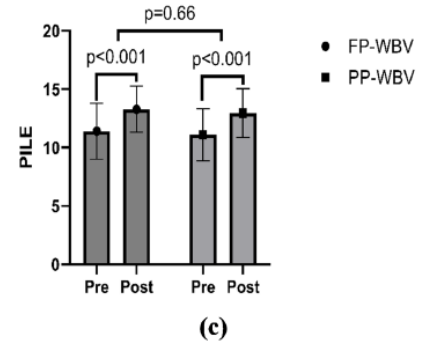
[1] Centre for Physiotherapy and Rehabilitation Sciences, Jamia Millia Islamia University, New Delhi, India
[2] Physiotherapy Department, Alhada Armed Forces Hospital, Alhada, Saudi Arabia
[3] Department of Physical Therapy, College of Applied Medical Sciences, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia


p=0.781
p<0.001
p<0.001
VAS
Pre Post Pre Post
FP-WBV
PP-WBV

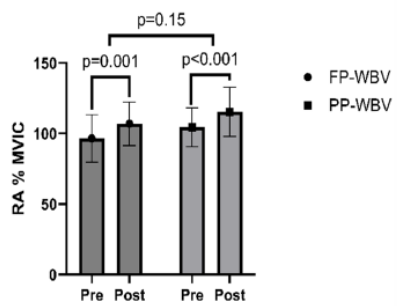
(a)


p = 1.0
p<0.001
p<0.001
RMDQ
Pre Post Pre Post
FP-WBV
PP-WBV

(b)


p=0.66
p<0.001
p<0.001
PILE
Pre Post Pre Post
FP-WBV
PP-WBV

(c)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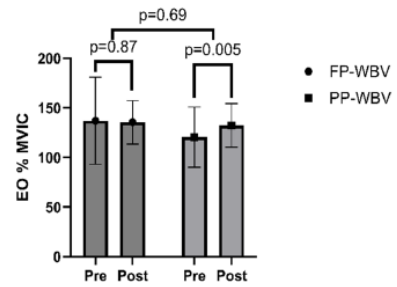
p=0.001
p<0.001
RA % MVIC
Pre Post Pre Post
FP-WBV
PP-WBV

(d)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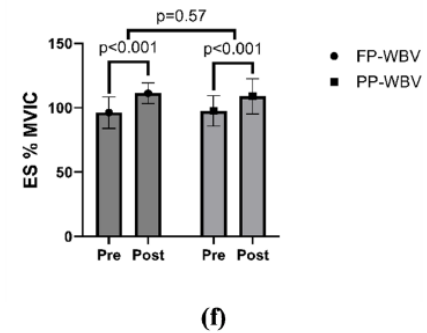
p=0.005
EO % MVIC
Pre Post Pre Post
FP-WBV
PP-WBV

(e)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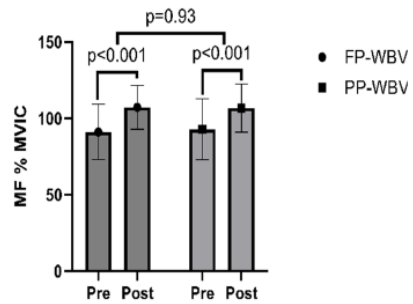
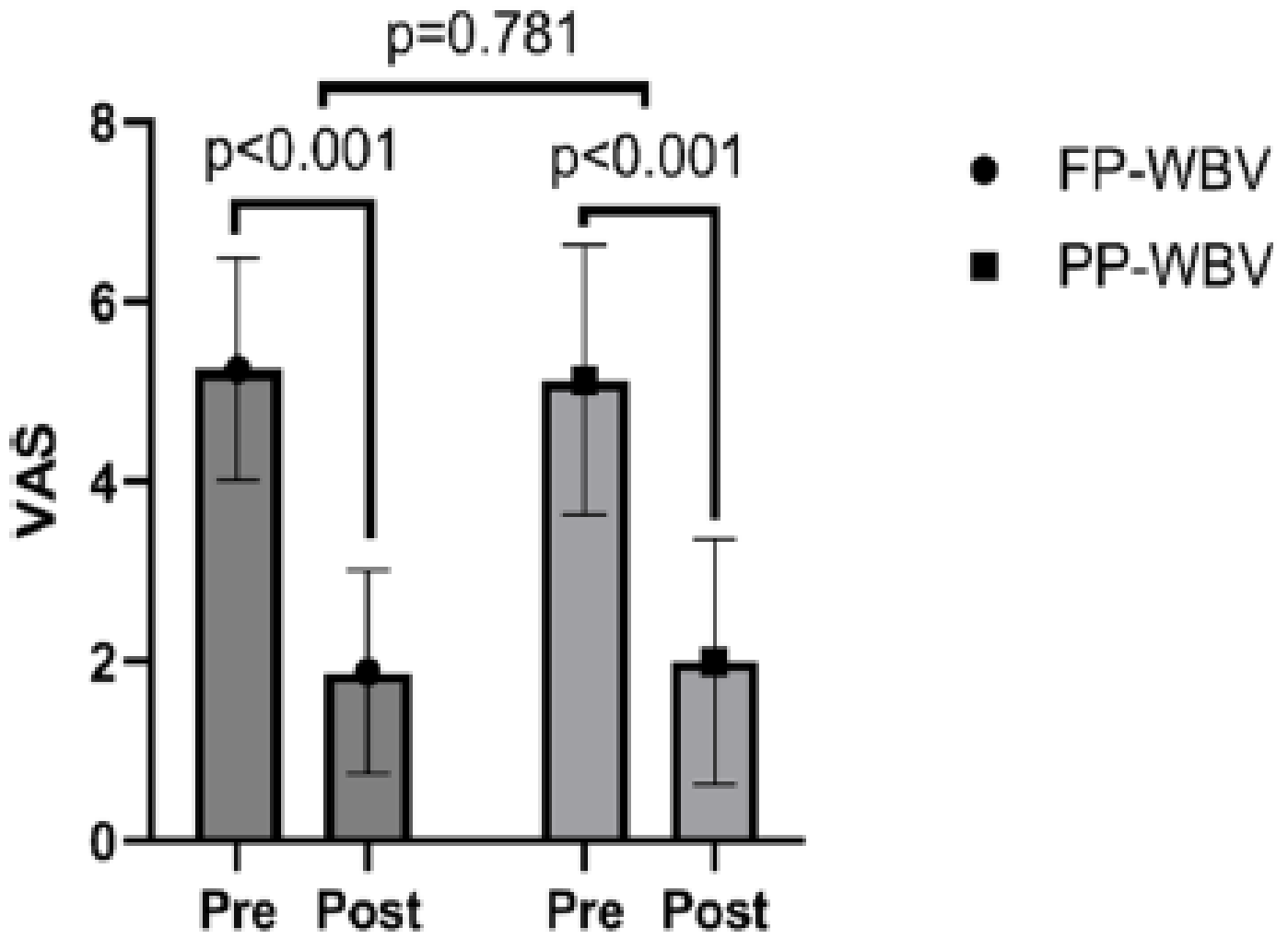
p<0.001
p<0.001
ES % MVIC
Pre Post Pre Post
FP-WBV
PP-WBV

(f)


p=0.93
p<0.001
p<0.001
MF % MVIC
Pre Post Pre Post
FP-WBV
PP-WBV

(g)


p=0.781
p<0.001
p<0.001
8
6
4
2
0
VAS
Pre
Post
Pre
Post
FP-WBV
PP-WBV

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AMERICAN CONGRESS OF REHABILITATION MEDICINE

Archives of Physical Medicine and Rehabilitation

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Archives of Physical Medicine and Rehabilitation 2019;■:■■■-■■■

REVIEW ARTICLE (META-ANALYSIS)

Whole Body Vibration Exercise for Chronic Musculoskeletal Pain: a Systematic Review and Meta-analysis of Randomized Controlled Trials

Yulin Dong, MS,[a] Wu Wang, BS,[a] Jiejiao Zheng, BS,[b] Su Chen, BS,[a] Jun Qiao, MS,[a,*] Xueqiang Wang, PhD[c,*]

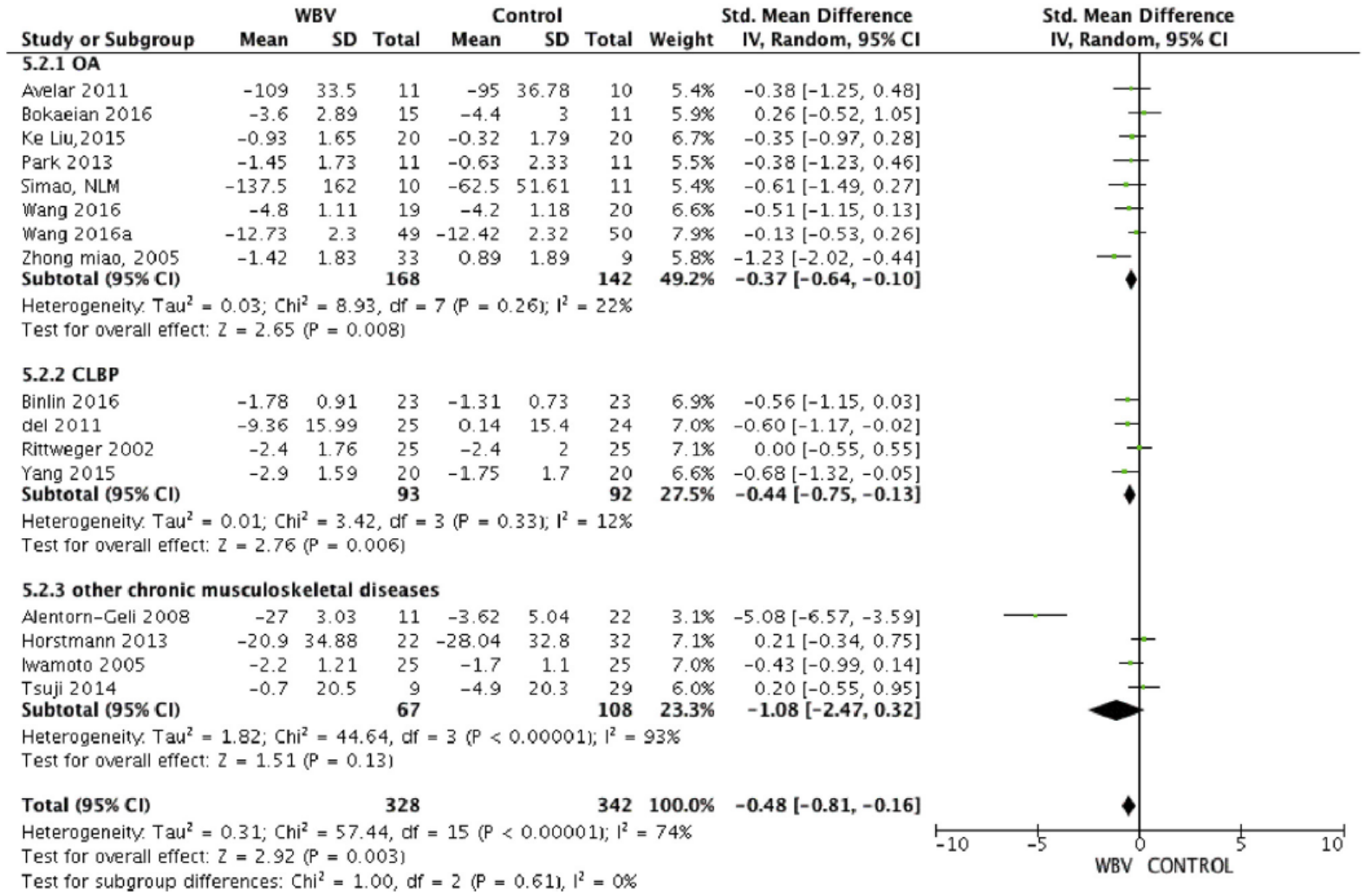
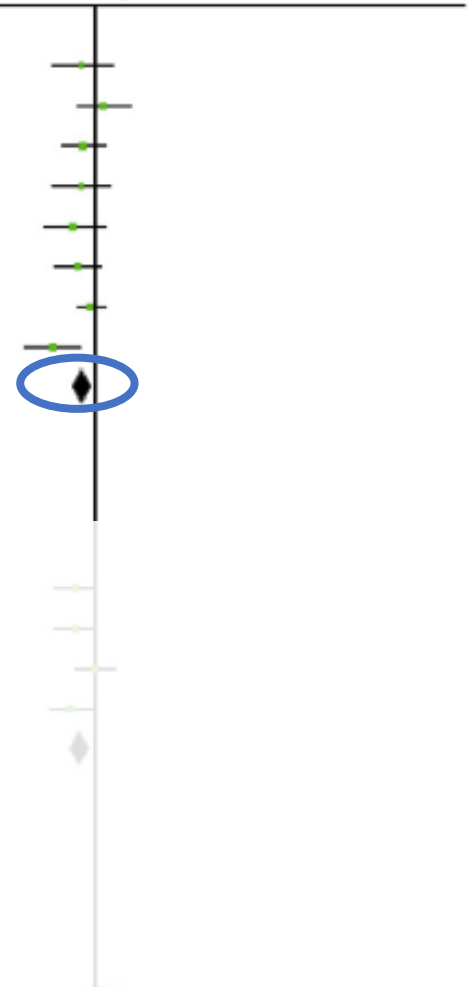


Fig 2 Forest plot of the subgroup analyses of WBVE for chronic musculoskeletal pain based on different diseases after intervention. SMD (95% CI) was calculated from 8 studies for OA, 4 studies for CLBP, and 4 studies for other chronic musculoskeletal diseases.

