The Scar as a Representation of the Osteopathic Principles

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Abstract

A scar is the manifestation of the skin's healing process following an injury. It can be a cosmetic concern to some individuals while dismissed and disregarded by others. New treatment options continue to be investigated, but no solution currently exists for erasing a problematic scar. By viewing the scar as a source of somatic dysfunction using the four osteopathic principles, the dermatologist is able to employ the use of osteopathic manipulative treatment techniques as an adjunctive tool in scar management. Here we explore the scar through an osteopathic lens and describe treatment strategies that have been shown to be effective in improving the somatic dysfunction caused by the presence of a scar.

Introduction

A scar, or cicatrix, is the end result of the wound repair mechanism in adults and children following an injury, either traumatic or surgical, beyond the epidermis. It is the consequence of a surgical incision and is inevitable despite the surgeon's best efforts to hide it within the skin's natural contour lines.

It is a common lesion encountered in dermatology, and it is the source of much cosmetic concern. More than 230 million surgical procedures are performed around the world each year, all of which result in cutaneous wounds that heal with scars. A recent survey indicated that 91% of patients who underwent a routine surgical procedure would value any improvement in scarring. Scars also affect other body systems including the musculoskeletal system or deep viscera in the form of adhesions. They are also linked to pain and depression.

The cosmetic outcome of a scar and its subsequent implications on a patient's overall wellbeing is of primary importance in dermatology. Patients are often left desperate for treatment options after first-line treatments—such as silicone sheeting, pressure dressings and intralesional steroids—fail. Osteopathic manipulative treatment (OMT) is a non-invasive, cost-effective therapy for scar management that may be employed by considering the scar as an application of osteopathic principles and practices. Here, we apply A.T Still's four osteopathic principles to the scar and describe the mechanisms responsible for the interaction between the scar and its surrounding skin as a source of somatic dysfunction. The OMT techniques applicable to scar management are reviewed and their effectiveness explored, revealing the growing opportunity for further osteopathic research.

Discussion

Osteopathy and scars

Principle 1. The body is a unit; the person is a unit of body, mind, and spirit.

This osteopathic principle represents how a scar can affect a person’s entire wellbeing. Much like the saying “a scar is more than skin deep,” a scar may have a deeper value to one person but not to another. It can serve as a permanent reminder of the past, whether it is pleasant or unpleasant, that extends to the body, mind and spirit.

It is known that the connection between the skin and the mind is a powerful one. For example, stress can exacerbate psoriasis and cause acne breakouts. Stress can also play a role in scar formation. Furtado et al. found that psychological stress influences the rate of recurrence of keloids when stress is experienced the day before keloid excision, increasing the chances of keloid recurrence by 34%. The location of the scar and the patient’s age or gender are factors that influence its impact. A scar on the chest of a young female, for example, may cause increased self-consciousness and impact the clothing she chooses to wear.

There is a variety of psychosocial comorbidities associated with scarring. Depression is the predominant finding in patients suffering from burn scars. A combination of anxiety, depression and PTSD-related disorders were seen in 64% of the patients who developed scars following ICU admission for severe soft-tissue infections in one study. Other psychosocial characteristics of patients with scars, particularly within the burn population, include avoidance of social interaction, loneliness and living a solitary lifestyle.

Thus, the first step in scar management is to consider the whole patient. The stressors and history behind the scar are important to address prior to subsequent treatment. Approaches such as suggesting stress-management techniques perioperatively may help improve the chances of a better scar outcome. Counseling or referring to psychiatry is important for patients displaying psychological symptoms. Education plays a helpful role, such as teaching the patient the importance of keeping the scar covered from the sun and applying sunscreen after the surgery. It is important to consider the whole patient when performing a procedure; the patient’s age, incision length and location should be respected in order to ensure the best possible scar outcome.

Principle 2. The body is capable of self-regulation, self-healing, and health maintenance.

