A pragmatic regional interdependence approach to primary frozen shoulder: a retrospective case series*

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ABSTRACT

Objectives: Although the shoulder is known to move together with the scapula and other upper quarter joints, the current frozen shoulder clinical practice guidelines describe only physical therapy study treatments directed to the shoulder. None received a strong recommendation, highlighting the need for alternate interventions. This retrospective case series describes a pragmatic regional interdependence approach to frozen shoulder with impairment and functional outcomes, noting whether final ROM approached normal.

Methods: Five consecutive patients referred with frozen shoulder diagnoses attended 11–21 sessions over 5–10 weeks with one physical therapist. Treatment addressed inter-related regions (shoulder, shoulder girdle, scapulothoracic/humerothoracic, and spine) following a pragmatic approach using impairment-based interventions (joint/soft tissue mobilization, muscle stretching/strengthening) as well as patient education, modalities and warm up that addressed individual presentations.

Results: All patients improved on all outcomes. Mean shoulder ROM at discharge, the impairment outcome, demonstrated large effect size increases: flexion (117 ± 10 – 179 ± 12 , $d = 5.9$), abduction (74 ± 8 – 175 ± 9 , $d = 9.3$), external rotation (23 ± 7 – 89 ± 2 , $d = 12.0$). The Disability of Arm Shoulder Hand functional outcome score upon follow up demonstrated a large effect size improvement ($d = 1.5$) from 40.0 ± 19.4 – 6.2 ± 3.7 . Final ROM approached normal.

Discussion: This case series utilized a regional interdependence approach to frozen shoulder that included manual therapy interventions directed to consistent upper quarter body segments. Shoulder ROM was returned to near normal with functional improvements evident months after discharge. A pragmatic regional interdependence approach addressing multiple joints related to shoulder function may benefit other people with frozen shoulder.

Level of Evidence: 4

KEYWORDS

Frozen shoulder; adhesive capsulitis; upper extremity; vertebrae; manipulation; mobilization with movement; strain counterstrain; soft tissue therapy; case report; shoulder; regional interdependence

Introduction

Frozen shoulder is a primarily clinical diagnosis characterized by restricted and painful shoulder range of motion (ROM) of insidious or traumatic origin [1]. A large prospective epidemiological study found frozen shoulder affects 1% of the general population, with women 40–60 years old most commonly affected [2]. Although theorized to progress through phases to full recovery of ROM and function without treatment, a recent systematic review found no objective longitudinal evidence to support this theory; in fact, strong contemporary evidence exists to the contrary [3]. The prevailing theory of recovery phases leading to full recovery without treatment is perpetuated in secondary references such as article introductions, texts, and reviews; and tertiary references such as internet health sites [3]. Continued misrepresentation of the prognosis for frozen shoulders

may inhibit patients from seeking care, physicians from recommending rehabilitation, and physical therapists from innovating effective evaluation and treatment methods [3].

The first to describe the stiff and painful shoulder condition characteristic of frozen shoulders was Duplay in 1872 who referred to the condition sometimes resulting from trauma as ‘periathritis’ [4]. In a case series investigating ‘periathritis,’ Codman noted rotator cuff muscle degenerative changes with inflammation and bursal adhesions and coined the term ‘frozen shoulder’ in 1934 [5]. Codman hypothesized that the adhesions could be reabsorbed over time, though such occurrence has not been documented. In a 1945 series of postmortem shoulder dissections, Neviaser found that surgical release of the adhered capsule could restore full motion to the shoulder leading to the term ‘adhesive capsulitis’ [6].

The ‘natural history’ theory of phased progression to full recovery without treatment for frozen shoulder was propelled by three single-author, low quality papers. Simmonds’ 1949 clinical review theorized a natural history without supporting data or analysis [7]. In what has become the most cited frozen shoulder reference since publication in 1975 (301 citations through June 2017), Reeves’ observational cohort retrospectively codified the commonly referred to progression through painful, stiff, and recovery phases after the patients: (1) presented with painful shoulders and were immobilized in slings for up to nine months—sometimes during hospitalization, (2) had shoulder stiffness after the slings were removed, and (3) gradually recovered ROM after allowed to move their shoulders [8]. Subsequently, Grey reported complete and spontaneous recovery from frozen shoulder at two-years follow-up in a one-page brief report that presented no methods, data, or analysis [9].