Study or Subgroup	WBV Mean	WBV SD	WBV Total	Control Mean	Control SD	Control Total	Weight	Std. Mean Difference IV, Random, 95% CI
5.2.1 OA								
Avelar 2011	-109	33.5	11	-95	36.78	10	5.4%	-0.38 [-1.25, 0.48]
Bokaeian 2016	-3.6	2.89	15	-4.4	3	11	5.9%	0.26 [-0.52, 1.05]
Ke Liu,2015	-0.93	1.65	20	-0.32	1.79	20	6.7%	-0.35 [-0.97, 0.28]
Park 2013	-1.45	1.73	11	-0.63	2.33	11	5.5%	-0.38 [-1.23, 0.46]
Simao, NLM	-137.5	162	10	-62.5	51.61	11	5.4%	-0.61 [-1.49, 0.27]
Wang 2016	-4.8	1.11	19	-4.2	1.18	20	6.6%	-0.51 [-1.15, 0.13]
Wang 2016a	-12.73	2.3	49	-12.42	2.32	50	7.9%	-0.13 [-0.53, 0.26]
Zhong miao, 2005	-1.42	1.83	33	0.89	1.89	9	5.8%	-1.23 [-2.02, -0.44]
Subtotal (95% CI)			**168**			**142**	**49.2%**	**-0.37 [-0.64, -0.10]**
Heterogeneity: $Tau^2 = 0.03$; $Chi^2 = 8.93$, df = 7 (P = 0.26); $I^2 = 22\%$								
Test for overall effect: Z = 2.65 (P = 0.008)								
5.2.2 CLBP								
Binlin 2016	-1.78	0.91	23	-1.31	0.73	23	6.9%	-0.56 [-1.15, 0.03]
del 2011	-9.36	15.99	25	0.14	15.4	24	7.0%	-0.60 [-1.17, -0.02]
Rittweger 2002	-2.4	1.76	25	-2.4	2	25	7.1%	0.00 [-0.55, 0.55]
Yang 2015	-2.9	1.59	20	-1.75	1.7	20	6.6%	-0.68 [-1.32, -0.05]
Subtotal (95% CI)			**93**			**92**	**27.5%**	**-0.44 [-0.75, -0.13]**
Heterogeneity: $Tau^2 = 0.01$; $Chi^2 = 3.42$, df = 3 (P = 0.33); $I^2 = 12\%$								
Test for overall effect: Z = 2.76 (P = 0.006)								
5.2.3 other chronic musculoskeletal diseases								
Alentorn-Geli 2008	-27	3.03	11	-3.62	5.04	22	3.1%	-5.08 [-6.57, -3.59]



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Subtotal (95% CI)			**168**			**142**	**49.2%**	**-0.37 [-0.64, -0.10]**

Heterogeneity: Tau² = 0.03; Chi² = 8.93, df = 7 (P = 0.26); I² = 22%
Test for overall effect: Z = 2.65 (P = 0.008)

5.2.2 CLBP

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Rittweger 2002	-2.4	1.76	25	-2.4	2	25	7.1%	0.00 [-0.55, 0.55]
Yang 2015	-2.9	1.59	20	-1.75	1.7	20	6.6%	-0.68 [-1.32, -0.05]
Subtotal (95% CI)			**93**			**92**	**27.5%**	**-0.44 [-0.75, -0.13]**

Heterogeneity: Tau² = 0.01; Chi² = 3.42, df = 3 (P = 0.33); I² = 12%
Test for overall effect: Z = 2.76 (P = 0.006)

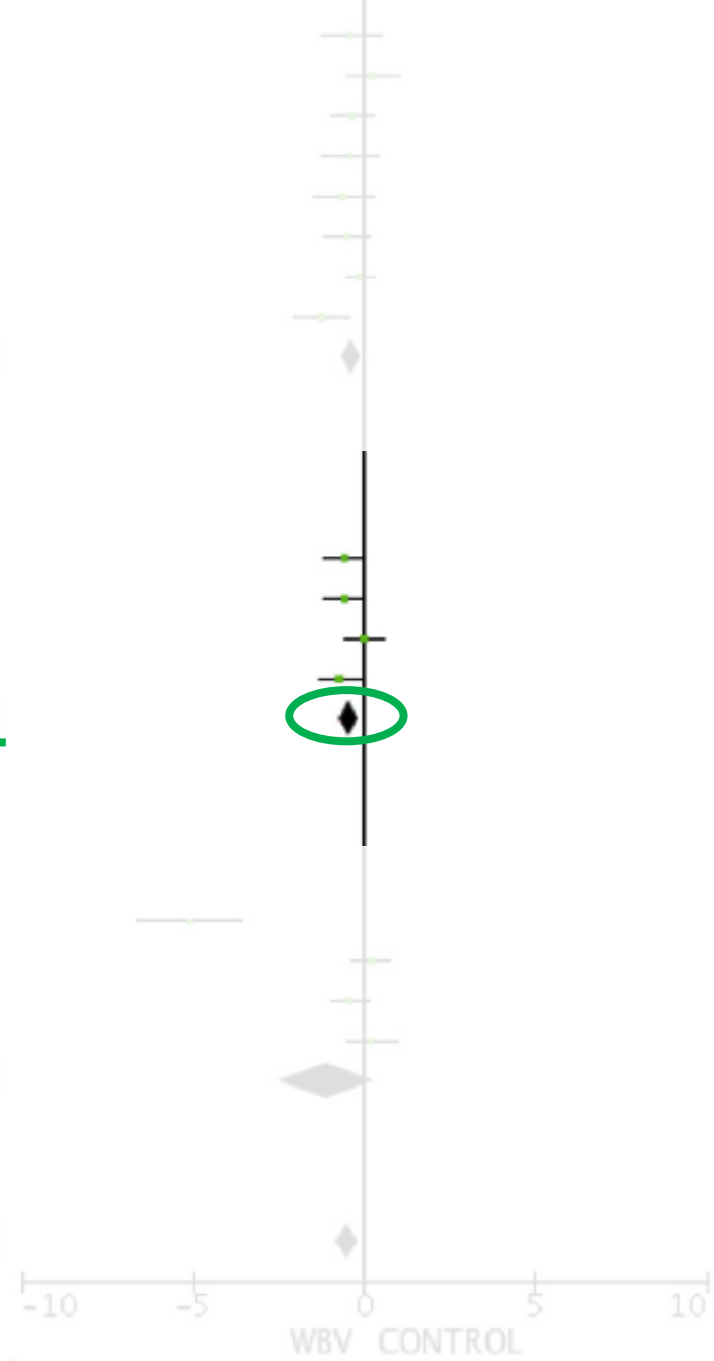
5.2.3 other chronic musculoskeletal diseases

Alentorn-Geli 2008	-27	3.03	11	-3.62	5.04	22	3.1%	-5.08 [-6.57, -3.59]
Horstmann 2013	-20.9	34.88	22	-28.04	32.8	32	7.1%	0.21 [-0.34, 0.75]
Iwamoto 2005	-2.2	1.21	25	-1.7	1.1	25	7.0%	-0.43 [-0.99, 0.14]
Tsuji 2014	-0.7	20.5	9	-4.9	20.3	29	6.0%	0.20 [-0.55, 0.95]
Subtotal (95% CI)			**67**			**108**	**23.3%**	**-1.08 [-2.47, 0.32]**

Heterogeneity: Tau² = 1.82; Chi² = 44.64, df = 3 (P < 0.00001); I² = 93%
Test for overall effect: Z = 1.51 (P = 0.13)

Total (95% CI)			**328**			**342**	**100.0%**	**-0.48 [-0.81, -0.16]**

Heterogeneity: Tau² = 0.31; Chi² = 57.44, df = 15 (P < 0.00001); I² = 74%
Test for overall effect: Z = 2.92 (P = 0.003)
Test for subgroup differences: Chi² = 1.00, df = 2 (P = 0.61), I² = 0%



del 2011	-9.36	15.99	25	0.14	15.4	24	7.0%	-0.60 [-1.17, -0.02]
Rittweger 2002	-2.4	1.76	25	-2.4	2	25	7.1%	0.00 [-0.55, 0.55]
Yang 2015	-2.9	1.59	20	-1.75	1.7	20	6.6%	-0.68 [-1.32, -0.05]
Subtotal (95% CI)			**93**			**92**	**27.5%**	**-0.44 [-0.75, -0.13]**

Heterogeneity: $Tau^2 = 0.01$; $Chi^2 = 3.42$, df = 3 (P = 0.33); $I^2 = 12\%$

Test for overall effect: Z = 2.76 (P = 0.006)

5.2.3 other chronic musculoskeletal diseases

Alentorn-Geli 2008	-27	3.03	11	-3.62	5.04	22	3.1%	-5.08 [-6.57, -3.59]
Horstmann 2013	-20.9	34.88	22	-28.04	32.8	32	7.1%	0.21 [-0.34, 0.75]
Iwamoto 2005	-2.2	1.21	25	-1.7	1.1	25	7.0%	-0.43 [-0.99, 0.14]
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Total (95% CI)			**328**			**342**	**100.0%**	**-0.48 [-0.81, -0.16]**

Heterogeneity: $Tau^2 = 0.31$; $Chi^2 = 57.44$, df = 15 (P < 0.00001); $I^2 = 74\%$

Test for overall effect: Z = 2.92 (P = 0.003)

Test for subgroup differences: $Chi^2 = 1.00$, df = 2 (P = 0.61), $I^2 = 0\%$

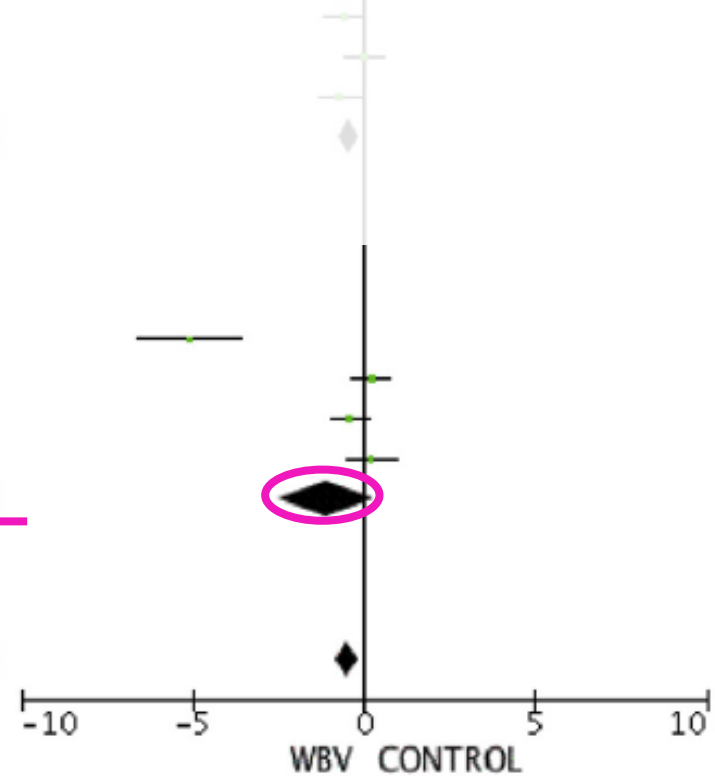
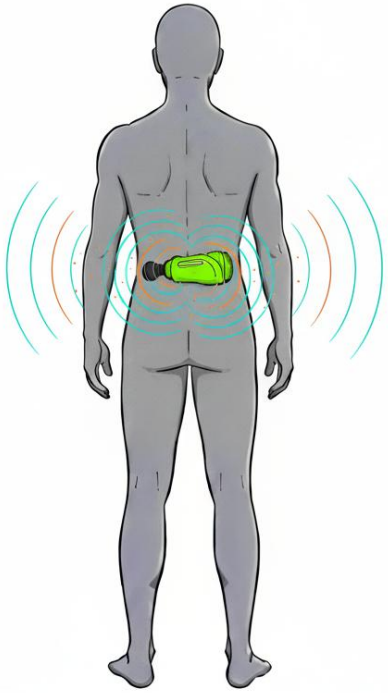


Fig 2 Forest plot of the subgroup analyses of WBVE for chronic musculoskeletal pain based on different diseases after intervention. SMD (95% CI) was calculated from 8 studies for OA, 4 studies for CLBP, and 4 studies for other chronic musculoskeletal diseases.

