Scar Tissue Adhesions, Neuromuscular Guarding, and Functional Recovery: A Case Report of Physical Therapy Post-Cholecystectomy

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ABSTRACT

Scar tissue from abdominal surgeries, such as cholecystectomy, can lead to long-term issues such as restricted movement, painful spasms, and impaired function. Laparoscopic adhesiolysis is a common surgical treatment for pathological scar tissue impairments. Conservative care, such as physical therapy, is a commonly used approach for managing pathological scar tissue. In this case, manual therapy techniques and targeted exercises successfully reduced the intensity and frequency of abdominal spasms, improved core strength and endurance, and enhanced overall functional mobility. These improvements were reflected in enhanced scores on the Lower Extremity Functional Scale and the Vancouver Scar Scale in a 59-year-old woman who was referred to physical therapy following a cholecystectomy five years prior. This case demonstrates the effectiveness of a combined manual and exercise-based physical therapy approach in treating chronic scar tissue adhesions, muscle spasms, and functional limitations post-cholecystectomy, highlighting the importance of a comprehensive treatment plan for managing patients with similar conditions.

Keywords: Cholecystectomy; Manual Therapy; Muscular Spasms; Physical Therapy

INTRODUCTION

Adverse consequences of scar-tissue formation, including malformation and pathological adhesions, are risks associated with any surgical intervention and can result in long-term impairments that negatively impact quality of life.[1,2,3] This is particularly problematic after abdominal surgeries due to limited tissue extensibility around vital organs, leading to movement impairments and muscle spasms.[1] While scar tissue complications from abdominal surgeries are not commonly treated in outpatient physical therapy, manual therapy has been shown to significantly improve scar tissue mobility and increase the abdominal pain pressure threshold, making it a viable conservative treatment option.[2,4,5]

Abdominal surgeries, such as cholecystectomy,

may involve the removal of organ components (eg, gallbladder in cholecystectomy), leading to inflammation and subsequent scar tissue formation. Scar tissue formation is a physiological process that involves complex interactions between various cell types, growth factors, and extracellular matrix components. Excessive collagen deposition during this process can lead to the formation of dense, fibrous tissue that lacks the elasticity and functionality of normal tissue.[2] As scar tissue matures, it contracts due to myofibroblast activity and becomes denser through collagen remodeling. Its final structure is influenced by mechanical stress, with collagen fibers aligning along lines of tension, which can impact tissue flexibility and function.[3,6] Reduced tissue mobility may result in a constant state of protective guarding due to increased reactivity of the neuromuscular system, leading to more frequent spasms from quick-stretch contractions in non-contractile tissue.[7] Failure to adequately address these impairments can limit a patient's functional mobility, potentially affect organ function, and lead to chronic pain syndromes, all of which negatively impact quality of life.[3,8-11]

Therefore, incorporating manual therapy alongside targeted exercises is crucial for effective functional scar remodeling. While adhesiolysis, the surgical removal of scar adhesions, is often used to reduce scar complications, it carries the risk of recurrence and additional scar formation, with reported success rates as low as 46.0%.[3,5,12] Physical therapy offers

a conservative option to address tissue mobility, musculoskeletal function, and proper collagen remodeling. Soft tissue mobilization (STM), including Instrument-Assisted Soft Tissue Mobilization (IASTM) and cupping, has been shown to effectively improve mobility and reduce symptoms associated with excessive scar tissue.[13-16] Additionally, movement-based treatments enhance tissue mobility, strength, and functional movement patterns, further supporting long-term healing and function.[17]

CASE REPORT

A 59-year-old woman presented to physical therapy five years after a cholecystectomy with persistent abdominal discomfort, painful spasms, and a significant decline in physical activity due to excessive scar tissue tension. She experienced spasms during movements involving the abdominal cavity, such as laughing, coughing, and sneezing, which limited her ability to participate in hobbies like gardening, kayaking, and walking her dogs. Her primary goals included exercising without pain or spasms and returning to kayaking, which had previously been a significant part of her recreational activities.

Examination revealed an observable and palpable adhesion around her 7-inch right-sided post-cholecystectomy scar. The Vancouver Scar Scale was utilized for a clinical scar assessment.[18] Abdominal musculature was palpably hypotonic in the affected region compared to the contralateral side (Table 1). The physical therapy assessment identified scar tissue adhesions and abdominal weaknesses as the primary factors limiting the patient's core stability and functional capacity.