The natural history theory of frozen shoulder, based mostly on expert opinions and very low-quality studies, was questioned since first described [7]. A recent systematic review identified no support for the existence of phased recovery leading to full recovery [3]. All studies reporting objective longitudinal data during no-treatment conditions reported limited ROM gains of roughly 60–80% after 1 year [10–12]. One retrospective study with no longitudinal data reported long-term follow-up for patients not receiving treatment for frozen shoulder [13]. While the authors concluded that in most cases the condition resolved to normal levels without treatment, selection bias was apparent because the analysis did not account for the 67% of subjects who chose to receive care for their frozen shoulders [13]. Patients who selected conservative care, manipulation under anesthesia, or surgery likely had more severe cases. Applying intent-to-treat principles to the reported data [13], the percentage of people recovering fully without treatment would be 6.5%.

While most patients demonstrate improved function, motion restrictions persist after an average 30–44 months follow-up [8,14]. It is worth noting that the follow-up time reflects the length of research not duration of shoulder stiffness, which worsened when assessed after 19–30 years follow-up [13]. No studies reported a reliably measured return to full ROM [15,16]. For instance, active ROM measured in standing, or compared contralaterally [8,13,14], allows movement compensations and performance variations. Understanding that the common assumption of full recovery without treatment for frozen shoulders is unfounded may prompt patients to seek treatment rather than wait for an uncertain resolution that may not occur even after multiple years.

Current frozen shoulder treatment approaches include surgical release, manipulation under anesthesia, corticosteroid injection, and physical therapy [17].

Of the conservative treatments summarized in the frozen shoulder clinical practice guidelines (CPG), only injections received a Grade A recommendation based on the strong level of evidence, though outcomes after injections demonstrated inconsistent results [17]. Inconsistent outcomes were also reported for physical therapy treatments for which support was weak to moderate, including patient education (Grade B), modalities (Grade C), joint mobilizations (Grade C), and stretching (Grade B) [17]. Notably, the current CPG only identified treatments aimed at the glenohumeral joint [17].

Regional interdependence is a model of musculoskeletal examination and intervention emphasizing relationships between anatomical regions [18]. Relationships among regions of the lower kinetic chain including the hip and pelvis as well as the ankle and foot are known to be involved in dynamic knee valgus, for instance [19], leading to various treatments for related conditions such as patellofemoral pain syndrome that include foot orthotics and hip strengthening [20]. Similarly relevant anatomic connections exist among upper kinetic chain segments including spine, scapulothoracic, shoulder girdle, and shoulder joints [21,22]. A regional interdependence approach to treatment is based on the concept that resolving impairments in inter-related segments may yield benefits for the symptomatic area. Pragmatic application of a treatment approach is person-centered in that treatment choices are determined by individual patient presentation. A pragmatic application of a regional interdependence approach to treatment for frozen shoulder has not been studied.

The purpose of this case series was to describe the application and outcomes for shoulder ROM impairment and functional limitation measured with the Disability of the Arm Shoulder and Hand (DASH) of a pragmatic regional interdependence approach for people with the frozen shoulder condition. The secondary purpose was to determine whether final ROM outcomes approached established norms.

Methods

This case series was a retrospective review and analysis of pre-existing de-identified data obtained from an external clinic. The case series was conducted in accordance with the protocol approved by the participating university medical center Institutional Review Board, which required signed informed consent for all patients upon discharge to use their de-identified records and follow up data. The treating clinician was a licensed physical therapist with >20 years of experience, certified as an orthopedic specialist by the American Board of Physical Therapy Specialists for >15 years. Case data were extracted and synthesized by 5 doctor of physical therapy student reviewers.

Patients

All patients were sequentially referred by physicians with a frozen shoulder or adhesive capsulitis diagnosis, without specific precipitating injury or other identified concurrent shoulder or cervical pathology, and assigned to one physical therapist in a private outpatient physical therapy practice from March 2014 to March 2015. Diagnosis was confirmed as primary frozen shoulder upon initial physical examination, as per the CPG diagnostic criteria, including gradual and insidious onset, pain at end range [17], and both active and passive ROM in all directions were restricted with less than 50% of shoulder external rotation motion apparent [23]. All referred patients were included for document review. The five patients ranged in age from 40 to 66 years (50.2 ± 9.8) and had reported worsening shoulder pain and stiffness without associated trauma for 2–30 weeks (14.2 ± 9.3) prior to seeking medical consultation, although all recalled otherwise innocuous minor trauma when questioned (Table 1). No patient received prior or concurrent care for the shoulder, including analgesic or steroidal injection. Patients were seen for 11–21 sessions (14.8 ± 3.4) over up to 10 weeks (7.6 ± 1.7).