Whole body vibration → Local vibration



Li *et al.*
Journal of Orthopaedic Surgery and Research (2023) 18:727
https://doi.org/10.1186/s13018-023-04217-2

Journal of Orthopaedic Surgery and Research

SYSTEMATIC REVIEW Open Access

Vibration therapy to improve pain and function in patients with chronic low back pain: a systematic review and meta-analysis

Qiang Li[1], Pan Liu[2,3], Zongbao Wang[2,3*] and Xin Li[1]

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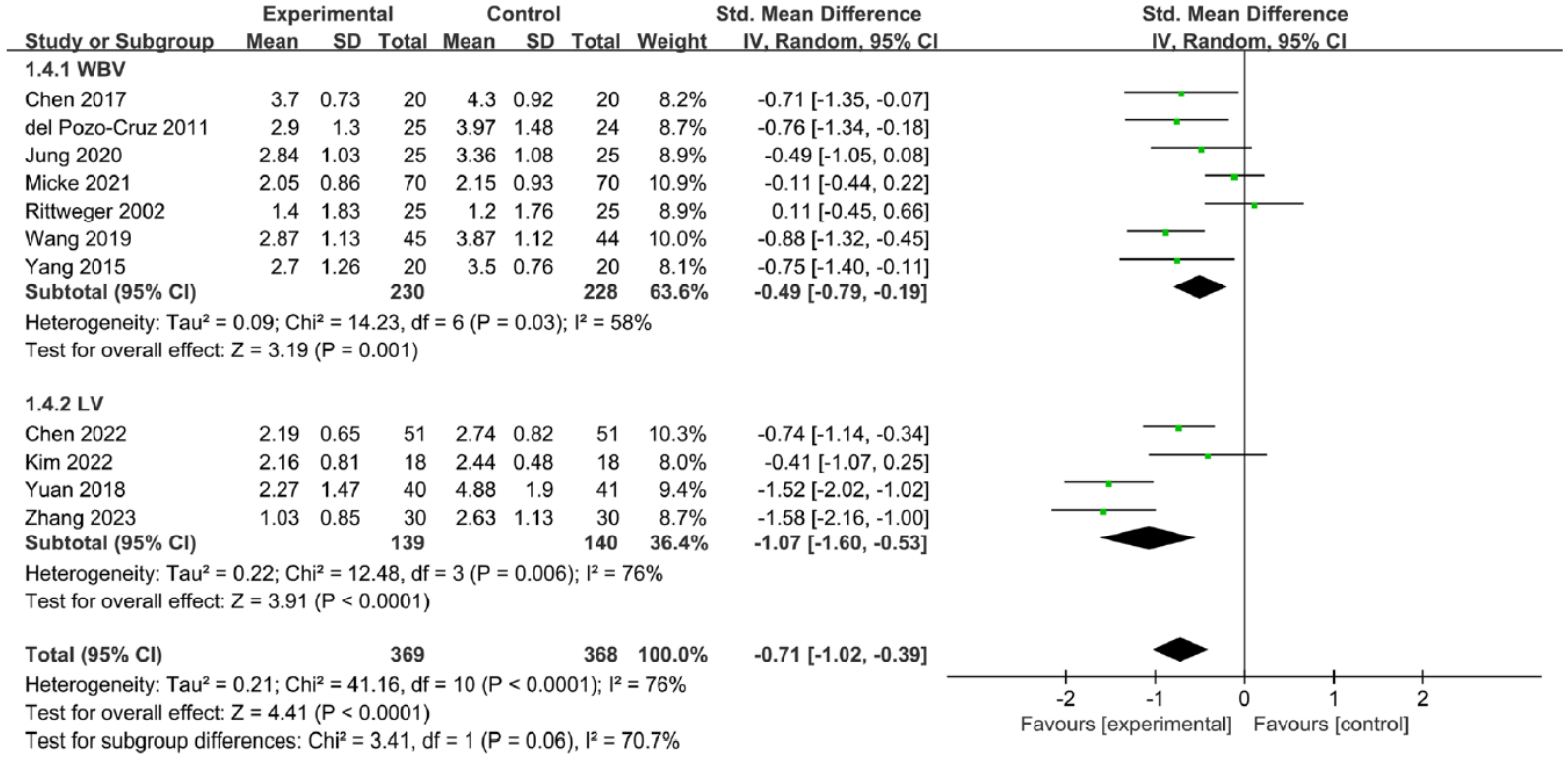

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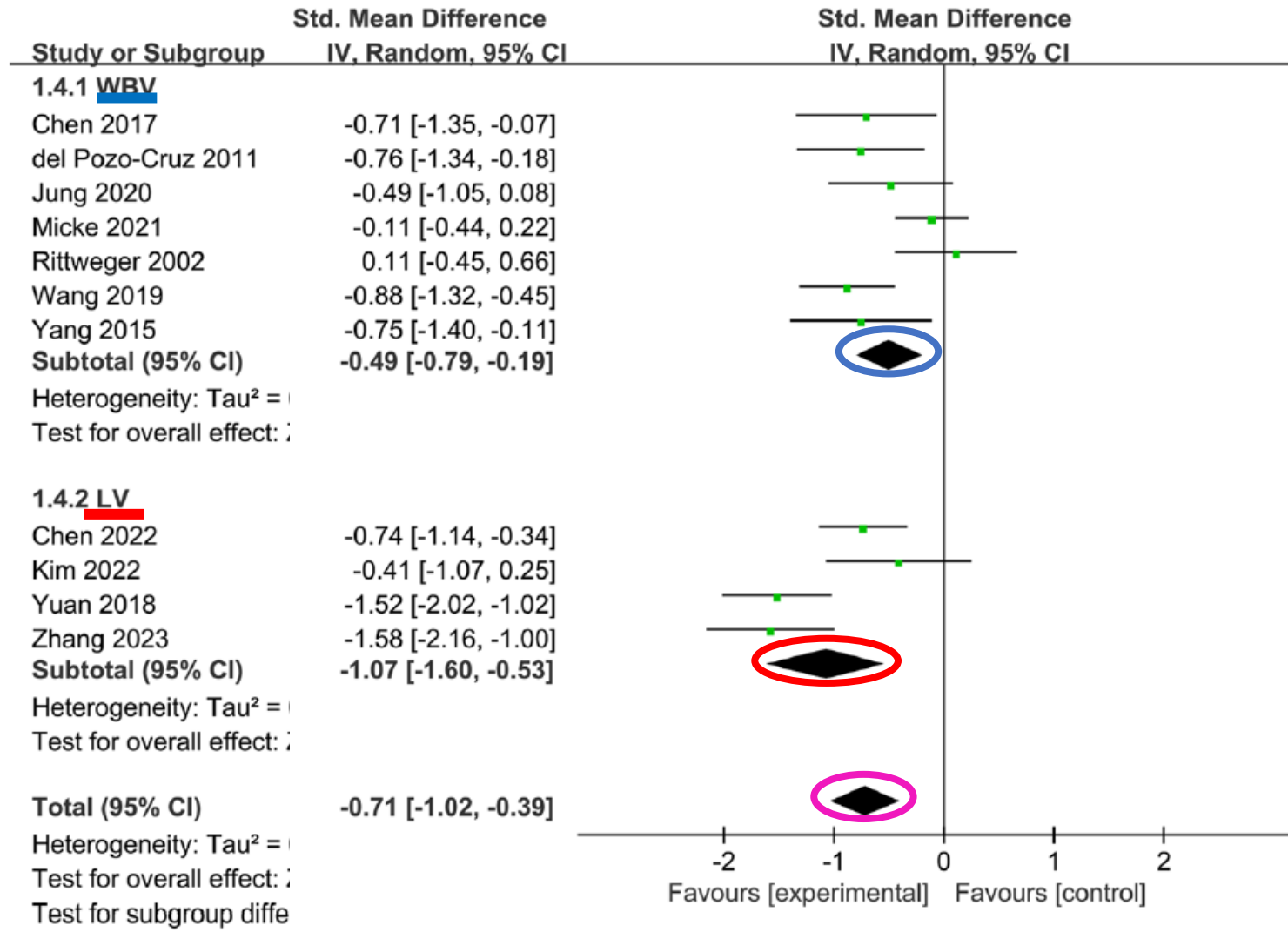
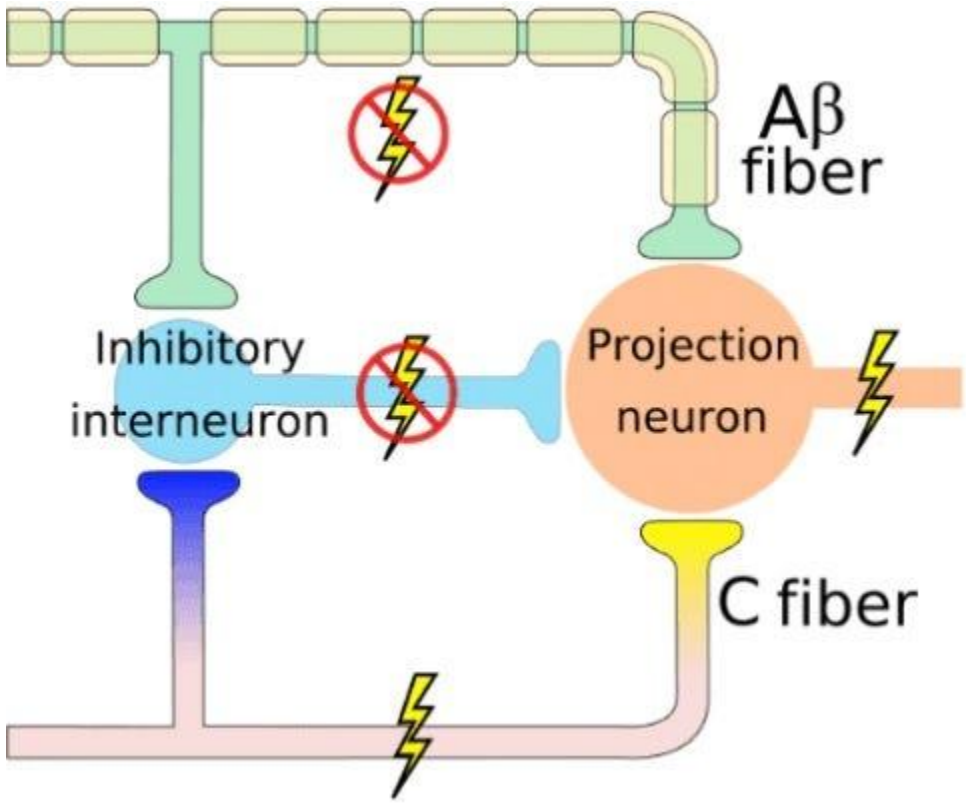
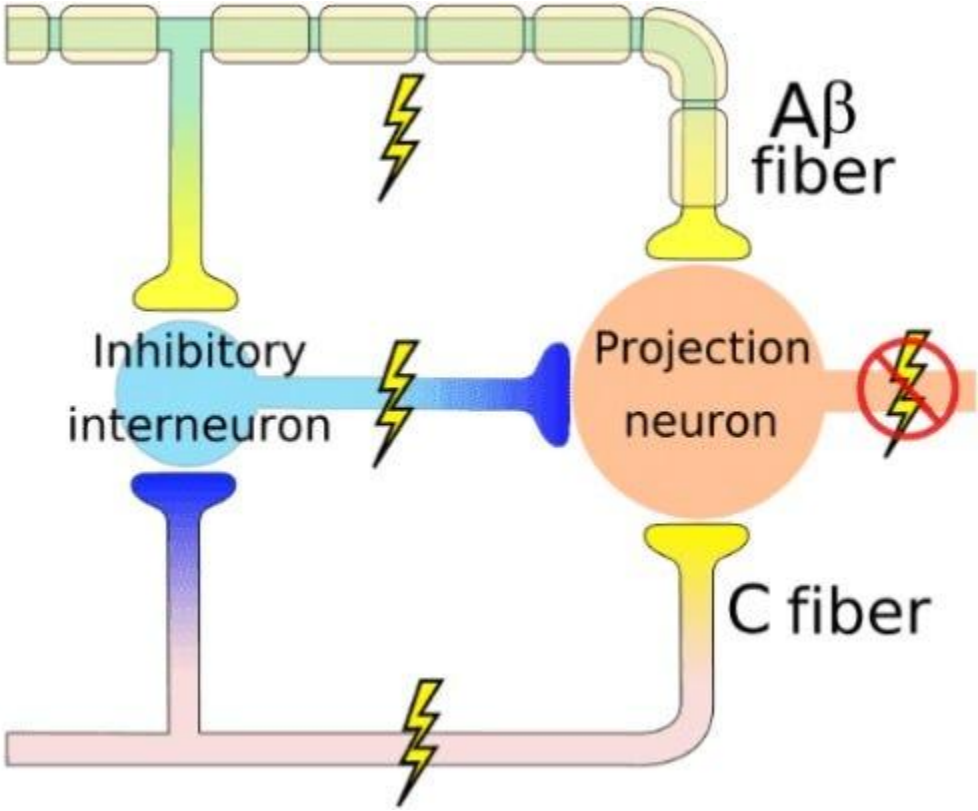


Teoria del cancello





Online version at https://www.minervamedica.it

European Journal of Physical and Rehabilitation Medicine 2022 April;58(2):306-15
DOI: 10.23736/S1973-9087.22.07415-9

SYSTEMATIC REVIEW

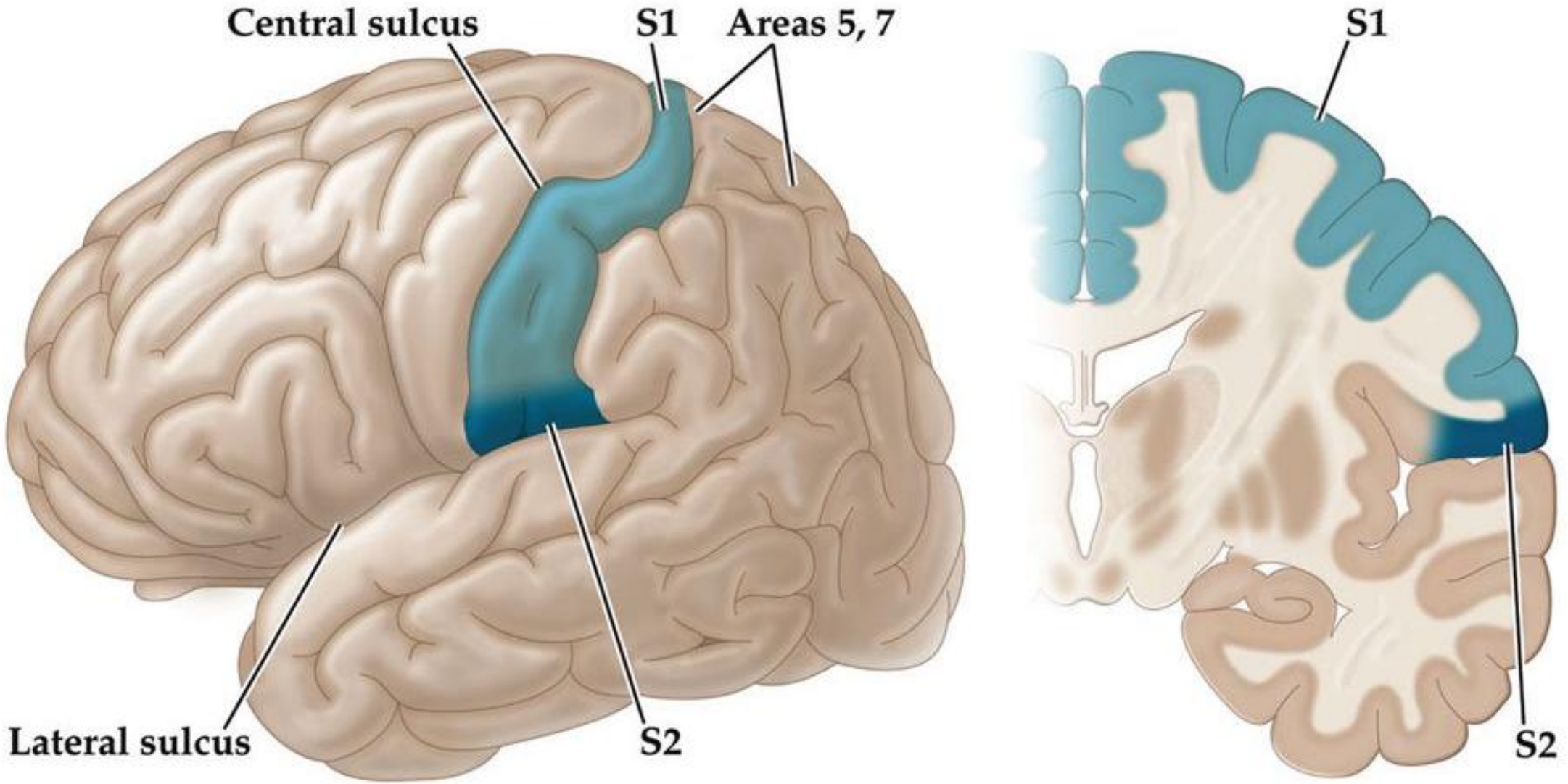
PAIN AND PHYSICAL MODALITIES

The analgesic effect of localized vibration: a systematic review
Part 1: the neurophysiological basis

