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Frozen shoulder: subjects' needs and perspectives and clinicians' beliefs and management strategies: do they align? A cross-sectional study

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Abstract

Objective Physiotherapists (PTs) play a crucial role in managing individuals with Frozen Shoulder (FS), frequently being the first healthcare professionals involved in the treatment of this condition.

Aim This study aimed to compare the beliefs, expectations, and perspectives of individuals with FS with the knowledge, skills, and strategies of PTs, highlighting similarities and differences.

Method This study adhered to the Checklist for Reporting Results of Internet E-Surveys (CHERRIES). From May 1st to August 1st, 2023, a two-part survey was conducted involving PTs and individuals diagnosed with FS. The survey focused on comparing key areas such as clinical assessment, patient education, treatment expectations, and the psychological aspects of the patient-clinician relationship.

Results A total of 501 PTs and 110 subjects with FS participated in the survey. Most PTs showed proficiency in FS pathoanatomical conditions and were also attentive to psychological aspects (88.4%), describing the pathology evolution in three or two stages (68.2%). They also highlighted the importance of patient education (89.6%) and recognized the potential benefits of a multiprofessional collaboration in managing FS (82.2%). Reassurance was reported as a priority by 32.3% of PTs. Subjects with FS expressed a preference for PTs who are both expert and empathetic (73.6%). Regarding their understanding of FS, 29.09% of subjects reported receiving a three-phase explanation, while 26.36% felt inadequately informed. Nearly half of the subjects (49.09%) anticipated being managed independently by a PT, with 93.64% prioritizing the improvement of their range of motion.

Conclusion This study revealed a general agreement between subjects with FS and PTs regarding aspects of the therapeutic relationship, patient education, pathology management, compliance and motivation strategies, and pain management preferences. However, significant differences emerged concerning the perception of physiotherapy effectiveness, primary treatment goals, subjects' priorities, and the importance of psychological assessment.

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Impact statement

- Physiotherapists and subjects suffering from frozen shoulder showed considerable differences in their perception of physiotherapy effectiveness, primary treatment goals, subjects' priorities, and the importance of psychological assessment.
- It is crucial for physiotherapists to delve deeper into the psychological dimension of subjects with FS in order to fully understand their needs and expectations.
- By incorporating individuals' priorities and psychological assessments into a multiprofessional care approach, physiotherapists can improve treatment adherence and outcomes, ultimately increasing the overall patient satisfaction.

Keywords Adhesive capsulitis, Frozen shoulder, Physical therapy modalities, Psychological factor, Patient Healthcare acceptance

Introduction

Frozen shoulder (FS) is a condition of uncertain etiology affecting the shoulder joint and characterized by gradual onset of pain, stiffness, and loss of both active and passive shoulder mobility [1, 2]. The prevalence of FS in the general population is 2–5%, increasing up to 59% in subjects with type-2 diabetes mellitus [3]. The pathogenesis of FS is characterized by (local) inflammation and subsequent fibrosis of the joint capsule and rotator interval. Typically, FS is normally categorized into three stages (i.e. “freezing”, “frozen” and “thawing” [4]). However, this “three-phase” theory lacks of enough supporting evidence [5], with some suggesting an early improvement in disability - with the greatest gains occurring in the early stages of the disease and slowing over time [6]. Prolonged limitations in active and passive ROM and functionality may therefore persist, with no evidence for complete recovery without supervised treatment [7].

The current management of FS primarily focuses on pain relief and restoring active and passive mobility and function [8]. The most effective conservative treatments include education [9], physiotherapy [10], corticosteroid injections, and pharmacological therapy [11]. Physiotherapy treatments mainly involve manual therapy, stretching, exercises [12, 13] - such as proprioceptive neurological facilitation [14], muscle energy techniques [15], and strengthening exercises [16]. The intensity of the treatment is based on the subjects' irritability levels [9].

Education should be considered as an integral part of the management of individuals with FS [17, 18], as a lack of information can lead to uncertainty, concerns, and anxiety [17, 19]. Oftentimes, individuals do not feel adequately understood by healthcare professionals, and this leads them to experience a sense of being in a ‘no man's land’ [19]. Furthermore, the psychological aspect appears to play a significant role in the lives of individuals affected by FS [19]. Anxiety, depression, catastrophizing, kinesiophobia, and altered pain beliefs can intensify symptom perception and negatively impact their function and

quality of life [20, 21]. Individuals experiencing depression and anxiety may overestimate their disability and struggle to adapt to and manage their upper extremity pain, potentially leading to a reduced adherence to the prescribed therapies and to poorer treatment outcomes [22]. Additionally, individuals with high levels of pain catastrophizing or fear of movement may perceive their pain as a threat; this perception could be exacerbated by a delayed diagnosis of FS or by the lack of awareness among healthcare professionals [17, 23]. Lastly, prolonged exhaustion and disability are closely associated with changes in self-perception, feelings of worthlessness, and hopelessness, profoundly impacting the subjects' overall mental and physical well-being [23].

Unfortunately, clinicians frequently underestimate these factors. When coupled with a divergence between treatment goals and priorities [17], this can lead to patients' dissatisfaction, mistrust of the treatment process [20], frustration [24], and significant disappointment with treatment outcomes [21].

No prior study has investigated the beliefs, expectations, and perspectives of both individuals with FS and PTs. While one study examined a different shoulder pathology [25], none have focused on FS. Therefore, this study aims to investigate the agreement between the knowledge, skills, and strategies of PTs with the needs, perceptions, and beliefs of individuals suffering from FS. By identifying both similarities and differences, the study aims to enhance care, understanding, and healthcare support for individuals with FS.

Materials and methods**Design of the study**

The reporting of this exploratory survey (observational study) followed the Checklist for Reporting Results of Internet E-Surveys (CHERRIES) [26]. Approval for this research was granted by the Ethics Committee of the University of Molise (Protocol number 10–11/2023), and all study procedures were conducted in accordance with the Declaration of Helsinki.

Sampling and recruiting

This study involved PTs and individuals experiencing FS, who voluntarily and anonymously chose to participate. Mandatory inclusion criteria for PTs included working in Italy and being proficient in reading and understanding Italian. The inclusion criteria for subjects were designed to prevent misdiagnosis and ensure specificity to FS. According to international guidelines [12], eligible subjects had to exhibit painful shoulder with external rotation at arm by side <50% compared to the contralateral side and ROM <25% in (at least) two or more other planes of movement. Additionally, symptoms needed to be stable or worsening for at least one month [12], and subjects should have had a negative x-ray [12]. Clinical evaluations were conducted by a PT specialized in shoulder disorders with 10 years of experience, who was not involved in the study.

Taking into account 72,000 Italian PTs, a confidence level of 95%, and a margin of error of 5%, our goal was to recruit a minimum of 383 responses [27, 28]. For the patient sample, considering a prevalence of 2–5% for FS, particularly prevalent among women aged 40 to 65 years [6], and based on Italy's population of 58,900,000 [29], we aimed to recruit at least 384 responses [28].

Data collection took place from May 1st to August 1st, 2023, and no further completion requests were accepted after this date. This timeframe was chosen to align with the durations used in other studies employing a similar approach.

Participants invitation

No inducements were provided for the participation in the study. All potential participants who met the inclusion criteria were invited to participate through a link or QR code generated by Google Form. Specifically, PTs were invited by social media platforms (Facebook and Twitter) and instant messaging applications (Telegram and WhatsApp), or via e-mail. No special lists or specific group of PTs on social media were invited. Subjects with FS were invited to participate upon their referral or self-referral to the authors' physiotherapy private practice, while they were seeking treatment. Specifically, all individuals with shoulder disorders, whether referred or self-referred to the authors' outpatient private practice, were screened for FS by a PT not involved in this study. If deemed eligible, the subjects were invited to participate through an information letter (Appendix 1).