Examination

The chief complaints were limited shoulder ROM, with external–internal rotation measured in 90 degrees abduction, and pain noted at end range limiting daily functions and restricting participation in activities of daily life, such as dressing, grooming, child care, and leisure activities (Table 1). The unaffected shoulder had normal ROM in all directions [15,16]. Limitations in functional ability were documented using the DASH patient-reported questionnaire (Table 2) [24].

Screening identified no red flags (cardiac, neurologic, psychological, cognitive): vitals were in the normal range, without neurological signs, integument break down, or systemic joint hypermobility. Cervical screening identified limited cervical ROM without sign of cervical pathology such as myelopathy and radiculopathy. Shoulder assessment revealed weakness without pain upon resistance suggesting rotator cuff tear was not the primary pathology. Limited passive ROM in supine, with rotation

measured in available abduction until 90 degrees abduction was achieved, was consistent with active motion limitations (Table 2); glenohumeral joint hypomobility and related soft tissue tightness were consistent with shoulder capsular tightness and the medical diagnosis of frozen shoulder/adhesive capsulitis.

Long-term goals were to restore full ROM to the affected shoulder to facilitate pain free return to prior functional level in the patients' activities of daily living, including personal care, home/family, work, and leisure/sport activities (Table 2).

Plan of care

The person-centered plan of care was a pragmatic application of a regional interdependence approach to shoulder dysfunction recognizing that glenohumeral function depends on scapular function [21], which in turn can be influenced by other upper kinetic chain segments depending on individual patient presentation. Retrospective analysis of the pre-existing data revealed a loosely sequential design of the plan of care with the following components addressed: (a) patient education to break preconceived assumptions of frozen shoulder and provide a home exercise program, (b) treatment of the upper kinetic chain using manual therapy and stretching exercise, followed by (c) strengthening, neuromuscular reeducation, and functional training by the end of the episode. Thus, identified movement limitations in all inter-related upper quarter regions were treated. Specific treatment techniques selected from a consistent set of options were applied as indicated by related impairments based on patient presentation and preference, and the treating physical therapist's clinical judgment. Treatment region and treatment type were categorized by consensus discussion among investigators and described below after patient education.

Patient education regarding the diagnosis, prognosis, and plan-of-care was the starting point for all patients. Misinformation common in health websites, textbooks, and primary literature related to the unsupported natural history of frozen shoulder theory and its prognosis without care [3] was discussed. Because rehabilitation for frozen shoulder can be painful, an emphasis was

Table 1. Description of patients.

Patient	Age (y)	Sex	Affected/Dominant arm	Symptom duration before diagnosis (wk)	Goals
1	46	F	L/R	9	Commute by car; lift, carry, and raise arm overhead for ADLs without pain
2	42	M	R/R	13	Return to leisure sports (basketball, swimming) without pain/limitation
3	57	M	R/R	2	Perform dressing, grooming, and overhead reaching without pain
4	66	F	R/R	30	Perform behind back (fasten bra) and overhead ADLs (hair) without pain
5	40	M	R/R	17	Return to full child care functions as father, overhead and behind back ADLs
Mean	50.2	–	–	14.2	–

Abbreviations: ADLs = activities of daily living, F = female, M = male, L = left, R = right, PT = physical therapy, wk = weeks, y = years.

Table 2. Patient initial evaluation findings.