Roberto CASALE [1] *, Per HANSSON [2, 3]

[1]OPUSMedica PC&R, Piacenza, Italy; [2]Department of Pain Management and Research, Norwegian National Advisory Unit on Neuropathic Pain, Division of Emergencies and Critical Care, Oslo University Hospital, Oslo, Norway; [3]Department of Molecular Medicine and Surgery, Karolinska Institutet, Stockholm, Sweden

*Corresponding author: Roberto Casale, OPUSMedica PC&R, Piacenza, Italy. E-mail: robertocasale@opusmedica.org

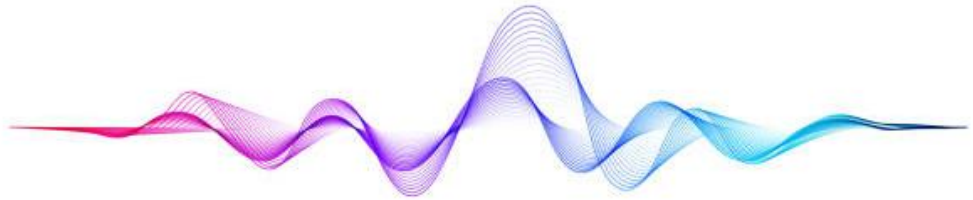

Central sulcus
S1
Areas 5, 7
Lateral sulcus
S2
S1
S2

Exp Brain Res. 2019 March ; 237(3): 805–816. doi:10.1007/s00221-018-05465-z.

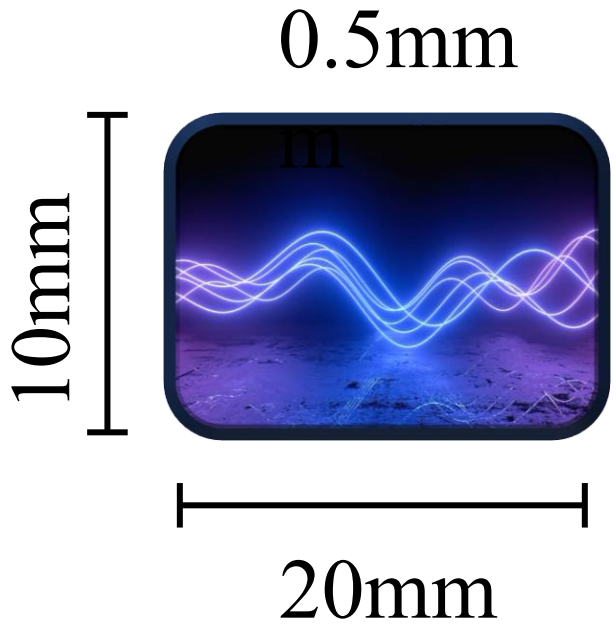
Use of imperceptible wrist vibration to modulate sensorimotor cortical activity.

Na Jin Seo, PhD[1,2], Kishor Lakshminarayanan, PhD[3], Abigail Lauer, MS[4], Viswanathan Ramakrishnan, PhD[4], Brian D. Schmit, PhD[5], Colleen A. Hanlon, PhD[6], Mark S. George, MD[6], Leonardo Bonilha, MD, PhD[7], Ryan J. Downey, PhD[1], Will DeVries, BS[6], and Tibor Nagy, BS[8]

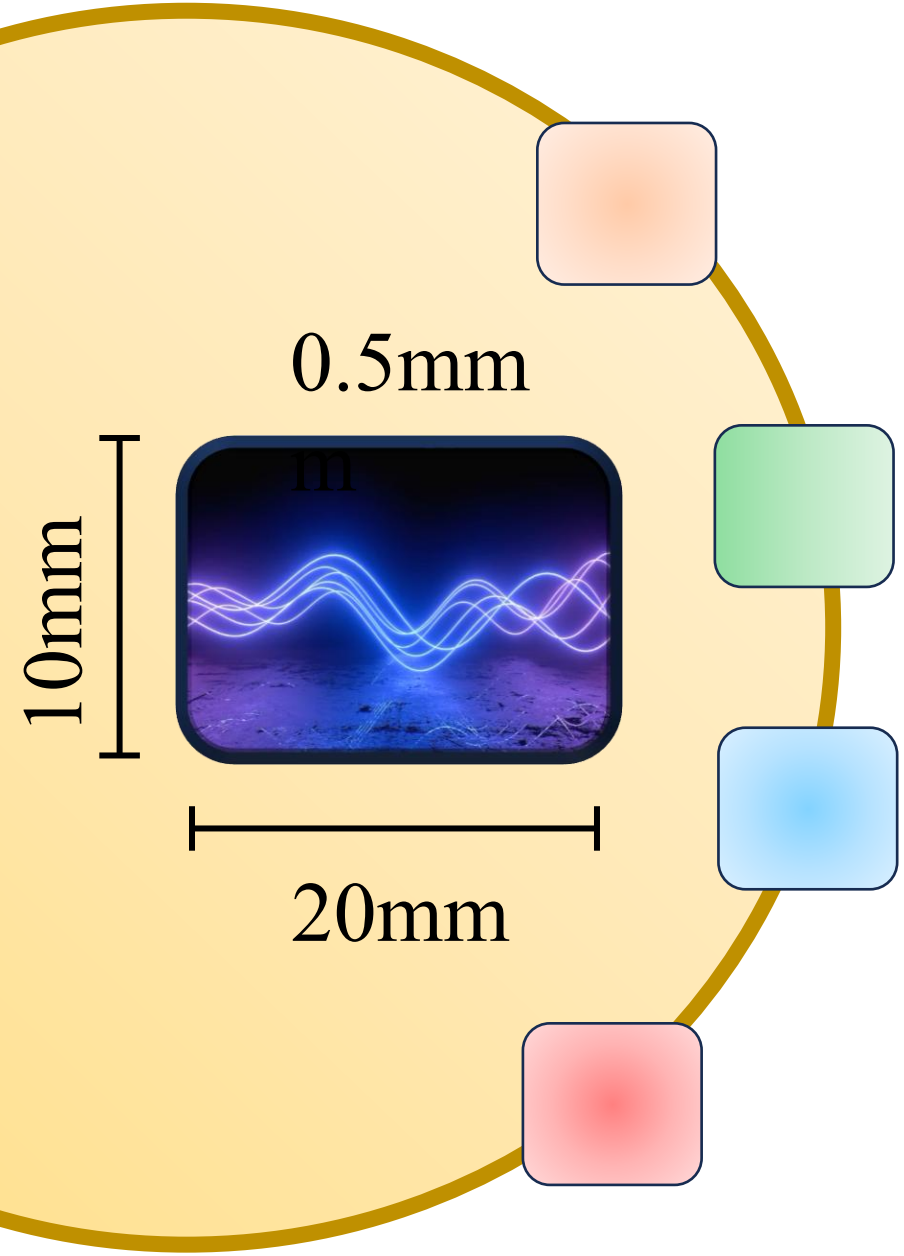
Can focal microvibration have a role in the management of chronic pain?



