Patient-centered management strategy for concurrent musculoskeletal complaints in elbows, shoulders, and neck after an isolated hand/forearm complaint

A prospective interventional study

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Original article

Patient-centered management strategy for concurrent musculoskeletal complaints in elbows, shoulders, and neck after an isolated hand/forearm complaint: A prospective interventional study

Étude prospective interventionnelle concernant une stratégie de prise en charge centrée sur les patient atteint de troubles musculo-squelettiques concomitants des coudes, des épaules et du cou après un diagnostic isolé au niveau de la main et de l'avant-bras

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ABSTRACT

The aim was to evaluate patient-reported outcomes before and after a patient-centered management strategy targeting concurrent proximal musculoskeletal complaints (MSCs) in patients with an isolated hand/forearm complaint. A prospective interventional study included 66 patients. Intervention targeting concurrent MSCs was implemented as a patient-centered add-on to standard treatment for primary hand/forearm complaints. The patient-centered management strategy included patient education, individualized exercises, and manual therapy. Patient-reported outcome measures and pain questionnaires regarding the location, frequency, and intensity of pain in hands, elbows, shoulders, and neck were collected at baseline, after the last session of the patient-centered management strategy, and at 3-month follow-up. There were significant improvements in all patient-reported outcomes between baseline and follow-up. DASH scores improved significantly, by 17–29 points on the 3 subscales. There was a significant improvement of 6 points in PCS, 2 points in HADS, and 0.051 points in EQ-5D index. Median pain intensity on NRS decreased from 6 (4–8) to 5 (2.5–7) in hands, 3 (0–6) to 0 (0–3) in elbows, 5 (2–7) to 2.5 (0–5) in shoulders, and 3 (0–6) to 2 (0–3) in the neck, between baseline and discharge. Patients reporting concurrent MSCs in the elbow, shoulder, and neck after an isolated hand/forearm complaint may benefit from patient-centered management comprising patient education, individualized exercises, and manual therapy targeting pain and functional deficits in the upper-limb and neck.
Level of evidence: IV.

Mots-clés:
Troubles musculo-squelettiques
Stratégie de prise en charge centrée sur le patient
Main
Coude
Epaule
Cou

RÉSUMÉ

Notre objectif était d'analyser des données obtenues après l'auto-évaluation de patients présentant un diagnostic isolé au niveau de la main et/ou de l'avant-bras, avant et après avoir appliqué une stratégie de prise en charge centrée sur le patient ciblant les troubles musculo-squelettiques (TMS) proximaux concomitants. Une étude interventionnelle prospective a inclus 66 patients. Une intervention ciblant les TMS concomitants a été mise en œuvre sous forme d'une prise en charge complémentaire au traitement standard utilisé pour les diagnostics primaires chez les patients atteints au niveau de la main et/ou de l'avant-bras. La prise en charge complémentaire comprenait l'éducation du patient, des exercices individualisés et une thérapie manuelle. Les patients répondaient à des questionnaires sur l'impact de

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leur diagnostic isolé au niveau de la main et/ou de l'avant-bras et de leurs TMS concomitants dans leur vie courante, et à des questionnaires concernant la localisation, la fréquence et l'intensité de la douleur au niveau de la main, du coude, de l'épaule et du cou. Ces questionnaires ont été recueillis pendant le suivi du patient, au début de la stratégie de prise en charge complémentaire, pendant la dernière séance et trois mois après la dernière séance. Il y eut des améliorations significatives dans tous les résultats rapportés par les patients entre le début de l'étude et les retours obtenus pendant le suivi des patients après traitement. Les scores DASH se sont améliorés de manière significative, avec des changements entre 17 et 29 points sur les trois sous-catégories. Il y eut une amélioration significative de 6 points du PCS, de 2 points du HADS et de 0,051 point de l'indice EQ-5D. La médiane de l'intensité de la douleur (ENA) a diminué de 6 (4–8) à 5 (2,5–7) à la main, 3 (0–6) à 0 (0–3) au coude, 5 (2–7) à 2,5 (0–5) à l'épaule et 3 (0–6) à 2 (0–3) au cou, entre le départ et le suivi à la sortie. Les patients présentant des TMS concomitants au niveau du coude, de l'épaule et du cou développés après une diagnostic isolé à la main et/ou à l'avant-bras peuvent bénéficier d'une stratégie de prise en charge centrée sur le patient comprenant l'éducation du patient, des exercices individualisés et une thérapie manuelle ciblant la douleur et les déficits fonctionnels du membre supérieur et du cou. *Niveau de preuve.* – IV.

1. Introduction

The burden of musculoskeletal disorders has increased significantly in the last three decades, with a global prevalence of more than 1.71 billion people affected in 2019 [1]. During this period, there has been a 63% increase in the number of individuals affected [1]. This burden is caused by both traumatic injuries and disorders with slow development.