Patient	Pain with activity	PROM F (deg)	PROM AB (deg)	PROM ER (deg)	PROM IR (deg)	MMT F	MMT AB	MMT ER	MMT IR	DASH (score)
1	NR	110	70	20	20	3+/5	3+/5	3+/5	4-/5	60.8
2	6/10	130	85	15	70	3+/5	3+/5	3+/5	4-/5	36.4
3	3/10	110	80	30	30	3-/5	3-/5	3/5	3+/5	14.2
4	NR	110	70	20	30	3/5	3-/5	3-/5	4-/5	58
5	7/10	125	65	30	70	3+/5	3+/5	5/5	4+/5	32
Mean $\pm$ SD	–	117 $\pm$ 10	74 $\pm$ 8	23 $\pm$ 7	44 $\pm$ 24	–	–	–	–	40.3 $\pm$ 13.4

Abbreviations: AB = abduction, deg = degrees, ER = external rotation in available abduction, F = flexion, IR = internal rotation in available abduction, MMT = manual muscle test, NR = not reported, PROM = passive range of motion, SD = standard deviation.

achieving patient understanding that without care the likely prognosis was years of lingering limitations [11,12,14]. In order to gain ROM as quickly as possible, a goal of 10 degrees per direction per session was set with the motivational concept that extra ROM could be banked and counted toward the expected progress for any future session in the event of a difficult day with slow progress. A home exercise program consisting of stretching exercises was provided after the stretches were introduced.

Four regions within the upper quarter were defined: (1) shoulder girdle (sternoclavicular joint, acromioclavicular joint, first rib via its ligamentous and muscular connection to the clavicle), (2) shoulder joint (glenohumeral joint, rotator cuff muscles), (3) scapulothoracic and humerothoracic muscles (pectoralis major, pectoralis minor, latissimus dorsi, serratus anterior), and (4) spine (cervical, thoracic, and costovertebral/costotransverse joints). Manual therapy to all four regions have improved shoulder ROM or function: At the shoulder joint, for instance, grade III–IV posterior mobilization increased shoulder external rotation ROM for people with frozen shoulder and significantly reduced self-reported pain [25]. Manual therapy for the shoulder girdle joints have improved shoulder function [21,26], and has been suggested for the first rib to improve shoulder function [27]. The scapulothoracic joint can be affected through joint mobilization [21] and pectoralis minor muscle soft tissue mobilization [28]. Finally, manual therapy for the cervical and thoracic spine have increased shoulder ROM, decreased pain [29,30], and increased strength [31].

Treatment types summarized in the CPG, including patient education and moist heat for warm up or pain relief, were used as a starting point to categorize treatment types [17], such as joint mobilization and stretching as described below.

Joint mobilization forms included grade III–IV joint mobilizations, high velocity low amplitude thrust (HVLAT), mobilization with movement (MWM); and osteopathic manipulation techniques including muscle energy (MET) and strain counterstrain (SCS). Mobilization techniques utilized in this case series included Grade III glenohumeral joint mobilizations [32] and HVLAT for thoracic spine and costovertebral/costotransverse hypomobility, methods shown to decrease pain and increase shoulder motion in multiple planes [30,33].

MWM combines joint mobilization with active movement to decrease pain and restore limited motion [34]. Although no studies document effective use of MWM applied to regions other than the glenohumeral joint for patients with frozen shoulder, MWM to related-regions can impact shoulder ROM and function [35]. MWM for shoulder girdle, glenohumeral, and cervical joints were utilized in this case series. MET is an active technique, in that the patient supplies the corrective muscular force in a controlled direction to lengthen muscles and mobilize restricted articulations [36]. Although no studies document MET use for frozen shoulder, cervicothoracic and shoulder girdle region MET was utilized in this case series because MET has been effective in treating posterior shoulder tightness [37], upper rib dysfunction [33], and limited cervical motion [38]. SCS is an indirect manual manipulation to reduce local pain and musculoskeletal dysfunction by passively positioning body segments so that affected joints or soft tissues are shortened and relieved [26,39]. No studies document SCS use for frozen shoulder, although shoulder girdle and cervicothoracic region SCS has been suggested and thus utilized in this case series to decrease shoulder pain and dysfunction, and increase neck and shoulder ROM [26].

While not included in the CPG, various soft tissue mobilization techniques have improved shoulder ROM and function including friction massage to the shoulder capsule and rotator cuff muscles [40]; and sustained pressure or perpendicular strumming of the pectoralis minor [28], rotator cuff muscles in the axilla [41,42], and the pectoralis major, latissimus dorsi, teres major, and trapezius muscles. Soft tissue mobilization in this case series was applied perpendicular to muscle fibers concurrent with passive or active patient movement in the glenohumeral and scapulothoracic regions. Stretching followed using passive, actively assisted, and active methods; with a home exercise program of stretches given to all patients.