Two separate links were created for each sample group, leading to the first page of their respective surveys. On this page, the information letter explained the study's purpose, identified the researchers, outlined the mandatory inclusion criteria for participation, provided information on data protection and result dissemination, indicated the time required for survey completion, and

included a clear statement regarding informed consent, the voluntary nature of participation, and the absence of inducements or reimbursement (Appendix 1).

Additionally, a sentence was included on this page to obtain explicit consent for participation ("the respondent who voluntarily agrees to participate in the study must explicitly give consent by clicking the 'ok' button, thereby confirming acceptance"). This approach was replicated from other surveys [30–35]. Only after the consent was confirmed, participants were granted access to complete the questionnaires.

Respondents were able to review and change their answers throughout the survey. However, once they clicked the 'submit' button at the end, their answers were finalized. Additionally, to prevent multiple completions from the same subject in both surveys, access from the same IP address was blocked.

All data retrieved were downloaded, anonymized, and securely stored in a protected file, which was sent for a blind statistical analysis once the surveys were closed.

Questionnaires development

Two surveys were conducted: one investigated perspectives, perceptions, and expectations of subject with FS, while the other investigated the knowledge, skills and strategies of PTs.

Both surveys comprised ten questions in the first demographic sections (Section A), and eleven questions in the section regarding the core research of the present investigation (Section B). All questions were mandatory.

Survey for PTs

This survey was developed based on a questionnaire by Brindisino et al. [32], and modified to specifically focus on FS by three experienced authors, with more than 12 years of expertise in rehabilitating shoulder pathologies. The authors specifically aimed to delve deeper into clinical examination procedures, role of patient's education, management strategies, and prognostic factors. Other questions were tailored to understand how PTs assess and consider their patient's perspective and whether they incorporate biopsychosocial aspects of care in their practice. The questionnaire underwent an evaluation by a team of colleagues with diverse experiences in shoulder disease rehabilitation to enhance clarity and comprehensibility. Only two questions were edited, and the team reached a consensus on the survey, resulting in its final version.

The initial section of the survey for PTs (Table 1- Sections A), aimed to provide a comprehensive description of the sample recruited through ten closed multiple-choice questions, allowing for one answer only. In particular, these questions explored: years of work experience, number of subjects with FS they treat per year, most

Table 1 Demographic characteristics of physiotherapists

SECTION A		Answers	Frequency (N/501)	Percentage (%)
Q1	Sex	Woman	193	38.5
		Man	308	61.5
Q2	Working area	Northern Italy	214	42.7
		Central Italy	124	24.8
		Southern Italy	163	32.5
Q3	Age	≤ 25 years	70	14.0
		26–35 years	270	53.9
		36–45 years	93	18.6
		46–55 years	49	9.8
		≥ 56 years	19	3.8
Q4	University degree	Bachelor's Degree in Physiotherapy	447	89.2
		Master's Degree	52	10.4
		PhD	2	0.4
Q5	OMPT specialization	Yes	150	29.9
		No	351	70.1
Q6	Years of work experience	≤ 5 years	205	40.9
		6–10 years	124	24.8
		11–15 years	76	15.2
		16–20 years	35	7.0
		≥ 21 years	61	12.2
Q7	Most engaged working context	Home-based activity	23	4.6
		Public hospital	51	10.2
		Accredited private facility/ facility affiliated with the NHS	141	28.1
		Private practice/freelance activities	286	57.1
Q8	Area of specialization most frequently practiced	Other (cardiologic, respiratory, pediatric)	14	2.8
		Geriatric	34	6.8
		Musculoskeletal	410	81.8
		Neurological	29	5.8
Q9	Number of working hours for week	Sporting	14	2.8
		0–10	9	1.8
		11–25	36	7.2
		26–35	119	23.8
		36–45	253	50.5
Q10	Number of subjects with frozen shoulder treated in a month	≥ 46	84	16.8
		≤ 2	373	74.5
		3	89	17.8
		4	19	3.8
		≥ 5	20	4.0
SECTION B		Answers	Frequency (N/501)	Percentage (%)
Q11	Which type of imaging do you believe provides the best and most useful indications upon initial assessment for FS subjects, aiming to rule out pathology beyond the scope of physiotherapy expertise? Please choose one	None	95	19.0
		MRI	96	19.2
		X-rays	107	21.4
		X-rays and MRI	110	22.0
		Ultrasound and MRI	59	11.8
		Ultrasound	8	1.6
Q12	In your clinical practice, when you relate to a subject with FS, you tend to be more:	X-rays and ultrasound	26	5.2
		Empathetic, and to build a relationship of trust	49	9.8
		Skilled about pathoanatomical conditions, more than anything else	7	1.4
		Skilled about pathological condition, but at the same time empathic/careful to psychological aspect	443	88.4
		Only careful to the pathological condition	2	0.4

Table 1 (continued)

SECTION A	Answers	Frequency (N/501)	Percentage (%)	
Q13	In your clinical practice with a subject with frozen shoulder, do you consider:	Mostly the anatomical aspects related to the shoulder problem (range of motion, pain, stiffness)	44	8.8
		Equally the anatomical aspects and psychological aspects (fear, worry, anxiety, anger) related to the shoulder problem	429	85.6
		The psychological aspect more than the anatomical aspect	9	1.8
		The anatomical aspect more than the psychological aspect	18	3.6
Q14	In your clinical practice, regarding the progression of the pathology, do you:	Provide detailed information about the two-stage evolution	144	28.7
		Provide detailed information about the three-stage evolution	198	39.5
		Provide detailed information about the four-stage evolution	22	4.4
		Offer superficial explanations on this matter	6	1.2
		Inform about the progression without specifying any phase	126	25.1
Q15	In your clinical practice, education about the nature of the condition, its pharmacological and rehabilitative management, represent:	Consider it not useful to provide this kind of explanations	5	1.0
		An aspect that I often ignore since not interesting/useful for the subject with FS	3	0.6
		An aspect not so significant for rehabilitation management	9	1.8
		A cross intervention throughout rehabilitation process, aimed at managing the psychological aspect	40	8.0
Q16	In your clinical practice, you generally manage subjects with FS:	A cross intervention throughout rehabilitation process, aimed at managing the psychological and painful aspects	449	89.6
		Independently	89	17.8
		In collaboration with a Practitioner (orthopedic, physiatrist)	238	47.5
		In collaboration with a psychologist	1	0.2
Q17	Considering your knowledge of the prognosis of patients with FS, which statement do you believe is most accurate	In collaboration with an Algologist	5	1.0
		Together with all the healthcare professional mentioned above when their respective competence is needed	168	33.5
		A subject with FS always recovers the 100% depending on their diligence to the rehabilitation and on prognostic factors	82	16.4
		The natural history of the pathology ends with a "restitutio ad integrum" without sequelae	92	18.4
		Rehabilitation is often ineffective and not sufficient for optimal recovery and full satisfaction of the subject with FS	66	13.2
Q18	In your experience, what do you think is the priority of these subjects?	There are factors indicating that the subject may experience more difficulty in recovering	261	52.1
		Management of daytime pain	25	5.0
		Management of night pain	98	19.6
		Recovery of full range of motion	26	5.2
		Improve sleep quality	32	6.4
		Improve autonomy in activities of daily life	77	15.4
Q19	In your clinical practice, how do you assess the psychological aspect of the subject with FS?	Functional recovery linked to work activities, hobbies and social role	81	16.2
		Be reassured about their condition	162	32.3
		Validated measurement scales for catastrophizing, fear, avoidance, anxiety, depression	157	31.3
		Extemporaneous, non-standardized and subjectivized questions	178	35.5
Q20	In your clinical practice, what kind of strategies do you predominantly use to increase subjects' compliance to home exercise?	During history taking	156	31.3
		I do not assess the psychological aspect	10	2.0
		Mobile phone videos and texts for motivational/educational purpose	242	48.3
		Illustrative booklet	96	19.2
		Diary	47	9.4
Q20	In your clinical practice, what kind of strategies do you predominantly use to increase subjects' compliance to home exercise?	None in particular	114	22.8
		I do not provide the patient with any exercises to be performed at home	2	0.4

Table 1 (continued)

SECTION A	Answers	Frequency (N/501)	Percentage (%)	
Q21	What do you consider the most effective conservative treatment to manage the painful phase?	Electrophysical agents (laser, tecartherapy, diathermy, transcutaneous electrical nerve stimulation, shockwave therapy)	91	18.2
		Corticosteroid therapy (oral or injection)	268	53.5
		Massage therapy	50	10.0
		Non-steroidal anti-inflammatory drugs	92	18.4

Acronym: Q=questions; N=Number; NHS=National Health Service; MRI=magnetic resonance, OMPT=orthopedic manipulative physical therapist; PHD=Doctor of Philosophy

frequently practiced area of specialization, and working context.