The device

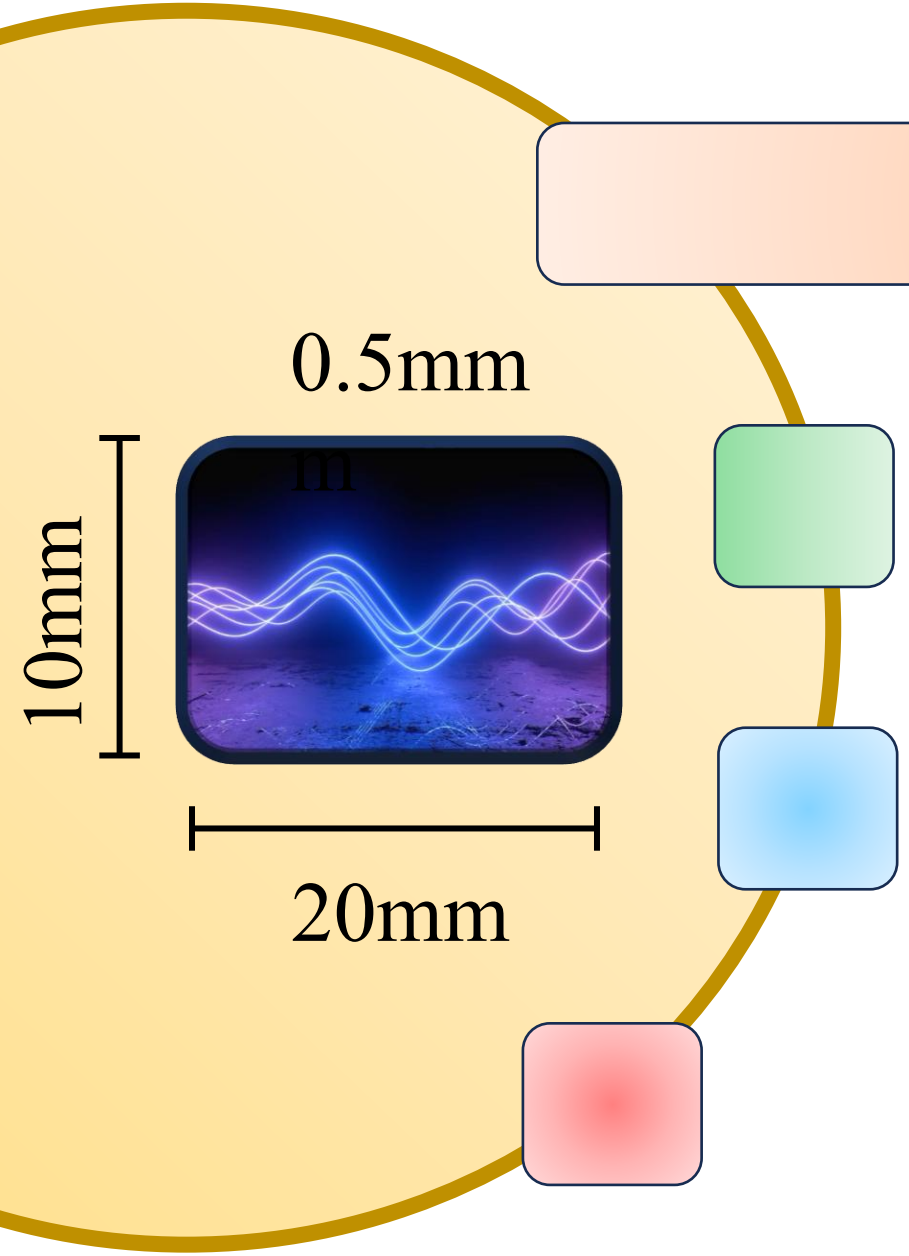


The device



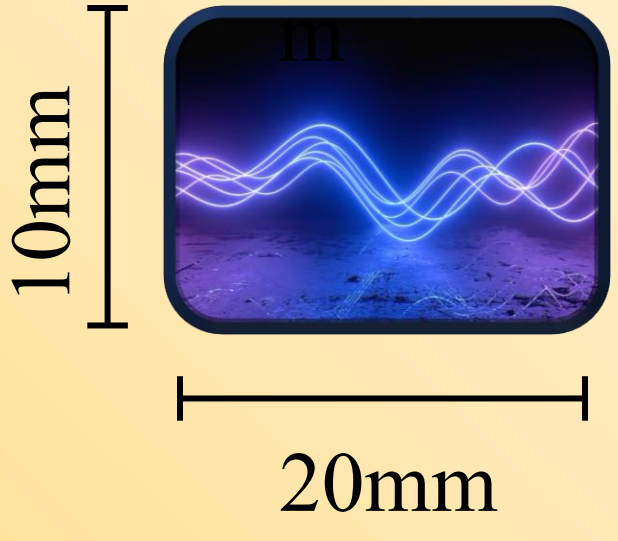
The device

Weight: 0.17g



The device

Weight: 0.17g



Frequency of vibration: 9000Hz

The device

Weight: 0.17g

Frequency of vibration: 9000Hz

Maximum length of vibration: 0.02mm

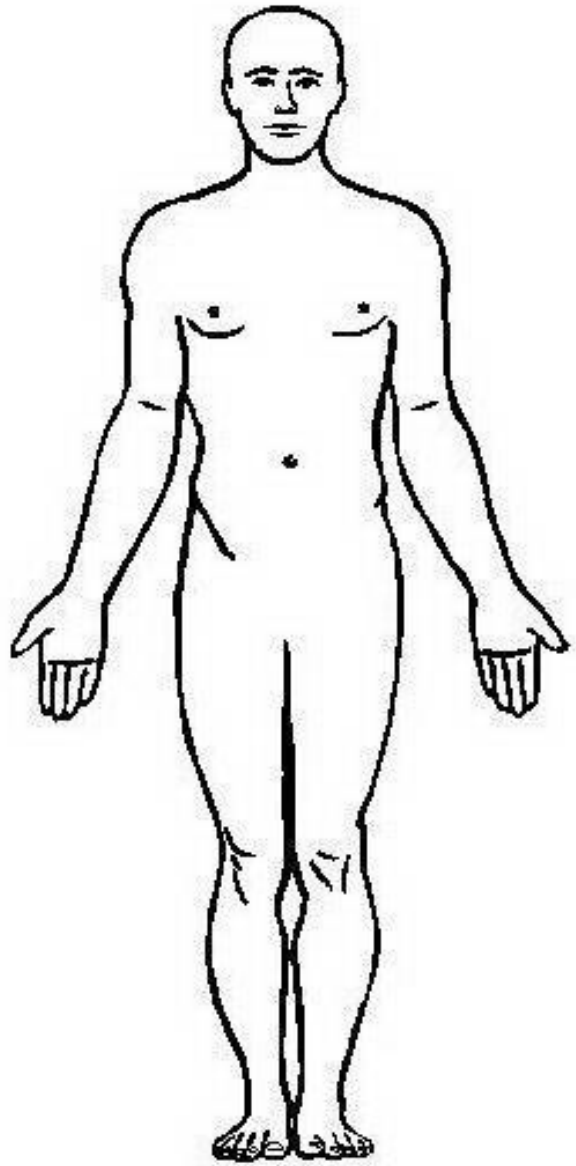
The device

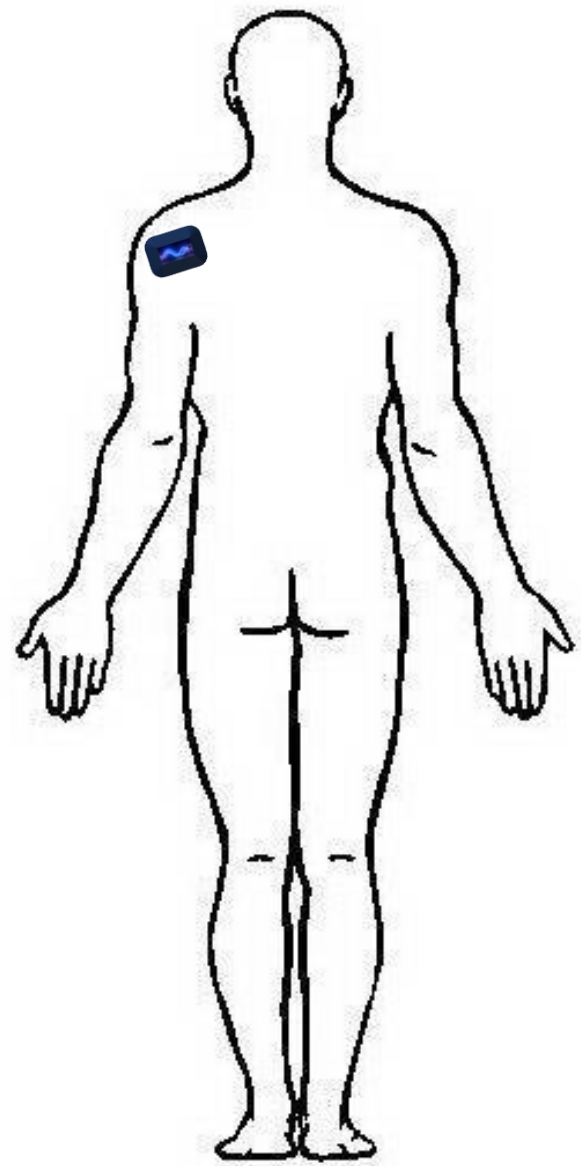
Weight: 0.17g

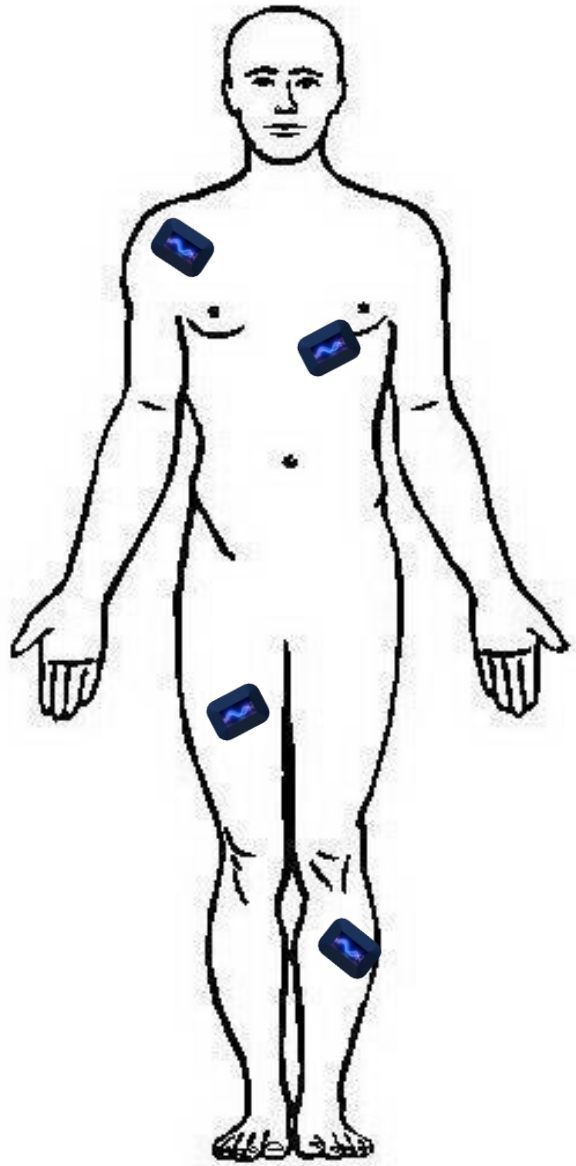
Frequency of vibration: 9000Hz

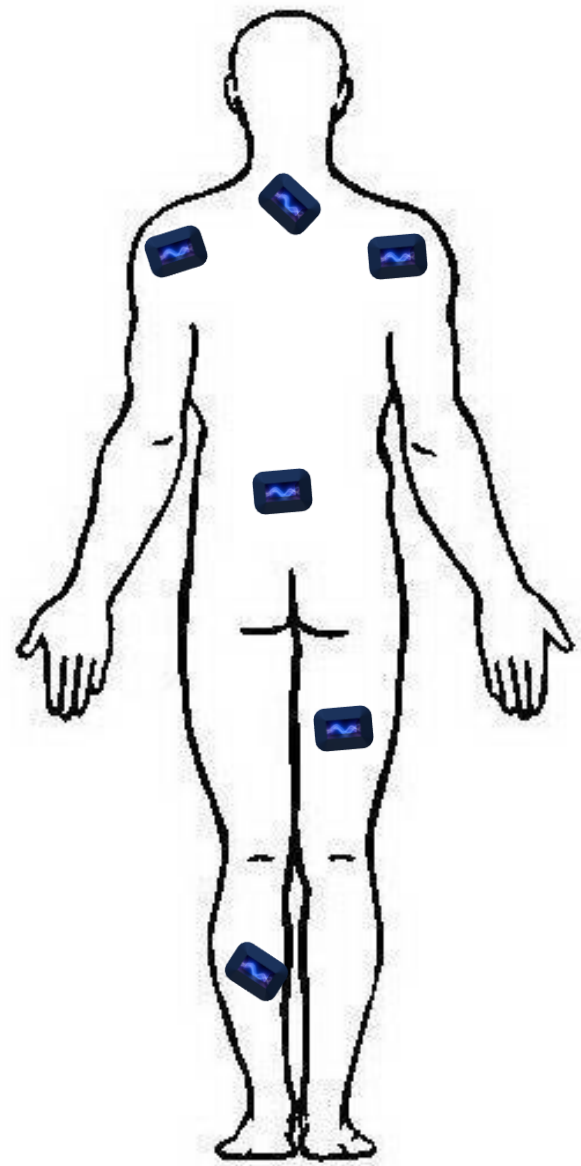
Maximum length of vibration: 0.02mm

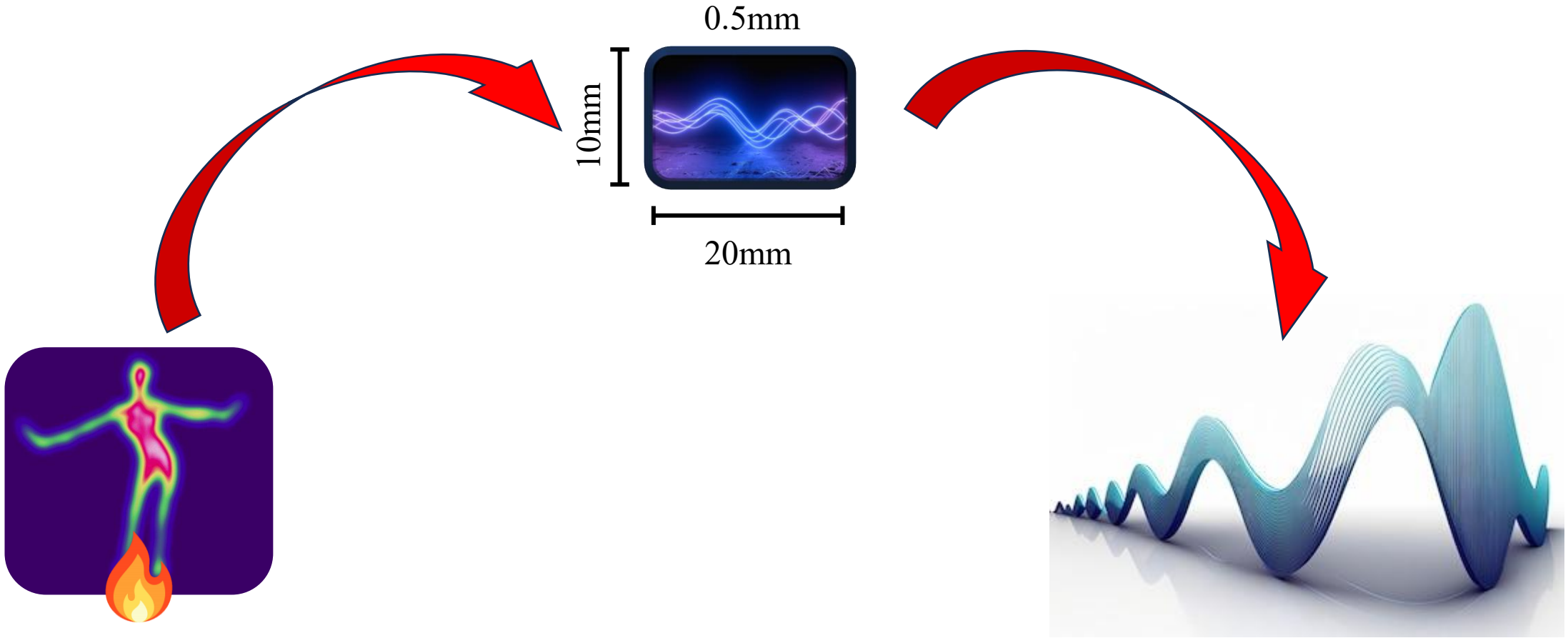
Energy: 0.8N










0.5mm
10mm
20mm

Restorative Neurology and Neuroscience 34 (2016) 869–876
DOI 10.3233/RNN-160665
IOS Press

The effects of mechanical focal vibration on walking impairment in multiple sclerosis patients: A randomized, double-blinded vs placebo study

Emanuele Spina, Antonio Carotenuto, Maria Gabriella Aceto, Ilaria Cerillo, Francesco Silvestre, Francesco Arace, Paolo Paone, Giuseppe Orefice and Rosa Iodice*
Department of Neurosciences, Odontostomatological and Reproductive Sciences· University of Naples "Federico II", Naples, Italy

		T0	T1	T2	*p value T0-T1*	*p value T0-T2*
First right step, FRS (cm)	***microvibr.***	36.26±3.32	42.88±5.13	43.55±6.09	0.012	0.017
	placebo	42.80±11.13	45.40±13.36	44.90±10.47	0.733	0.802
Average stride lenght, ASL (cm)	***microvibr.***	36.77±5.73	39.77±6.42	39.66±6.16	0.011	0.127
	placebo	43.90±9.71	43.40±12.91	43.80±10.67	0.872	0.902
Double support time, DST (ms)	***microvibr.***	400.18±278.43	274.77±198.41	318.40±287.40	0.008	0.038
	placebo	248.89±258.48	304.87±232.98	279.29±231.71	0.433	0.881

