

**Massage Therapy as an Effective Treatment of Chronic Cribriform Scarring: a Case  
Study**

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### **Disclaimer Bias**

It must be stated that there was a pre-existing relationship between the therapist and patient prior to the commencement of this study. A therapeutic relationship was established at the onset, avoiding possible bias and conflict of interest.

## Abstract

**Background:** Pyoderma gangrenosum (PG) is an autoinflammatory neutrophilic dermatosis exhibiting rapidly progressive necrotizing ulcerations. Following the healing phase, the lesions result in characteristic cribriform scarring, contributing to a multitude of pathological conditions such as functional impairment, fascial rigidity, edema, and sensory loss.

**Purpose:** To determine the effectiveness of massage therapy as a treatment for chronic cribriform scarring and edema in a patient diagnosed with ulcerative pyoderma gangrenosum

**Participant:** The patient is a twenty-six-year-old female, diagnosed with PG in May 2015. Her primary complaints include skin pruritis, reduced sensation, limited ankle range of motion (ROM), and chronic edema in the lower limbs.

**Intervention:** A total of eight 75-minute sessions were completed over a two-month period. Treatment modalities included myofascial release (MFR) and lymphatic drainage (LD) techniques applied to the lower limbs, with emphasis on specific lesions to address fascial restrictions and reduced circulation. Progress was documented using ROM, girth measurements, Visual Analog Scale (VAS), Patient Observer Scar Assessment Scale (POSAS), two-point discrimination tests, and photography.

**Results:** Objective improvements include a significant decrease in girth measurements of the lower extremity, a moderate increase in range of motion, and improved 2-point discrimination scores. Subjective results include reduced pruritis and improved tissue pliability, vascularity, and pigmentation as indicated by VAS and POSAS scores.

**Conclusion:** The findings demonstrate that massage therapy, specifically MFR and LD, is

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effective in the treatment of chronic cribriform scarring and edema. Further research with a larger subject base is suggested, due to the varying presentation of an individual's tissue.

*Keywords: Pyoderma Gangrenosum, Cribriform scarring, Massage therapy, Myofascial release, Lymphatic drainage*

## Introduction

Pyoderma gangrenosum is a rare and aggressive ulcerative skin condition that is considered part of a larger group of autoinflammatory disorders known as Neutrophilic Dermatitis<sup>(1)</sup>. The etiology is unknown but has been linked to inflammatory bowel disease, malignancies, and other systemic conditions<sup>(2)</sup>. The disease affects three to ten patients per million people per year; limiting research to single case-studies or small patient series<sup>(2)</sup>. It affects women and men equally, generally aged 20 to 50, and rarely affects children<sup>(1)</sup>. Pyoderma gangrenosum presents in four different variants: vegetative, bullous, pustular, and ulcerative, with the latter presenting most commonly<sup>(2)</sup>. It develops with a non-infectious histology, making a diagnosis of this disease a process of exclusion rather than being clearly defined<sup>(3)</sup>. Clinical presentation of pyoderma gangrenosum is varied but is generally characterized by two distinct stages: (a) the active ulcerative stage and (b) the wound healing stage<sup>(3)</sup>.

- (a) The active ulcerative stage consists of single or multiple rapidly progressing ulcerative lesions, typically on the lower extremity<sup>(4)</sup>. Initial lesions begin as nodules or pustules that form in response to minor skin trauma and rapidly progress to ulcerations with irregular borders and necrotic centers. Systemic conditions are also reported in the acute phase such as fever, arthralgia, and myalgia<sup>(2)</sup>.
- (b) The healing phase exhibits slowing of the ulcerations with epithelial projections reaching into the ulcer bed<sup>(3)</sup>. Successful treatment of the disease includes topical and systemic corticosteroids such as oral or intravenous prednisone and immunosuppressive agents<sup>(1)</sup>. With effective treatment and time, the ulcerations regress, resulting in cribriform scarring of varying degrees<sup>(3)</sup>.

Cicatrization, more commonly known as scar formation, is the result of the body's reaction to epidermal and dermal injury. Wound healing presents in two physiological responses: epidermal wound healing when the trauma occurs to the superficial epidermis, or deep wound healing when trauma extends into the dermis or subcutaneous tissue layer<sup>(5)</sup>. Deeper trauma tends to produce additional scar tissue due to excessive edema and increased amounts of granulation tissue<sup>(6)</sup>. Cicatrization and fibrosis typically occur with the formation of hypertrophic, keloid, or in the case of pyoderma gangrenosum, cribriform scarring. Hypertrophic scarring is defined as scars raised above the level of skin, but which remain within the confines of the original lesion<sup>(7)</sup>. Cribriform scarring has a similar pathogenesis and is defined as showing a characteristic criss-cross pattern<sup>(3)</sup>. Both are described with marked colour change, fascial rigidity, and elevation that may persist<sup>(8)</sup>. A significant percentage of scars can result in pathological conditions following injury: malformed adhesions, functional impairment, discolouration, edema, sensory loss, and soft tissue contracture are often reported. Skin pruritus, fascial tension, and discomfort from scar formation accompany these conditions<sup>(9)</sup>.