Survey for subjects with FS

A draft of the questionnaire was developed by three authors with extensive experience in shoulder diseases. Additionally, a psychotherapist was consulted to enhance the appropriateness and reliability of assessing psychological themes. The questionnaire was initially tested on four individuals who had previously suffered from FS, followed by testing on four individuals currently suffering from FS - in order to further ensure its content validity and identify any potentially overlooked relevant issue. The subjects' feedback emphasized the importance of themes related to "pain" and "fear". Subsequently, the researchers developed specific questions (currently Q19) and presented them to the same subjects, who confirmed that these questions effectively addressed their concerns. The final version of the survey was finalized during an online meeting.

The initial sections of the survey for subjects with FS (Table 2- Sections A) aimed to provide a comprehensive description of the sample recruited through ten closed multiple-choice questions, allowing for only one answer. Specifically, subjects with FS were asked about the duration of their symptoms, the number of healthcare professionals consulted before receiving their diagnosis, their type of work, and to rate their daily and nightly pain, as well as stiffness, on a scale from 0 to 10.

Sections B of both surveys (in Table 1 for PTs, and in Table 2 for subjects with FS) aimed to investigate clinical assessment, education, expectations, psychological aspects and therapeutic relationship. Specifically, the first three questions explored "diagnostic imaging and therapeutic relationship" (Q11-Q13), the next three covered "explanation, education, and management" (Q14-Q16), and the following three addressed "beliefs, main targets, and psychological aspects" (Q17-Q19). Finally, the last two questions inquired about "preferred therapeutic strategies" (Q20 and Q21). Therefore, these two surveys were designed to address comparable topics and themes, despite having different structures.

Section B of the questionnaire administered to PTs consisted of 11 specific closed multiple-choice

mandatory questions arranged in three screens, concerning pre-specified topics of interest, with only one choice available for each question. This methodology has been used in similar studies [30, 31, 35] to survey PTs' knowledge and therapeutic approaches.

Conversely, the survey for subjects with FS consisted of 11 mandatory questions presented across four screens. It included seven closed multiple-choice questions (Q11-Q14, Q16, Q20, Q21) and four 5-point Likert scale questions to assess subjects' agreement with specific statements on predetermined areas of interest.

The study adopted a hybrid structure base on prior research [36, 37], facilitating the comparison across the recruited samples to gain deeper insights into how each participant prioritized specific aspects of their pathology. The survey evaluated participants' views on education effectiveness, rehabilitation expectations, progress towards their goal, mood, concerns, and overall psychological outlook (Q15, Q17-19).

The first author tested the technical functionality of the electronic questionnaire, conducted a pre-administration test, and ensured the correct answer registration prior to the survey launch.

Statistical analysis

A descriptive analysis was conducted on both study groups. Categorical variables were expressed as frequencies and percentages, while continuous variables were summarized with means and standard deviations. Differences between the groups for questions with identical answer choices (e.g., Q11, Q12, Q13, and Q16) were assessed using Pearson's Chi-squared test with simulated p-values (based on 2000 replicates), with a significance level set at $p < 0.05$ for each comparison.

All statistical analyses were carried out using R with the Tidyverse package [38].

Results

Sociodemographic characteristics of PTs

All questions were filled out completely. According to the software, PTs spent an average of 8.05 min completing the survey, while subjects with FS spent 11.22 min.

A total of 110 subjects with FS were invited and all voluntarily chose to participate. It was not possible to

Table 2 Demographic characteristics of subjects complaining frozen shoulder

SECTION A		Answers	Frequency (N/110)	Percentage (%)
Q1	Sex	Woman	72	65.45
		Man	38	34.55
Q2	Geographical origin	Northern Italy	51	46.36
		Central Italy	20	18.18
		Southern Italy	39	35.45
Q3	Age	≤ 39 years old	2	1.82
		40–50 years old	47	42.73
		51–60 years old	36	32.73
		61–65 years old	18	16.36
		≥ 66 years old	7	6.36
Q4	Educational qualification	Elementary school diploma	3	2.73
		Middle school diploma	9	8.18
		High school diploma	56	50.91
		University Degree	42	38.18
Q5	Type of job	Mainly inactive (most of the time spent in the same position)	67	60.91
		Mainly dynamic (most of the time spent during different activities/often changing position)	43	39.09
Q6	Duration of your symptoms from the onset:	For more than 5 months	69	62.73
		3 months or more but less than 5 months	24	21.82
		For more than 1 month and less than 3 months	17	15.45
		For less than 1 month or a month exactly	0	0
Q7	Number of clinicians consulted before your diagnosis:	1	44	40
		2	30	27.27
		3	24	21.82
		> 3	12	10.91
Q8	From 0 to 10, where 0 indicates no pain and 10 represents the worst pain you have ever felt in your life, please quantify your DAYTIME pain	0 no pain	5	4.55
		1	6	5.45
		2	2	1.82
		3	7	6.36
		4	7	6.36
		5	14	12.73
		6	17	15.45
		7	25	22.73
		8	17	15.45
		9	7	6.36
10 worst pain ever	3	2.73		
Q9	From 0 to 10, where 0 indicates no pain and 10 represents the worst pain you have ever felt in your life, please quantify your NIGHT pain	0 no pain	7	6.36
		1	7	6.36
		2	2	1.82
		3	3	2.73
		4	10	9.09
		5	9	8.18
		6	4	3.64
		7	15	13.64
		8	22	20
		9	14	12.73
10 worst pain ever	17	15.45		
Q10	From 0 to 10 (where 0 means no stiffness and 10 means the worst stiffness you can imagine) how do you quantify your STIFFNESS	0 no stiffness	0	0
		1	1	0.91
		2	2	1.82
		3	4	3.64
		4	5	4.55
		5	8	7.27
		6	13	11.82
		7	11	10
		8	34	30.91
		9	18	16.36
10 worst stiffness ever	14	12.73		

Table 2 (continued)