One of the most common complaints seen in emergency and orthopedic departments is isolated hand/forearm injury or pathology [2–4], most often consisting of: fractures of the fingers, wrist and distal radius and/or ulna; amputations; carpal or distal radioulnar instability; soft tissue injuries to the fingers and hands; and nerve injuries affecting upper-limb function [3,5]. These injuries are associated with disability and problems with self-care, leisure, and work activities [2,6,7].

We recently reported that 4 out of 10 patients with isolated hand/forearm injuries or pathologies experienced concurrent musculoskeletal complaints (MSCs) in the elbow, shoulder, and neck [8]. More than a quarter these patients develop concurrent MSCs after their initial injury or pathology [8]. At present, little is known about how to manage concurrent MSCs in this patient population. Most studies of patients with isolated hand/forearm complaints investigated the effect of primary interventions and reported outcomes related only to the hand/forearm [9–12]. There is a dearth of research evaluating interventions aimed at reducing pain and improving function in the upper-limb and neck following an isolated hand/forearm complaint. And there are no evidence-based treatments targeting concurrent MSCs developing after isolated hand/forearm complaints.

The aim of the present study was to explore patient-reported outcomes and functional impairments before and after implementation of a patient-centered management strategy comprising patient education, individualized exercises, and manual therapy targeting concurrent proximal MSCs after an isolated hand/forearm complaint.

2. Patients and methods

2.1. Study design

This was a prospective interventional study on patients with concurrent MSCs in the elbow, shoulder, and neck developing after an isolated hand/forearm injury or pathology. The study was approved by the Danish Data Protection Agency (J.nr.2017-74). Written informed consent was obtained from all patients before participation. The report complies with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement [13].

2.2. Recruitment and eligibility criteria

Participants were recruited by the Aalborg University Hospital (Denmark) Hand-Therapy Team of the Department of Physiotherapy and Occupational Therapy between April 2017 and July 2018. Eligibility was determined based on clinical interview and self-report questionnaires, using predefined inclusion and exclusion criteria.

Inclusion criteria comprised: self-reported pain and/or stiffness in the elbow, shoulder, or neck (concurrent MSC) developing after a hand/forearm complaint.

Exclusion criteria comprised: concurrent MSC developing before the hand/forearm complaint, and cognitive impairment that could affect the patient's ability to participate in the study.

2.3. Assessment of movement patterns in the upper-limb and neck

In relation to each patient's self-reported concurrent MSC, we assessed upper-limb and neck movement patterns using Selective Functional Movement Assessment (SFMA) [14]. The SFMA is a standardized movement assessment tool designed to identify and classify dysfunctional movement patterns and was used to individualize treatment [14]. The SFMA is based on the concept of regional interdependence, to guide identification, assessment, and treatment of the remote body parts and dysfunctions that may relate to the main complaint [15]. The authors chose the SFMA as the present study sample was very heterogeneous, and SFMA could provide a framework for systematization within the study and subsequent replication. The first part of the assessment included applying the SFMA categorical scoring tool to detect painful and dysfunctional movement patterns in the upper-limb and neck [16]. The procedure matched other studies in which SFMA was implemented [17,18]. However, for the purposes of the present study, only upper-limb and cervical movement patterns were assessed.

The second part of the assessment included systematic SFMA-breakout [14] to dissect each of the dysfunction patterns and determine whether dysfunctions were associated with mobility (1st group) or stability and/or motor control dysfunction (2nd group). The third group consisted of patients with pain as a dominant characteristic of the dysfunction and in whom it was

Table 1
Allocation matrix based on the location and the main characteristic of the complaint.

	a) Elbow	b) Shoulder	c) Neck
1) Mobility dysfunction	1a	1b	1c
2) Stability/motor control dysfunction	2a	2b	2c
3) Pain	3a	3b	3c

impossible to distinguish between mobility and stability and/or motor control dysfunction.

After the assessment, the patients were allocated to specific treatment groups based on the location of the concurrent MSC (elbow, shoulder, and/or neck) and the dominant dysfunction characteristic according to SFMA (mobility, stability/motor control, or pain) (Table 1).

2.4. Patient-centered management strategy

All participants received standard treatment for their primary hand/forearm complaint, including surgery and/or instruction in self-management and exercises. Selected patients received supervised treatment by the Hand-Therapy Team in the Department of Physiotherapy and Occupational Therapy or a municipal outpatient setting. The type, dose, and delivery of the standard treatment were based on primary diagnosis, severity of symptoms related to the primary complaint, clinical guidelines, and therapist and/or hand surgeon's independent clinical judgment.

The patient-centered management strategy targeting concurrent MSCs was implemented by a senior physiotherapist (LW) with more than 10 years' experience treating upper-limb MSCs. It was organized as an add-on to the standard treatment for the primary hand/forearm complaint.