Upon any introduction of trauma to the skin, the body elicits an instant repair mechanism that is designed to restore the natural homeostasis of the tissue. This repair mechanism is divided into a series of stages, each having unique characteristics.

The first stage of wound healing is known as the inflammatory phase, where cytokines and inflammatory cells are recruited and infiltrate the site to destroy potential pathogens, remove debris, and initiate coagulation through the formation of an initial thrombus. The inflammatory pathway of wound healing, a large determinant of the outcome of a scar, has long been the focus of attack for anti-scarring research, but strategies that block inflammation alone have so far proved suboptimal with significant side effects.

The second stage, called proliferation, is characterized by the fibroblast cell. Fibroblasts are responsible for producing collagen, which provides the structure to the wound and creates a new matrix—the groundwork of a scar.

Remodeling, the final stage of wound repair, begins at about two to three weeks following trauma and can last for years depending on the size of the wound. During this stage, fibroblasts are responsible for organizing and cross-linking the collagen, increasing the strength of the new site, and causing contraction of the wound edges in the process.

The appearance of a scar is influenced by many factors: the depth of trauma (injury limited to the epidermis can heal without scarring), the location (the chest is an area more susceptible to scar formation), whether the patient is at risk of keloid or hypertrophic scarring (genetics, ethnicity, etc.), age, and nutritional and vitamin deficiencies.

It is important to appreciate that the dynamics between the wound repair process and the scar do not end immediately. Rather, an interplay between the traumatized tissue, the scar, and the surrounding non-traumatized tissue results in altered tissue arrangement that manifests as tissue texture changes contributing to the scar's appearance.
This mechanism can best be explained through the osteopathic bioelectric model of fascia as described by Judith O’Connell, DO, FAAO, which illustrates the important relationship between the dermis and its underlying fascia. Fascia is found between the deep and superficial adipose layers and is connected to the dermis through perpendicular septa of fibrous extensions. It communicates with the dermis via bioelectric currents through the extracellular fluid, which is considered a homeostatic relationship within the skin.

The presence of a scar applies extra mechanical tension to the tissue, causing a disruption of the normal homeostatic signaling between the fascia and dermis. The collagen within the scar itself also releases microelectrical-potential changes into the extracellular fluid. This aberrant bioelectric current not only alters the local architecture of the dermis and fascia but also the arrangement of surrounding tissue (neural, muscular, vascular, and lymphatic), resulting in changes such as stiffness, altered motion, pain, and edema that can be restored using OMT.

Thus, it is important to acknowledge that the wound repair process and its end product, the scar, is not a static process. Rather, there are many dynamic homeostatic elements that are ongoing following scar formation that contribute to the overall somatic dysfunction and scar appearance.

**Principle 3. Structure and function are reciprocally interrelated.**

This principle stems from Dr. Still’s belief that abnormal tissue structure is likely to result in disruptions in tissue function and vice versa. A scar disrupts the normal architecture and function of surrounding skin. The clinical result is an area of skin tissue whose biomechanical function and normal viscoelastic behavior is compromised; it is an area of somatic dysfunction. The skin’s basic protective functions are altered in the presence of a scar. The fibrotic infiltration of a scar alters the complex arrangement of desmosomes and elastin that is used to provide protection and support, leaving the site susceptible to mechanical damage. Similarly, protection against UV radiation is compromised as a scar alters the arrangement of melanin pigments. The processes of hyperkeratinization and DNA repair are also compromised by the altered vascularization created by a scar.

Sensation becomes impaired when the anatomy of the skin’s free nerve endings that normally extend to the epidermis is altered even by the most superficial of scars. Adnexal structures (e.g., hair follicles, sweat and sebaceous glands) as well as components of the dermal extracellular matrix may fail to regenerate following the formation of a scar, resulting in a loss of normal skin function and impaired morphology.