While there are many treatment modalities used in scar rehabilitation centers, massage therapy offers a holistic approach to myofascial dysfunction. Roh et al. indicates that massage therapy for post-burn hypertrophic scarring improves skin pruritus, tissue quality, and depression in burn survivors (226). In addition, Rattray & Ludwig demonstrate that lymphatic drainage (LD) techniques are successful in managing chronic edema (220). The American Massage Therapists Association recognizes manual therapy as an essential treatment of burn scar rehabilitation, and suggests further research be conducted<sup>(12)</sup>. The purpose of this case report seeks to explore the effectiveness of massage therapy, specifically myofascial release and

superficial lymphatic drainage, in the treatment of chronic cribriform scarring and edema in a patient with ulcerative pyoderma gangrenosum.

## **Methods**

### **Patient profile**

The patient is a moderately active 26 year-old female endomorph. As a hairstylist in the film industry, she routinely works lengthy fifteen hours days with long periods of standing. In her health history form, the patient notes a familial history of type 2 diabetes, a personal history of polycystic ovarian syndrome, as well as past gastrointestinal problems and constipation. She has recently undergone bariatric bypass surgery, losing over one hundred pounds since October 2016. Konopka et al. describes gastrointestinal dysfunction as a potential causative factor of pyoderma gangrenosum (25). This patient was diagnosed with the ulcerative variant in May 2015.

The disease is commonly misdiagnosed, resulting in this patient's condition persisting for several months, prior to the final diagnosis and appropriate treatment several months later. A multitude of pathologies relate to skin ulcerations such as infections, tumors, vascular disorders, and trauma, making a diagnosis of pyoderma gangrenosum a process of elimination rather than definitive<sup>(1)</sup>. Multiple treatments of topical corticosteroids, oral prednisone and systemic immunosuppressants were administered to slow the progression of the ulcerations. Seven months after the initial lesions presented, the patient was cleared of any newly forming ulcerations resulting in numerous cribriform scars on her lower extremities. The patient's primary complaints include moderate pruritis, limited sensation in specific lesions, chronic edema in both lower limbs, and discomfort standing for long periods due to adhesions at the

ankle joints. She did not seek any other medical, personal or surgical interventions for the scarring prior to our proposed treatment plan.

After careful assessment and approval from her medical doctor, no contraindications pertaining to this case were present. Precautions were taken relative to her recent gastrointestinal surgery by avoiding prolonged deep-pressure strokes; in addition, the depth of techniques were moderated based on her decreased sensory perception. Moreover, no hot hydrotherapy applications were applied to the distal limbs, ensuring optimal lymphatic and venous return<sup>(6)</sup>.

### **Assessment**

Both the initial and final appointments of this study were reserved for detailed interview and assessment. These include postural examination, palpation, range of motion (ROM), orthopedic and special testing, dermatome and myotome testing, photographic measurements, Visual Analogue Scales (VAS) and Patient Observer Scar Assessment Scales (POSAS); no treatment was intended. Only clinically relevant assessments were re-tested, based on presenting symptoms at the time of treatment.

In treatments one, five and eight, photographs and girth measurements of specific scars were documented, along with descriptive notes of tissue quality, fascial glide, and the patient's sensory perception. Corresponding scar-specific VAS forms were completed in correlation with the most dysfunctional scars. VAS is a highly reliable evaluation tool based on four criteria: pigmentation, vascularity, acceptability and contour; criteria are graded on a scale from one (minimal change) to 4 (maximum change)<sup>(13)</sup>. POSAS forms were also utilized and expanded on data captured from the VAS from both the therapist's and patient's perspectives<sup>(14)</sup>. It rates

vascularity, pigmentation, pliability, itchiness, stiffness and other subjective information based on the overall presentation of the lesions on a scale of one (least) to ten (worst).

Active and passive ranges of motion of the ankle joints were performed at each appointment. All ranges were performed with the aid of a universal goniometer to measure exact motions in degrees<sup>(16)</sup>. Initial findings suggested restrictions in all ranges (aside from left inversion which remained near baseline throughout).

In treatments one, four, six and eight, girth measurements of lower extremities were performed to document edematous variances. Bilateral measurements were taken at the proximal femur, proximal and distal patella, middle tibia, and proximal talocrual joint using a soft measuring tape following textbook protocols<sup>(6)</sup>. Initial findings demonstrated a one-centimeter difference between right and left legs, and consistently declined following treatments.