Although not included in the CPG either, neuromuscular reeducation, strengthening and functional training were added to help maintain the recovered ROM. Neuromuscular reeducation included retraining active functional movement in newly regained ranges. Strengthening followed a progression of exercises including: (1) isometrics in the newly established end ranges, (2) isotonic exercises for specific shoulder

Table 3. Summary of the physical therapy care: treatment types.

Treatment type	Patient A	Patient B	Patient C	Patient D	Patient E
Patient education	✓	✓	✓	✓	✓
Modalities	✓	✓	✓	✓	✓
Aerobic warm up	✓	✓	✓	✓	✓
Joint mobilization					
Grade III-IV	✓	✓	✓	✓	✓
MWM	✓	✓	✓	✓	✓
MET	✓	✓	✓	✓	✓
HVLAT	✓	✓	✓	○	✓
SCS	○	✓	✓	✓	✓
Soft tissue mobilization					
Rotator cuff in axilla	✓	✓	✓	✓	✓
Pectoralis minor	✓	✓	✓	✓	✓
Pectoralis major	✓	○	✓	✓	○
Latissimus dorsi	○	✓	✓	✓	✓
Teres major	✓	○	○	✓	✓
Deltoids	○	○	○	✓	○
Exercise					
Stretching	✓	✓	✓	✓	✓
Strengthening	✓	✓	✓	✓	✓
Function	✓	✓	✓	✓	✓
Neuromuscular reeducation	✓	✓	✓	✓	✓

Abbreviations: ✓ = done, ○ = not done, HVLAT = high velocity low amplitude thrust, MET = muscle energy, MWM = mobilization with movement, SCS = strain counterstrain.

motions performed against resistance and exercises such as military press, (3) scapula stabilization exercises, such as different types of planks and sustained overhead positioning to perform therapeutic tasks, (4) isokinetic activities such as throwing, and (5) plyometric exercises such as catching weighted balls. Resisted strengthening exercise in the newly gained ROM is important to advance and maintain functional shoulder use [43]. Functional training included hair, hygiene, and dressing activities of daily living that involved reaching behind the back and over the head.

In summary, although the order and number of treatments to the various regions using the planned treatment types varied by case, all regions were addressed for all patients using all treatment types (Table 3). Variation existed among patients with regard to specific muscles treated with soft tissue mobilization and form of joint mobilization applied, as determined by the pragmatic clinical judgment of the physical therapist to address individual movement impairments.

Outcome Analysis

The primary outcomes were (1) passive ROM at discharge compared to the 4–7 degree standard error of measurement (SEM) and 11–16 degree minimal clinically important difference (MCID) for shoulder ROM [16], and (2) self-reported functional outcome on the DASH obtained at follow up ≥ 12 weeks after discharge compared to the reported 4.6 SEM and 10.8 MCID and minimal detectable change [44]. When the direction of change was the same for all patients, group means were reported. Effect size changes (Cohen's d) were calculated with 95% confidence intervals to describe the magnitude of group

change [45]. The secondary outcome was to compare the final ROM outcomes to established norms for people with and without shoulder pathology [15,16].

Results

The primary outcomes were improved shoulder passive ROM and functional ability measured with the DASH. At discharge, passive ROM for each patient improved beyond the SEM and MCID, with group increases in flexion ($62 \text{ degrees} \pm 11$), abduction ($101 \text{ degrees} \pm 11$), and external rotation ($66 \text{ degrees} \pm 7$) (Table 4). Increased passive ROM demonstrated large effect sizes at discharge for shoulder flexion ($d = 5.7$, CI95%: 2.9–8.5), abduction ($d = 11.9$, CI95%: 6.6–17.3), and external rotation ($d = 13.2$, CI95%: 7.3–19.0) (Figure 1) after mean 14.8 sessions in the average 7.6-week treatment window (Table 4). Disability level on the DASH decreased for all patients with four of five having improvements beyond the SEM and MCID. Functional improvement on the post-discharge DASH at 32.4 ± 16.3 weeks follow-up also reflected a large effect size ($d = 2.4$, CI95%: 0.9–4.1) (Figure 2).