The add-on aimed to broaden the patients' standard treatment delivered by the Hand-Therapy Team, which usually focuses solely on patients' pathoanatomic condition in the hand and forearm. This study expanded the usual treatment to target concurrent MSCs proximally in the upper-limb and neck.

The add-on management strategy combined patient education, exercises, and hands-on components (manual therapy and/or self-mobilization), and was individually adapted based on the characteristics, location of symptoms, and functional deficits, based on the SFMA (Table 1). The proportions of the management components were adjusted based on the patient's symptoms and preferences. For instance, more weight was placed on patient education in selected patients in the pain group compared to greater focus on functional training in the stability/motor control group. The educational component aimed to improve patients' knowledge and self-management of pain and possible factors contributing to the spread of pain, and encouraged active strategies such as movement and physical activity. In the training part of the intervention, patients were instructed in an individual progressive home-based exercise program targeting functional deficits in the elbow, shoulder, and/or neck. Exercise level was adjusted to individual pain intensity, functional ability, quality of exercise performance, and specific activities of daily life. Range-of-motion exercises in prone position were the basic level, and resistance exercises in more functional weight-bearing positions represented higher levels. In the hands-on component, patients were treated by manual therapy in addition to exercises. The patient's independence from the therapist and self-management after instruction in relevant self-mobilization and/or stretching techniques were emphasized (Table 2).

2.5. Demographics

At inclusion, diagnoses of hand and forearm complaints were obtained from the patients' medical records. A self-report questionnaire was used to collect age, gender, weight, height, pain duration in hand, elbow, shoulder and/or neck, trauma mechanism, and the unilateral or bilateral nature of the pain.

2.6. Patient-reported outcome measures

Patient-reported outcome measures (PROMs) and pain questionnaires regarding the location, frequency, and intensity of pain in hand, elbow, shoulder, and neck were collected at baseline, after the last session of the add-on (discharge), and at 3-month follow-up.

PROMs included the Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire [19]. This 30-item questionnaire includes 21 physical function-, six symptom-, and three social/role function items. There are also two optional 4-item modules: one for working populations and one for athletes/musicians/artists. Each item has five response options. Scores for all items are used to calculate a scale score ranging from 0 (no disability) to 100 (most

Table 2
Overview of the components and elements of patient-centered management.

Components of patient-centered management	Main elements of patient-centered management for each component		Target group
Patient education	Basic information about pain and possible factors contributing to the pain spreading Inactivity vs. movement Rationale for treatment		All patients, More weight on educational component in the pain group
Exercises	Position (non-weightbearing/weightbearing)	-Lying down -Sitting -Standing	All patients, Exercise level according to pain, functional ability, quality of exercise performance, and preference for specific activities of daily living
	Resistance (no resistance/resistance)	-Active -Isometric -Isotonic	
Hands-on	Soft tissue mobilization Passive motion and joint mobilization Self-mobilization and stretching		Mainly patients in the mobility group. Independence from the therapist and self-management were emphasized