In treatment six, a two-point discrimination test was introduced to monitor changes in sensory perception of healthy and scarred tissue<sup>(15)</sup>. The patient's distal legs were divided into anterior and posterior quadrants distal to the knee and a sharp-tipped instrument was applied to the skin using one or two skin pricks as indicated on the assessment form. Initial findings suggested definitive sensory changes in scarred tissue, which improved significantly in the subsequent sessions.

The following assessments were performed in treatment one as part of a wider view of clinical presentation: range of motion of the knee joints, lumbar spine myotomes and dermatomes, functional squat and balance tests, and manual muscle tests according to textbook protocols<sup>(15, 17)</sup>. The findings, however, were deemed unremarkable and were only retested in the final assessment.

## **Treatment Plan**

At the onset of this project, ten appointments were scheduled for this treatment plan; however, due to conflicting schedules and travel, it was agreed upon that the treatment plan would be terminated at the end of session eight. All appointments lasted seventy-five minutes, with the first and last appointments consisting mainly of interview and assessment. The remaining six appointments were primarily treatment-based, with ten minutes of a brief assessment, fifty-five minutes of hands-on treatment, and five minutes of reassessment and homecare.

Each treatment followed the same basic protocol, with slight variances depending on the presenting symptoms and daily assessment. The patient began in prone position with a Thermophore applied to the low back. Therapeutic touch was introduced using grounding and centering and systemic compressions<sup>(6)</sup>. Diaphragmatic breathing was taught and routinely referred to when utilising direct MFR procedures. In total, warm-up procedures lasted five minutes per leg. The patient's leg was uncovered, then passive range of motion (PROM) of the hip, knee and ankle were applied. Effleurage to the posterior thigh and calf without the use of oil were used to facilitate superficial circulation and the warming of the patient's tissues<sup>(6)</sup>.

Approximately 25 minutes of myofascial treatment was allotted per leg. This began with broad-contact shearing being held for ninety seconds and was repeated in neighbouring areas. A successful fascial release is indicated by hyperemia, palpable heat, and a softening of the tissue<sup>(18)</sup>. Scar-specific treatment began with myofascial stack-and-load with slight torque following the indirect fascial restriction. A gentler pressure was chosen, given the fragile nature of the tissue and the patient's impaired sensory function in the lesions. Kanazawa et al, demonstrated that cyclical cell stretching reduced connective tissue growth factor, effectively

decreasing scar tissue adhesions on a cellular level (323). Hence, micro-shearing, skin-rolling and cross-fiber frictions in all directions composed the foundation of scar-specific treatment. Cyriax describes cross-fiber frictions causing minor inflammation, facilitating local vasodilation and likely accelerating tissue repair, while Barnes suggests that a low-load sustained pressure may allow the viscoelastic fascia to elongate<sup>(20, 11)</sup>. It is suggested that active and passive range of motion used in conjunction with scar massage prevents joint fusion and contracture<sup>(21)</sup>. Therefore, direct myofascial stack-and-load techniques were applied using ankle AROM to facilitate the greatest effect. Following the direct techniques, light effleurage with oil was applied for moisturizing benefits, then PROM of the ankle, knee, and hip respectively. The patient was then re-draped, repositioned into supine, and the Thermophore was replaced to the abdomen. A similar protocol as above was applied to the anterior surface of the lower extremity.

The final ten to fifteen minutes of treatment were reserved for superficial lymphatic drainage techniques (LD), with greater emphasis placed on these modules if the patient presented with edema that day. LD encourages lymphatic flow, decreases edema and promotes clearance of stagnant metabolic wastes from edematous tissue<sup>(6)</sup>. Nodal clearing began at the iliac lymph nodes, then stationary circle strokes following lymphatic watersheds were applied to the thigh, working proximal to distal<sup>(6)</sup>. Popliteal nodes were cleared using a nodal scooping method on the posterior knee, followed by stationary circle stroking to the shins for a total of three to five minutes<sup>(6)</sup>. Lastly, the therapist used AROM of the ankle in plantar and dorsiflexion, finishing treatment with light effleurage to facilitate venous and lymphatic return<sup>(6)</sup>.

### **Home Care**

Given the nature of the patient's grueling fifteen hour/day work schedule, homecare was designed to be simple yet effective. The patient was instructed to lie supine with her legs up the

wall for fifteen to twenty minutes at the end of each day, using AROM of the ankles while doing so. Since the lymphatic system relies heavily on surrounding skeletal musculature for circulation, the goal of this activity was to facilitate lymphatic and venous return, while maintaining joint and muscular health through active modalities<sup>(6, 22)</sup>. Contrast hydrotherapy methods were also suggested, in the context of shunting fluids toward the core, away from extremities. A warm compress to her core and a cool compress to her feet were applied simultaneously to facilitate venous and lymphatic return<sup>(23)</sup>. Self-massage at home was also suggested, including skin rolling, superficial lymphatic effleurage, as we had completed in our sessions.

