

Parsonage–Turner Syndrome mimicking musculoskeletal shoulder pain: A case report during the SARS-CoV-2 pandemic era

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Abstract

Parsonage–Turner Syndrome or neuralgic amyotrophy is a peripheral neuropathy typically characterized by an abrupt onset of pain, followed by progressive neurological deficits (e.g. weakness, atrophy, occasionally sensory abnormalities) that involve the upper limb, mainly the shoulder, encompassing an extensive spectrum of clinical manifestations, somehow difficult to recognize. This case report describes the proper management of a 35-year-old, bank employee and sports amateur who reported subtle and progressive upper limb disorder with previous history of neck pain. SARS-CoV-2 pandemic era made patient's access to the healthcare system more complicated. Nevertheless, proper management of knowledge, relevant aspects of telerehabilitation-based consultation for musculoskeletal pain, advanced skills, tools and technologies led the physiotherapist to suspect an atypical presentation of Parsonage–Turner Syndrome. Further, neurologist consultation and electromyography suggested signs of denervation in the serratus anterior and supraspinatus muscle. Therefore, an appropriate physiotherapist's screening for referral is conducted to correct diagnosis and thorough treatment.

Keywords

Brachial plexus neuritis, COVID-19, differential diagnosis, telerehabilitation, physical therapy modalities, case report, telehealth, pandemic

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Background

Parsonage–Turner Syndrome (PTS) – also known as or brachial plexus neuritis – is a peripheral neuropathy usually considered as a rare disorder, with an annual incidence of 2/100,000 people.¹ As far as pathophysiology is concerned, the available evidence suggests that PTS involves a complex interaction between genetic predisposition, auto-immune triggering factors and a mechanical vulnerability²: nearly 10% of patients described strenuous physical activity before the onset of the symptoms.³ Typically, PTS is characterized by an abrupt onset of pain, reported as the first symptom in 90% of cases and described as relentless, worse at night, with scores of ≥ 7 on the Numeric Pain Rating Scale (NPRS).^{3,4} Furthermore, high prevalence of patients develop persistent symptoms possibly because of hypersensitivity of the damaged nerves.⁵ Progressive neurological deficits, including weakness, atrophy, and

occasionally sensory abnormalities can usually appear between 2 and 6 weeks.⁶ Sensory loss usually involves the upper cervical root or brachial plexus, but may also involve some nerve trunks, such as the lateral and medial antebrachial cutaneous nerves, the distal median or ulnar nerves.^{7,8}

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Unfortunately, evidence suggests that this condition is diagnosed in three out of four cases within 28 weeks after the disease onset.⁹ For this reason, health professionals, especially those who visit the patient in direct access, have a critical role to identify this condition as soon as possible. However, PTS may present similar characteristics to other, more common, neurological and musculoskeletal conditions such as shoulder joint pathologies, peripheral nerve entrapments or cervical root disorder.^{3,10,11} A wrong or delayed diagnosis means greater risk in developing persistent pain associated with severe fatigue, long-term disability and longer recovery time.⁵

Therefore, a thorough neuromusculoskeletal examination is required and, alongside face-to-face examination, online consultation is just one of the physiotherapist's (PT) tools in response to the strict social distancing policies which characterizes the SARS-CoV-2 pandemic era.¹² Online consultation permits to listen and guide the patient's history and to get consistent information through posture and quality of movement observation.¹³ Moreover, COVID-19 has widely affected the delivery of health care. In response, telerehabilitation has emerged as an alternative care model.¹⁴ Often recognized as a viable way of providing health care over distance, and an effective way to increase access for individuals with transport difficulties or those living in rural and remote areas¹⁵ telehealth management has been recently described as equivalent or more clinically effective when compared to usual care, accounting many positives for patients, clinicians and the health system.¹⁶ In this context, real-time telerehabilitation offers positive clinical results and appears to be effective and comparable to conventional face-to-face methods of healthcare delivery or rehabilitation processes for the improvement of physical function and pain in a variety of musculoskeletal conditions, as demonstrated by several recent systematic reviews.¹⁷⁻¹⁹

This case report describes the patient presentation and clinical decision-making process that led a specialized PT to suspect PTS in a patient presenting with shoulder pain and disability, (1) documenting the use of telemedicine for the first consultation and telerehabilitation for healthcare delivery, (2) highlighting the importance of differential diagnosis to recognize atypical signs and symptoms and (3) emphasizing the role of the PT's screening for referral.

Case presentation

A 35-year-old, right-hand-dominant bank employee and sports amateur cyclist (two training sessions/week, average distance 60 km/session) calls the PT for subtle and progressive upper limb disorder in May 2020. Approximately three months earlier, during the first Italian COVID-19 pandemic national lockdown, the patient complained of neck pain (NPRS 3/10) located in the right upper trapezius area and a wider night numbness

sensation developed after a repeated activity of cutting wood in the previous days. Neck pain spontaneously resolved in less than two days, but later in the following week, a subtle, nuanced feeling of discomfort affected the right shoulder. The patient showed progressively occasional difficulties in performing overhead movements and noticed a 'weird' alteration of his scapular position, even at rest, which worried him.

Therefore, the patient called the general practitioner (GP), who prescribed by phone non-steroidal anti-inflammatory drugs (NSAIDs), moderate rest and X-ray scans, which resulted in normal findings (Appendix 1). That is, the patient was scheduled for an orthopaedic consultation. After physical examination and suspecting a shoulder impingement, probably due to past repeated physical activity, the orthopaedist prescribed an MRI (Appendix 2). The patient was then advised to proceed with moderate rest and 'wait and see' approach for spontaneous resolution and possibly to resort to a subsequent cortisone injection within a few weeks.

Dissatisfied with the results, unclear diagnosis and received advice, the patient opted for further consultation by a PT skilled in Orthopaedic Manipulative Physical Therapist (OMPT).²⁰

Details of the patient's history are shown on the timeline (Figure 1).

Investigation procedures

Due to SARS-CoV-2 pandemic restrictions, the first online consultation was planned.^{21,22} No previous injury, other pathologies or other relevant genetic information were reported. The patient suspended cycling to avoid possible shoulder strains and started running training. A body chart.pdf form was sent to the patient to better understand the distribution and features of symptoms (Figure 2).