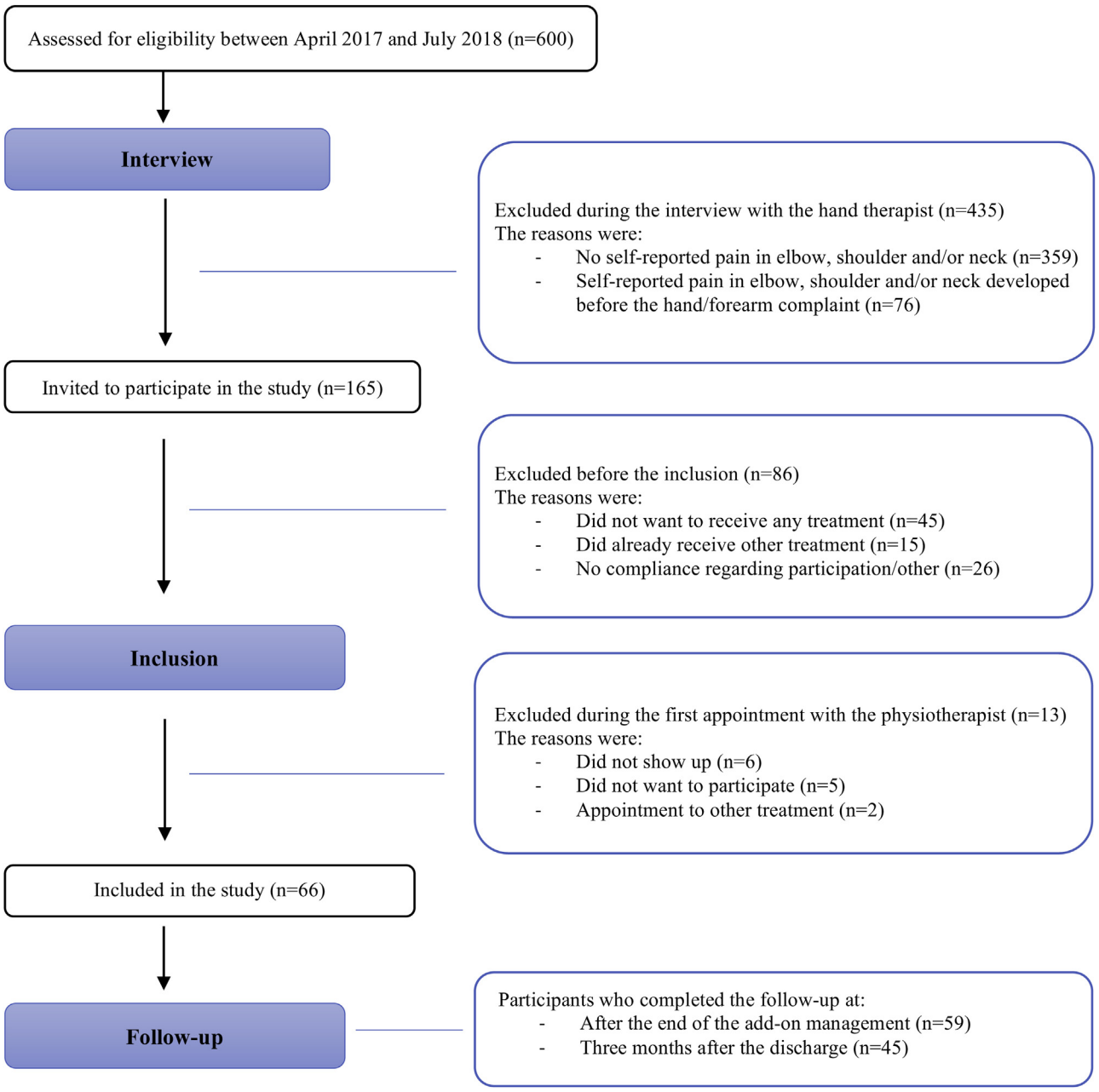

Fig. 1. Flowchart for recruitment, inclusion, and follow-up of participants.

severe disability). A minimal clinically important difference (MCID) threshold of 10.83 points for the DASH was selected for the study [20].

Psychological distress was assessed on the Hospital Anxiety and Depression Scale (HADS) [21] and the Pain Catastrophizing Scale (PCS) [22]. HADS is a 14-item scale consisting of 2 subscales, for anxiety and depression. A score of 8/21 was defined as cut-off for both subscales [21]. PCS is a 13-item scale that measures the patient's level of catastrophic thinking experienced while in pain. PCS total score was reported as the sum of all 13 items (range, 0–52), with scores >20 as cut-off, as they indicate increased risk of poor outcome, including functional impairment [22,23].

Health-related quality of life was measured on the European Quality of Life 5 Dimensions questionnaire (EQ-5D), with three levels [24]. The EQ-5D consists of five dimensions: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression, each with three levels: no, some, and extreme problems. We converted the 5-dimension health-state profile obtained from EQ-5D to a single index score based on the Danish data-set [25].

Pain frequency was reported on a 5-point frequency scale (never, every month, every week, every day, or constantly). Pain intensity was assessed on a 0–10 numerical rating scale (NRS), where 0 is no pain and 10 the worst pain imaginable. Patients were asked to report pain intensity in their hand, elbow, shoulder, and neck in terms of the worst pain during the last seven days.

In addition to the PROMs and pain questionnaire, self-reported motivation for treatment was measured at baseline and after every consultation, asking, "To what extent are you motivated to follow the project course with the physiotherapist?", with a response on an NRS, where 0 was "not motivated" and 10 "highly motivated".

Adherence to treatment was assessed by asking, "To what extent have you followed the physiotherapist's instructions since

your last consultation?" with a response on an NRS, where 0 was "not at all," and 10 "to the highest degree".

Satisfaction was assessed at 3-month follow-up on a 4 -point Likert scale, ranging from "very satisfied" to "very dissatisfied".

2.7. Sample size

No sample size calculations were performed for this study since no relevant prior data were available. The final sample size was based on the explorative study design and a predefined time of 15 months for inclusion, based on incidence calculations of previous patients in the department and an inclusion goal of a minimum 50 patients [8].

2.8. Data analysis

Patient demographics and changes in outcomes were reported as mean (SD) or median (IQR). Categorical data were reported as percentage with 95% confidence interval (CI).

The primary analyses concerned changes in pain and PROMs, using repeated-measures ANOVA with post-hoc testing, reporting mean change over time with 95% CI. In cases where the assumption of sphericity was violated, Greenhouse-Geisser correction was applied. Changes in pain were assessed on non-parametric Friedman's ANOVA, following Hodges-Lehmann estimate to calculate difference in medians. The proportion test was used to calculate percentage change with 95% CI.