## **Results**

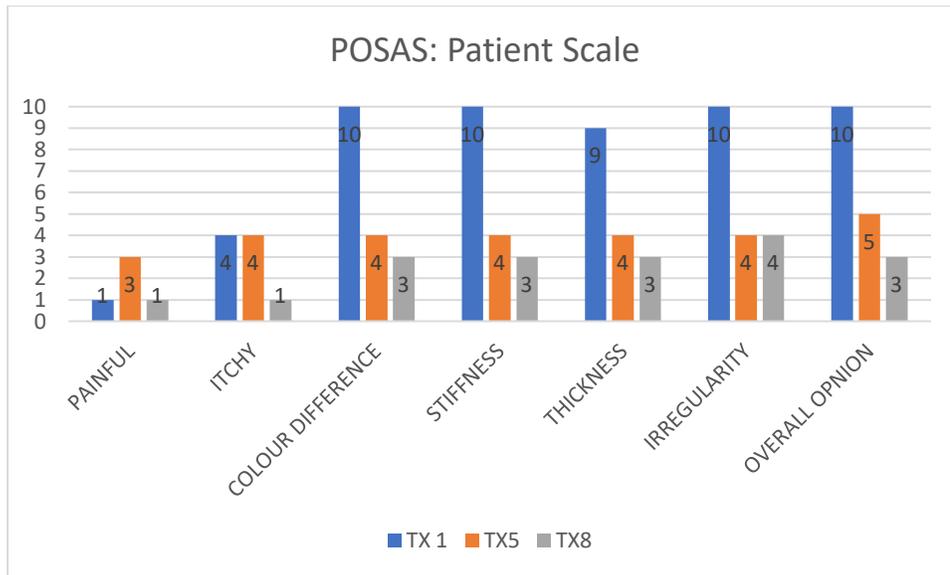
The results of this study demonstrated commendable improvements in most areas tested. VAS and POSAS scores decreased, indicating an improvement in tissue quality and skin pruritis, as well as a decrease in bilateral girth measurements. AROM of the ankle joint increased, as well as the patient's two-point discrimination score, indicating an improvement of sensory awareness.

Initial findings of the VAS demonstrated a marked difference in colour, texture, contour and distortion in all examined lesions. Following treatment, improvements in tissue vascularity, pigmentation, pliability, and contour are documented.

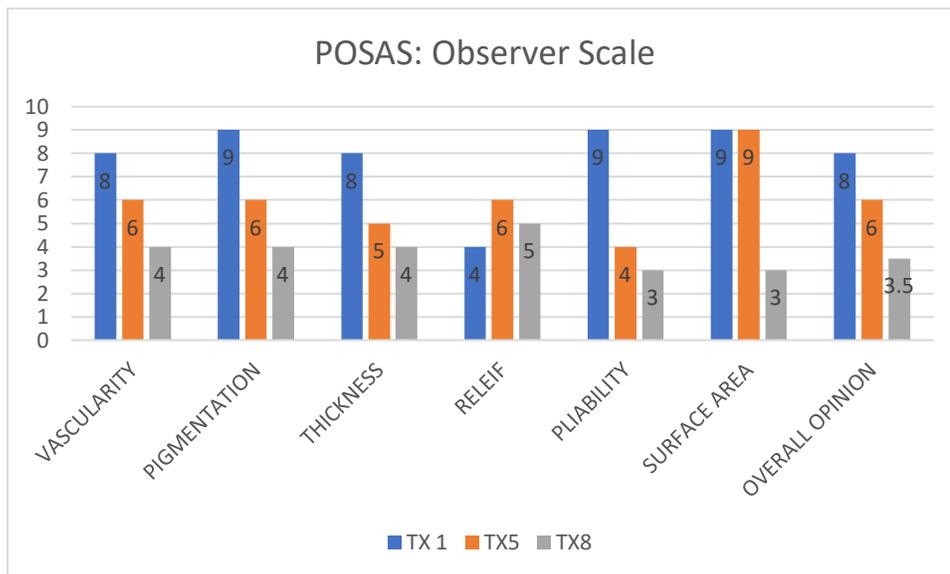
The POSAS demonstrates subjective improvements from both the therapist's and patient's perspectives. The patient's overall opinion in treatment one was rated maximum of 10/10, and decreased significantly to 3/10 in treatment eight. The observer scale also

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demonstrated a high grade of 8/10 in overall opinion in treatment one, with significant decrease to 3/10 in treatment eight. Please refer to figure 1 & 2, for specific POSAS improvements following treatment:

