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Review

Prevention or treatment of hypertrophic burn scarring: A review of when and how to treat with the Pulsed Dye Laser

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ABSTRACT

The purpose of this review is to investigate the use of Pulsed Dye Laser (PDL) as a therapeutic tool for hypertrophic burns scarring. The difference between keloids and hypertrophic scars is first described. The review then outlines the progress and assessment of hypertrophic scars for burns patients and the problem of their clinical management. The assessment using both objective and subjective measurements for complete account of hypertrophic scars is explained. The efficacy of PDL for both prevention and treatment is summarised for all hypertrophic scarring and the various laser treatment protocols in previous research is studied. The differentiation between prevention and treatment is discussed in relation to scar duration and the need for prevention rather than treatment is then proposed for intervention using PDL. The paper concludes with recommendations for future research through a prospective randomised, controlled study using 595 nm PDL in the prevention of scars with less than 6 month duration.

Contents

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1. Introduction

Pulsed Dye Laser (PDL) is sparingly used in the clinical environment to treat hypertrophic scars, yet in some major burns centres it has become standard of care. There remains a lack of strong evidence in the literature as to the effectiveness of PDL in the alleviation of hypertrophic burn scars and their symptoms. Improved clarity as to the method and timing of PDL intervention would be beneficial both to patients and to healthcare professionals. This review explores the use of PDL in the treatment of hypertrophic burns scars and outlines the reported effects. It also examines the indications for intervention and the time since injury before laser therapy is performed. This article further investigates the choice of laser settings and the intervention protocol for either treatment or prevention of hypertrophic burn scarring.

2. Hypertrophic and keloid scars

The occurrence of keloids and hypertrophic scars is a common clinical problem that can cause functional impairment and cosmetic deformities. They are pathological cutaneous scars that occur due to surgery, burns or other traumatic wounds. A clinical distinction between hypertrophic and keloidal scars is important but remains clinically difficult and thus controversial. These scars will evidently require different therapeutic strategies but the terms are still used inconsistently and interchangeably [1].

It has been shown that scars can be differentiated from normal skin in their overabundance of collagen in which the bundles are organised in a more parallel manner [2]. Hypertrophic scars contain primarily type III collagen oriented parallel to the epidermal surface, whereas keloid tissue, in contrast, is mostly composed of disorganised type I and III collagen [3].

Hypertrophic scars are known to have significantly higher blood perfusion than keloids, which have poor vascularisation with sparse, dilated blood vessels [4]. The scars are characterised by a diffuse redness that results from a proliferation of capillary vessels inherent to chronic inflammation [5]. Hypertrophic scars are generally elevated, firm and erythematous. They can also tend to be pruritic and tender. By definition, they are limited to the site of the original wound and grow in size by pushing out the scar margins, whereas keloids expand or invade beyond these boundaries. Keloids are sharply elevated, irregularly shaped benign tumours that progressively enlarge due to excessive collagen formation in the dermis during connective tissue repair. They have a similar appearance to hypertrophic scars but can manifest months or years after injury and show no tendency to regress. As opposed to keloids, which are known to have phases of reactivation and enlargement without a quiescent or regressive phase, hypertrophic scarring is known to decrease with time [6].

Keloids mainly affect people aged between 10 and 30 years old [7] and are less common in very young or elderly people. Keloids can affect all races but incidence ranges are highest in African populations at 6–16%. Hypertrophic scarring can occur at any age and rates of occurrence vary from 40% to 70% following surgery to up to 91% following a burn injury, depending on the depth of the wound [8–10]. Both types of scarring have an equal gender distribution.

3. Hypertrophic burn scars

This review aims to focus on the clinical problem of hypertrophic scars in burns patients. Hypertrophic scarring is often seen to occur where the injury affects the reticular dermis and, in particular, after a deep dermal or full thickness burn [11]. Burns scars can cause widespread skin damage and are common in both children and adults. Children are particularly susceptible to hypertrophic scarring due to the rapid nature of their cell formation [12].

Survival from burns injury has improved over the last few decades but the management of aesthetic appearance has not kept up with this. Indeed there is no clearly superior method to treat burns scars. These scars generally cause great morbidity and thus incur a problematic management. A study on patients with hypertrophic scars and keloids has shown that there is impairment to their quality of life [13]. For example, the scars may be continually itchy or painful resulting in a loss of sleep. There may be a loss in mobility due to contracture that results in a loss of function in the underlying joint. In larger areas of hypertrophic scarring, there can be additional problems such as loss of hair follicles or sweat glands. This can result in a decrease in protection from mechanical trauma, reduced protection from UV radiation and loss of thermoregulation.

It has been demonstrated that hypertrophic scars can become psychologically debilitating by affecting both self-esteem and body image [14]. Therefore the pressing need to lessen the degree of scarring and to address the symptoms is deemed highly important in clinical medicine.

4. Progress of hypertrophic scars

Hypertrophic scars generally develop between 2 and 6 months after initial injury. Scar hypertrophy shows increased levels between 6 and 12 months and a tendency to regress during the maturation phase between 18 and 24 months after injury [4]. They are more prevalent in anatomical areas of high skin tension such as the chest wall, shoulders and upper arms and lesions are commonly found in areas that are difficult to hide. Many factors such as race, age, genetics and immunological response of the patient appear to play a role in the development of hypertrophic scars and there are other complicating factors such as infection that may increase the degree of hypertrophy.

Their formation results from alterations in the sequential process of wound healing, which normally proceeds in three stages; inflammation, proliferation and remodelling. They are characterised by proliferation of dermal tissue with excessive deposition of fibroblast-derived extracellular matrix proteins and by persistent fibrosis and inflammation.

Hypertrophic scars are notoriously difficult to treat due to their high recurrence rate and the adverse effect profile