		T0	T1	T2	*p value T0-T1*	*p value T0-T2*
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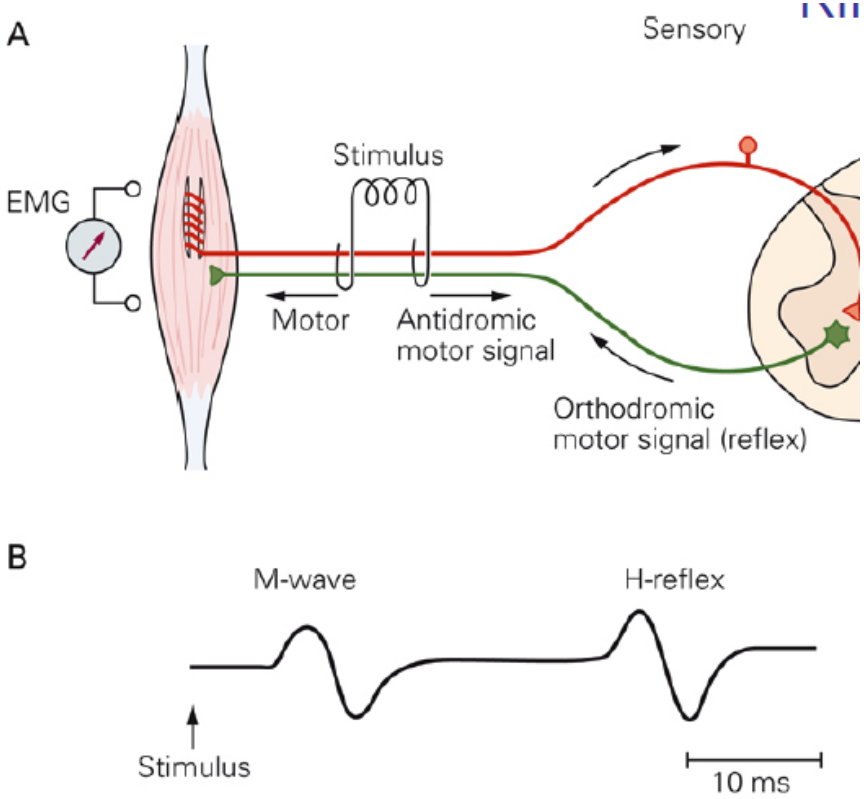
Acute effects of high-frequency microfocal vibratory stimulation on the H reflex of the soleus muscle. A double-blind study in healthy subjects

Enrico Alfonsi, MD[a,c]
Paolo Paone, BSc (Statistics)[a]
Cristina Tassorelli, PhD, MD[b,c]
Roberto De Icco, MD[b,c]
Arrigo Moglia, PhD, MD[a,c]
Elena Alvisi, MD[a,b]
Lucky Marchetta, BSc (Neurophys Tech)[a]
Mauro Fresia, BSc (Neurophys Tech)[a]
Alessandra Montini, BSc (Neurophys Tech)[a]
Marzia Calabrese, BSc (Neurophys Tech)[a]
Vittorio Versiglia, BSc (Neurophys Tech)[a]
Giorgio Sandrini, PhD, MD[b,c]

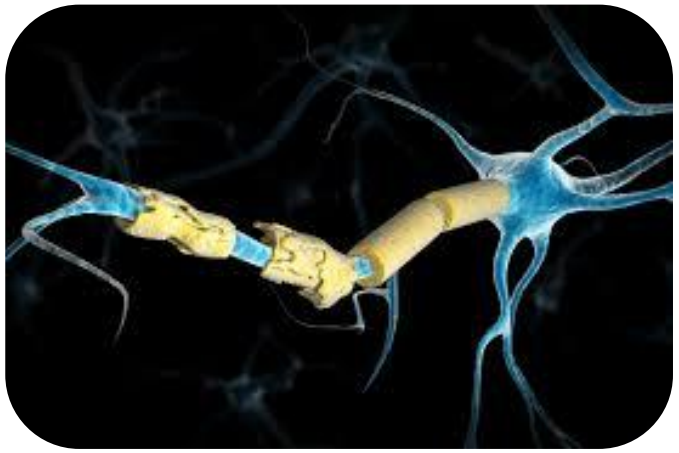


	T_0	T_1	p-value
H1 (mV)	9.29±4.01	8.7±4.7	ns
H2 (mV)	1.3±2.52	0.83±2.34	0.025
H3 (mV)	8.77±4.04	7.64±4.27	ns
Mmax (mV)	18.26±5.98	18.8±6.04	ns
H1/Mmax	0.49±0.16	0.44±0.19	0.036
H3/Mmax	0.47±0.19	0.40±0.19	0.042
VI	9.51±15.85	4.79±12.80	0.006
VI late	10.33±17.40	5.65±14.81	0.01

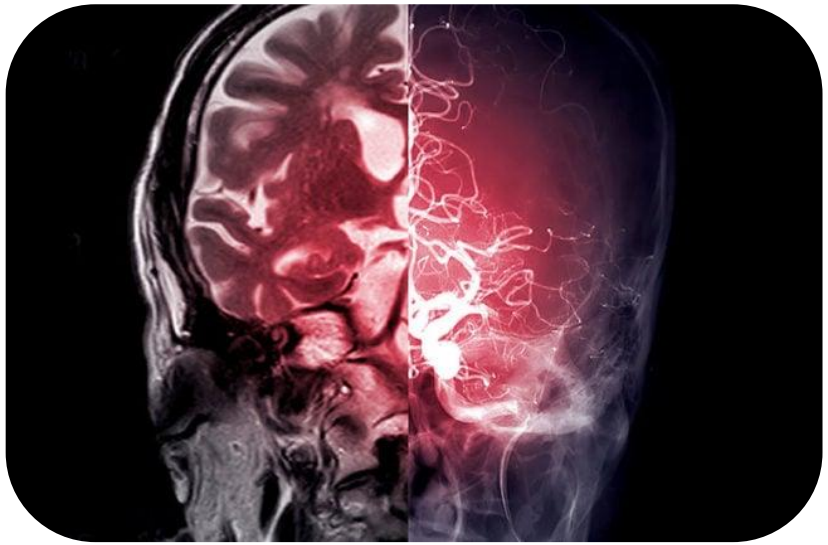
Abbreviations: H1=mean of 10 maximum H-reflex amplitudes at baseline; H2=mean of 10 maximum H-reflex amplitudes during TVS; H3=mean of 10 maximum H-reflex amplitudes 3 minutes after TVS; Mmax=mean of 10 consecutive Mmax (maximum-amplitude CMAP) responses; H1/Mmax=ratio between H1 and Mmax; H3/Mmax=ratio between H3 and Mmax; VI (Vibratory Index)=(H2/H1)x100; VI late (Vibratory Index late effect)=(H2/H3)x100.

Stimulus strength (V)

Application of focal microvibration

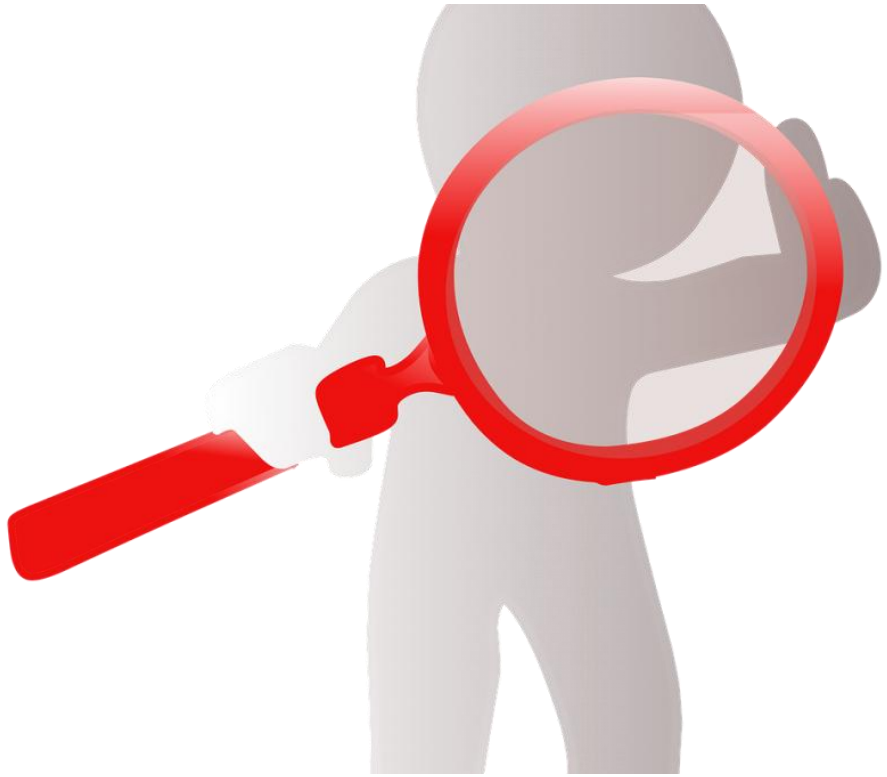


Sclerosi multipla



Stroke

Our experience



Pain > 6 months

Different origin

Psychiatric disorders
SCS
Recent radiofrequency

Characteristic	Group E	Group C	p value
Age, *median (IQR)*	57 (48.25-67)	59 (47-70)	0.756
Gender	F 16	F 14	0.686
	M 12	M 15	0.686
Type of pain			
Osteoarticular pain	10	12	0.867
Trigeminal neuralgia	1	0	0.986
Headache	1	1	1
Scar pain	3	1	0.579
Pelvic pain	1	1	1
Radicular pain	11	12	0.913
Spinal stenosis	1	2	1
Duration of pain, years *median (IQR)*	3 (2-6)	3 (2-7)	0.532
Drugs			
Opioids	4	5	1
Paracetamol	8	9	1
FANS	8	10	0.845
Gabapentinoids	7	8	1
Corticosteroidds	2	3	1
Antiepileptic	1	1	1
SNRI	1	2	1
Muscle relaxant	3	2	0.967
Comorbidities			
Arterial hypertension	12	13	1
COPD	1	2	1
Diabetes	4	6	0.774
Dyslipidemia	7	8	1
Peripheral Chronic Obliterative Arteriopathy	1	0	0.986
Depression	2	0	0.456
Hypothyroidism	1	0	0.986
Psoriatic arthritis	1	0	0.986

Characteristic	Group E	Group C	p value
Type of pain			
Osteoarticular pain	10	12	0.867
Trigeminal neuralgia	1	0	0.986
Headache	1	1	1
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Spinal stenosis	1	2	1
Duration of pain, years *median (IQR)*	3 (2-6)	3 (2-7)	0.532

Brief Pain Inventory (BPI)

		T0	T7	T15	T30	T60	T90	p
Q3. Worst pain last 24 hours	**Group E**	8 (7-10)	6 (6-8)	5.5 (3.25-6.75)*	5 (3.25-6) †	5 (3-6) †	4 (3-5) †	<0.001
	Group C	7.5 (6-9.5)	8 (6-9)	7 (4.5-9)	7 (4.5-9)	7 (6-8)	6. (5-8)	0.198
p value		0.303	0.125	0.128	<0.001	0.003	0.004	
Q4. Least pain last 24 hours	**Group E**	4 (2.5-5.5)	3 (2-4)	3 (2-5)	2.5 (2-4)	2.5 (1.75-4)	2 (1.5-4.5)	0.225
	Group C	5 (3-6.5)	4.5 (3-5.5)	4 (2-6)	4 (3-5)	4 (3-5)	4 (2-5)	0.345
p value		0.278	0.032	0.429	0.003	0.032	0.106	
Q5. Average pain last 24 hours	**Group E**	6 (5-7)	5 (4-6)	5 (3-5)*	4.5 (3-5.75)*	4 (2.75-5.25)*	4 (2.5-5.5)*	<0.001
	Group C	6 (4-7.5)	6 (4-7)	5 (3-7.5)	5 (3-6)	5 (3-6.5)	5 (4-6.5)	0.077
p value		0.437	0.254	0.323	0.418	0.27	0.216	
Q6. Current pain	**Group E**	6 (4-7.5)	4 (3-5)	3 (2-5.75)	3.5 (2.25-6)	3.5 (2-5)	3 (2-5)	0.09
	Group C	6 (4.5-7)	7 (5-8)	6 (4-7)	6.5 (5-8)	6 (4-8)	5.5 (2.5-7)	0.717
p value		0.981	0.974	0.001	0.002	0.014	0.079	
Q8. Pain relief from drugs or interventions	**Group E**	40% (25-60)	50% (35-75)	50% (30-60)	50% (32.5-60)	50% (32.5-62.5)	50% (25-50)	0.846
	Group C	42.5% (30-60)	42.5% (30-55)	40% (30-55)	50% (30-65)	50% (30-70)	50% (30-77.5)	0.240
p value		0.647	0.344	0.684	0.973	0.702	0.358	