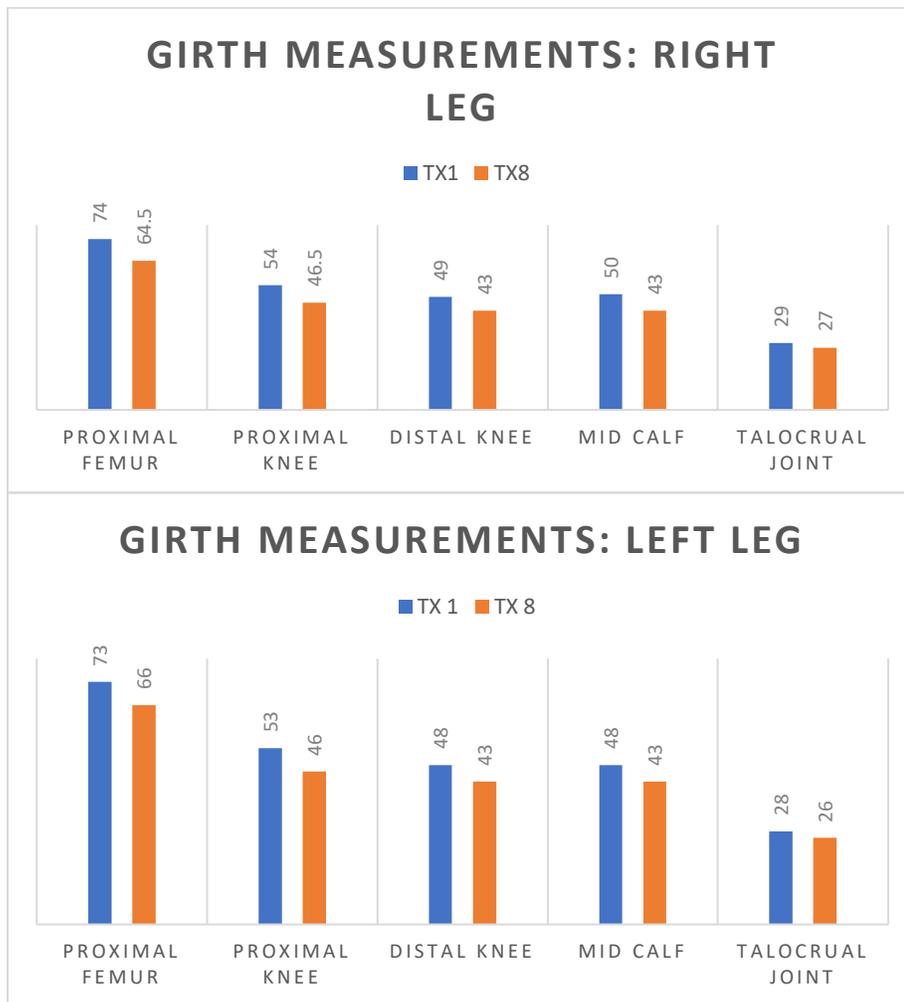


*Figure 1.* POSAS: Patient Scale. This figure depicts the patient's view of tissue quality, pruritis, and overall opinion of her scars from treatment one to treatment eight.



*Figure 2.* POSAS: Observer Scale. This figure depicts the therapist's view of change in tissue quality, pigmentation, and overall opinion of lesions from treatment one to treatment eight.

The most remarkable objective changes are that of girth measurements depicting edematous variances. Compared to initial findings, both legs decreased in girth measurements throughout the treatment plan, with the final assessment showing a significant change in girth at all levels (See Figure 3, below).



*Figure 3.* Girth Measurements of right & left legs. This figure illustrates a decline in edematous variances from treatment one to treatment eight.

Additionally, the patient reports less heaviness and discomfort as well as reduced puckering and protrusion in specific lesions when edema is present. She also describes a reduction in daily occurrence of edema overall.

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Active range of motion of the ankle joints demonstrated slight variances throughout treatment. No range of motion was completed in treatment two because of the in-depth assessment completed the day prior. The most affected AROM of the ankle was dorsiflexion: the right side displayed a pre-treatment measurement of 28° and increased to 50° in the final assessment.

ROM -- RIGHT	NORMAL	TX 1	TX2	TX3	TX4	TX5	TX6	TX7	TX8
DORSIFLEXION	50	28	-	50	25	50	50	50	50
PLANTAR FLEXION	20	10	-	10	10	17	15	15	12
EVERSION	15-30	5	-	5	15	12	10	10	7
INVERSION	45-60	40	-	45	40	40	40	40	40

ROM -- LEFT	NORMAL	TX 1	TX 2	TX3	TX4	TX5	TX6	TX7	TX8
DORSIFLEXION	50	20	-	50	45	50	50	50	40
PLANTAR FLEXION	20	15	-	15	15	20	20	15	15
EVERSION	15-30	12	-	10	15	10	15	10	15
INVERSION	45-60	45	-	40	45	40	40	40	45

*Table 1.* Range of Motion of Right and Left Ankle Joints. This chart illustrates the progression of ranges throughout the treatment plan; Highlighted areas indicate an improvement in range in the final assessment.