Scars, in the form of adhesions, have the potential to disrupt normal visceral function. Intraperitoneal adhesions are cited to occur after 50% to 100% of the surgical interventions of the abdomen. They can lead to bowel obstruction, irregular bowel movements, meteorism, digestive disorders, female infertility, and chronic lower abdominal pain.

Scars can also cause dysfunction of major muscles and joints. Frozen shoulder, for example, is a well-known complication of the shoulder joint following rotator cuff injury where the shoulder exhibits pain and neurological symptoms from scar accumulation.

Muscular dysfunction may be observed in the dermatological arena following the formation of facial scars. The SMAS is a structure that enmeshes the facial muscles and neurovasculature and plays an intricate role in coordinating and exaggerating facial expressions. If a scar extends to the level of the SMAS, the thickened fibrosis may cause stiffness of the fascia, which may lead to altered range of motion of the facial muscles, affecting normal facial expression.

**Principle 4. Rational treatment is based on an understanding of the basic principles of body unity, self-regulation, and the interrelationship of structure and function.**

Treating relies on a full understanding of how a scar can affect the entire body while acknowledging the first-line evidence-based treatment strategies and knowing alternatives for more refractory cases. First-line treatment for scars includes a variety of options such as silicone sheeting, pressure dressings, intralascular steroids, 5-FU, bleomycin, and verapamil, as well as laser therapy, localized radiotherapy, micro-needling, and intralascular cryotherapy for the more refractory cases.

Osteopathic manipulative therapy is a cost-effective and non-invasive treatment option that may be employed as an adjunct and for those scars resistant to the standard therapy. Several techniques may be utilized and have been shown to be effective in improving the appearance of a scar and its surrounding tissue.

It is important for the osteopathic dermatologist to gain an understanding of which scar characteristics are clinically relevant for OMT and the rationales for treatment based on the models of osteopathic care.

**Identifying a scar to be treated**

The first step in effective OMT is to properly identify whether a scar and its surrounding tissue would benefit from treatment. The level of acuity must be assessed. It is important to not manipulate acute scars, i.e., hot, boggy, tender or erythematous scars, or those exhibiting venous congestion/edema. Manipulation of an acute scar would delay the wound healing process, which would worsen the structure and function dynamics of the scar.

The scar should exhibit chronic somatic dysfunction. By its standard definition, chronic somatic dysfunction is “impairment or altered function of related components of the somatic (body framework) system characterized by tenderness, itching, fibrosis, and tissue contraction; identified by TARTTM.” The forces exerted by the scar to the surrounding tissue, as described above, may manifest as tissue texture changes listed in Table 1. The extent of the tissue texture changes and the restriction and resistance (pathological barriers) of the deeper tissue may be determined by palpation.

**Table 1. Tissue texture changes associated with chronic somatic dysfunction of a scar**

<table>
<thead>
<tr>
<th>Texture Change</th>
<th>Definition</th>
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<tr>
<td>Ropiness</td>
<td>Cord-like, fibrotic feeling (in the scar itself)</td>
</tr>
<tr>
<td>Stringiness</td>
<td>Fine or string-like myofascial structures</td>
</tr>
<tr>
<td>Firmness</td>
<td>Hardening</td>
</tr>
<tr>
<td>Temperature Changes</td>
<td>Changes in temperature increases</td>
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<tr>
<td>Increased/Decreased Moisture</td>
<td>Moisture changes</td>
</tr>
<tr>
<td>Lymphedema</td>
<td>Common finding associated with chronic somatic dysfunction of a scar</td>
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Lymphedema is a common finding associated with the chronic somatic dysfunction of a scar. The term “scar lymphedema” is used to describe the localization of lymphatic fluid around the scar site due to the damage of the lymphatic channels and pathways caused by the surgical incision. The difference between edema and lymphedema surrounding a scar is based upon location of the swelling. With lymphedema, swelling affects only the “upstream” side of a healed incision (such as the circumscribed central area of a U-shaped scar), whereas nonspecific edema will surround the entire scar.