Secondary outcomes included final passive ROM for all patients that approached normal values. Shoulder flexion, abduction, and external rotation passive ROM at discharge for all patients approached established normal values and exceeded passive ROM documented in people with shoulder pathologies. Improvement appeared to follow a pattern of faster ROM improvement in the first half dozen sessions followed by slower improvement and an eventual plateau later in the episode of care (Figure 1). While patients did not return for follow up ROM reassessments, the positive functional outcomes on the DASH at 13–56 weeks after discharge suggest lasting treatment benefits.

Table 4. Outcomes for passive range of motion (PROM) and shoulder disability (DASH).

Patient	PROM F (deg)	PROM AB (deg)	PROM ER (deg)	DASH (score)	Treatment (visits)	Treatment duration (wk)	Follow up post-discharge (wk)
1	180	180	90	0.8	14	10	25
2	180	180	90	8.3	21	7.5	56
3	180	175	90	10.8	11	5.5	21
4	160	160	85	5.0	13	6	47
5	193	180	90	6.0	15	9	13
Mean $\pm$ SD	179 $\pm$ 12	175 $\pm$ 9	89 $\pm$ 2	6.2 $\pm$ 3.7	14.8 $\pm$ 3.4	7.6 $\pm$ 1.7	32.4 $\pm$ 18.2

Abbreviations: AB = abduction, deg = degrees, ER = external rotation in 90 degrees abduction, F = flexion, PROM = passive range of motion, SD = standard deviation, wk = weeks.

Figure 1. Mean passive range of motion with error bars for shoulder flexion, abduction, and external rotation suggests improvement occurs early and slows with time.

Figure 2. Individual disability of arm shoulder hand (DASH) scores (mean with standard deviation in black). Note: Zero signifies no disability.

Discussion

The current CPG summarized the frozen shoulder treatments studied to date, all of which have focused exclusively on the shoulder joint [17]. This retrospective case series of de-identified data introduced a pragmatic regional interdependence approach to frozen shoulder that directed treatment toward related upper quarter joint segments that can affect shoulder ROM. The outcomes included restoration of normal shoulder passive ROM within 10 weeks and functional improvements maintained months after discharge. The magnitude and pattern of improved ROM in this case series may challenge common perception of the course of frozen shoulder rehabilitation [3].

The final passive ROM outcomes after a mean of 7.6 weeks (Figure 1) exceeded outcomes reported in frozen shoulder intervention studies, which report persistent impairment [10–12] particularly in external rotation for which less than 60 degrees is common after 2 years [3,10]. Future comparison studies are warranted to determine whether such results are achievable in a controlled trial. The pattern of a faster pace of ROM improvement in the first half dozen sessions was consistent with results for both intervention and no-treatment comparison groups from multiple randomized control trials [10–12], but stands in contrast with the longstanding though unsupported theory of initial stiffness progressing to thawing and full recovery [3]. Increases in ROM after manual therapy may result from disruption of capsular thickening [46,47] and adhesions [48] identified arthroscopically in contemporary frozen shoulder studies. The slower rate of increased ROM toward the end of care when treatment focused on the glenohumeral joint may

be attributed to progressive capsular stretching required for tissue plasticity to produce lasting change.

Functional improvements measured months after discharge in these five cases were consistent with findings for people with frozen shoulder whether they received intervention or not [10–12]. People with stiff shoulders may adapt and compensate for limited shoulder motion to manage their activities of daily living. In this case series, however, functional improvement coincided with restoration of normal motion. Because follow up ROM measurements were not obtained, it remains unknown whether the functional improvements documented months after discharge were related to shoulder motion improvements.