Treatment addressed primary impairments including scar tissue adhesions, soft-tissue restrictions, and core weakness. Manual therapy treatment included IASTM, STM, and cupping for scar tissue mobilization to increase tissue extensibility, remodel adhesions, and improve mobility.[5,12-15] These techniques have been shown to decrease scar tissue and myofascial adhesions, stimulate connective tissue remodeling through fibroblast recruitment and collagen repair, and improve scar mobility by lifting and separating fascial layers.[16,19] Therapeutic exercises were used to enhance core strength, mobility, and functional capacity while supporting proper soft tissue alignment for effective scar tissue remodeling (Appendix 1).[15,17]

Patient education played a significant role in the treatment process. The patient was instructed to use coordinated and synchronized breathing techniques during functional movements. Additionally, she received instructions for home exercises and soft tissue mobilization, and actively engaged in self-management strategies to maintain progress beyond therapy sessions.

At discharge, the patient achieved all goals, with notable improvements both subjectively and objectively. She experienced spasms only rarely during quick movements, and they were minimal in intensity compared to her initial presentation. Previously difficult daily activities became more comfortable. While the patient had not yet attempted kayaking, she expressed confidence that she would be able to resume this activity without difficulty. At discharge, she felt equipped with the tools and strategies needed to maintain her gains at home and continue progressing with her home exercise program (HEP). She mentioned that she was confident in her ability to return to all of her desired physical activities.

The patient's scar tissue showed considerable improvement, with diminished pain during palpation and pressure. This was supported by the observable improvement in her functional mobility. While she did not meet the minimal clinically important difference (MCID) for the Lower Extremity Functional Scale (LEFS), a self-reported questionnaire used to assess

Table 1. *Objective Findings Before and After Treatment*

Objective Measure	Initial Evaluation	Discharge
Lumbar lateral flexion ROM	R: 16cm*; L: 14cm*	R: 21cm; L: 21cm
Hip extension MMT	R: 4-; L: 4+	R: 4+; L: 4+
Hip abduction MMT	R: 4+; L: 4-	R: 4+; L: 4
Hip internal rotation MMT	R: 4+; L: 4-	R: 4+; L: 4+
Hip external rotation MMT	R: 4+; L: 4-	R: 4+; L: 4+
DLLT hold at 15° flexion	28 seconds	34 seconds
LEFS	70	74
Single-leg stance time	R: 4 seconds; L: 4 seconds	R: 30 seconds; L: 30 seconds
Vancouver Scar Scale	4	1

*R = Right; L = Left; ROM = Range of Motion; * = Symptom Provocation; MMT = Manual Muscle Test; DLLT = Double Leg Lowering Test; LEFS = Lower Extremity Functional Scale*

functional ability in performing everyday tasks related to the lower extremities, there was a notable positive change in this measure.[20] Her progress in functional goals, along with subjective reports, indicates meaningful improvement achieved through physical therapy treatment. The limited objective improvement in LEFS score is due to the patient reporting a lack of intention to run or hop, activities accounting for 20.0% of the total LEFS score.[20]

The patient made considerable progress toward her goals and is expected to continue improving with ongoing adherence to her HEP. She was also encouraged to gradually reintroduce functional activities, such as kayaking, once she feels ready, while monitoring for any recurrence of spasms. At discharge, the patient expressed satisfaction with her progress and felt well-prepared to independently manage her condition moving forward.

DISCUSSION

This case highlights the effectiveness of a combined manual and exercise-based physical therapy approach in addressing chronic scar tissue adhesions, muscle spasms, and functional limitations in a patient following a cholecystectomy. Physical therapy interventions targeting scar tissue mobilization and core stabilization were effective in improving her functional capacity and reducing symptoms. By integrating manual therapy for scar tissue mobilization with core stabilization and functional exercises, the patient experienced considerable improvements in mobility, strength, and function, leading to improvement in her overall quality of life. The positive outcomes emphasize the importance of a comprehensive, patient-centered approach to post-surgical rehabilitation and highlight the value of physical therapy as a non-invasive, effective intervention for managing complications associated with scar tissue dysfunction.

The interventions work synergistically to enhance flexibility, restore normal movement patterns, and promote collagen remodeling, all while decreasing the protective reactivity of the neuromuscular system, a vital component of overall functional improvement.[8,21] Compared to surgical intervention, conservative care is a viable, non-invasive, and cost-effective option with fewer potential adverse consequences.