A secondary analysis distinguished outcomes in patients with different levels of disability. Patients were divided into low (22/45) and high (23/45) disability groups based on median cut-off of 16 points on the DASH ADL score at 3-month follow-up. This method corresponds to other studies showing varying cut-offs for severity [19]. All statistical analyses used SPSS software v.28 (IBM SPSS).

3. Results

3.1. Baseline characteristics

During the 15-month inclusion period, 66 patients with concurrent MSCs following isolated hand/forearm complaint were included (Fig. 1). Baseline characteristics and primary diagnoses are shown in Table 3. Response rates were 89% following add-on patient-centered management and 68% at the 3-month follow-up.

Nine patients required assessment by an orthopedic surgeon or another medical doctor during the study period. The main reason was for assessment of pain medication or further assessment after the end of the project. Four patients required hand/forearm re-operation due to complications (osteosynthesis material removal or delayed bone healing). There were no adverse events implicating the add-on patient-centered management. The add-on comprised a median of 3 physiotherapy consultations during an 18-month period.

3.2. Baseline symptoms

The most common location of self-reported concurrent MSCs was the shoulder (85%, 95% CI: 76%–94%), followed by the neck (72%, 95% CI: 61%–83%) and the elbow (67%, 95% CI: 56%–78%). Eighty-three percent (95% CI: 74%–92%) of patients had concurrent MSCs in 2 or 3 regions of the upper-limb and neck. Table 4 shows baseline characteristics regarding pain and symptoms. Most dysfunctions identified on SFMA were related to the shoulder (52%) and neck (32%). Stability/motor control dysfunction and pain were the largest management groups in the study (49% and 43%, respectively, Table 5).

Table 3
Basic characteristics of the 66 patients (Data reported as mean (SD) or n (%) for count data, unless otherwise stated).

Age [years]	48 (16.5)
Gender [% women]	68%
Weight [kg]	75 (15)
Height [cm]	171 (9)
Body Mass Index kg/m^2[a]	24.4 (23–27)
Primary diagnosis:	
Distal radius and ulna fracture	21 (32%)
Distal radioulnar joint instability	7 (11%)
Multi-trauma (wrist)	6 (9%)
Forearm shaft fracture	5 (8%)
Finger fracture	5 (8%)
Thumb OA (operated on)	4 (6%)
Ligament lesion and tears (fingers)	3 (5%)
Other (fingers)	3 (5%)
Other (wrist)	2 (3%)
Intra-articular wrist fracture	2 (3%)
Amputation (fingers)	2 (3%)
Infection (fingers)	2 (3%)
Dupuytren's disease	2 (3%)
Tendon lesion and tear (fingers)	2 (3%)
Treatment of primary diagnosis: operated/conservative [% operated patients]	76%

[a] Data presented as median (IQR).

3.3. Changes in self-reported pain, disability, psychological distress, and quality of life

Changes in disability (DASH), pain, psychological distress (PCS and HADS), and quality of life (EQ-5D index and VAS) are reported in Table 6.

At the 3-month follow-up, the mean DASH scores for the three subscales were: ADL 24.7 (SD 19.7), Work 31.7 (SD 32.5), and Sport 47.5 (SD 28.9). Repeated-measures ANOVA showed a significant main effect of time for all three DASH subscales: ADL ($F_{1.7,73.5} = 48$; $p < 0.001$), Work ($F_{2,46} = 22$; $p < 0.001$), and Sport/Art ($F_{2,22} = 12$; $p < 0.001$), indicating a significant increase between inclusion and the 3-month follow-up. The post-hoc test for pairwise comparisons with Bonferroni adjustment showed an increase in all three subscales between inclusion and add-on treatment ($p < 0.001$) and 3-month follow-up ($p < 0.001$).

There was a significant effect of time for PCS ($F_{1.6,69} = 16$; $p < 0.001$) and HADS ($F_{2,84} = 9$; $p < 0.001$). The EQ-5D index score increased significantly between inclusion and 3-month follow-up ($F_{2,86} = 22.2$; $p < 0.001$). The post-hoc test showed an increase of 0.051 points after management and 0.08 points at the 3-month follow-up ($p < 0.001$).

The highest degree of pain in the elbows, shoulders, and neck during the preceding week and the number of patients with constant and daily pain decreased significantly from baseline to after add-on patient-centered management and to 3-month follow-up ($p < 0.001$).

3.4. Outcomes in patients with low and high disability

Outcomes in patients with either low or high disability levels at the 3-month follow-up are presented in Table 7. Results suggested that patients with high-level disability at 3 months also had higher levels of disability at baseline. Improvements from baseline to follow-up were observed in both groups.

Table 4
Baseline pain and symptoms.