The regional interdependence approach to frozen shoulder treatment in this case series differed from the studies included in the CPG, which only listed treatments directed at the shoulder joint. To visually analyze the impact of the approach for each patient, treatment regions were plotted graphically with shoulder passive ROM (Figure 3). Early improvements in passive ROM, for instance, appeared to parallel treatment to regions other than the glenohumeral joint, suggesting that multiple upper quarter joint segments may yield passive shoulder ROM improvements (Figure 3). Passive ROM improvement after thoracic spine, scapulothoracic, and shoulder girdle region treatments in this case series was consistent with results from past studies and may be unsurprising, given that glenohumeral ROM is dependent on humeral and scapular motion and position, with the scapula in turn affected by thoracic spine and rib position [18,21]. Thoracic spine and rib HVLATs have increased shoulder ROM with a corresponding 51% reduction in shoulder

Figure 3. Progression of care with respect to treatment region with improvements in shoulder range of motion for Patient 2, provided as an example because their functional outcome paralleled mean improvement (see Figure 2).

pain [31]. The scapular posterior tilting required for arm elevation but known to be reduced in people with shoulder pathology [21], may be restricted by pectoralis minor tightness that can be reduced with soft tissue mobilization [28]. Although acromioclavicular and sternoclavicular joint mobility are difficult to measure, the clavicular mobility required for normal shoulder elevation is limited in people with shoulder pathology [21] and improved by joint mobilization [49].

The manual treatment approaches were pragmatically applied based on patient presentation and clinician judgment at each of these regions including various joint mobilizations including MWM, SCS, MET, and HVLAT techniques, and soft tissue mobilizations. No conclusions regarding any specific benefit of these treatment techniques can be drawn, as this was not a controlled study to test the efficacy of any specific treatment. Rather, none of these techniques resulted in any adverse effect for the five people in this case series, suggesting that the approach may be safely applied in similar cases of frozen shoulder.

Further Research: A pragmatic treatment approach has strengths and weaknesses. In a controlled study, all patients receive the same treatments regardless of the need for any specific treatment. Patients for whom the treatment is indicated could be expected to improve; while those that received the treatment when not indicated, can be anticipated to not improve. Thus, the mean outcomes reported in clinical trials may not reflect particular treatment effectiveness since all patients may not have had the same discrete limitations regardless of the same included pathology. A pragmatic approach provides specific treatment options within a protocol to match specific limitations identified upon examination, allowing the research to be tested under conditions that better mimic real-world clinical practice [50]. Pragmatic methodologies have gained popularity in clinical physical therapy research [51–53] and could be operationalized by establishing inclusion and exclusion criteria for specific limitations, such as specifying that joint mobilization be performed for specific joints when found hypomobile, and sequencing regions to be treated based on clearing of each region's limitations. Research into the potential effects of a pragmatic regional interdependence approach to frozen shoulder similar to that used in this case series is warranted.

Limitations: As with all case studies, no cause and effect can be determined; the specific contribution of any region or treatment cannot be assessed, and results cannot be generalized to other cases. Interpretation of the results should take into account the study procedure and design: (1) frozen shoulder and adhesive capsulitis is primarily a clinical diagnosis acknowledged to be variable [23]. While adhesive capsulitis can be arthroscopically determined [48], this diagnostic process is not typical before referral to physical therapy [17,23]. This case series assumes that the referring physicians'

diagnoses, confirmed by the physical therapist's findings, were accurate. Past minor injury drawn out in the history, although not attributed as a precipitating injury, could indicate an initial mechanical origin. (2) This retrospective case series analyzed existing data and could not provide information about the physical therapist's clinical decision-making process, nor allow for subsequent collection of missing data. Future prospective and controlled studies are needed to determine treatment efficacy. Although the small number of patients was a limitation, all patients from the given year were sequentially recruited with none excluded. (3) The pragmatic approach meant that each patient received different treatments over different durations, though all received similar treatment to the same regions. (4) Assessment was conducted by one clinician, which could increase inter-rater reliability, but also increase bias. Some outcome measures, such as pain, internal rotation and cervical ROM, and follow-up timing were inconsistent.

Conclusions

The pragmatic regional interdependence approach to frozen shoulder applied in this case series yielded nearly complete recovery of normal shoulder ROM within 5–10 weeks with functional improvement maintained 3–12 months after discharge. Given that the longstanding but unsupported theory that the frozen shoulder condition is self-limited with ROM limitations resolving completely over time, effective treatments for frozen shoulder are particularly important to identify. The pragmatic approach to interdependent related body segments that influence shoulder motion and function described in this case series provides an avenue for future research and the potential development of effective treatments.

Contributors

CKW conceived and designed the study, obtained ethics approval, collected the data, wrote the article in whole/part, revised the article. BLS, GAS, EAM, RSK, and KSD extracted and analysed the data, wrote the article in whole/part.

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