The patient's adherence to a HEP, coupled with family support in performing scar tissue mobilization at home, played a crucial role in her progress and confidence in continuing maintenance after discharge from physical therapy. This highlights the importance of patient education and self-management strategies in achieving sustained success in rehabilitation.[22] The positive outcomes in this case emphasize the value of physical therapy as a non-invasive, effective intervention for managing complications associated with scar tissue dysfunction. However, it is important to note that the treatment approach may need to be tailored for different surgical sites or patient populations. Future research could explore the efficacy of this combined manual and exercise therapy approach in a larger cohort of patients with various post-surgical scar tissue complications. Additionally, while this case demonstrated success in treating long-standing scar tissue issues, earlier intervention may potentially lead to even better outcomes. Future studies should investigate the optimal timing for initiating physical therapy interventions after surgery to prevent or minimize scar tissue complications.

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Appendix 1. *Therapeutic Interventions*

Visit Number	Treatment
Visit 1 (Initial Evaluation)	• Patient (Pt) education/discussion of current condition and anatomy, course of treatment and plan of care; HEP discussion* • Scar tissue mobilization (using myofascial induction therapy) with Pt education of mechanism, treatment, techniques, and post-treatment expectations • Transverus Abdominus (TrA) education and execution with demo-back • Partial oblique curl-up with TrA, 2 x 15 each side • Static resistance band resisted core twist and return, with neutral spine and deep core-stabilization, resistance band stabilized at door and held out by arms at xiphoid process height, TrA 2 x 15 each side
Visit 2	• Warm up: Elliptical Level (L) 1 x 10 minutes • Open books 10 reps x 10 seconds, each side • Thread the needle 10 reps x 10 seconds, each side • Scar tissue mobilization/myofascial release, cupping ("moving cupping")
Visit 3	• Warm up: Elliptical L1 x 10 minutes • Open books 10 reps x 10 seconds, each side • Thread the needle 10 reps x 10 seconds, each side • Scar tissue mobilization/IASTM scraping.
Visit 4	• Warm up: Elliptical L2 x 10 minutes • IASTM and STM at abdominal to thoracic scarring • Open books 10 x 10 seconds, each side • Seated lateral trunk stretch 10 x 10 seconds, each side
Visit 5	• Warm up: Elliptical L3-4 x 10 minutes • STM and scar tissue mobilization to R lower abdominal quadrant and into R lower rib (some mobilization under R lower rib for access to diaphragm and scar tissue surrounding gallbladder area), including lumbar musculature • Sacral lateral rocking for improved mobility with limited mobility findings during joint play testing. • Thread the needle 10 x 10 seconds, each side • Open books 10 x 10 seconds, each side • Oblique curl up 2 x 15, each side. • Core twist with RTB 2 x 15, each side
Visit 6	• Warm up: Elliptical L4 x 10 minutes • Bilateral sacral rocking grade III - IV; STM at anterior scar tissue utilizing myofascial induction therapy • Seated hamstring stretch, 10 x 10 second holds each.
Visit 7	• Warm up: Treadmill (TM) L3 incline and 3.4 speed x 10 minutes; focus on core engagement and long stride length • STM x 4 minutes each area of scar tissue (x 12 minutes total); cupping x 5 minutes using "moving cupping technique" to R abdominal quadrants for scar tissue adhesions and relief • Standing Lat stretch 5 reps x 10 second holds • D1/D2 flexion and extension motions using core anti-rotation 2 x 10, each side
Visit 8	• Warm up: TM L3 incline and 3.4 speed x 13 minutes; focus on core engagement and long stride length • STM x 4 minutes each area of scar tissue (x 12 minutes total); cupping x 5 minutes to R abdominal quadrants for scar tissue adhesions and relief • D1/D2 flexion and extension motions using core rotation 2 x10, each side • RTB resisted arm extension in standing for improved core control 1 x 10
Visit 9	• Warm up: Elliptical L3 x 13 minutes; focus on core engagement and long stride length • IASTM followed by cupping (using a suction then glide over skin technique) to R abdominal quadrants for scar tissue adhesions, soft tissue restrictions, and soft tissue remodeling • Prone press up 5 reps x 10 second holds, each • LTR's x 2 minutes • Open books 2 x 10, each side • Front plank 3 x 30 second holds
Visit 10	• Warm up: TM 3.5 mph, incline 3 for 14 min • Prone press-up 5-10 reps x 10 second holds, each • Pulley system pushes and pulls of 10 lb. x 10, each • Single-arm rows with black TheraBand resistance, x 10, each • Discharge measurements taken

**All exercises performed were continued as HEP, to be performed daily, except on treatment days.*