SECTION A		Answers	Frequency (N/110)	Percentage (%)
SECTION B		Answers	Frequency (N/110)	Percentage (%)
Q11	Which type of imaging have doctors suggested for completing a clinical diagnosis of FS	None	26	23.64
		MRI	24	21.82
		X-rays	17	15.45
		X-rays and MRI	17	15.45
		Ultrasound and MRI	10	9.09
		Ultrasound	9	8.18
		X-rays and ultrasound	7	6.36
Q12	Thinking about your rehabilitation treatment, what kind of physical therapist would you like to relate to?	I would like the physiotherapist to be skilled in managing my shoulder condition, empathetic, and genuinely concerned about my condition	81	73.64
		I would like the physiotherapist to be skilled in managing my shoulder condition, more than anything else	23	20.91
		I would like to find an ally and build a relationship of trust	5	4.55
		I prefer a professional who maintains a detached relationship and focuses solely on assessing and treating my shoulder problem.	1	0.91
Q13	You would like the PT to pay attention to:	Both anatomical and psychological aspects (fear, worry, anxiety, anger, ...) related to the shoulder problem	57	51.82
		Mostly anatomical aspects (range of movement, pain, stiffness) related to shoulder problem	33	30
		More to the anatomical aspect than psychological aspect	17	15.45
		More to the psychological aspect than anatomical aspect	3	2.73
Q14	How PTs explained the course of FS to me	They provided me with detailed explanations of the pathology evolution in three stages, including timing and recommended treatments	32	29.09
		I received satisfactory explanations but without mentioning any specific "phase"	23	20.91
		They provided me with detailed explanations of the pathology evolution in two stages, including timing and recommended treatments	17	15.45
		I have not received satisfactory explanations regarding my condition	13	11.82
		They provided me with superficial explanations of the pathology evolution in two or three stages, including timing and recommended treatments	16	14.54
		Multiple professionals provided me conflicting information	9	8.18
Q15	How much you agree with the following statements about explanation received: I was not informed at all about my condition	I totally agree	8	7.27
		I agree	21	19.09
		Neither agree nor disagree	15	13.64
		I disagree	41	37.27
		I totally disagree	25	22.73
	The explanations I received were unhelpful and did not change anything with respect to the management of my condition	I totally agree	5	4.55
		I agree	22	20
		Neither agree nor disagree	19	17.27
		I disagree	40	36.36
		I totally disagree	24	21.82
	The explanations I received increased my anxiety and concern about the possibility of not recovering	I totally agree	8	7.27
		I agree	18	16.36
		Neither agree nor disagree	22	20
		I disagree	32	29.09
		I totally disagree	30	27.27

Table 2 (continued)

SECTION A	Answers	Frequency (N/110)	Percentage (%)		
	The explanations I received helped me to react in moments of discouragement, calmed and encouraged me, and I was able to modulate the pessimistic thoughts I had about pain	I totally agree	20	18.18	
		I agree	39	35.45	
		Neither agree nor disagree	26	23.64	
		I disagree	23	20.91	
		I totally disagree	2	1.82	
	The explanations I received encouraged me, and I felt less afraid to move as much as possible	I totally agree	22	20	
		I agree	48	43.64	
		Neither agree nor disagree	16	14.55	
		I disagree	22	20	
		I totally disagree	2	1.82	
Q16	Do you prefer that your shoulder problem should be better managed by:	The Physiotherapist independently	54	49.09	
		By all the professionals mentioned above when their respective competence is needed	50	45.45	
		in collaboration with a practitioner (<i>orthopedic, physiatrist...</i>)	3	2.73	
		in collaboration with a medical doctor expert in pain management (<i>algologist</i>)	3	2.73	
Q17	How much you agree with the following statements: If I engage in the rehabilitation treatment, I will surely recover completely from FS	I totally agree	31	28.44	
		I agree	44	40.37	
		Neither agree nor disagree	20	18.35	
		I disagree	14	12.84	
		I totally disagree	0	0	
	These treatments will be ineffective, and I will not return to the way I was before	I totally agree	0	0	
		I agree	21	19.09	
		Neither agree nor disagree	20	18.18	
		I disagree	42	38.18	
		I totally disagree	27	24.55	
If I commit to the treatment, I will improve but not recover completely	I totally agree	4	3.64		
	I agree	28	25.45		
	Neither agree nor disagree	29	26.36		
	I disagree	40	36.36		
	I totally disagree	9	8.18		
Q18	How important do you think it is to achieve these targets: Managing daytime pain	Not important at all	1	0.91	
		Unimportant	3	2.73	
		Neutral	10	9.09	
	Managing daytime pain	Important	43	39.09	
		Very important	53	48.18	
		Managing night pain	Not important at all	1	0.91
			Unimportant	3	2.73
	Neutral		5	4.55	
	Important		22	20	
	Very important	Very important	79	71.82	
		Recover full range of motion	Not important at all	0	0
			Unimportant	2	1.82
			Neutral	5	4.55
Important	25		22.73		
Very important	Very important	78	70.91		
	Improve sleep quality	Not important at all	4	3.64	
		Unimportant	0	0	
		Neutral	5	4.55	
Important		35	31.82		
Very important	Very important	66	60		

Table 2 (continued)

SECTION A	Answers	Frequency (N/110)	Percentage (%)	
Q19	Improve autonomy in daily life activities (to wash, to get dressed, to drive, etc.)	Not important at all	0	0
		Unimportant	1	0.91
		Neutral	9	8.18
		Important	35	31.82
		Very important	65	59.09
	Functional recovery linked to work activities, hobbies and social role	Not important at all	0	0
		Unimportant	2	1.82
		Neutral	18	16.36
		Important	29	26.36
	How much is important for you to be reassured about your clinical condition?	Very important	61	55.45
		Not important at all	0	0
		Unimportant	1	0.91
		Neutral	18	16.36
	How much you agree with the following statements? I'm afraid of worsening my condition if I keep moving my shoulder	Important	49	44.55
		Very important	42	38.18
		I totally agree	0	0
		I agree	25	22.73
		Neither agree nor disagree	21	19.09
	I'm afraid of worsening my condition if I keep moving my shoulder	I disagree	47	42.73
		I totally disagree	17	15.45
I totally agree		2	1.82	
I agree		31	28.18	
Neither agree nor disagree		31	28.18	
I'm afraid that the FS will cause irreversible damage to my shoulder	I disagree	33	30	
	I totally disagree	13	11.82	
	I totally agree	9	8.18	
	I agree	41	37.27	
I'm afraid I won't go back to doing what I could do before	Neither agree nor disagree	22	20	
	I disagree	25	22.73	
	I totally disagree	13	11.82	
	I totally agree	19	17.27	
	I disagree	10	9.09	
I will never raise my arm again as I used to do before	Neither agree nor disagree	35	31.82	
	I agree	43	39.09	
	I totally agree	3	2.73	
	I totally disagree	23	20.91	
The pain is terrible and will not go away	I disagree	15	13.64	
	Neither agree nor disagree	30	27.27	
	I agree	40	36.36	
	I totally agree	2	1.82	
	I totally disagree	29	26.36	
Whatever I do to heal is useless	I disagree	21	19.09	
	Neither agree nor disagree	38	34.55	
	I agree	20	18.18	
	I totally agree	2	1.82	
	I totally disagree	29	26.36	
My life is ruined	I disagree	25	22.73	
	Neither agree nor disagree	27	24.55	
	I agree	8	7.27	
	I totally agree	1	0.91	
	I totally disagree	49	44.55	
I feel overwhelmed by this condition	I disagree	20	18.18	
	Neither agree nor disagree	38	34.55	
	I agree	26	23.64	
	I totally agree	1	0.91	
	I totally disagree	25	22.73	

Table 2 (continued)

SECTION A	Answers	Frequency (N/110)	Percentage (%)	
	I am concerned	I totally disagree	9	8.18
	to know that the	I disagree	18	16.36
	pathology will last a	Neither agree nor disagree	28	25.45
	long time	I agree	41	37.27
		I totally agree	14	12.73
Q20	If exercises were to be administered to be done at home, which mode would you prefer to remember the techniques and how to perform them?	Mobile phone video and text messages with motivational/educational purpose	52	47.27
		Illustrative booklet	42	38.18
		None in particular	11	10
		Drawings made by the physiotherapist	5	4.55
Q21	What would you prefer to be combined with physiotherapy to best manage the painful phase?	Corticosteroid therapy (oral or injection)	30	27.27
		Electrophysical agents (laser, Tecar therapy, diathermy, transcutaneous electrical nerve stimulation, shockwave therapy)	28	25.45
		Massage therapy	18	16.36
		No one preferred	18	16.36
		Non-steroidal anti-inflammatory drugs	16	14.55

Acronym: Q=questions; N=Number; FS, Frozen Shoulder; MRI=Magnetic Resonance Imaging

determine the exact number of PTs who read the message on social media platforms and decided to participate. However, all PTs and subjects who started the survey completed it in full, achieving a 100% completion rate.