		T0	T7	T15	T30	T60	T90	p
Q9. Pain interference last 24 hours								
a. general activity	**Group E**	7 (6-7)	5 (4-6)	4 (3-6)*	5 (3-5)*	3.5 (3-6)*	3 (3-5.5)*	0.002
	Group C	6.5 (5-8)	7 (6-9)	6 (3-7.5)	6 (4-7.5)	6.5 (5-8)	6 (4.5-8)	0.102
p value		0.924	<0.001	0.213	0.027	<0.001	<0.001	
b. mood	**Group E**	7.5 (5-8.75)	5 (4-6)	4.5 (2-6.75)	4.5 (2.25-6)*	3 (1-5)*	2 (1-3.5)* †	<0.001
	Group C	5.5 (3-8)	6.5 (3-8)	6 (5-8)	6 (4-8)	5 (3.5-7.5)	7 (4.5-8.5)	0.168
p value		0.052	0.324	0.011	0.027	0.007	0.042	
c. walking ability	**Group E**	7 (3.25-8)	5 (3-8)	4 (1-5.75)*	4 (1-5)*	3 (1-5)*	2 (1-4.5)*	<0.001
	Group C	6.5 (4-8.5)	6 (4-8)	6.5 (3-8)	5.5 (2-6.5)	6 (4.5-9)	6 (2.5-7)	0.096
p value		0.900	0.552	0.054	0.038	0.008	<0.001	
d. normal work	**Group E**	7.5 (5-8.75)	5 (2-6)	5 (2-5)*	4 (2-5)*	4.5 (2-5.5)	3 (2-5)*	<0.001
	Group C	6 (5-9)	7 (6-8)	6 (5-8)	6.5 (4-8)	6 (5-7.5)	6.5 (5-8)	0.152
p value		0.968	0.168	0.038	0.029	<0.012	<0.001	
e. relations	**Group E**	6 (2-7)	4.5 (1-6)*	2 (1-4)*	2.5 (1-4.75)*	2 (1-4.25)*	2 (1-4)*	<0.001
	Group C	6.5 (3-8)	6.5 (3-8)	5.5 (2-6.5)	5.5 (2.5-6.5)	5.5 (2.5-7)	6 (3-7.5)	0.612
p value		0.632	0.067	<0.001	<0.001	0.005	<0.001	
f. sleep	**Group E**	6.5 (2.25-8)	4.5 (1.75-7)	2.5 (1-6.25)	3 (1-6.5)	2.5 (0.75-4)*	1 (0-3.5)*	<0.001
	Group C	5 (3.5-7)	6 (3-8)	5 (2.5-7)	5.5 (2.5-6.5)	5 (3-6.5)	4.5 (2-7)	0.368
p value		0.604	0.155	0.104	0.104	0.013	<0.001	
g. enjoyment of life	**Group E**	6.5 (4-8.75)	4.5 (1.75-6.25)	3 (2-5.75)*	4 (2-6)*	2 (1-4)*	2 (1-3.5)* †	<0.001
	Group C	7 (5-8.5)	6 (4.5-8)	5.5 (3-8)	4.5 (2-7)	7 (4.5-8)	6 (2.5-8)	0.431

		T0	T7	T15	T30	T60	T90	p
Q9. Pain interference last 24 hours								
a. general activity	**Group E**	7 (6-7)	5 (4-6)	4 (3-6)*	5 (3-5)*	3.5 (3-6)*	3 (3-5.5)*	0.002
	Group C	6.5 (5-8)	7 (6-9)	6 (3-7.5)	6 (4-7.5)	6.5 (5-8)	6 (4.5-8)	0.102
p value		0.924	<0.001	0.213	0.027	<0.001	<0.001	
b. mood	**Group E**	7.5 (5-8.75)	5 (4-6)	4.5 (2-6.75)	4.5 (2.25-6)*	3 (1-5)*	2 (1-3.5)* †	<0.001
	Group C	5.5 (3-8)	6.5 (3-8)	6 (5-8)	6 (4-8)	5 (3.5-7.5)	7 (4.5-8.5)	0.168
p value		0.052	0.324	0.011	0.027	0.007	0.042	
c. walking ability	**Group E**	7 (3.25-8)	5 (3-8)	4 (1-5.75)*	4 (1-5)*	3 (1-5)*	2 (1-4.5)*	<0.001
	Group C	6.5 (4-8.5)	6 (4-8)	6.5 (3-8)	5.5 (2-6.5)	6 (4.5-9)	6 (2.5-7)	0.096
p value		0.900	0.552	0.054	0.038	0.008	<0.001	
d. normal work	**Group E**	7.5 (5-8.75)	5 (2-6)	5 (2-5)*	4 (2-5)*	4.5 (2-5.5)	3 (2-5)*	<0.001
	Group C	6 (5-9)	7 (6-8)	6 (5-8)	6.5 (4-8)	6 (5-7.5)	6.5 (5-8)	0.152
p value		0.968	0.168	0.038	0.029	<0.012	<0.001	
e. relations	**Group E**	6 (2-7)	4.5 (1-6)*	2 (1-4)*	2.5 (1-4.75)*	2 (1-4.25)*	2 (1-4)*	<0.001
	Group C	6.5 (3-8)	6.5 (3-8)	5.5 (2-6.5)	5.5 (2.5-6.5)	5.5 (2.5-7)	6 (3-7.5)	0.612
p value		0.632	0.067	<0.001	<0.001	0.005	<0.001	
f. sleep	**Group E**	6.5 (2.25-8)	4.5 (1.75-7)	2.5 (1-6.25)	3 (1-6.5)	2.5 (0.75-4)*	1 (0-3.5)*	<0.001
	Group C	5 (3.5-7)	6 (3-8)	5 (2.5-7)	5.5 (2.5-6.5)	5 (3-6.5)	4.5 (2-7)	0.368
p value		0.604	0.155	0.104	0.104	0.013	<0.001	
g. enjoyment of life	**Group E**	6.5 (4-8.75)	4.5 (1.75-6.25)	3 (2-5.75)*	4 (2-6)*	2 (1-4)*	2 (1-3.5)* †	<0.001
	Group C	7 (5-8.5)	6 (4.5-8)	5.5 (3-8)	4.5 (2-7)	7 (4.5-8)	6 (2.5-8)	0.431

		T0	T7	T15	T30	T60	T90	p
Q9. Pain interference last 24 hours								
a. general activity	**Group E**	7 (6-7)	5 (4-6)	4 (3-6)*	5 (3-5)*	3.5 (3-6)*	3 (3-5.5)*	0.002
	Group C	6.5 (5-8)	7 (6-9)	6 (3-7.5)	6 (4-7.5)	6.5 (5-8)	6 (4.5-8)	0.102
p value		0.924	<0.001	0.213	0.027	<0.001	<0.001	
b. mood	**Group E**	7.5 (5-8.75)	5 (4-6)	4.5 (2-6.75)	4.5 (2.25-6)*	3 (1-5)*	2 (1-3.5)* †	<0.001
	Group C	5.5 (3-8)	6.5 (3-8)	6 (5-8)	6 (4-8)	5 (3.5-7.5)	7 (4.5-8.5)	0.168
p value		0.052	0.324	0.011	0.027	0.007	0.042	
c. walking ability	**Group E**	7 (3.25-8)	5 (3-8)	4 (1-5.75)*	4 (1-5)*	3 (1-5)*	2 (1-4.5)*	<0.001
	Group C	6.5 (4-8.5)	6 (4-8)	6.5 (3-8)	5.5 (2-6.5)	6 (4.5-9)	6 (2.5-7)	0.096
p value		0.900	0.552	0.054	0.038	0.008	<0.001	
d. normal work	**Group E**	7.5 (5-8.75)	5 (2-6)	5 (2-5)*	4 (2-5)*	4.5 (2-5.5)	3 (2-5)*	<0.001
	Group C	6 (5-9)	7 (6-8)	6 (5-8)	6.5 (4-8)	6 (5-7.5)	6.5 (5-8)	0.152
p value		0.968	0.168	0.038	0.029	<0.012	<0.001	
e. relations	**Group E**	6 (2-7)	4.5 (1-6)*	2 (1-4)*	2.5 (1-4.75)*	2 (1-4.25)*	2 (1-4)*	<0.001
	Group C	6.5 (3-8)	6.5 (3-8)	5.5 (2-6.5)	5.5 (2.5-6.5)	5.5 (2.5-7)	6 (3-7.5)	0.612
p value		0.632	0.067	<0.001	<0.001	0.005	<0.001	
f. sleep	**Group E**	6.5 (2.25-8)	4.5 (1.75-7)	2.5 (1-6.25)	3 (1-6.5)	2.5 (0.75-4)*	1 (0-3.5)*	<0.001
	Group C	5 (3.5-7)	6 (3-8)	5 (2.5-7)	5.5 (2.5-6.5)	5 (3-6.5)	4.5 (2-7)	0.368
p value		0.604	0.155	0.104	0.104	0.013	<0.001	
g. enjoyment of life	**Group E**	6.5 (4-8.75)	4.5 (1.75-6.25)	3 (2-5.75)*	4 (2-6)*	2 (1-4)*	2 (1-3.5)* †	<0.001
	Group C	7 (5-8.5)	6 (4.5-8)	5.5 (3-8)	4.5 (2-7)	7 (4.5-8)	6 (2.5-8)	0.431

		T0	T7	T15	T30	T60	T90	p
Q9. Pain interference last 24 hours								
a. general activity	**Group E**	7 (6-7)	5 (4-6)	4 (3-6)*	5 (3-5)*	3.5 (3-6)*	3 (3-5.5)*	0.002
	Group C	6.5 (5-8)	7 (6-9)	6 (3-7.5)	6 (4-7.5)	6.5 (5-8)	6 (4.5-8)	0.102
p value		0.924	<0.001	0.213	0.027	<0.001	<0.001	
b. mood	**Group E**	7.5 (5-8.75)	5 (4-6)	4.5 (2-6.75)	4.5 (2.25-6)*	3 (1-5)*	2 (1-3.5)* †	<0.001
	Group C	5.5 (3-8)	6.5 (3-8)	6 (5-8)	6 (4-8)	5 (3.5-7.5)	7 (4.5-8.5)	0.168
p value		0.052	0.324	0.011	0.027	0.007	0.042	
c. walking ability	**Group E**	7 (3.25-8)	5 (3-8)	4 (1-5.75)*	4 (1-5)*	3 (1-5)*	2 (1-4.5)*	<0.001
	Group C	6.5 (4-8.5)	6 (4-8)	6.5 (3-8)	5.5 (2-6.5)	6 (4.5-9)	6 (2.5-7)	0.096
p value		0.900	0.552	0.054	0.038	0.008	<0.001	
d. normal work	**Group E**	7.5 (5-8.75)	5 (2-6)	5 (2-5)*	4 (2-5)*	4.5 (2-5.5)	3 (2-5)*	<0.001
	Group C	6 (5-9)	7 (6-8)	6 (5-8)	6.5 (4-8)	6 (5-7.5)	6.5 (5-8)	0.152
p value		0.968	0.168	0.038	0.029	<0.012	<0.001	
e. relations	**Group E**	6 (2-7)	4.5 (1-6)*	2 (1-4)*	2.5 (1-4.75)*	2 (1-4.25)*	2 (1-4)*	<0.001
	Group C	6.5 (3-8)	6.5 (3-8)	5.5 (2-6.5)	5.5 (2.5-6.5)	5.5 (2.5-7)	6 (3-7.5)	0.612
p value		0.632	0.067	<0.001	<0.001	0.005	<0.001	
f. sleep	**Group E**	6.5 (2.25-8)	4.5 (1.75-7)	2.5 (1-6.25)	3 (1-6.5)	2.5 (0.75-4)*	1 (0-3.5)*	<0.001
	Group C	5 (3.5-7)	6 (3-8)	5 (2.5-7)	5.5 (2.5-6.5)	5 (3-6.5)	4.5 (2-7)	0.368
p value		0.604	0.155	0.104	0.104	0.013	<0.001	
g. enjoyment of life	**Group E**	6.5 (4-8.75)	4.5 (1.75-6.25)	3 (2-5.75)*	4 (2-6)*	2 (1-4)*	2 (1-3.5)* †	<0.001
	Group C	7 (5-8.5)	6 (4.5-8)	5.5 (3-8)	4.5 (2-7)	7 (4.5-8)	6 (2.5-8)	0.431

		T0	T7	T15	T30	T60	T90	p
Q9. Pain interference last 24 hours								
a. general activity	**Group E**	7 (6-7)	5 (4-6)	4 (3-6)*	5 (3-5)*	3.5 (3-6)*	3 (3-5.5)*	0.002
	Group C	6.5 (5-8)	7 (6-9)	6 (3-7.5)	6 (4-7.5)	6.5 (5-8)	6 (4.5-8)	0.102
p value		0.924	<0.001	0.213	0.027	<0.001	<0.001	
b. mood	**Group E**	7.5 (5-8.75)	5 (4-6)	4.5 (2-6.75)	4.5 (2.25-6)*	3 (1-5)*	2 (1-3.5)* †	<0.001
	Group C	5.5 (3-8)	6.5 (3-8)	6 (5-8)	6 (4-8)	5 (3.5-7.5)	7 (4.5-8.5)	0.168
p value		0.052	0.324	0.011	0.027	0.007	0.042	
c. walking ability	**Group E**	7 (3.25-8)	5 (3-8)	4 (1-5.75)*	4 (1-5)*	3 (1-5)*	2 (1-4.5)*	<0.001
	Group C	6.5 (4-8.5)	6 (4-8)	6.5 (3-8)	5.5 (2-6.5)	6 (4.5-9)	6 (2.5-7)	0.096
p value		0.900	0.552	0.054	0.038	0.008	<0.001	
d. normal work	**Group E**	7.5 (5-8.75)	5 (2-6)	5 (2-5)*	4 (2-5)*	4.5 (2-5.5)	3 (2-5)*	<0.001
	Group C	6 (5-9)	7 (6-8)	6 (5-8)	6.5 (4-8)	6 (5-7.5)	6.5 (5-8)	0.152
p value		0.968	0.168	0.038	0.029	<0.012	<0.001	
e. relations	**Group E**	6 (2-7)	4.5 (1-6)*	2 (1-4)*	2.5 (1-4.75)*	2 (1-4.25)*	2 (1-4)*	<0.001
	Group C	6.5 (3-8)	6.5 (3-8)	5.5 (2-6.5)	5.5 (2.5-6.5)	5.5 (2.5-7)	6 (3-7.5)	0.612
p value		0.632	0.067	<0.001	<0.001	0.005	<0.001	
f. sleep	**Group E**	6.5 (2.25-8)	4.5 (1.75-7)	2.5 (1-6.25)	3 (1-6.5)	2.5 (0.75-4)*	1 (0-3.5)*	<0.001
	Group C	5 (3.5-7)	6 (3-8)	5 (2.5-7)	5.5 (2.5-6.5)	5 (3-6.5)	4.5 (2-7)	0.368
p value		0.604	0.155	0.104	0.104	0.013	<0.001	
g. enjoyment of life	**Group E**	6.5 (4-8.75)	4.5 (1.75-6.25)	3 (2-5.75)*	4 (2-6)*	2 (1-4)*	2 (1-3.5)* †	<0.001
	Group C	7 (5-8.5)	6 (4.5-8)	5.5 (3-8)	4.5 (2-7)	7 (4.5-8)	6 (2.5-8)	0.431