Initial findings of the two-point discrimination test demonstrated a grade of 70% correct in healthy tissue and 22% correct in scarred tissue. The scores increased throughout the following treatments, with the final assessment graded at 83% in healthy tissue and 67% in scarred tissue (see Figure 4 below).

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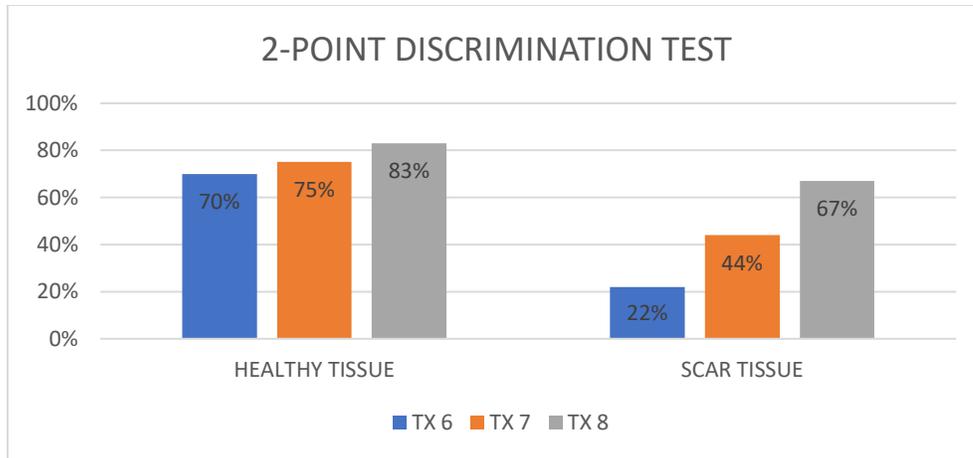


Figure 4. 2-point Discrimination Test. This figure depicts an increase in the patient’s sensory perception in healthy and scarred tissue throughout sessions six, seven and eight.

Dermatomes, myotomes, functional squat and balance tests, and manual muscles tests were performed in treatment one as part of a broad view of clinical presentation, and were reassessed in the final examination only. The results of these tests are shown in Table 2 & 3:

LEVEL	MYOTOME / DERMATOME	INITIAL TX	INITIAL TX	FINAL TX	FINAL TX
-	-	RIGHT LEG	LEFT LEG	RIGHT LEG	LEFT LEG
L2	HIP FLEXION	-	-	-	-
L3	KNEE EXTENSION	-	-	-	-
L4	DF OF ANKLE	-	-	-	-
		No feeling medial #1 distal phalanx at terminus		No feeling medial #1 distal phalanx at terminus	
L5	EXT OF #1 MTP	-	-	-	-
		Paresthesia at #3 & #4 phalanges, dorsal aspect			

S1	PF OF ANKLE	-	-	-	-
S2	KNEE FLEX	-	-	-	-

*Table 2.* Myotomes and Dermatomes of the Lumbar Spine. This chart depicts the initial and final findings; the highlighted area indicates a dermatomal change at level L5 in the final assessment.

MANUAL MUSCLE TESTS	SIDE	INITIAL TX	PAIN	FINAL TX	PAIN
		GRADE		GRADE	
TIBIALIS ANTERIOR	RIGHT	5	0	5	0
	LEFT	5	0	5	0
PERONEALS	RIGHT	4+	0	5	0
	LEFT	4+	0	4+	0
FLEXOR DIGITORUM LONGUS	RIGHT	4+	0	4+	0
	LEFT	4+	0	4+	0
EXTENSOR DIGITORUM	RIGHT	4+	0	5	0
	LEFT	4	0	4+	0

*Table 3.* Manual Muscle Tests of the Lower Extremity. This chart depicts the initial and final findings of the muscles tested; the highlighted area indicates a change in strength of affected musculature.

## Discussion

The purpose of this case report was to explore the effectiveness of massage therapy, specifically myofascial release and superficial lymphatic drainage, in the treatment of chronic cribriform scarring and edema. Cicatrisation is managed in a variety of ways such as laser and cryotherapy, radiation surgery, silicone gel application, and intralesional corticosteroids. For many patients with chronic scarring, primary symptoms are often managed solely with pharmaceutical interventions, yet they do not address the numerous presenting complaints. There is a multitude of research supporting scar release massage therapy as supplementary

treatment for patients with chronic scarring and dysfunction, addressing a holistic view of the body, without the excessive side effects<sup>(6, 7, 9, 10, 11, 12, 20, 26)</sup>.