A total of 501 PTs completed the survey. The majority were male (61.5%, $n=308$) and primarily aged between 26 and 35 (53.9%, $n=270$). Approximately 42.7% of respondents worked in northern Italy, with most having less than five years of experience (40.9%, $n=205$) and working 36 to 45 h per week (50.5%, $n=253$). Additionally, most PTs worked in private practice (57.1%, $n=286$), mainly treating individuals with musculoskeletal disorders (81.8%, $n=410$) and typically seeing fewer than two subjects with FS per month (74.5%, $n=373$). Academic background analysis revealed that most held a bachelor's degree in physiotherapy (89.2%, $n=447$). See detailed data in Table 1, Section A.

Sociodemographic characteristics of subjects with FS

A total of 110 consecutive subjects with FS completed the survey, with 65.45% being female ($n=72/110$). 46.36% of respondents were from northern Italy ($n=51$). The majority were aged between 40 and 50 years (42.73%, $n=47$), had a high school diploma (50.91%, $n=56$), and were predominantly involved in sedentary jobs (60.91%, $n=67$). A significant portion of respondents reported experiencing FS for over 5 months (62.73%, $n=69/110$), with no one indicating a duration of less than one month. 40% of participants ($n=44/110$) reported consulting one clinician, while 32.73% ($n=36/110$) had consulted three or more clinicians before receiving an FS diagnosis.

Participants were asked to rate their daytime pain, night pain, and stiffness on a scale from 0 (no pain) to 10 (worst pain imaginable). For daytime pain, 66.36% of respondents ($n=73/110$) reported experiencing moderate to severe pain in a range from 5/10 up to 8/10. Only 6.36% ($n=7/110$) reported pain intensity at 9/10, and 2.73% ($n=3/110$) reported the highest pain intensity (10/10). For night pain, the majority (61.82%, $n=68/110$) reported higher values, typically ranging from 7/10 to 10/10. Regarding stiffness, 81.82% ($n=90/110$) reported stiffness levels between 6/10 and 10/10. Detailed data is provided in Table 2- Section A.

Diagnostic imaging and therapeutic relationship (Q11-Q13)

PTs recommended various diagnostic imaging methods to rule out pathology beyond their expertise. Specifically, 21.4% ($n=107/501$) suggested X-rays, and 22% ($n=110/501$) recommended a combination of X-rays and Magnetic Resonance Imaging (MRI). Surprisingly, 19% of PTs ($n=95/501$) believed that no imaging was necessary - whereas subjects with FS reported that clinicians recommended no imaging in 23.64% of cases ($n=26/110$), MRI in 21.82% ($n=24/110$), and X-rays or X-rays associated with MRI in 15.45% ($n=17/110$). A significant difference was observed between the two groups (p -value=0.003).

Regarding their approach to subjects with FS, 88.4% ($n=443/501$) of PTs highlighted their expertise in pathological conditions, alongside their consideration of psychological factors. Similarly, a majority of FS subjects ($n=81/110$, 73.64%) favored PTs who were knowledgeable about shoulder conditions and displayed empathy.

There was a significant difference between the responses of the two groups (p-value=0.0005).

85.6% of PTs (n=429/501) equally valued anatomical and psychological aspects related to FS when determining the key priorities in their clinical practice. Similarly, 51.82% of subjects with FS (n=57/110) expressed that a PT should consider both anatomical and psychological factors. However, 8.8% of PTs (n=44) and 30% of subjects (n=33) emphasized that the most crucial factors were exclusively related to function and anatomy. A significant difference between the two groups was observed (p-value=0.0005).

Explanation, education and management (Q14-Q16)

PTs' explanations regarding the course of FS varied widely: 39.5% (n=198/501) described its progression in three stages, 28.7% (n=144/501) in two stages, and 25.1% (n=126/501) without specifying any phases. Responses from subjects with FS also varied similarly: 29.09% (n=32/110) received detailed explanations in three phases, 20.91% (n=23/110) received satisfactory explanations without mentioning any phase, and 15.45% (n=17/110) received explanations in two phases. 11.82% (n=13/110) of subjects with FS did not receive satisfactory explanations, and 8.18% (n=9/110) of them reported receiving different explanations from different clinicians (Fig. 1).

Most PTs (89.6%, n=449/501) considered patient education on FS crucial for managing psychological and pain aspects during rehabilitation, while only 2.4% (n=12/501) deemed it as not important for the rehabilitation purpose. However, 26.36% (n=29/110) of subjects with FS stated that they were not informed about FS, 24.55% (n=27/110) received unhelpful explanations, and 23.63% (n=26/110) received explanations that increased their

anxiety and worry about their chance of not recovering. Conversely, 53.63% (n=59/110) of respondents with FS reported receiving reassuring explanations that helped them cope with discouragement and manage pessimistic thoughts about FS. Additionally, 63.64% (n=70/110) received encouraging explanations that reduced their fear of movement (Fig. 2).

When PTs were asked about their management of subjects with FS, 47.5% (n=238/501) reported collaborating with practitioners (orthopedic, physiatrist), 33.5% (n=168/501) mentioned collaborating other specialists (psychologist, algologist, orthopedic, physiatrist) when their expertise was needed, while 17.8% (n=89/501) managed their patients independently. In response to the same question, most respondents with FS (n=54/110, 49.09%) expressed a preference for being managed independently by their PTs, whereas 45.45% (n=50/110) expected their condition to be addressed by a multi-professional team when necessary. A significant difference between the two groups was noted (p-value=0.0005).

Beliefs, main target and psychological aspect (Q17-Q19)

About half of the PTs (n=261/501, 52.1%) believed that certain factors could indicate a more challenging recovery for patients with FS. Specifically, 34.8% (n=174) of PTs stated that FS typically resolves without leaving deficits or symptoms, while 13.2% (n=66) believed that some restrictions or impairments might persist. Among subjects with FS, the majority believed that engaging in a rehabilitation treatment would result in either full recovery (68.81%, n=75) or partial recovery (29.09%, n=32). However, 19.09% (n=21/110) expressed skepticism about the effectiveness of physiotherapy (Fig. 2).

When PTs were asked about the priorities for subjects with FS, 32.3% (n=162/501) emphasized the importance