Pain onset: gradual vs. simultaneous [% of gradual onset after hand/forearm complaint]	85%			
Pain unilateral vs. bilateral [% unilateral]	80%			
Duration of symptoms (n (%))[a]	Hand n = 64	Elbow n = 42	Shoulder n = 56	Neck n=41
0–3 months	35 (55%)	35 (83%)	35 (63%)	26 (63%)
3–6 months	11 (17%)	4 (10%)	11 (20%)	6 (15%)
6–12 months	8 (13%)	2 (5%)	6 (11%)	2 (5%)
>12 months	10 (16%)	1 (2%)	4 (7%)	7 (17%)
Pain duration [months][b]	3 (2–7)	2 (1.5–2.5)	2.5 (1–5)	1.5 (1–5)
Pain frequency (n (%))	n = 66	n = 44	n = 56	n = 48
Constantly	25 (38%)	4 (6%)	10 (15%)	4 (6%)
Daily	33 (50%)	30 (45%)	31 (47%)	29 (44%)
Weekly	7 (10.5%)	6 (9%)	12 (18%)	10 (15%)
Monthly	1 (1.5%)	4 (6%)	3 (5%)	5 (8%)
No pain	0 (0%)	22 (33%)	10 (15%)	18 (27%)
Worst pain last week[b,c]	6 (4–8)	3 (0–6)	5 (2–7)	3 (0–6)

[a] 2 patients did not report duration of pain in the hand, 2 in the elbow, and 7 in the neck.
[b] Values presented as median (IQR).
[c] NRS (0–10), based on reports from 66 patients.

3.5. Patient motivation, treatment adherence, and satisfaction

Median self-reported motivation for add-on patient-centered management was 10 (IQR 8–10), and self-reported adherence was 9 (IQR 8–10). The Likert scale at the 3-month follow-up showed that 73% of patients (33/45) were very satisfied, and 27% (12/45) satisfied with the add-on patient-centered management.

4. Discussion

This study explored the changes in self-reported outcomes after implementation of a patient-centered management strategy in upper-limb and neck complaints developing after an isolated hand/forearm complaint. There were significant and clinically important changes between inclusion and discharge, high motivation for treatment, and a high level of adherence. The results indicate that the strategy improved recovery.

4.1. Add-on patient-centered management strategy targeting concurrent MSCs

The intervention was developed based on clinical observations and a recent cross-sectional study indicating that several patients develop associated MSCs in the upper-limb and neck after an

Table 5
Distribution of the allocation matrix, based on SFMA.

	a) Elbow	b) Shoulder	c) Neck	Total (characteristic, n (%))
1) Mobility dysfunction	3	5	11	19 (7)
2) Stability/motor control dysfunction	12	74[d]	46	132 (49)
3) Pain	26	61[f]	29	116 (43)
Total (location, n (%))	41 (15)	140 (52)	86 (32)	

[d] Including 34 cases related to shoulder girdle and/or thorax.
[f] Including 19 cases related to shoulder girdle and/or thorax.

Table 6
Changes in outcome over time.

	Mean (SD)[#] or Median (IQR)[§]			Difference (95% CI)	
Outcome	Baseline n = 66	Post-management n=59	3-month follow-up, n = 45	Baseline to post-management	Baseline to 3- month follow-up
DASH[#]					
ADL	46.3 (17.7)	29.8 (17.6)[c]	24.7 (19.7)[c]	16.93 (13–21)	21.59 (16.2–27)
Work	67.7 (30.4)	35.4 (28.3)[c]	31.7 (32.5)[c]	28.6 (20.4–36.8)	34.6 (21.7–47.5)
Sports/Arts	72.9 (27.1)	43.4 (29.9)[c]	47.5 (28.9)[c]	23.4 (13.2–33.7)	26.3 (11.5–41.5)
PCS Total[#]	13.8 (11.6)	9.2 (10.2)[c]	8.6 (10.9)[c]	6.4 (4.3–8.5)	5.8 (2.8–8.9)
HADS[#]					
Anxiety	6.3 (3.8)	5.1 (3.9)[c]	4.6 (4.8)[c]	1.2 (.04–1.9)	1.7 (0.5–2.9)
Depression	5.2 (3.9)	3.9 (3.8)[c]	3.3 (3.8)[c]	1.3 (0.44–2.1)	1.7 (0.7–2.7)
Total	11.5 (7.2)	9.0 (7.3)[c]	7.9 (8.2)[c]	2.4 (1–3.9)	3.4 (1.5–5.3)
EQ-5D[#]					
Index	0.73 (0.06)	0.78 (0.1)[c]	0.82 (0.1)[c]	.051 (.031–.71)	.08 (.05–.11)
VAS	64 (19)	74 (18)[c]	77.5 (17)[c]	8.9 (4.6–13.2)	10.9 (6.7–15.1)
Worst pain last week [§a]					
Hand	6 (4–8)	5 (2.5–7)[c]	3 (1–6)[c]	1.5 (0.5–2.5)	2.5 (1.5–3)
Elbow	3 (0–6)	0 (0–3)[c]	0 (0–4)[c]	1.5 (0.5–2)	2 (1–3)
Shoulder	5 (2–7)	2.5 (0–5)[c]	2 (0–5)[c]	1.5 (0.75–2.25)	2 (1–3)
Neck	3 (0–6)	2 (0–3)[c]	1 (0–3.5)[c]	1.25 (0.5–2.0)	1 (0–2)
Pain frequency[b]					
Hand	58 (88%)	45 (76%)	26 (58%)[c]	12% (6%–24%)	29% (11%–44%)
Elbow	34 (52%)	15 (25%)[c]	8 (18%)[c]	27% (14%–38%)	38% (20%–52%)
Shoulder	41 (62%)	22 (37%)[c]	17 (38%)[c]	25% (12%–37%)	29% (10%–45%)
Neck	33 (50%)	16 (27%)[c]	6 (13%)[c]	24% (8%–38%)	29% (14%–42%)