The results of this study further support the aforementioned research. Due to the positive impact of the chosen modalities had on the presenting condition, minimal treatment variances occurred. The myofascial techniques which the researcher found particularly effective were skin rolling and direct stack-and-load with AROM, since profound tissue changes were immediately palpable following treatment. Initially, tissue presented as dense, adhered and unable to glide; with every session, the tissue gained pliability, elasticity and sensation, with the concluding treatment demonstrating commendable progress. The final POSAS and VAS scores indicated great improvements in the patient's overall satisfaction of her scarring, as well as reduced pruritis, improved tissue pliability, texture, and colour. These findings suggest that MFR modalities directly affect the underlying fascial restrictions, thereby improving circulation and tissue quality<sup>(11)</sup>. Moreover, while a small emphasis was placed on lymphatic techniques during treatment, the homecare was largely targeted toward facilitating lymphatic flow. A significant decrease in girth measurements following the sessions suggests that lymphatic drainage effectively reduces the occurrence and severity of chronic edema<sup>(6)</sup>.

While there is substantial evidence of the efficacy of massage therapy in the treatment of chronic scarring, further investigations based on treatment expectancy and protocols would be beneficial to explore. In this case, the sporadic nature of the appointments along with moderate patient compliance to homecare activities may have detracted from achieving the best possible results. Roh et al., suggests weekly massage sessions of thirty minutes, as well as daily self-massage be consistently performed over a period of three months. Moreover, Field et al.

suggests scar rehabilitation massage be applied in the remodeling phase of healing, rather than in the chronic phase, such as in this case study.

While the outcomes of this study were mostly positive, the therapist encountered several limitations throughout the treatment plan. Firstly, a major hindrance in documenting fascial gains was the inability to chart them objectively. Ultimately, careful notes of tissue quality, along with VAS and POSAS charts were utilized, as both tools are of high clinical reliability<sup>(25)</sup>. Secondly, ROM measurements may have been skewed by the therapist's inexperience with a goniometer; nevertheless, this skill improved over the course of the treatment plan. Additionally, the two-point discrimination test would have ideally been performed at the onset of the study; however, the therapist only learned of this type of test after treatment five.

A significant percentage of scars can result in pathological conditions following injury: functional impairment, pruritus, edema, sensory loss, and contracture are often reported. While primary complaints remain subjective to the individual patient, this case study demonstrates that myofascial release and superficial lymphatic drainage techniques can be effective in managing chronic scarring and edema. Ultimately, this report and treatment plan may contribute to future research; however, further investigation with a larger subject group and more experienced researchers is suggested.

## References

1. Alavi, A., French, L. E., Davis, M. D., & Kirsner, R. S., “Pyoderma gangrenosum: an update on pathophysiology, diagnosis and treatment.” American Journal of Clinical Dermatology 18.3 (2017): 355-372. DOI: 10.1007/s40257-017-0251-7
2. Konokapa, C. L., Padulla, G. A., Oritz, M. P., Beck, A. K., Bittencourt, M. R., & Dalcin, D. C., “Pyoderma gangrenosum: a review article.” Journal Vascular Brasileiro 12.1 (2013): 25-33. DOI: 10.1590/S1677-54492013000100006
3. Gameiro, A., Pereira, N., Cardoso, J. C., & Goncalo, M., “Pyoderma gangrenosum: Challenges and solutions.” Clinical Cosmetic Investigational Dermatology 8 (2015): 285-293. DOI: [10.2147/CCID.S61202](https://doi.org/10.2147/CCID.S61202)
4. Su, W. P. D., Davis, M. D., Weenig, R. H., & Perry, H. O., (2004). “Pyoderma gangrenosum: Clinicopathologic correlation and proposed diagnostic criteria.” International Journal of Dermatology 43.11 (2004): 790-800. DOI: 10.1111/j.1365-4632.2004.02128.x
5. Tortora, G., & Derrickson, B., Principles of Anatomy and Physiology (14th ed.). NJ, NJ: John Wiley & Sons, 2014.
6. Rattray, F., & Ludwig, L., Clinical Massage Therapy: Understanding, Assessing and Treating over 70 conditions. Toronto, ON: Talus, 2000.
7. Cho, Y. S., Jeon, J. H., Hong, A., & Seo, C. H., “The effect of burn rehabilitation massage therapy on hypertrophic scar after burn: A randomized control trial.” Burns: Journal of the International Society for Burn Injuries 40.8 (2014): 1513-1520. DOI:10.1016/j.burns.2014.02.005