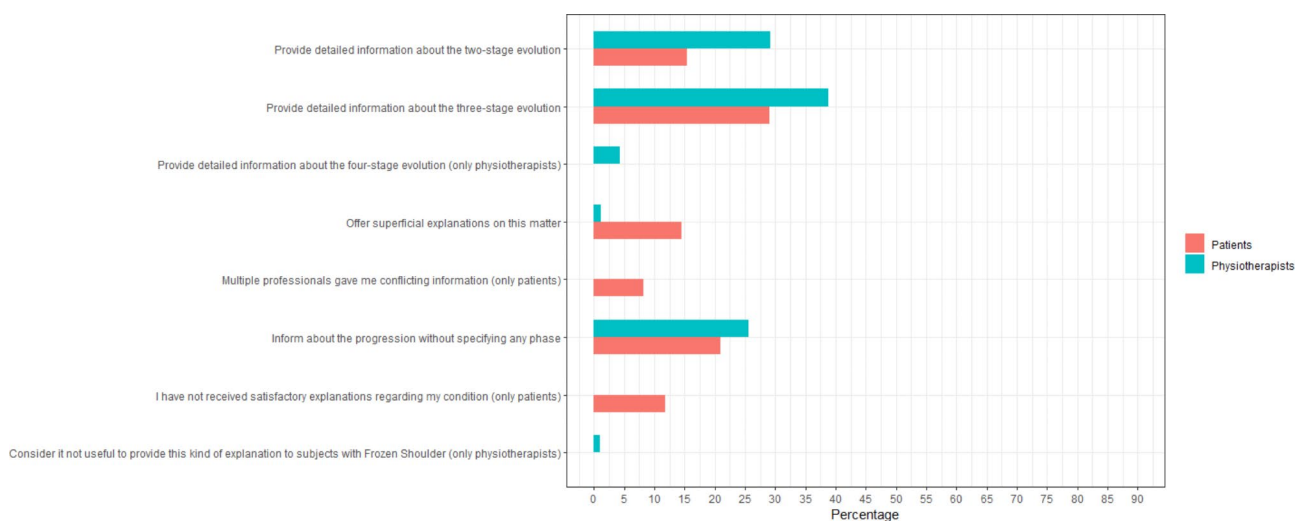


Fig. 1 Bar chart for the answer to Q14

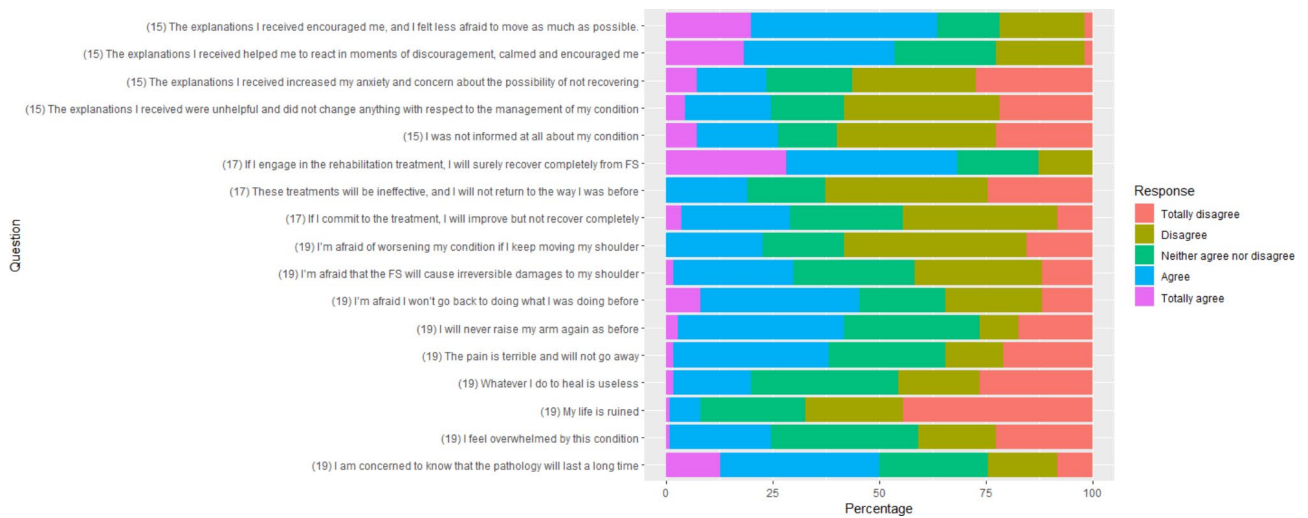


Fig. 2 Stacked bar chart for the answer to Q15, Q17, Q19

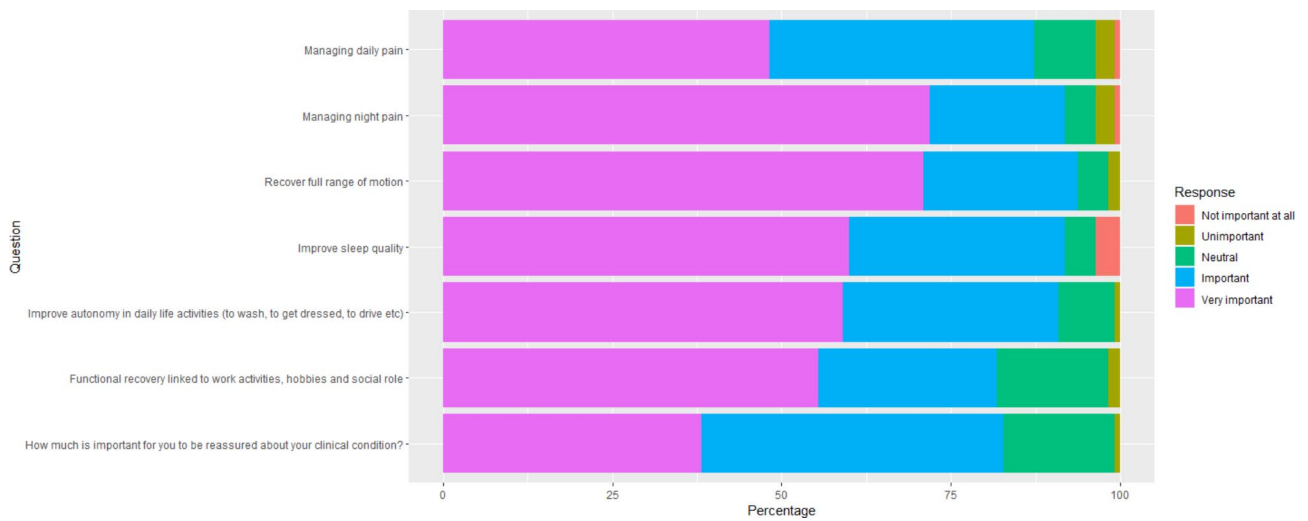


Fig. 3 Stacked bar chart for the answer to Q18

of “being reassured about their condition”, while 19.6% ($n=98/501$) focused on managing subjects’ night pain, and 16.2% ($n=81/501$) highlighted functional recovery related to their work, hobbies, and social roles. Daily pain management was least prioritized (5%, $n=25/501$). Conversely, nearly all subjects with FS expressed that restoring their full range of motion ($n=103/110$, 93.64%), managing night pain ($n=101/110$, 91.82%), improving sleep quality ($n=101/110$, 91.82%), enhancing their autonomy in daily life ($n=100/110$, 90.91%), managing daily pain ($n=96/110$, 87.27%), being reassured ($n=91/110$, 82.73%), and improving occupational and social activities ($n=90/110$, 81.81%) were to be considered important or very important (Fig. 3).

Regarding the psychological aspect, 35.5% ($n=178/501$) of PTs stated that they assessed it with extemporaneous questions, while 31.3% ($n=157/501$) used validated

patient-reported measurement scores. Regarding the presence of fear and catastrophizing beliefs among respondents with FS, 22.73% ($n=25/110$) expressed fear that moving their shoulder could worsen their condition, 30% ($n=33/110$) believed FS had irreversibly damaged their joint, and 45.45% ($n=50/110$) thought they would never return to their previous level of activity. Half of the respondents with FS ($n=55/110$, 49.99%) expressed concerns about the chronic nature of FS. Furthermore, a significant percentage believed that their arm would not regain its previous range of motion ($n=46/110$, 41.82%), perceived their pain as relentless ($n=42/110$, 38.18%), and felt that their efforts were futile ($n=22/110$, 20%). A minority of subjects reported feeling overwhelmed by FS ($n=27/110$, 24.55%) or believed that this condition had ruined their life ($n=9/110$, 8.18%) (Fig. 2).

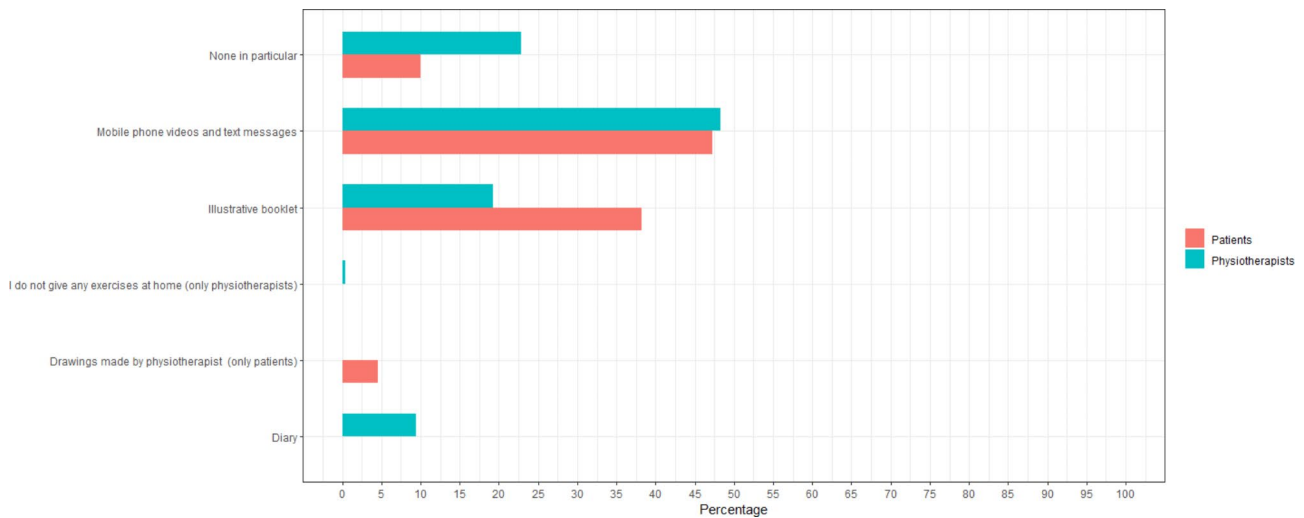


Fig. 4 Bar chart for the answer to Q20

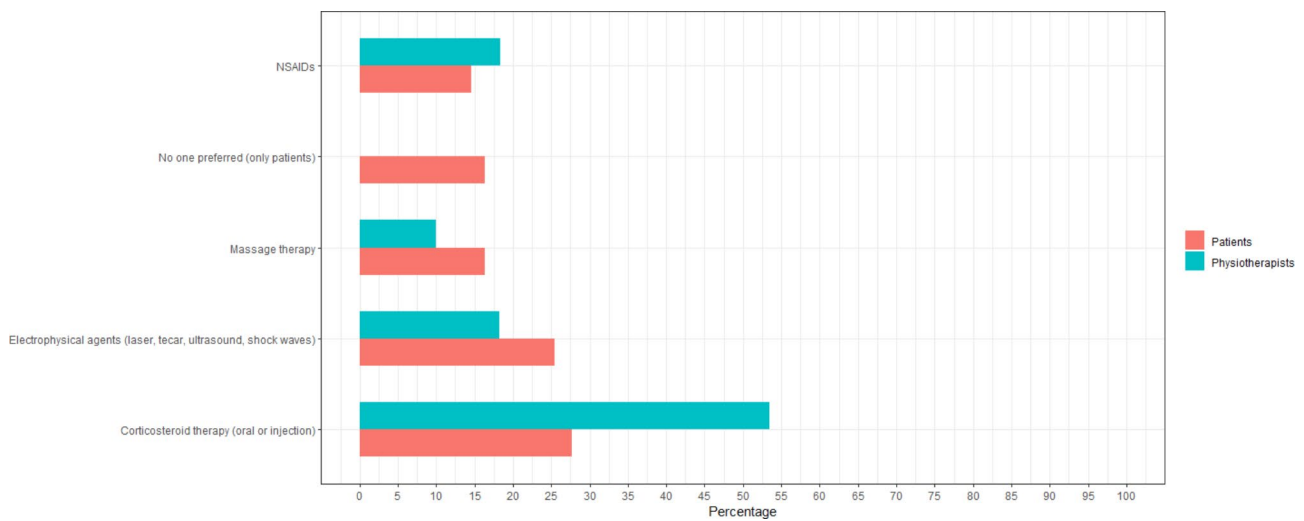


Fig. 5 Bar chart for the answer to Q21

Preferred therapeutic strategies (Q20, Q21)

Regarding strategies to enhance compliance with home exercise among subjects with FS, most PT respondents ($n=242/501$, 48.3%) reported opting for mobile phone videos and texts, whereas 19.2% ($n=96/501$) favoring illustrative booklets. Similarly, among subjects with FS, 47.27% ($n=52/110$) expressed a preference for receiving exercise guidance through mobile phone videos and text messages, while 38.18% ($n=42/110$) favored using a booklet (Fig. 4).

Half of the PT ($n=268/501$, 53.5%) favored corticosteroid therapy as additional therapy for managing the painful phase. A smaller percentage ($n=92/501$, 18.4%) preferred non-steroidal anti-inflammatory drugs, while 18.2% ($n=91/501$) opted for electrophysical agents (laser, Tecar therapy, diathermy, transcutaneous electrical nerve stimulation, or shockwave therapy). Similarly, among

subjects with FS, 27.27% ($n=30/110$) expressed a preference for corticosteroids, 25.45% ($n=28/110$) chose electrophysical agents, 16.36% ($n=18/110$) preferred massage or no specific treatment, and 14.55% ($n=16/110$) opted for non-steroidal anti-inflammatory drugs. (Fig. 5).

All this data was detailed in **Sections B** from Tables 1 and 2.

Discussion

This study aimed to investigate the agreement between the knowledge, skills, and strategies of physiotherapists and the needs, perceptions, and beliefs of subjects suffering from FS. The findings showed partial alignment on certain aspects, alongside significant differences in others.

Diagnostic imaging and therapeutic relationship

PTs' answers showed disagreement on recommended imaging for managing individuals with FS, with many advocating against it. This was reflected in FS patients' experiences, as most reported not being advised for any diagnostic imaging. This discrepancy with the established International guidelines [12] is concerning, especially since about 20% of PTs considered imaging unnecessary, raising risks of overlooking pathologies that could mimic FS.

FS is occasionally undiagnosed or misdiagnosed by clinicians, particularly because its initial presentation typically involves pain without significant motion limitation [4]. However, in later stages, FS is characterized by fibroproliferative tissue fibrosis, resulting in shoulder capsular fibrotic contractures and clinical stiffness [4]. Additionally, restricted shoulder ROM may be attributed to muscle contraction in response to the underlying pathophysiology or due to cognitive and emotional factors - such as fear of pain or anxiety [39].

This highlights the importance of recognizing FS as a condition influenced by psychological factors and integrating psychological aspects into rehabilitation. Individuals with FS expressed a preference for knowledgeable and empathetic PTs. Most PTs indicated they equally value both anatomical and psychological aspects related to FS, which, according to the subjects, are crucial areas for PTs to address. These findings suggest that the traditional view of FS as solely a physical condition is outdated and should be replaced by acknowledging its psycho-pathological aspects. Therefore, rehabilitation approaches that exclusively focus on joint mechanics without addressing patients' psychological needs may prove inadequate. Incorporating psychological considerations could potentially enhance overall patient satisfaction with healthcare providers, addressing concerns that are often reported as disappointing [21].

Furthermore, the presence [20] and the prognostic value [22] of psychological aspects in FS subjects have been clearly established; these findings underscore the critical need for PTs to thoroughly understand and effectively manage these psychological dimensions in an updated and informed manner.