Online assessment

Clinical online examination showed slight thoracic hypokyphosis on lateral plane and visible, asymmetrical scapular position on the frontal plane, with the right scapula internally and downward rotated. Moreover, the inferior angle of the scapula was lower compared to the contralateral side. No significant alteration of back muscle and scapular muscle bellies were noted. Subsequently, functional overhead movements were requested (at least 10 repetitions): repeated active forward flexion and abduction revealed scapular downward rotation, anterior tilting and external rotation compared with the contralateral, associated to self-referred fatigue. A further set of 10 repetitions of active loaded movements (1 kg weight, held in the hands, for both sides) emphasized subjective fatigue reported by the patient and highlighted a marked detachment of the medial border and inferior angle of the scapula. Mild pain was reported (NPRS 1-2/10).

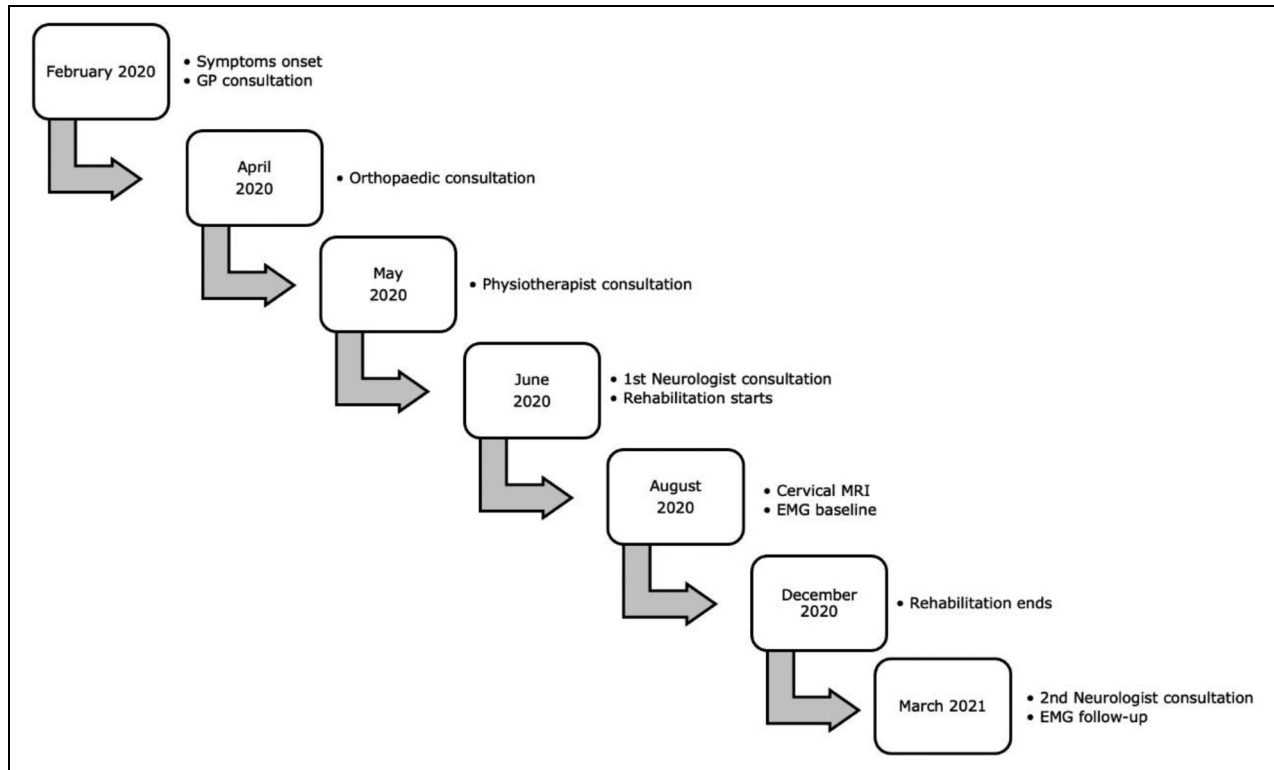


Figure 1. Timeline.

Because of the need to reduce the risk of COVID-19 infection, Italian law provided for limiting the influx of patients to specialist outpatient clinics, except for certain cases defined as particularly relevant from the healthcare point of view and with the authorization issued by the GP. So, due to the incongruence with the initial diagnosis of shoulder impingement, the obvious alteration of scapular kinematics and progressive weakness reported by the patient during repetitive movements, the OMPT requested an urgent face-to-face examination, to better understand the patient clinical condition.

Live assessment

After three days, a complete musculoskeletal physical examination of the neck, shoulder and scapular movements was performed. Previously stated observed posture alterations were confirmed (Figure 3a).

Shoulder physical assessment²³ emphasized scapular dyskinesia during active end-range forward flexion (150°) and abduction (140°) (Figure 3b), while passive range of motion (pROM) overpressure triggered an unpleasant localized sensation of discomfort localized in the right shoulder. Special shoulder tests²⁴ were not administered, since current understanding suggests that just one test cannot be relied upon as sufficient evidence of shoulder impingement.^{25–27}

Shoulder strength testing with isometric resistance, using standard position and procedures,^{28,29} highlighted significant serratus anterior (SA) weakness in sitting position (2/5) rather than in supine position (4/5).³⁰ SA has been identified with a key role in scapula stabilization and movement,³¹ therefore, clinical observation of scapular altered movement or dyskinesia³² was corroborated by other functional tests to better understand scapular kinematics. Scapular retraction test,³³ and scapular assistance test³⁴ did not modify patient symptoms, movement quality and quantity. Repeated wall push-ups were also performed, highlighting scapular dyskinesia (Figure 3c and 3d). In addition, the patient reported fatigue and discomfort around the shoulder.

Due to previous history of short-term neck pain as a possible trigger of shoulder discomfort and disability, the OMPT also investigated the neck: lateral glide, compression and distraction tests, repeated neck active flexion and extension were performed with negative results. For this reason, in order to exclude or suspect specific nerve involvement and somatic motor dysfunction, the OMPT also performed a quick neurological examination, corroborated with the Leeds Assessment of Neuropathic Signs and Symptoms Pain Scale (LANSS).³⁵ Quantitative sensory testing³⁶ and Upper Limb Tension Tests (ULTTs)³⁷ were also performed. Nuanced alteration in pinprick threshold and two-point tactile discrimination in the scapular region was highlighted.