“Active scar” is another term used to describe a scar that would benefit from OMT; it is “active” if it exhibits soft-tissue changes characterized by increased skin drag, owing to increased moisture (swelling), impaired skin stretch, and a thickened skin fold.

The exact timeline of when it is appropriate to treat scars using OMT has not been formally established. The use of pressure therapy on scars after burn injury showed that earlier treatment (scars treated <6 months after burn injury) resulted in better outcome than those treated later. It has been proposed that noninvasive scar management, such as manipulation, typically occur within the early maturation phase of the wound healing process in order to improve scar outcome and accelerate time of scar maturity. More studies are needed to investigate the most appropriate time to implement OMT.

**Treatments**

The biomechanical model and the respiratory-circulatory model of osteopathy help guide the dermatologist to select the most appropriate OMT therapies. Based on these models, soft-tissue techniques, myofascial release and a lymphatic approach to the scar are considered. The therapeutic principles of the models in the osteopathic bioelectric models of fascia and the rationales for treatment based on the models of osteopathic care.
Biomechanical Model: Soft Tissue Techniques and Myofascial Release

The goal of the biomechanical model seeks to address problems with the soft tissue, muscle and fascia by removing the restrictive forces of the tissue. As previously mentioned, there are many restrictive forces or tissue texture abnormalities that may be palpated surrounding the scar. Soft tissue OMT and scar (myofascial) release are two techniques that address these forces and have been shown to improve scar outcome.

Both techniques utilize the concept of pressure restoring balance to the scar. Physical pressure at the site of a scar causes local hypoxia, which induces the regeneration of fibroblasts, suppresses collagen production, and activates collagenase, which overall expedites collagen dismantling. The fibroblasts, which play a role in contracting collagen lattices, are relaxed through the pressure of manipulation. This relaxation results in increased microcirculation to the site owing to the restoration of tissue texture abnormalities. It has been shown that manipulation encourages collagen fibrils of the dermis to realign. The immediate result of these changes can be palpated through the form of a release.

There is a variety of soft-tissue techniques that may be used for treating scars. The treatment goals include increasing tissue elasticity, enhancing circulation to local fascial structures, improving local tissue nutrition and oxygenation, improving local immune response, and providing a general state of relaxation. Scar soft-tissue manipulation is distinguished from scar massage therapy in that it makes use of the barrier-and-release phenomenon; scar massage does not. Soft-tissue techniques used for scars include effleurage, skin rolling, stretching, and petrissage.

Effleurage is a light stroking soft-tissue technique that is used on more superficial scar tissue. McKay performed a five-week treatment of soft-tissue techniques including effleurage to improve the appearance and function of cleft-lip scars. Based upon patient subjective results, she found soft-tissue manipulation to be an effective means for increased patient satisfaction and improvement of the appearance of the scar.

Skin rolling is another soft-tissue technique. It involves lifting the skin away from the deeper structures and “rolling” the skin fold along the body. Pohl examined the changes in the structure of collagen in scars following...
manual treatment using skin rolling with ultrasound. Prior to therapy, the tension of the scar was appreciated using ultrasound echoes that detected higher densities within the collagen fibers. Following the skin-rolling technique, she found a reduction in the densifications of collagen within the dermis as well as an overall increase of thickness in the dermis. These changes were attributed to the relaxation of fibroblasts.

Soft-tissue stretching along the site of a scar has also been shown to be effective in scar management. Soft-tissue stretch engages the barrier palpated along the distal ends of the scar while slowly stretching and releasing the surrounding tissue in multiple planes. Lewit et al. used soft-tissue skin stretching in combination with heat on “active” scar sites following a variety of operations including appendectomy, breast surgery and gynecologic surgery and found marked immediate results with general soft-tissue stretch. The treatment led to decreased pain and increased tissue mobility in the majority of cases. The scar ends were found to be the most active sections of the scar, and treatment was aimed predominately at these sites.