Explanation, education and management

Inconsistent explanations about the progression of FS were noted in both study groups. These findings underscore the substantial variability in the literature regarding the clinical course and development of FS [40]. Clinicians' differing explanations may stem from varying levels of knowledge and expertise, potentially causing confusion among subjects, raising concerns about healthcare professionals' competence, and eliciting feelings of frustration and uncertainty [19, 21]. Most PTs

considered education as pivotal, and most subjects with FS reported receiving reassuring, encouraging, and helpful information. However, a significant portion found the explanations they had received to be not encouraging or not helpful, which ultimately heightened their anxiety and concerns about (non)recovery. This type of "nocebo" communication not only fosters anxiety and worry, but also undermines confidence in healthcare professionals [17].

Evidence suggests that patient education is a key component of therapeutic management, as it can improve pain, disability, catastrophizing, fear-avoidance behaviors, beliefs about pain, and subjects' compliance [41, 42]. However, before educating subjects with FS about their healthcare journey, prioritizing clinician education is essential. This enhances their ability to boost subjects' confidence and coping skills for pain and disability, and to reduce their fears and negative thoughts [43]. Physical therapists should emphasize enhancing their communication skills as a crucial therapeutic technique that positively impacts satisfaction and clinical outcomes [44].

Half of the subjects with FS anticipated the involvement of a multidisciplinary team (i.e. orthopedists, physiatrists, psychologists, and pain specialists) whereas only a few PTs indicated collaborating with other professionals when needed. Despite the widespread understanding and application of the biopsychosocial model, many PTs still tend to overlook the importance of a multiprofessional approach. This oversight may result in neglecting their patients' needs, including psychological factors, reassurance, social roles, daily routines, and engagement in leisure activities. Embracing a multidisciplinary approach enables personalized, targeted interventions which closely align with patients' needs and preferences, thereby promoting a patient-centered approach.

Beliefs, main target, and psychological aspect

There were differing opinions between PTs and subjects suffering from FS regarding the effectiveness of physiotherapy in the treatment of FS. These discrepancies and the subjects' lack of confidence in their rehabilitative treatment could pose barriers to adherence, potentially resulting in distrust, dissatisfaction, and a loss of faith in physiotherapy [45].

Divergent treatment priorities were observed between the groups, highlighting a disparity between the needs expressed by individuals with FS and the perspectives of PTs. This misalignment of treatment goals could result in dissatisfaction and undermine individuals' compliance [24]. These findings are consistent with previous qualitative investigations that highlighted individuals' experiences of feeling misunderstood, frustrated, and lacking adequate psychological support. This situation contributes to a negative cycle that can adversely affect

treatment compliance and prognosis [21]. Overall satisfaction with treatment depends not solely on clinicians' experience or priorities but on placing the patient at the center of the care process [46]. This underscores the importance of communication and shared goal-setting, which involve addressing the needs and expectations of individuals with FS from the beginning of their treatment. This approach empowers individuals to actively engage in their journey toward recovery [47].

The majority of responses from individuals with FS indicated the presence of negative and catastrophizing thoughts about their condition. Many believed their joint damage to be irreversible and their return to their previous activities to be impossible as well. Furthermore, most respondents reported feelings of fear, low mood, being overwhelmed, and apprehension about the long-lasting nature of their condition. It is noteworthy that FS extends beyond personal health - impacting also familial and sociocultural domains, and therefore resulting in changes to physical and mental well-being, and a disrupted sense of self [19, 21]. Psychological factors should be comprehensively assessed from the outset, using validated patient-reported measurement scales, which are essential for capturing how the disease impacts the subjects' overall well-being [48]. However, most PTs reported using non-standardized methods or relying solely on the patient's medical history, raising concerns about incomplete assessment of these crucial psychological aspects.

Preferred therapeutic strategies

Subjects with FS and PTs agreed on the approach to enhance compliance and motivation in a home exercise program. PTs emphasized the importance of identifying potential barriers to adherence - such as low self-efficacy and difficulties with exercise recall - actively supporting and promoting adherence [49]. Individuals with FS showed a preference for combining corticosteroid injections with physiotherapy as an additional therapy to manage the painful phase.

Corticosteroid injections were seen as pivotal in pain management, overcoming concerns and potential adverse effects [19, 50]. Notably, preferences expressed by FS individuals aligned with PTs, indicating agreement with subjects' expectations and adherence to current evidence [8, 51, 52].

Despite evidence suggesting otherwise [53], a minority of PTs and subjects with FS favored electrophysical agents for managing the painful phase. PTs must adhere to evidence-based recommendations, emphasizing the need for an educational approach to clearly communicate the benefits of therapeutic interventions to individuals with FS. This ensures treatment strategies are optimized and based on solid evidence.

Strength and limitation of this study

This study was the first attempt to understand the agreement between the knowledge, skills, and strategies of PTs with the needs, perceptions, and beliefs of individuals with FS, serving as a baseline for future investigations.

Subjects were strictly selected based on inclusion criteria from international guidelines [12] to prevent the inclusion of individuals with conditions that mimic FS (i.e. glenohumeral arthritis, neoplasms, or posterior dislocation) [54]. Subjects were not differentiated based on their FS phase, making our results applicable to individuals at any stage of FS.

Furthermore, the number of questionnaires obtained from PTs supports the generalizability of our results [27].

However, the present survey assessed the sample using a non-a-priori validated questionnaire, which may have implications for the robustness of the results. Additionally, our survey included only 110 subjects with FS; these factors could potentially limit the generalizability of our findings in that population. Nonetheless, it is noteworthy that our sample size remains one of the largest recruited worldwide for a survey on FS.

Future perspectives

Future studies should aim to investigate the needs, perceptions, and beliefs of subjects with FS using validated questionnaires to gain a more comprehensive understanding of their perspectives. Specifically, psychological domains should be assessed using validated patient-reported outcome measures, and a tailored psychological profile of individuals with FS should be developed. This approach would enable PTs to enhance their proficiency in addressing psychological factors, potentially also through multidisciplinary collaboration, to improve treatment outcomes.

It is essential to continue investigating the needs, perceptions, and beliefs of individuals suffering from FS, to ensure they do not feel misunderstood by healthcare professionals. Moreover, it is crucial to consistently assess their priorities. By prioritizing these aspects and understanding their goals, healthcare providers can potentially reduce dissatisfaction, build trust in treatment, alleviate frustration, and improve treatment adherence among subjects with FS.

Conclusion

This study revealed a general agreement between subjects and PTs on aspects such as the therapeutic relationship, the importance of education and pathology management, strategies to enhance compliance and motivation, and preferences for additional pain management interventions. However, significant discrepancies emerged regarding perceptions of physiotherapy effectiveness,

primary treatment goals, subjects' priorities, and the importance of psychological assessment.

Given these differences, it is crucial for PTs to undergo pathology-specific training and develop advanced educational skills- including a deeper understanding of the psychological dimension of FS and individuals' needs and expectations. By focusing on a patient-centered care within a multidisciplinary framework that prioritizes individual preferences, PTs can improve treatment adherence, achieve better outcomes, and increase overall patient satisfaction.

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12891-024-07803-5>.

Appendix 1

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Author contributions

Concept / idea: FB, DF; Research design: FB, SS; Writing: FB, SS, DF, MC, AA, FS; Data collection: FB, MC; Data analysis: DF, FB, MC; Project management: FB, SS; Consultation (including review of manuscript before submitting): FB, SS, DF, MC, AA, FS; Final approval of the Manuscript: FB, SS, DF, MC, AA, FS.

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Data availability

All data generated or analyzed during this study are included in this published article.

Declarations

Ethics approval and informed consent to participate

Ethical approval was obtained from the Ethics Committee of University of Molise (Italy) with the registration number 10–11/2023. All the study-related procedures were performed according to the principles of the Declaration of Helsinki. Informed consent to participate was provided by all subjects included.

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Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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