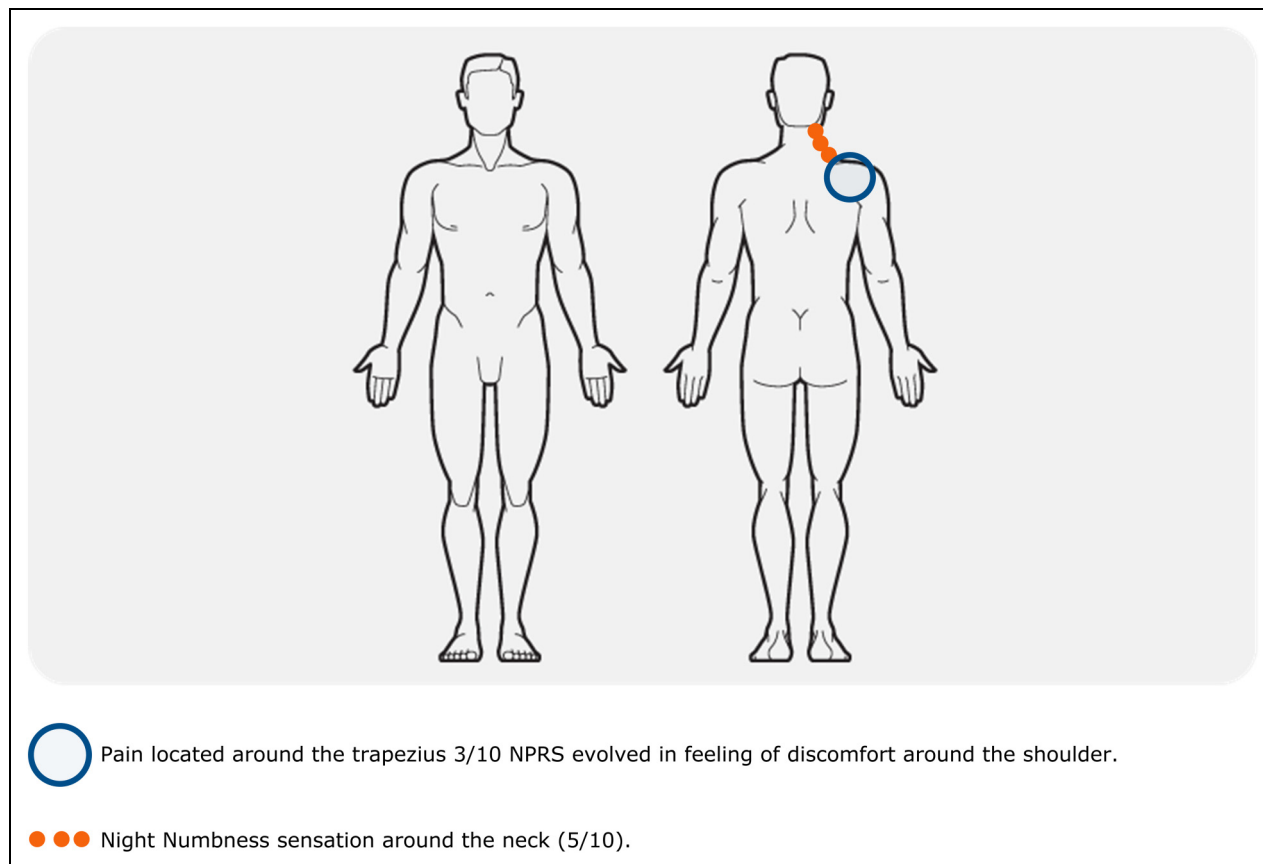


Figure 2. Body chart. Pain located around the trapezius 3/10 Numeric Pain Rating Scale (NPRS) evolved in the feeling of discomfort around the shoulder. Night numbness sensation around the neck (5/10).

In conclusion, to assess patient's 'shoulder-specific' and 'general' health status, the Italian version of the Shoulder Pain and Disability Index (SPADI)³⁸ and the Italian version of the Short Form-36 Health Questionnaire (SF-36)³⁹ were administered (Table 1).

Taking into account the characteristics of the onset of the patient's complaints, all the reported signs and symptoms (altered scapular kinematic, moderate shoulder girdle muscle weakness and other mild unclear neurological signs) during the physical assessment, the OMPT suspected an upper limb neuropathy and therefore suggested the patient for a neurological consultation aiming to evaluate and to permit a better pathway management process.

Medical referral

After 10 days, the neurologist visited the patient: a shoulder girdle electromyography (EMG) was promptly performed (Figure 4), highlighting significant signs of denervation, presence of only some motor units that can be activated voluntarily by SA and presence of polyphasic potentials and minimal signs of denervation in the supraspinatus. Normal distal and proximal motor conduction velocity were preserved.

For completeness, a cervical spine magnetic resonance was also prescribed to rule out cervical concurrent neuropathies (Appendix 3).

The neurological consultation concluded with a diagnosis of axonal injury of the right thoracic long nerve and minimal injury of the suprascapular nerve. These findings were consistent with a form of neuralgic scapular amyotrophy, better known as PTS.

The patient was therefore recommended to concurrently start a program of conservative rehabilitation with the PT and to perform, possibly, another EMG within six months.

Such prescribed shared treatment plan followed the limited evidence published in the Cochrane Database of Systematic Reviews that also suggests no pharmacological approach.⁴⁰

Intervention

The physiotherapy pathway started 8 days later and lasted 6 months; 16 treatment sessions were performed in a twofold way: initially, in the outpatient clinic of the senior author, then, following the onset of the second pandemic wave, with telerehabilitation.^{41,42}



Figure 3. Patient's clinical presentation. (a) Posterior view/resting position. The right scapula is mildly elevated, internally rotated and downward rotated. The inferior angle is highly visible. (b) Posterior view/active forward flexion. The right scapula is visibly detached, as its inferior angle. Scapular dyskinesia was noted. Full active ROM is not achievable. (c) Posterior view/wall push-up. The right scapula is visibly detached, as its medial border (proximal to the spine) and inferior angle. Scapular dyskinesia was noted. Reported fatigue after repetitions. (d) Posterior view/active abduction. The right scapula is mildly elevated, internally rotated and downward rotated. The inferior angle is visible and detached. Signs of fatigue are appreciable through moderate elbow flexion.