Pettrissage, which is a deeper kneading and squeezing pressure, is considered to be an excellent soft-tissue technique for scars. Morien et al. investigated a combination of effleurage, pettrissage, stretching and rolling in a group of post-burn patients, which showed improvement in range of motion at the scar site and overall patient satisfaction. Field et al. compared a group of post-burn patients who received a combination of skin rolling, stretching and stroking to a group who received no manipulation. It was found that those in the manipulation group experienced a relief of pruritus, pain, anxiety and improvement in mood associated with their scarring.

“Scar release” is an indirect form of a myofascial-release technique that may be used to reduce asymmetric tension and restore functional balance to the stresses transmitted through a scar. It is utilized to engage deeper tissue such as muscle and fascia. Successfully releasing the deep fascial restriction and correcting the restrictive forces in turn activates surrounding bioenergetic tissue.

It has been reported to be an effective technique in improving post-mastectomy axillary cord anchoring secondary to scar formation, leading to improvement of axillary-scar appearance and surrounding lymphedema.

**Respiratory-Circulatory Model:**

**Diaphragm Release and Lymphatic Pump**

Based upon the respiratory-circulatory model, lymphatic techniques are designed to remove impediments to lymphatic circulation and promote and augment the flow of lymph. As previously noted, lymphedema can be a prominent feature of the chronic scar; it may even be measured using lymphoscintigraphy. Mobilizing the tissue surrounding the scar can help improve circulation and the exchange of lymphatic fluids and metabolites, which can ultimately encourage the normal distribution of fibrin and collagen.

The proposed application of lymphatic treatments to scars involves first opening the myofascial pathways to increase microcirculation to the site (via the soft-tissue techniques and myofascial release), and then treating the diaphragms. By definition, diaphragms occur at important anatomical crossroads in the body where curves and cavities change and where passage points for major circulatory and lymphatic vessels occur. Maximizing the motion of diaphragms helps improve circulatory and lymphatic flow, which would be beneficial in the setting of a scar exhibiting lymphedema in the setting of chronic somatic dysfunction. In dermatology, the relevant diaphragms are both peripheral and central, based on the location of the scar as listed in Table 2. Clinical studies are needed in order to explore the outcome of diaphragm release and other lymphatic treatments for scars.

**Examples of Osteopathic Manipulative Treatment Techniques**

**Indirect myofascial scar release (Figure 1)**

1. Place fingers parallel to either side of the scar.
2. Approximate your fingers gently to reduce tension on the scar.
3. Move the tissues on either side gently in different directions (cephalic, caudal, left, right) to determine the tension pattern in the surrounding tissues.
4. Gently move your fingers on either side of the scar in the direction that most reduces tension until you perceive a sense of balance.
5. Hold in the balanced position until you perceive a release, that is, a further relaxation of tension.
6. Achieve relaxation of the tissue by lightly stroking the scar and surroundings.

**Diaphragm release (Figure 2)**

Based on the location of the scar and patient history, choose the most appropriate diaphragm to treat, as noted in Table 2.

1. Using compression, distraction or the full deep respiration cycle, induce motion and note the different patterns of interaction between the normal and dysfunctional tissue response.
2. The dysfunctional pattern, whether a barrier or point of ease, should become apparent at the diaphragm, making the primary dysfunction at the scar evident, and a release should begin.
3. If treating using respirations, motion in the tissue should begin as a release occurs, with a new end point of motion manifesting.

**Conclusion**

By viewing the scar through an osteopathic lens, the dermatologist is able to gain an understanding of how the scar is more than just a fibrosis on the skin; it represents how one dermatological lesion can affect the entire person. It is an active participant within the homeostatic environment of the skin that can affect both structure and function of the human body. Based on available clinical data, osteopathic manipulative treatment should be considered in the dermatological arena as a therapeutic strategy for scar management. Further clinical studies are needed to establish the most effective OMT modalities and the most appropriate time to initiate and continue therapy.

**References**

3. Bordoni B, Zanier E. Skin, fascias and scars: