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Original research

Kinesiotape and Polarized Light Therapy on Post-Burn Scars: A narrative review.

Nosiba Abdelnasser Abdelwahed [1]*, ***Amal Mohamed Abd El Baky*** [1], ***Hanan Rabea Nada*** [2], ***Shaimaa Mohamed Elsayeh*** [1].

[1]*Department of Physical Therapy for Surgery, Faculty of Physical Therapy, Cairo University, Giza, Egypt.*
[2]*Department of Dermatology and Venereology, Faculty of Medicine, Cairo University, Giza, Egypt.*

***Correspondence to:**

Nosiba Abdelnasser Abdelwahed*; PT, MSc, Department of Physical Therapy for Surgery, Faculty of Physical Therapy, Cairo University.*

Email:
nosibaelgabrty@gmail.com

Telephone:
+20 1126499337

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Abstract

Background: Post-burn hypertrophic scars are a major clinical challenge due to their tendency to cause contractures, pain, aesthetic disfigurement, and psychological distress. **Purpose:** This review explores the synergistic potential of kinesiotaping (KT) and polarized light therapy (PLT), two non-invasive interventions with promising effects on scar modulation. **Methods:** A literature search was performed using PubMed, ScienceDirect, and Google Scholar for studies published between 2006 and 2023. Peer-reviewed clinical trials, observational studies, and systematic reviews were included. Keywords included "kinesiotaping," "polarized light," "post-burn scar," "photobiomodulation," and "modified Vancouver Scar Scale. **Results:** The combination of KT and PLT offers a dual-mechanism approach addressing both mechanical tension and inflammatory pathways. Further randomized controlled trials are needed to define treatment protocols and validate long-term outcomes. **Conclusion:** The combination of KT and PLT offers a dual-mechanism approach addressing both mechanical tension and inflammatory pathways. Further randomized controlled trials are needed to define treatment protocols and validate long-term outcomes.

Keywords: Burn rehabilitation, Hypertrophic scar, Kinesiotaping, Photobiomodulation, Polarized light therapy.

INTRODUCTION:

Hypertrophic scar (HTS) is abnormal excessive healing response as a common consequence of burn injury. These scars, marked by excessive collagen deposition and tissue thickening, typically develop within one to three months post-burn and are associated with contractures, disfigurement, and functional limitations. Globally, millions of individuals are affected, and in high-income countries alone, abnormal skin scarring is estimated to impact approximately 100 million people annually[1].

Individuals with darker skin tones are particularly at risk, with hypertrophic scarring reported in 4.5% to 16% of Black and Hispanic populations[2]. In addition to causing physical impairments, such as limited joint mobility and pain, these scars frequently contribute to psychological distress, including reduced self-esteem, anxiety, and social isolation[3].

Despite the availability of multiple treatment modalities—including pressure therapy, silicone gels, corticosteroid injections, laser treatments, and surgical revisions—hypertrophic scar management remains

suboptimal, with outcomes often failing to meet clinical expectations[4]. The economic burden is also substantial, with global wound care expenditures estimated at $20.8 billion annually[5].

In response to these limitations, there has been growing interest in non-invasive, adjunctive therapies that promote scar remodeling while minimizing side effects. One such modality is kinesiotaping, a biomechanically based technique that involves the application of elastic tape to lift the epidermis microscopically. This reduces pressure on mechanoreceptors, enhances local circulation, and facilitates lymphatic drainage, thereby creating an optimal environment for tissue repair and remodeling[6].

Another emerging strategy is polarized light therapy, which supports wound healing through photobiomodulation. Unlike natural light, polarized light features a uniform electric field orientation, either generated at the source or through specialized optical filters[7]. Devices such as Bioptron emit safe, polychromatic, non-coherent polarized light that activates cellular processes without the thermal risks associated with lasers[8]. Documented therapeutic effects include improved microcirculation, enhanced collagen reorganization, and downregulation of inflammatory mediators such as interleukin-6 (IL-6)[9].

Given the individual benefits of kinesiotaping and polarized light and the limitations of conventional interventions investigating their combined application presents a novel, promising strategy. This narrative review aims to synthesize current evidence regarding the independent and synergistic efficacy of kinesiotaping and polarized light therapy in managing post-burn hypertrophic scars.

METHODS

A comprehensive literature search was conducted across PubMed, ScienceDirect, and Google Scholar for articles published from 2006 to 2023. The selection criteria included peer-reviewed clinical trials, observational studies, and systematic reviews. The search utilized keywords such as "kinesiotaping," "polarized light," "post-burn scar," "photobiomodulation," and "modified Vancouver Scar Scale".

Pathophysiology of Post-Burn Scars

Post-burn hypertrophic scarring arises from a dysregulated wound healing cascade characterized by persistent inflammation and abnormal fibroblast activity[5]. In typical healing, three overlapping stages occur: inflammation, proliferation, and remodeling. Thermal injuries often prolong the inflammatory and proliferative phases, delaying maturation and resulting in aberrant scar formation[10].

Following a burn injury, an intense inflammatory response is triggered, leading to elevated levels of cytokines such as IL-6, TNF-α, and TGF-β. While IL-6 and TNF-α initiate early inflammatory responses, TGF-β is instrumental in activating fibroblasts and promoting the deposition of type I and III collagen[11]. Excessive TGF-β activity transforms fibroblasts into myofibroblasts, which persist abnormally and continue secreting extracellular matrix long after re-epithelialization. As a result, hypertrophic scars form within the original wound margins as raised, dense, and rigid lesions with disorganized collagen bundles. This differentiates them from keloids, which invade surrounding healthy skin[3]. The disordered collagen contributes to reduced tissue pliability, limited range of motion, and potential contracture formation (**Figure 1)**.

A key predictor of hypertrophic scarring is delayed wound closure. Re-epithelialization that exceeds three weeks significantly increases the risk, largely due to prolonged cytokine signaling [12]. Moreover, mechanical tension on the wound stimulates mechanosensitive signaling pathways that further activate fibroblasts and increase collagen production[5]. This explains the frequent occurrence of hypertrophic scars in high-mobility regions such as joints, shoulders, and the anterior chest[1].

Other contributing factors include burn depth, anatomical site, patient age, and skin type. Individuals of African and Hispanic descent are especially susceptible, likely due to genetic variations in inflammatory response and fibroblast activity[2].

Understanding these underlying biological mechanisms provides the basis for exploring targeted, non-invasive interventions, such as kinesiotaping and polarized light, that can modulate the inflammatory microenvironment, regulate fibroblast behavior, and promote collagen reorganization.

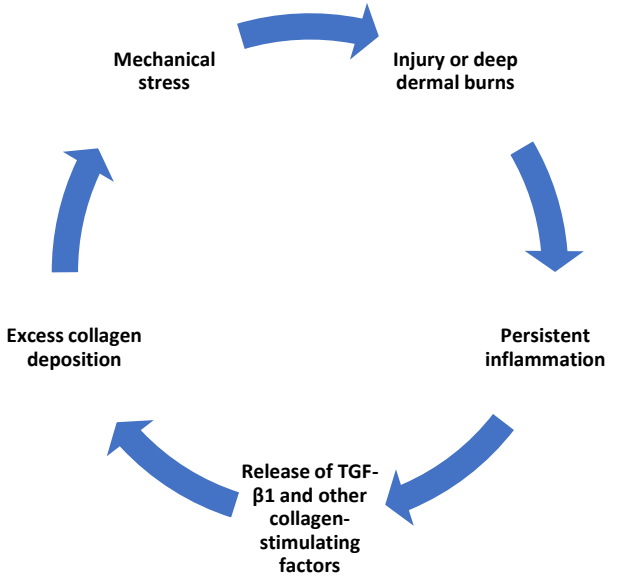

Figure 1. Pathophysiology of hypertrophic scars. Deep dermal injury triggers a prolonged inflammatory response, fibroblast activation, excess collagen deposition, and mechanical tension-all of which contribute to thick, raised scar formation.

Assessment Tools for Post-Burn Scars

Reliable assessment of hypertrophic scars is essential for individualized treatment planning, therapeutic monitoring, and consistent data reporting in clinical research. Scar evaluation methods are typically divided into two categories: subjective and objective. Subjective tools include the Vancouver Scar Scale (VSS) and its modified version (mVSS), which assess vascularity, pigmentation, pliability, and height to generate a composite severity score. Additional validated instruments such as the Visual Analogue Scale (VAS), the Patient Scar Assessment Scale, and the Manchester Scar Scale incorporate patient-reported perceptions regarding scar appearance, discomfort, and function. However, these methods are susceptible to inter-rater variability and observer bias, particularly in the evaluation of color and texture [13].

To overcome these limitations, objective assessment tools are increasingly used to quantify the biomechanical and physiological properties of scar tissue. Cutometers measure skin elasticity through suction-induced deformation, while tonometers and durometers assess firmness and pliability. Chromameters and spectrophotometers are employed to analyze scar pigmentation, offering standardized colorimetric data. High-frequency ultrasound is commonly utilized to evaluate scar thickness and structural characteristics, whereas laser Doppler imaging provides valuable insights into scar perfusion and vascular dynamics[14].

Among these, the Schiotz tonometer—originally developed for measuring intraocular pressure—has been adapted for scar evaluation by assessing mechanical resistance through standardized indentation. Although effective, its accuracy can be influenced by factors such as skin hydration and the thickness of underlying tissues[15].

Given the complex nature of hypertrophic scarring, a multimodal assessment strategy that combines subjective tools like the mVSS with objective devices such as the Schiotz tonometer is recommended. This integrated approach improves diagnostic accuracy, facilitates tailored treatment decisions, and enhances the consistency and reproducibility of clinical research findings[16].

Rehabilitation of Post-Burn Scars

Hypertrophic scars, often resulting from deep dermal burns, are characterized by excessive collagen deposition, resulting in raised, red, and rigid lesions. These scars can significantly impair joint mobility, cause pain and pruritus, and adversely affect psychological well-being [3]. Effective rehabilitation requires a multidisciplinary approach involving medical, surgical, and physical therapy interventions[4].

Medical management includes topical agents such as nonsteroidal anti-inflammatory drugs (NSAIDs), onion extract gel, and mugwort lotion, which have demonstrated limited but encouraging evidence in small-scale studies[17]. Oral tranilast, an anti-allergic medication known to inhibit transforming growth factor-beta 1 (TGF-β1), has shown potential in reducing scar-

associated inflammation and subjective symptoms[18].

Surgical intervention is generally reserved for smaller, linear hypertrophic scars or in cases of significant cosmetic concern. When contractures impair movement, release procedures become necessary to restore function. Techniques such as Z-plasty, W-plasty, and local flap procedures, often in combination with subcutaneous or fascial tension-reducing sutures, are commonly employed to redistribute mechanical forces and improve surgical outcomes[19].

Physical therapy forms the cornerstone of conservative scar management. Common modalities include topical or intralesional corticosteroid administration, compression therapy, and silicone gel sheeting—widely regarded as first-line treatments to reduce scar thickness, erythema, and related discomfort[20].

Kinesiotaping (KT) has emerged as a valuable adjunct in post-burn scar rehabilitation. Developed by chiropractor Kenzo Kase in 1973, KT is an elastic, cotton-based adhesive tape capable of stretching up to 140% of its original length. It supports soft tissue without restricting movement[21]. KT has been associated with improved muscle tone regulation, reduced paresthesia and edema, and enhanced functional performance, particularly in patients with dorsal hand burns[22]. Applied to clean, degreased skin, the tape typically remains in place for up to seven days[23].

Mechanistically, KT is thought to reduce scar contracture by redistributing dermal tension, thus modulating the biomechanical forces that contribute to fibrosis[24]. This is especially beneficial in areas overlying joints, where maintaining range of motion is critical. When applied properly, KT can influence scar height, elasticity, pigmentation, and sensitivity. Its elastic recoil may aid in disrupting fibrotic tissue while stimulating remodeling of laminin and collagen fibers, ultimately improving pliability[25]. Clinical findings have reported reductions in scar thickness and a decreased need for surgical revision in KT users[26].

Bioptron polarized light therapy (PLT) is another non-invasive, adjunctive strategy with growing clinical relevance. It utilizes UV-free, polychromatic polarized light (480–3400 nm) to stimulate cellular and physiological processes conducive to wound healing and scar remodeling [27]. The Bioptron device emits low-energy, incoherent light with parallel-polarized waves, mimicking natural solar light without UV radiation[28]. Its therapeutic benefits include enhanced microcirculation, mitochondrial activation, promotion of collagen and elastin synthesis, and suppression of localized inflammation[29].

At the cellular level, polarized light is believed to reorganize phospholipid bilayers, improve membrane protein functionality, and facilitate key processes such as neurotransmitter release, ion transport, and ATP synthesis. These effects promote efficient tissue regeneration[30]. Moreover, Bioptron light has been shown to decrease levels of interleukin-6 (IL-6), a cytokine closely linked to hypertrophic scar pathogenesis, and stimulate cytochrome C oxidase activity within the mitochondrial respiratory chain[31].

DISCUSSION

The integration of KT and Bioptron PLT offers a dual-mechanism approach targeting both the biomechanical and cellular dimensions of scar formation. KT alleviates mechanical stress and supports dermal realignment, while polarized light modulates the inflammatory and metabolic environments at the tissue level. Together, they may enhance scar elasticity, reduce hypertrophy and erythema, alleviate symptoms such as pain and pruritus, and improve overall joint function and quality of life[8].

Although kinesiotaping and polarized light therapy have each been investigated for their individual benefits in scar management, scientific evidence regarding their combined application remains limited. Preliminary clinical observations indicate that the simultaneous use of both interventions may accelerate scar softening and alleviate symptoms such as tightness and discomfort, potentially offering faster and more noticeable improvements in scar quality[27]. For instance, **Abdalla et al. (2023)** demonstrated that kinesiotaping significantly

improved hypertrophic scar characteristics following burn injuries, while other studies have confirmed the role of polarized light in enhancing wound healing, reducing inflammation, and promoting tissue regeneration[1]. Despite these promising findings, standardized treatment protocols including ideal application timing, duration, and sequencing have yet to be established. Given that both therapies are non-invasive and generally well-tolerated, their combined use may serve as a valuable alternative for patients who are unsuitable for more invasive treatments.

Though direct research evaluating this dual approach is still emerging, the strength of evidence supporting each modality individually highlights the potential of an integrated therapeutic strategy. By addressing both mechanical tension and cellular-level healing, a combined regimen may yield superior outcomes in scar appearance, pliability, and function. Incorporating such multimodal interventions into standard burn rehabilitation programs holds significant promise, provided that future large-scale, randomized trials confirm their efficacy and establish optimal clinical guidelines.

Limitations

This narrative review is subject to several limitations. Most notably, the current literature lacks high-quality studies specifically investigating the combined application of kinesiotaping and polarized light therapy in the treatment of post-burn hypertrophic scars. The majority of available evidence assesses these therapies independently, limiting our ability to draw definitive conclusions about their synergistic potential.

Furthermore, the studies included often involve small and heterogeneous patient populations and employ inconsistent treatment parameters and follow-up durations. These methodological discrepancies reduce the generalizability and comparability of findings. Additionally, many studies rely heavily on subjective scar assessment tools, which are susceptible to inter-rater variability and observer bias. The evidence base is also predominantly composed of observational studies and non-randomized designs, contributing to a lower overall level of scientific rigor.

To address these limitations, future research should focus on well-designed randomized controlled trials with standardized protocols, sufficient sample sizes, and long-term outcome evaluation. Such studies are essential to establish the clinical efficacy of combining kinesiotape and polarized light therapy, as well as to guide the development of evidence-based guidelines for post-burn scar rehabilitation.

Clinical Implications

Incorporating kinesiotaping and Bioptron polarized light therapy into post-burn rehabilitation protocols holds considerable clinical promise. These non-invasive modalities may help shorten the duration of scar maturation, reduce reliance on surgical interventions, and improve both functional and cosmetic outcomes. Importantly, their non-pharmacological nature makes them attractive options in resource-limited settings where access to advanced surgical or laser-based treatments is restricted. Standardizing these techniques and integrating them into early-phase rehabilitation protocols may enhance accessibility, reduce treatment costs, and improve overall patient outcomes.

CONCLUSION

The management of post-burn hypertrophic scars is complex, involving a confluence of mechanical stress, prolonged inflammation, and excessive collagen deposition. Kinesiotaping and polarized light therapy offer complementary mechanisms that target the biomechanical and cellular underpinnings of scarring. KT redistributes skin tension and facilitates tissue remodeling, while polarized light stimulates mitochondrial activity, enhances perfusion, and reduces pro-inflammatory cytokines.

Together, these therapies present a promising dual-modality approach that may optimize scar healing, reduce symptoms, and improve quality of life. Although preliminary evidence is encouraging, robust clinical trials are urgently needed to validate their combined use and to inform the development of integrated, evidence-based protocols for post-burn scar rehabilitation.

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Conflicts of Interest
There is no conflict of interest.

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