Table 1. Outcome measures; baseline assessment.

ACTIVE ROM	Flexion	Extension	Abduction	ERI	ER2	IR
	0-150°	0-30°	0-140°	0-70°	0-50°	T5-T6 HBB
	NPRS 2/10	n.a.	NPRS 2/10	NPRS 2/10	NPRS 2/10	NPRS 1/10
	(scapular compensation + reported fatigue)		(scapular compensation + reported fatigue)	(scapular compensation + reported fatigue)	(scapular compensation + reported fatigue)	(scapular compensation + reported fatigue)
PASSIVE ROM	Flexion	Extension	Abduction	ERI	ER2	IR
	0-160°	0-30°	0-150°	0-80°	0-70°	T5-T6 HBB
	NPRS 2/10	n.a.	NPRS 2/10	NPRS 2/10	NPRS 2/10	NPRS 1/10
FUNCTIONAL TESTS	SRT ¹	SAT ²	Wall Push-Up ¹			
	No changes	No changes	Significant scapular 'winging' after the first repetition. Self-referred fatigue after 5 repetitions.			
STRENGTH ASSESSMENT	SSP ³	UT ⁴	MT ⁵	LT ⁶	SA (supine) ⁶	SA (sitting) ⁷
	3/5	4/5	4/5	4/5	4/5	2/5
	NPRS 1/10	n.a.	n.a.	n.a.	NPRS 1/10	NPRS 2/10
QUANTITATIVE SENSORY TESTING (fibres type)	Thermo-testing Heat stimulation (C, A β)	Thermo-testing Cold Stimulation (C, A δ)	Needle stimuli (pinprick) (C, A δ)	Pressure algometer (C, A δ)	Cotton skin brushing (A β)	Two-point tactile discrimination (A β)
LANSS PAIN SCALE ⁸						
SPADI ⁹	Pain Score	Physical Role	Bodily Pain	General Health	Vitality	Total Score
	10/50 (20%)	75	77	90	70	19/30 (15%)
SF-36 ¹⁰	Physical functioning	Physical Role	Bodily Pain	General Health	Vitality	Social functioning
	90	75	77	90	70	63
						Emotional Role
						100
						Mental Health
						80

⁸Score <12, then neuropathic mechanisms are unlikely to contribute to the patient's pain, while if score >12, then neuropathic mechanisms are likely to contribute to the patient's pain.
⁹Higher values indicate higher levels of disability.
¹⁰For each subscale, the total score ranges from 0 to 100. Higher values indicate better general health status.
¹Performed in sitting position. Patient's elbow bent at a right angle, with the arm placed in abduction to shoulder level. The arm is a few degrees forward from the mid-coronal plane, and is held in a few degrees of external rotation to put it in line with the major part of the supraspinatus. The patient held this position of slight anterior abduction and slight external rotation against pressure.
²Upper trapezius assessment is performed in sitting position. Patient performed elevation of the acromial end of the clavicle and Scapula. The physiotherapist applied pressure against the shoulder, in the direction of depression.
³Middle trapezius assessment is performed in prone position. Patient shoulder was placed in 90° abduction and in lateral rotation sufficient to bring the scapula into lateral rotation of the inferior angle. Physiotherapist's pressure was applied against the forearm, in a downward direction towards the table.
⁴Lower trapezius assessment is performed in prone position. Physiotherapist's hand was placed below the scapula on the opposite side to stabilize patient's arm in line with the lower fibres of the trapezius. Physiotherapist's pressure was applied against the forearm, in a downward direction towards the table.
⁵Supine position: patient performed an abduction of the scapula, projecting the upper extremity anteriorly (upward from the table); physiotherapist's pressure was applied against patient's far and patient performed good grade of muscle force on left side but showed difficult in right side against pressure. This test represents one of the 'traditional' serratus anterior tests, but could be difficult to disclose any weakness. The scapula will not wing, because it's supported by the table, and patient pectoralis minor tilted the shoulder forward in (apparent) test position against pressure.
⁶Sitting position: the test emphasized the upward rotation action of the muscle in the abducted position when compared to the emphasis on the abduction action shown during the supine test, assessing the ability to stabilize the scapula in a position of abduction and lateral rotation, with the arm in a position of approximately 120°-130° of flexion. Physiotherapist's pressure was applied against the dorsal surface of the arm between the shoulder and elbow, downward in the direction of extension, and slight pressure against the lateral border of the scapula.
⁷The Modified Scapular Assistance test involves application of both an upward rotary and retraction force to the scapula by a single examiner in an effort to reduce pain during arm elevation.
⁸The Scapula Retraction Test has been described as: stabilization of the scapula in a position of retraction in relation to the thorax by manual application of force along the medial border of the scapula.
⁹Patient performs wall push-ups for 15-20 times. Weakness of scapular muscles (mainly serratus anterior) or winging, usually shows up with 5-10 push-ups. For stronger or younger population, perform the test on floor.
¹⁰ERI: external rotation with arm at side; ER2: external rotation with arm at 90° of abduction; HHB: hand behind back; LANSS: Leeds Assessment of Neuropathic Signs and Symptoms Pain Scale; LT: lower trapezius; MT: middle trapezius; NPRS: Numeric Pain Rating Scale; SA: serratus anterior; SAT: scapular assistance test; SF-36: Short Form-36 Health Questionnaire; SRT: scapular retraction test; SPADI: Shoulder Pain and Disability Index; SSP: supraspinatus; UT: upper trapezius.

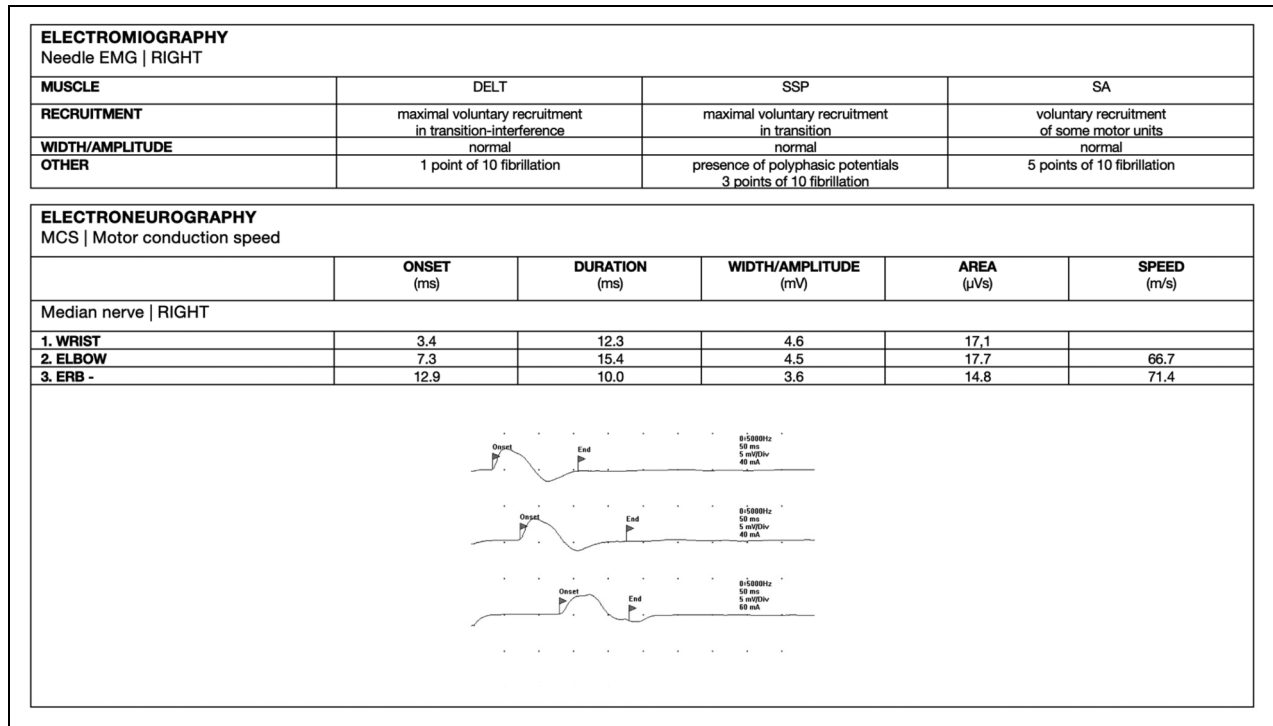


Figure 4. Electromyography (EMG) study at baseline.

DELTA: deltoid; ms: millisecond; mV: millivolt; m/s: meters per second; SA: serratus anterior; SSP: supraspinatus; μ Vs: microvolt per second.

Updated rehabilitation concepts were applied,⁴³ mainly based on education and therapeutic exercise⁴⁴ to manage patient's conditions during the activity of daily life and at work (Table 2).⁴⁵ No painful events were reported from the start of the rehabilitation programme to the end. The patient was also invited to promote home self-treatment and to progressively resume cycling, which he had suspended in the last months.

Follow-up patient reported outcome measures

The patient was reassessed by the OMPT at the end of December 2020. Significant improvement in all values assessed at the baseline was observed; aROM, pROM and muscle strength assessment were performed (Figure 5a–e).

After six months the patient returned to cycling at pre-morbidity levels. Örebro Musculoskeletal Pain Screening Questionnaire (Short) was used to estimate the risk for future work disability⁴⁶ (7/100; very low estimated risk). Detailed result of patient follow-up assessment health-related scores administration is reported in Table 3.

The patient showed great adherence to the physical therapy programme; moreover, at the end of this episode of care, the patient expressed gratitude to the OMPT for proper and timely referral to the neurologist

for successful treatment that allowed him to return to his previous sport activity.

Follow-up medical consultation

Follow-up neurologist consultation was planned in March 2021. The EMG investigation showed a persistent slight reduced recruitment to the right SA with progressive signs of reinnervation (polyphasic potential) and the absence of signs of denervation (Figure 6).

Discussion

This case report highlights the clinical reasoning process that led an OMPT to refer a patient due to suspicion of a peripheral neuropathy, then identified as a PTS, emphasizing the role of telemedicine and online consultation as one of the PT's tools in response to the strict social distancing policies which characterizes SARS-CoV-2 pandemic era. Online assessment conducted to PT's screening for direct access referral⁴⁷ and to proper multidisciplinary specific management. The virtuous communication between different health professionals and their ability to put together each piece of the tell-tale history as a jigsaw resulted in a safe and effective application of best practice management.

SARS-CoV-2 pandemic era made patient's access to the healthcare system more complicated, with the increasing risk to create a gap between the clinician and patients

Table 2. Exercise progression, dosage and frequency of session.

TREATMENT/ PHASE (months)	PHASE I (1–3 months)	PHASE II (4–5 months)	PHASE III (6–7 months)
Sessions (number)	Six sessions	Two sessions	Four sessions
Setting	ONE-TO-ONE REHABILITATION SUPERVISED HOME-BASED TRAINING	TELEREHABILITATION ON-LINE	
Education	<ul style="list-style-type: none"> ■ Informing patient about his condition ■ Pain management during ADL ■ Pain relief strategies during job activity and hobbies 	<ul style="list-style-type: none"> ■ Briefing about progress achieved ■ Listening to patient perception about his symptoms ■ Introducing new strategies based on patient activities 	<ul style="list-style-type: none"> ■ Improving strategies to manage residual symptoms
Therapeutic exercise	<ul style="list-style-type: none"> ■ Graded exposure exercises focusing on scapulo-thoracic muscles strengthening with adaptations ■ Planning home exercises prescription ■ Body conditioning strategies encouraging aerobic activity (running and progressive cycling) 	<ul style="list-style-type: none"> ■ Graded exposure exercises of strengthening with progressions, involving functional movement ■ Home exercises progression ■ Body conditioning strategies encouraging aerobic activity (cycling) 	<ul style="list-style-type: none"> ■ Exercise, with progression, increasing volume, intensity and load
Manual therapies	<ul style="list-style-type: none"> ■ Gleno-humeral techniques ■ Scapular mobilization ■ Thoracic spine mobilization 	<ul style="list-style-type: none"> ■ Soft tissue mobilizations (trigger points, myofascial release, other) 	

resulting in therapeutic failures due to lack of understanding of patient's needs. In this case, the patient saw both GP and orthopaedic for consultations, with a diagnosis of shoulder impingement, rest and NSAIDs intake prescription. Complaining about the persistence of symptoms, he spontaneously contacted the PT. In this context, World Confederation for Physical Therapy (WCPT), which represents physiotherapists worldwide, and WCPT Italian representative organization Associazione Italiana di Fisioterapia (AIFI), recommended its members to postpone treatments considered not urgent to ensure safety, still guaranteeing the essential rehabilitation services.^{18,19} That means a barrier for health care professionals who are usually in close contact with patients needing low-intensity care, such as musculoskeletal PTs. The rapid uptake of telehealth has mainly been due to necessity, following social distancing requirements and the need to reduce the risk of transmission.⁴⁸ The COVID-19 scenario of restriction promoted the publication of a position statement of the WCPT on the use of telerehabilitation to improve accessibility to rehabilitation care, offering to the community of PTs the opportunity to reflect on this new method of care delivery.^{49,50} Despite telehealth and telecare management has been

mainly used reactively more than proactively, this new uptake surely requires a significant change in management effort and the redesign of existing models of care, aiming to generate greater benefits in the long term and to help with the everyday (and emergency) challenges in healthcare.⁵¹

Promising systematic reviews have reported that telerehabilitation-based consultation for musculoskeletal pain is feasible in terms of concurrent validity and intra-rater and inter-rater reliability in the assessment of peripheral joints and the spine, with good to excellent psychometric properties for the different clinical outcomes.^{52,53} Specifically, shoulder examination using telerehabilitation has limited diagnostic accuracy but promising evidence of high patients and health professional satisfaction ratings: its utilization can empower patients, giving them higher confidence levels and a deeper understanding of their condition, leading to improved health outcomes.¹³

Consistent clinical findings using online consultation led to face-to-face examination, where the clinician can go deeply into the patient's condition assessing both symptomatic and asymptomatic extremities, including regions the patient does not specifically complain

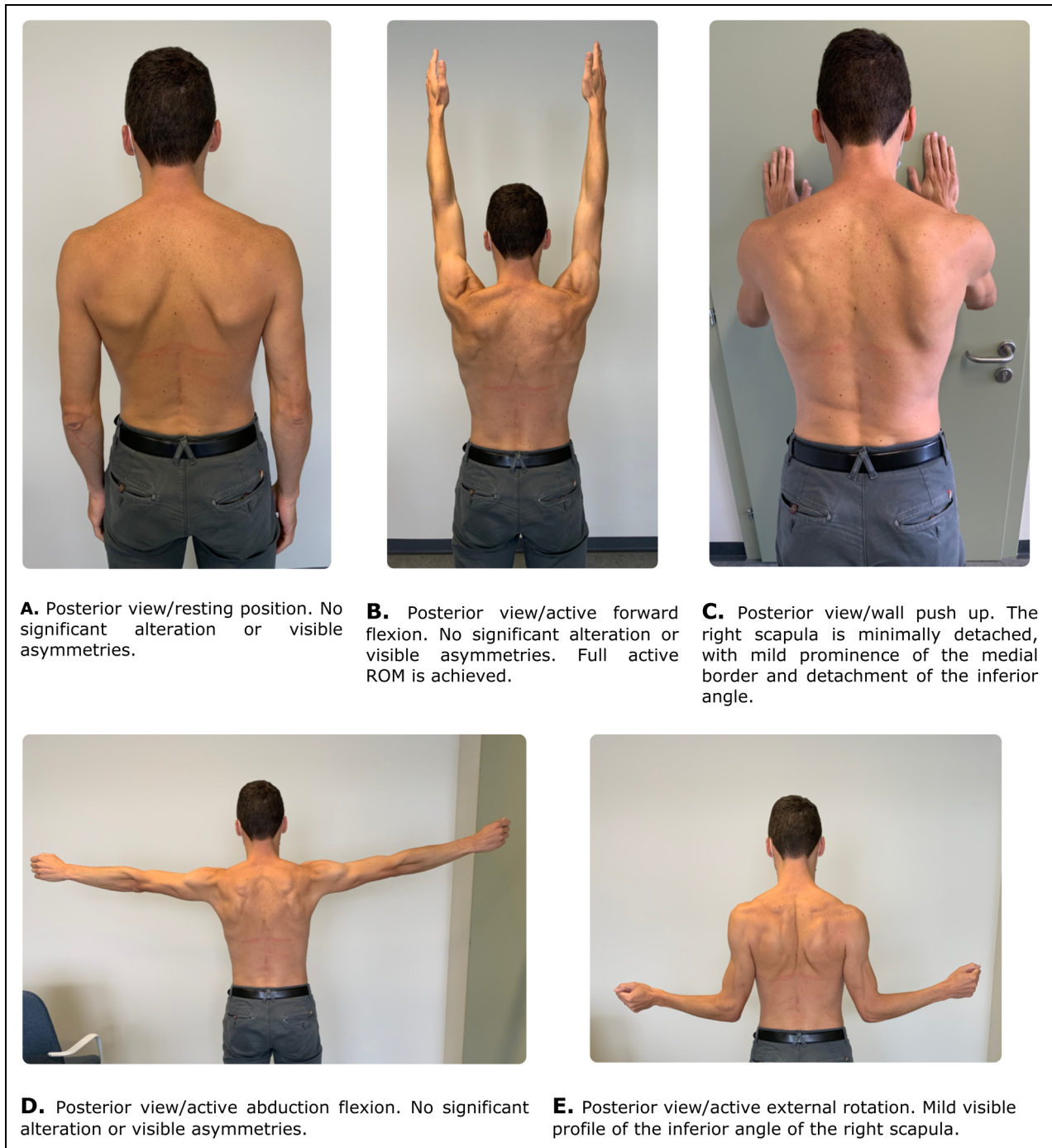


Figure 5. Patients at the final assessment. (a) Posterior view/resting position. No significant alteration or visible asymmetries. (b) Posterior view/active forward flexion. No significant alteration or visible asymmetries. Full active ROM is achieved. (c) Posterior view/wall push-up. The right scapula is minimally detached, with mild prominence of the medial border and detachment of the inferior angle. (d) Posterior view/active abduction flexion. No significant alteration or visible asymmetries. (e) Posterior view/active external rotation. Mild visible profile of the inferior angle of the right scapula.

about and refer to diagnostic studies for further investigations.⁶

Moreover, despite some contradictory results,¹⁹ telerehabilitation in physical therapy could be comparable with in-person rehabilitation for many musculoskeletal conditions, as

reported in this case report: patient's care pathway was conducted in a twofold way, both in-person and through online exercise sessions, yielding excellent clinical outcomes for the patient.

After one year from the onset, the EMG showed complete recovery, without any residual reported symptoms

Table 3. Outcome measures; final follow-up assessment.

ACTIVE ROM	Flexion 0–170°	Extension 0–30°	Abduction 0–170°	ERI 0–80°	ER2 0–70°	IR T5–T6 HBB
PASSIVE ROM	Flexion 0–180°	Extension 0–30°	Abduction 0–180°	ERI 0–80°	ER2 0–80°	IR T5–T6 HBB
FUNCTIONAL TESTS	SRT ^k	SAT ^l	MT ^g	SA (supine) ^l	SA (sitting) ^l	Wall Push-Up ^m
STRENGTH ASSESSMENT	SSP ^e 5/5	UT ^f 5/5	Needle stimuli (pinprick) (C, A β)	Pressure algometer (C, A β)	Cotton skin brushing (A β)	Two-point tactile discrimination (A β)
QUANTITATIVE SENSORY TESTING (fibres type)	Thermo-testing Heat stimulation (C, A β)	Thermo-testing Cold Stimulation (C, A β)				
LANSS PAIN SCALE^a			Total Score 0/24	Disability Score 1/80	Total Score 1/130	
SPADI^b	Pain Score 0/50 (n.a.)	Physical functioning	Bodily Pain	General Health	Vitality	Emotional Role
SF-36^c	100	100	100	100	90	100
ÖREBRO PAIN SCREENING QUESTIONNAIRE (short version)^d			Total Score 7/100			Mental Health 96

^aScore <12, then neuropathic mechanisms are unlikely to contribute to the patient's pain, while if score >12, then neuropathic mechanisms are likely to contribute to the patient's pain.

^bHigher values indicate higher levels of disability.

^cFor each subscale, the total score ranges from 0 to 100. Higher values indicate better general health status.

^dThe total score ranges between 1 and 100, with a score >50 indicating higher estimated risk for future work disability.

^ePerformed in sitting position. Patient's elbow bent at a right angle, with the arm placed in abduction to shoulder level. The arm is a few degrees forward from the mid-coronal plane, and is held in a few degrees of external rotation to put it in line with the major part of the supraspinatus. The patient held this position of slight anterior abduction and slight external rotation against pressure.

^fUpper trapezius assessment is performed in sitting position. Patient performed elevation of the acromial end of the clavicle and Scapula. The physiotherapist applied pressure against the shoulder, in the direction of depression.

^gMiddle trapezius assessment is performed in prone position. Patient shoulder was placed in 90° abduction and in lateral rotation sufficient to bring the scapula into lateral rotation of the inferior angle. Physiotherapist's pressure was applied against the forearm, in a downward direction towards the table.

^hLower trapezius assessment is performed in prone position. Physiotherapist's hand was placed below the scapula on the opposite side to stabilize patient's arm is placed diagonally overhead, in line with the lower fibres of the trapezius. Physiotherapist's pressure was applied against the forearm, in a downward direction towards the table.

ⁱSupine position: patient performed an abduction of the scapula, projecting the upper extremity anteriorly (upward from the table); physiotherapist's pressure was applied against patient's fist and patient performed good grade of muscle force on left side but showed difficult in right side against pressure. This test represents one of the 'traditional' serratus anterior tests, but could be difficult to disclose any weakness. The scapula will not wing, because it is supported by the table, and patient pectoralis minor tilted the shoulder forward in (apparent) test position against pressure.

^jSitting position: the test emphasized the upward rotation action of the muscle in the abducted position when compared to the emphasis on the abduction action shown during the supine test, assessing the ability to stabilize the scapula in a position of abduction and lateral rotation, with the arm in a position of approximately 120°–130° of flexion. Physiotherapist's pressure was applied against the dorsal surface of the arm between the shoulder and elbow, downward in the direction of extension, and slight pressure against the lateral border of the scapula.

^kThe Modified Scapular Assistance test involves application of both an upward rotary and retraction force to the scapula by a single examiner in an effort to reduce pain during arm elevation.

^lThe Scapula Retraction Test has been described as stabilization of the scapula in a position of retraction in relation to the thorax by manual application of force along the medial border of the scapula.

^mPatient performs wall push-ups for 15–20 times. Weakness of scapular muscles (mainly serratus anterior) or winging usually shows up with 5–10 push-ups. For stronger or younger population, perform the test on floor.

ERI: external rotation with arm at side; ER2: external rotation with arm at 90° of abduction; H-HB: hand behind back; LANSS: Leeds Assessment of Neuropathic Signs and Symptoms Pain Scale; LT: lower trapezius; MT: middle trapezius; SA: serratus anterior; SAT: scapular assistance test; SF-36: Short Form-36 Health Questionnaire; SPADI: Shoulder Pain and Disability Index; SRT: scapular retraction test; SSP: supraspinatus; UT: upper trapezius.