8. Bray, R., Forrester, K., Leonard, C., McArthur, R., Tulip, J., & Lindsay, R., “Laser Doppler imaging of burn scars: a comparison of wavelength and scanning methods.” Burns 29.3 (2003): 199-206. DOI: [http://dx.doi.org/10.1016/S0305-4179\(02\)00307-8](http://dx.doi.org/10.1016/S0305-4179(02)00307-8)
9. Roh, Y. S., Cho, H., Oh, J. O., & Yoon, C. J., “Effects of skin rehabilitation massage therapy on pruritus, skin status, and depression in burn survivors.” Journal of Korean Academy of Nursing 37.2 (2007): 221-226. Retrieved from: <https://synapse.koreamed.org/Synapse/Data/PDFData/1006JKAN/jkan-37-221.pdf>
10. Bloemen, M. C., van der Veer, W. M., Ulrich, M. M., van Zuijlen, P. P., Niessen, F. B., & Middelkoop, E., “Prevention and curative management of hypertrophic scar formation.” Burns 35.4 (2009): 463-475. DOI: [10.1016/j.burns.2008.07.016](https://doi.org/10.1016/j.burns.2008.07.016)
11. Barnes, J., Myofascial Release: The Search for Excellence. Rehabilitation Services Inc. Malvern, PA, 1990
12. Lopez, S., DeLegge, & S., Leming, A., “Position statement proposal on therapeutic massage for burn scars.” American Massage Therapy Association. 2014. Retrieved from: [http://www.amtamassage.org/uploads/cms/documents/2014\\_burn\\_scars\\_ps\\_proposal.pdf](http://www.amtamassage.org/uploads/cms/documents/2014_burn_scars_ps_proposal.pdf)
13. Fearmonti, R., Bond, J., Erdmann, D., & Levinson, H., “A review of scar scales and scar measuring devices.” Eplasty Journal of Plastic Surgery 10 (2010): 43. Retrieved from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2890387/>
14. Van de Kar, A. L., Corion, L., Smeulders, M., & van Zuijlen, P., “Reliable and feasible evaluation of linear scars by the patient and observer scar assessment scale.” Plastic and Reconstructive Surgery 116.2 (2005): 514-522.  
DOI: 10.1097/01.prs.0000172982.43599.d6
15. Magee, D.J., Orthopedic Physical Assessment (6th ed.). St. Louis, MO: Elsevier, 2014

16. Norkin, C., & White, J., Measurement of Joint Motion: A guide to goniometry (4th ed.). F.A. Davis Co, 2009
17. Kendall, F.P., McCreary, E.K., Provance, P.G., Rodgers, M.M., & Romani, W.A., Muscle Testing and Function with Posture and Pain (5th ed). Philadelphia, PA: Williams and Wilkins, 2005
18. Greenman, P. E., Principles of Manual Medicine. Baltimore: Williams and Wilkins, 1989
19. Kanazawa, Y., Nomura, J., Yoshimoto, S., Toshikazu, S., Kita, K., Suzuki, N., & Ichinose, M., “Cyclical cell stretching of skin-derived fibroblasts downregulates connective tissue growth factor (CTGF) production.” Connective Tissue Research 50 (2009): 323-329.  
DOI: 10.1080/03008200902836081
20. Cyriax, J., & Coldham, M., Textbook of Orthopedic Medicine, Volume 2, Treatment by Manipulation, massage and injection, (11th Ed.) London: Bailliere Tindall, 1984
21. Rochet, J. M., & Zaoui, A., “Burn scars rehabilitation and skin care.” La Revue Du Practicien 52.20 (2002): 2258-2263. Retrieved from:  
<https://www.ncbi.nlm.nih.gov/pubmed/12621946>
22. Kisner, C., & Colby, L. A. Therapeutic exercise: Foundations and techniques. Philadelphia: F.A. Davis, 2007
23. Sinclair, M., Modern Hydrotherapy for the Massage Therapist. Philadelphia, PA: Lippincott, Williams and Wilkins, 2008
24. Registered Massage Therapists of British Columbia (2017). RMTBC Recommended Fee Guide 2017 & 2018. Retrieved from:  
[http://www.rmtbc.ca/sites/default/files/files/ProfessionalFees\\_2017-18.pdf](http://www.rmtbc.ca/sites/default/files/files/ProfessionalFees_2017-18.pdf)

25. Ferriero, G., Di Carlo, S., Ferreiro, A., Salgovic, L., Bravini, E., Sartorio, F., & Vercelli, S.,

“Post-surgical scar assessment in rehabilitation: A systematic review.” Physical

Therapy and Rehabilitation 2 (2015): 2. DOI: <http://dx.doi.org/10.7243/2055-2386-2-2>

26. Field, T., Peck, M., Hernandez-Reif, M., Krugman, S., Burman, I., & Ozment-Schenck, L.,

“Postburn itching, pain, and psychological symptoms are reduced with massage therapy.”

The Journal of Burn Care & Rehabilitation 21.3 (2000):189-193. Retrieved from:

<https://www.ncbi.nlm.nih.gov/pubmed/10850898>