		T0	T7	T15	T30	T60	T90	p
Q9. Pain interference last 24 hours								
a. general activity	**Group E**	7 (6-7)	5 (4-6)	4 (3-6)*	5 (3-5)*	3.5 (3-6)*	3 (3-5.5)*	0.002
	Group C	6.5 (5-8)	7 (6-9)	6 (3-7.5)	6 (4-7.5)	6.5 (5-8)	6 (4.5-8)	0.102
p value		0.924	<0.001	0.213	0.027	<0.001	<0.001	
b. mood	**Group E**	7.5 (5-8.75)	5 (4-6)	4.5 (2-6.75)	4.5 (2.25-6)*	3 (1-5)*	2 (1-3.5)* †	<0.001
	Group C	5.5 (3-8)	6.5 (3-8)	6 (5-8)	6 (4-8)	5 (3.5-7.5)	7 (4.5-8.5)	0.168
p value		0.052	0.324	0.011	0.027	0.007	0.042	
c. walking ability	**Group E**	7 (3.25-8)	5 (3-8)	4 (1-5.75)*	4 (1-5)*	3 (1-5)*	2 (1-4.5)*	<0.001
	Group C	6.5 (4-8.5)	6 (4-8)	6.5 (3-8)	5.5 (2-6.5)	6 (4.5-9)	6 (2.5-7)	0.096
p value		0.900	0.552	0.054	0.038	0.008	<0.001	
d. normal work	**Group E**	7.5 (5-8.75)	5 (2-6)	5 (2-5)*	4 (2-5)*	4.5 (2-5.5)	3 (2-5)*	<0.001
	Group C	6 (5-9)	7 (6-8)	6 (5-8)	6.5 (4-8)	6 (5-7.5)	6.5 (5-8)	0.152
p value		0.968	0.168	0.038	0.029	<0.012	<0.001	
e. relations	**Group E**	6 (2-7)	4.5 (1-6)*	2 (1-4)*	2.5 (1-4.75)*	2 (1-4.25)*	2 (1-4)*	<0.001
	Group C	6.5 (3-8)	6.5 (3-8)	5.5 (2-6.5)	5.5 (2.5-6.5)	5.5 (2.5-7)	6 (3-7.5)	0.612
p value		0.632	0.067	<0.001	<0.001	0.005	<0.001	
f. sleep	**Group E**	6.5 (2.25-8)	4.5 (1.75-7)	2.5 (1-6.25)	3 (1-6.5)	2.5 (0.75-4)*	1 (0-3.5)*	<0.001
	Group C	5 (3.5-7)	6 (3-8)	5 (2.5-7)	5.5 (2.5-6.5)	5 (3-6.5)	4.5 (2-7)	0.368
p value		0.604	0.155	0.104	0.104	0.013	<0.001	
g. enjoyment of life	**Group E**	6.5 (4-8.75)	4.5 (1.75-6.25)	3 (2-5.75)*	4 (2-6)*	2 (1-4)*	2 (1-3.5)* †	<0.001
	Group C	7 (5-8.5)	6 (4.5-8)	5.5 (3-8)	4.5 (2-7)	7 (4.5-8)	6 (2.5-8)	0.431

		T0	T7	T15	T30	T60	T90	p
Q9. Pain interference last 24 hours								
a. general activity	**Group E**	7 (6-7)	5 (4-6)	4 (3-6)*	5 (3-5)*	3.5 (3-6)*	3 (3-5.5)*	0.002
	Group C	6.5 (5-8)	7 (6-9)	6 (3-7.5)	6 (4-7.5)	6.5 (5-8)	6 (4.5-8)	0.102
p value		0.924	<0.001	0.213	0.027	<0.001	<0.001	
b. mood	**Group E**	7.5 (5-8.75)	5 (4-6)	4.5 (2-6.75)	4.5 (2.25-6)*	3 (1-5)*	2 (1-3.5)* †	<0.001
	Group C	5.5 (3-8)	6.5 (3-8)	6 (5-8)	6 (4-8)	5 (3.5-7.5)	7 (4.5-8.5)	0.168
p value		0.052	0.324	0.011	0.027	0.007	0.042	
c. walking ability	**Group E**	7 (3.25-8)	5 (3-8)	4 (1-5.75)*	4 (1-5)*	3 (1-5)*	2 (1-4.5)*	<0.001
	Group C	6.5 (4-8.5)	6 (4-8)	6.5 (3-8)	5.5 (2-6.5)	6 (4.5-9)	6 (2.5-7)	0.096
p value		0.900	0.552	0.054	0.038	0.008	<0.001	
d. normal work	**Group E**	7.5 (5-8.75)	5 (2-6)	5 (2-5)*	4 (2-5)*	4.5 (2-5.5)	3 (2-5)*	<0.001
	Group C	6 (5-9)	7 (6-8)	6 (5-8)	6.5 (4-8)	6 (5-7.5)	6.5 (5-8)	0.152
p value		0.968	0.168	0.038	0.029	<0.012	<0.001	
e. relations	**Group E**	6 (2-7)	4.5 (1-6)*	2 (1-4)*	2.5 (1-4.75)*	2 (1-4.25)*	2 (1-4)*	<0.001
	Group C	6.5 (3-8)	6.5 (3-8)	5.5 (2-6.5)	5.5 (2.5-6.5)	5.5 (2.5-7)	6 (3-7.5)	0.612
p value		0.632	0.067	<0.001	<0.001	0.005	<0.001	
f. sleep	**Group E**	6.5 (2.25-8)	4.5 (1.75-7)	2.5 (1-6.25)	3 (1-6.5)	2.5 (0.75-4)*	1 (0-3.5)*	<0.001
	Group C	5 (3.5-7)	6 (3-8)	5 (2.5-7)	5.5 (2.5-6.5)	5 (3-6.5)	4.5 (2-7)	0.368
p value		0.604	0.155	0.104	0.104	0.013	<0.001	
g. enjoyment of life	**Group E**	6.5 (4-8.75)	4.5 (1.75-6.25)	3 (2-5.75)*	4 (2-6)*	2 (1-4)*	2 (1-3.5)* †	<0.001
	Group C	7 (5-8.5)	6 (4.5-8)	5.5 (3-8)	4.5 (2-7)	7 (4.5-8)	6 (2.5-8)	0.431

Oswestry Disability Index (ODI)

		T0	T7	T15	T30	T60	T90	p value
Q1. Pain intensity	**Group E**	2.5 (2-3.75)	2 (1-2)*	2 (1-2.5)	2 (1-2.5)*	2 (1-2)*	1.5 (1-2)*	<0.001
	Group C	3 (2-4)	2 (1-4)	1 (0-3)	2 (1-3)	2 (1-4)	2 (1-4)	0.405
p value		0.645	0.381	0.583	0.826	0.105	0.159	
Q2. Personal care	**Group E**	1 (1-1.75)	1 (1-2)	1 (1-1)	1 (0-1)	1 (0-1)	1 (0-1)	0.192
	Group C	1 (1-2)	1 (1-2)	1 (0-1)	1 (1-2)	1 (0-4)	1 (0-1)	0.214
p value		0.646	0.764	0.295	0.129	0.091	0.646	
Q3. Lifting	**Group E**	2 (2-3.75)	2.5 (2-4)	2 (1-3)	2 (1-2)*	2 (1-2)*	1.5 (1-2)*	0.049
	Group C	2 (2-4)	2 (1-4)	0 (0-2)	2 (1-4)	2 (0-3)	2 (1-4)	0.871
p value		0.599	0.303	0.665	0.523	0.453	0.164	
Q4. Walking	**Group E**	2 (1-3)	1.5 (1-3)	1 (1-3)	1 (0-3)	1 (1-2)	1 (1-2)	0.231
	Group C	2.5 (1-4)	2.5 (1-4)	2 (0-2)	0 (0-2)	1 (0-2)	2 (1-2)	0.325
p value		0.728	0.472	0.152	0.260	0.897	0.902	
Q5. Sitting	**Group E**	2 (1-2.75)	1.5 (1-2)	1 (0.5-2)	2 (1-4)	2 (1-3)	2 (1-3)	0.608
	Group C	2 (1-3)	2 (1-4)	1 (0-2)	2 (1-2)	2 (1-3)	2 (1-3)	0.569
p value		0.205	0.161	0.339	0.906	0.732	0.549	

		T0	T7	T15	T30	T60	T90	p value
Q6. Standing	**Group E**	2 (2-3.75)	2 (1.25-3.75)	2 (1-3)	2 (1-3)	3 (1.5-3)	2.5 (1-3)	0.379
	Group C	2 (1-3)	2 (1-3)	1 (0-1)	3 (2-4)	2 (2-4)	2 (1-3)	0.237
p value		0.586	0.335	0.703	0.231	0.838	0.809	
Q7. Sleeping	**Group E**	2 (1-3)	2 (1-2.75)	1 (1-2)	2 (1-2)	2 (1-2)	2 (0-2)	0.287
	Group C	2 (1-2)	1 (1-3)	1 (0-2)	1 (0-3)	2 (1-3)	2 (1-3)	0.153
p value		1	0.664	0.085	0.725	0.127	0.115	
Q8. Sex life	**Group E**	1 (0-1)	1 (1-2.75)	1 (1-2)	1 (0-1)	1 (0.5-1)	1 (0.25-1)	0.112
	Group C	1 (0-1)	0 (0-3)	0 (0-1)	1 (0-3)	1 (0-1)	1 (0-1)	0.312
p value		0.879	0.077	0.111	0.349	0.249	0.986	
Q9. Social life	**Group E**	2 (1-3)	2 (1-2)	2 (1-2.5)	2 (1-3)	2 (1-2.5)	1.5 (1-2)	0.792
	Group C	2 (1-3)	2 (1-3)	1 (0-2)	1 (0-2)	2 (1-3)	2 (1-2)	0.301
p value		1	0.565	0.486	0.440	0.603	0.107	
Q10. Travelling	**Group E**	2 (1-3)	2 (1-3)	1.5 (1-2.75)	2 (0.5-3.5)	2 (1-3)	1.5 (0.75-3)	0.444
	Group C	2 (1-3)	2 (1-2.75)	1 (0-1)	2 (1-2)	2 (1-3)	2 (1-4)	0.901
p value		0.842	0.859	0.803	0.969	0.751	0.490	

Work Ability Index (WAI)

		T0	T7	T15	T30	T60	T90	p
Q1. Current work ability compared to highest work ability ever	**Group E** **Group C**	5.5 (3-8) 6 (3-8)	5 (5-8) 6 (4-7)	8 (5-8) 6.5 (4-8)	7 (5-8) 6 (3-7)	7 (5-8) 7 (4-8)	7 (5-8) 7 (4-8)	0.672 0.193
p value		0.640	0.831	0.565	0.375	0.919	0.766	
Q2. Work ability in relation to demands	**Group E** **Group C**	3 (2-4) 3 (2-5)	4 (3-4)* 3 (2-5)	4 (4-4) * 3 (2-4)	4 (4-4)* 4 (2-5)	4 (3-4)* 3 (2-4)	4 (3.25-4) 3 (2-5)	0.022 0.935
p value		0.311	0.347	0.064	0.687	0.373	0.611	
Q4. Estimated work impairment due to diseases	**Group E** **Group C**	3 (2-4) 3 (2-5)	3.5 (2.75-4) 3 (2-4)	5 (3-5) 3 (2-3)	5 (4-5) 3 (1-4)	5 (3,5-5) 4 (2-4)	4.5 (2.75-5) 4 (2-4.5)	0.399 0.893
p value		0.887	0.894	0.032	0.006	0.058		
Q5. Illness within last year (12 months)	**Group E** **Group C**	4 (2-5) 4 (2-5)	3 (3-5) 4 (2-4)	4 (2.5-4.5) 4 (2-5)	4 (3.25-5) 3 (2-4)	4 (3-4.75) 4 (2-5)	3.5 (2.25-4.75) 4 (2-4)	0.075 0.397
p value		0.697	0.655	0.826	0.028	0.973	0.910	
Q6. Estimation of own work ability in 2 years	**Group E** **Group C**	4 (4-7) 4 (4-7)	4 (4-7) 4 (1-7)	7 (4-7) 4 (4-7)	7 (4-7) 4 (1-7)	7 (4.75-7) 4 (1-7)	7 (4-7) 4 (4-7)	0.859 0.816
p value		0.519	0.473	0.234	0.198	0.089		
Q7.1. Considering the last three months: Have you been able to enjoy your regular daily activities?	**Group E** **Group C**	2 (2-3) 2 (2-4)	2 (1-3) 2 (1-4)	3 (2-3) 3 (2-4)	3 (2-4) 2 (2-3)	2.5 (2-4) 3(1-4)	2 (2-3) 2 (2-3)	0.363 0.711
p value		0.338	0.641	1	0.048	0.593		
Q7.2. Considering the last three months: Have you been active and alert?	**Group E** **Group C**	2 (1-3) 3 (2-4)	2 (1-3) 2 (1-4)	3 (3-3) 3 (2-4)	3 (2-3.25) 3 (2-4)	3 (2-4) 2 (2-4)	3 (3-4) 3 (2-4)	0.106 0.426
p value		0.349	0.777	0.378	0.833	0.240	0.616	
Q7.3. Considering the last three months: Have you felt yourself to be full of hope about the future?	**Group E** **Group C**	2 (2-3) 2 (1-3)	3 (1-3) 3 (2-4)	3 (3-4) 3 (2-4)	3 (2.75-3.25) 3 (2-4)	3 (1.75-4) 2 (2-4)	3 (2-3) 2 (1-3)	0.817 0.697
p value		0.809	0.264	0.078	0.721	0.506	0.237	


Grazie