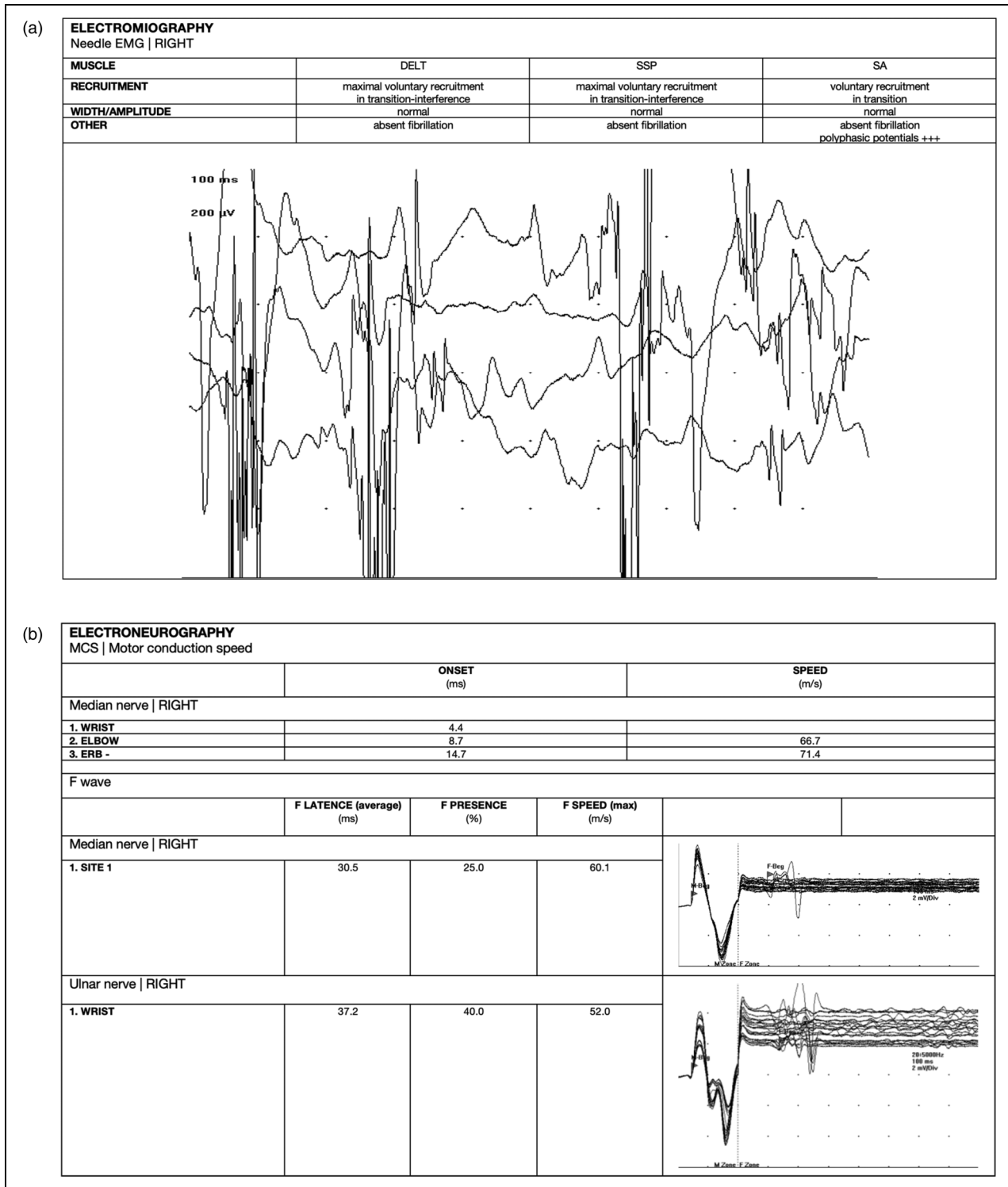


Figure 6. Electromyography (EMG) study at the final follow-up (part 1). EMG study at the final follow-up (part 2). DELT: deltoid; ms: millisecond; mV: millivolt; m/s: meters per second; SA: serratus anterior; SSP: supraspinatus; μ Vs: microvolt per second.

by the patient. In terms of outcome, prior studies have reported an excellent recovery in pain, atrophy and sensory deficits in 89% of patients in three years.^{54,55}

Assessing disability and quality of life, studies shows that about a quarter to a third of the patients reports significant persisting pain and fatigue, and half to two-thirds still

have disabilities in several personal or household tasks and sports⁵⁶ after an average of six years and after 2.5 years as indicated with a disability of the arm, shoulder and hand score of 33.33%.³ In this context, physical therapy treatment, focusing on improving the altered scapular kinematics and noted muscle deficits, may help to improve shoulder pain and function.⁵⁷ In a previous case report, a rehabilitation program including strengthening and stretching for the involved structures, has been shown to improve pain and movement alterations over five months of treatment in a patient with long thoracic nerve involvement.⁵⁷

Conclusion

The role of a PT is crucial for an appropriate evaluation and management of a patient complaining of musculoskeletal disorders mimicking other neurological conditions, particularly if a proper medical referral is needed. In this regard, an exhaustive screening for referral is a mandatory step for every health professional, especially for those in a direct access setting. Notably, certain medical condition like PTS, requires advanced clinical reasoning skills that, in some case, may drastically change patient prognosis and reduce the risk of a misdiagnosis. Finally, the neurological findings of such type of peripheral neuropathy did not exclude a conservative approach, which truly represents the first-line choice for most patients, especially when symptoms are not clearly related to imaging findings.

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Ethical approval

This case report was written following the CARE checklist. The patient signed a written informed consent to allow any data and imaging to be used for the publication of this case report.

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Appendices

Appendix 1 Right shoulder X-ray findings

Regular bone structure.
Normal interrelation between the components of the joints.
Absence of soft tissue calcification.

Appendix 2 Right shoulder MRI findings

Absence of rotator cuff tears.
Regular signal intensity and normal thickness of long head of biceps tendon.
Presence of small amount of fluid surrounding the long head biceps tendon.

Amount of fluid distended subcoracoid bursa.
Small cystic area in the posterolateral humeral head side.
Absence of glenoid labrum tears.

Appendix 3 Cervical spine MRI findings

The vertebral bodies are normal in height and alignment and cervical lordosis within the limits.
No alteration of the signal bone intensity from imaging STIR technique.
Normal atlanto-occipital and subaxial joint interrelation. No disc herniation or significant bulging. Spinal cord diameter and signal intensity are within the limits. Regular sagittal diameter of the cervical spinal canal.