DASH: Disabilities of the Arm, Shoulder and Hand; *ADL*: activities of daily living; *PCS*: Pain Catastrophizing Scale; *HADS*: Hospital Anxiety and Depression Scale; *EQ-5D*: EuroQol questionnaire; *VAS*: visual analog scale.
[a] NRS (0–10).
[b] n (%) of patients with constant and daily pain.
[c] significant change from baseline, $p < 0.05$.
[#] Values presented as mean (SD).
[§] Values presented as median (IQR).

Table 7
Outcomes in patients with low and high disability level. (Based on median cut-off of 16 points DASH ADL at 3-month follow-up).

Outcome	Mean (SD)[#] or Median (IQR)[§]			
	Low disability	High disability	Low disability	High disability
	Baseline n = 23	Baseline n = 22	3-month follow-up n = 23	3-month follow-up n = 22
Age [years][#]	51 (15)	54 (15)		
Gender [% women]	65%	73%		
BMI[§]	24.5 (23–26)	26 (22–29)		
Treatment [% operated]	74%	82%		
DASH[#]				
ADL	37.3 (17.8)	55.7 (15.2)	10.3 (5.4)	39.7 (17.6)
Work	48.8 (28.1)	83.2 (22.8)	12.5 (15.2)	58.2 (31.6)
Sports/Arts	59.1 (28.7)	76.9 (27.5)	31.3 (10.2)	61.7 (33)
DASH MCID [n]			19	17
PCS Total[#]	13 (9.2)	16 (11.5)	3.4 (3.8)	14.1 (13.1)
PCS cut-off [n]	6	8	0	6
HADS[#]				
Anxiety	5.3 (3.2)	7.1 (4.1)	2.5 (2.5)	6.9 (5.7)
Depression	3.3 (3.3)	6 (4.1)	1.4 (1.9)	5.3 (4.4)
Total	9 (6.2)	13.1 (7.8)	3.9 (3.9)	12.2 (9.5)
HADS cut-off [n]	10	23	1	12
EQ-5D[#]				
Index	0.76 (0.05)	0.71 (0.05)	0.88 (0.1)	0.75 (0.07)
VAS	75 (12)	58 (17)	88 (8.5)	66 (16)
Worst pain last week[§,a]				
Hand	5 (3.5–6.5)	7.5 (5–8)	2 (0.5–3)	5 (3–7)
Elbow	1.5 (0–4)	5.5 (2.5–7)	0 (0–0)	3 (0–5)
Shoulder	4 (3–6)	5 (1–8)	0 (0–1.5)	4 (2–5)
Neck	2 (0–4)	4 (0–6)	0 (0–1)	3.5 (0–6)
Pain frequency[b]				
Hand	18 (78%)	21 (95%)	10 (43%)	16 (73%)
Elbow	11 (48%)	14 (64%)	1 (4%)	7 (32%)
Shoulder	15 (65%)	15 (68%)	5 (22%)	12 (54.5%)
Neck	7 (30%)	12 (54.5%)	1 (4%)	5 (23%)

BMI: body mass index; *DASH:* Disabilities of the Arm, Shoulder and Hand; *ADL*: activities of daily living; *MCID*: minimum clinically important difference; *PCS*: Pain Catastrophizing Scale; *HADS*: Hospital Anxiety and Depression Scale; *EQ-5D*: EuroQol questionnaire; *VAS*: visual analog scale.
[a] NRS (0–10).
[b] n (%) of patients with constant and daily pain.
[#] Values presented as mean (SD).
[§] Values presented as median (IQR).

isolated hand/forearm injury or condition [8]. These results emphasized the need for specific intervention for the large group of patients presenting with concurrent upper-limb and neck MSCs following an isolated hand/forearm complaint. In the current study, we developed and implemented an add-on management strategy in addition to the standard treatment of the primary hand/forearm complaint, targeting early detection and treatment of the concurrent MSCs. Additional pain sites and dysfunctions proximally in the upper-limb and neck are typically not addressed in clinical practice, where the focus is on the patient's pathoanatomic condition in the hand and forearm. The present high levels of satisfaction and significant improvement in function and pain suggest that this type of management strategy improves overall recovery in this large patient group.

Despite the significant improvements in function and pain, approximately a quarter of patients-reported constant and daily pain in the elbow and neck, and more than one-third in the shoulder, after the add-on. Our results indicate that recovery may be longer following an isolated hand/forearm complaint in some patients.

There is a need to further optimize the type, dose, and delivery of the add-on, to achieve better outcome.

Multiple musculoskeletal pain sites lead to later recovery and greater healthcare use and cost [26,27]. Most patients in the current study (83%) reported concurrent MSCs in more than one location in the upper-limb and neck: 41/66 in the neck, 42/66 in the elbow, and 56/66 in the shoulder. Eighty-five percent developed concurrent MSCs gradually following the primary hand injury/pathology, suggesting non-traumatic etiology. These results indicate the need for further evidence-based management strategies, including the upper-limb and neck, in the assessment and treatment of patients presenting with an isolated hand/forearm complaint. The number of concurrent complaint sites and high pain levels these patients experienced over and above the primary complaint had a detrimental effect on daily living, work, and sports/art activities, as illustrated by DASH scores. A rehabilitation program focusing exclusively on pathoanatomic conditions in the hand and forearm may delay recovery. In case of hand/forearm complaints, patients may benefit from routine screening for concurrent MSCs and immediate management, perhaps early after onset of the primary complaint, to limit the progression toward additional pain sites. However, further research is needed to investigate the effectiveness of rehabilitation programs targeting concurrent upper-limb and neck MSCs following an isolated hand/forearm complaint.

4.2. Comparison with previous studies

At present, little is known about how to manage concurrent MSCs in patients presenting with concurrent upper-limb and neck MSCs following an isolated hand/forearm complaint. Most studies of isolated hand/forearm complaints investigate the effect of primary interventions and report outcomes related solely to the hand/forearm [9–12]. As a result, the comparison of results between the present study and the literature is limited. The only study addressing this important area investigated the effectiveness of adding a specific scapular exercise program to standard treatment in patients over 60 years of age after conservatively

treated distal radius fracture [28]. The study showed significant improvement in arm function (DASH) and pain relief with movement in the intervention group. However, comparison with the present study is difficult, as the authors did not specifically include patients with associated symptoms related to elbow, shoulder, and neck, indicating different patient populations.

Prognosis after upper-limb and neck complaints was investigated in several studies [29–31]. Psychosocial characteristics of baseline somatization, kinesiophobia, and catastrophizing were associated with poor prognosis [29,30]. Widespread complaints, complaints lasting more than three months, high severity or pain intensity, history of trauma, poor general health, and baseline musculoskeletal comorbidity were associated with a severe disability during two years' follow-up of patients with a new forearm, neck, and/or shoulder complaint [31]. We found similar results: greater disability, pain, and psychological distress at baseline were associated with poorer outcomes at 3 months. However, the relatively large number of patients who improved beyond the minimal clinically important difference on DASH in both low and high disability groups (19 and 17 patients, respectively) suggests a potential for moderate to large improvement, irrespective of baseline severity. This is important information for both clinicians and patients and can be used in discussing prognosis.

4.3. Limitations and future research

Due to the pragmatic design of this study without control group, the specific treatment effects could not be disentangled from the natural course of the patients' conditions. However, the significant and clinically relevant improvements in patient-reported outcomes and satisfaction suggest a benefit of the intervention. We used the SFMA to guide treatment focus. It is unclear whether other approaches, such as more detailed biomechanical testing, would have changed the focus of the management program for individual patients. Future research should consider how this patient population should be examined and how treatment could be prioritized.

5. Conclusion

Patients with concurrent MSCs in the elbow, shoulder, and neck developing after an isolated hand/forearm complaint may benefit from an add-on patient-centered management strategy targeting pain and functional deficits in the upper-limb and neck. Future research should investigate how to optimize this add-on and test the effectiveness of this strategy compared with usual care focusing solely on the primary hand/forearm complaint.

Disclosure of interest

The authors declare that they have no known competing financial or personal relationships that could be viewed as influencing the work reported in this paper.

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Human and animal rights

The authors declare that the study was carried out in accordance with the Declaration of Helsinki of the World Medical Association revised in 2013 for experiments involving humans.

Informed consent and patient details

The authors declare that they obtained written informed consent from the patients included in the study and that this report does not contain any personal information that could lead to their identification.

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