# A Systematic Review of the Effectiveness of Laser Therapy for Hypertrophic Burn Scars

Jennifer Zuccaro, MSc[a,b,*], Natalia Ziolkowski, MD[a,b], Joel Fish, MD, MSc, FRCSC[a,b,c]

**KEYWORDS**

• Burn • Scar • Hypertrophic • Laser therapy • Scar management

**KEY POINTS**

- Hypertrophic scars are a common complication following a burn injury.
- Different lasers can be used to treat the symptomatic characteristics associated with hypertrophic scars.
- The aim of this systematic review is to assess the effectiveness of laser therapy for the treatment of hypertrophic scars resulting from a burn injury.

## BACKGROUND

The World Health Organization has recognized that nonfatal burn injuries are a key contributor to morbidity.[1] The most common complication experienced by burn survivors is the development of hypertrophic scarring, with incidence rates ranging from 30% to >60%.[2,3] Hypertrophic scars occur when the normal healing process is disrupted, causing increased inflammation and excess collagen accumulation at the wound site.[4] As a result, hypertrophic scars appear thicker than normal scars and are associated with symptoms including redness, stiffness, pain, and pruritus. Over the last several decades, laser therapy has emerged as a therapeutic tool to improve the symptomatic characteristics associated with hypertrophic scars caused by serious burn injuries.[5] According to Anderson and colleagues,[5] the three main groups of lasers that can be used to improve scars include the following: (1) pulsed dye lasers (PDLs) and devices that use similar technology, (2) Q-switched Nd:YAG lasers, and (3) ablative and nonablative fractional lasers. In 2011, Vrijman and colleagues[6] conducted a systematic review that investigated the effectiveness of laser and intense pulsed light (IPL) therapy for hypertrophic scars resulting from any cause. After carrying out the review, the investigators concluded that they did not have adequate evidence to comment on the efficacy of the different lasers used. However, they noted that restricting the review to include scars from a single cause may reduce the risk of bias because response to treatment may differ among different types of scars (ie, burn, acne, surgical). Thus, the aim of this systematic review is to assess the effectiveness of laser therapy for the treatment of hypertrophic scars resulting from a burn injury.

The authors have nothing to disclose.

[a] Division of Plastic and Reconstructive Surgery, Hospital for Sick Children, 555 University Avenue, Toronto, Ontario M5G 1X8, Canada; [b] Institute of Medical Science, University of Toronto, 1 King's College Circle, Toronto, Ontario M5S 1A8, Canada; [c] Department of Surgery, University of Toronto, 149 College Street, Toronto, Ontario M5T 1P5, Canada

* Corresponding author. Division of Plastic and Reconstructive Surgery, Hospital for Sick Children, 555 University Avenue, Toronto, Ontario M5G 1X8, Canada.

*E-mail address:* Jennifer.zuccaro@sickkids.ca

Clin Plastic Surg ■ (2017) ■–■

http://dx.doi.org/10.1016/j.cps.2017.05.008

## METHODS

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses checklist was used to carry out this systematic review.[7]

### Objective

The objective of this systematic review is to assess the effectiveness of laser therapy for the treatment of hypertrophic burn scars.

### Selection Criteria

#### Inclusion criteria

Peer-reviewed journal articles that were randomized controlled trials (RCTs), quasi-RCTs, observational studies, and case series $\geq$5 were considered for review. Only patients that were diagnosed with hypertrophic scars secondary to burn injuries were included. The treatment of the intervention group was limited to laser therapy only (without a co-intervention). If present, comparative control interventions consisted of another therapy or no treatment at all. Last, only studies that used objective and/or subjective scar assessment scales and/or patient/clinician-reported outcome measures were included.

#### Exclusion criteria

Studies that included other scar types or scars from other causes were excluded from this review unless the appropriate subgroup analysis was carried out (subgroup = hypertrophic burn scar $\geq$ 5 cases).

### Search Strategy

In conjunction with the principal author, an expert medical librarian from the authors' institution developed the search strategy for this review by updating and adapting the search strategy used by Vrijman and colleagues.[6] The databases MEDLINE (1946 to December 2016), EMBASE (1947 to December 2016), CENTRAL (inception to December 2016) on the Ovid platform, and Web of Science (1900 to December 2016) were searched. Search terms included database subject headings and text words for the concepts "hypertrophic scars" and "laser therapy." When appropriate, truncation symbols were used to capture variations in the endings of the text word search terms. The search was limited to human studies only and those published in English. The reference lists of relevant studies were then hand-searched to identify additional studies.

### Study Selection

After all duplicate articles were removed, two review authors (J.Z. and N.Z.) independently examined study titles and abstracts to determine which articles should be included for further review. Full-text versions of the agreed upon articles were then reviewed according to the above-mentioned selection criteria. Authors of articles with unclear selection criteria were contacted for further clarification. Disagreements between reviewers regarding study eligibility were resolved by the third author (J.F.). The overall process for study selection is depicted in **Fig. 1**.

### Data Extraction

The two reviewers (J.Z. and N.Z.) used a customized data extraction form designed (E.S. Ho and colleagues, unpublished observations, 2016) that was based on the Cochrane Consumers and Communication Review Group's data extraction template.[8] Disagreements between reviewers regarding data extraction were resolved by the third author (J.F.).

### Risk of Bias and Quality Assessment

Evaluation of risk of bias and methodological quality were informed by the Risk of Bias in Nonrandomised Studies of Interventions (ROBINS-I) tool, and Strengthening the Reporting of Observational studies in Epidemiology (STROBE) guidelines.[7,9–12] Using a template designed by Ho and colleagues, study biases were categorized as (+) low risk, (−) high risk, or (?) unclear, whereas the reporting and rigor of study quality components were evaluated as (Y) yes, (N) no, (?) unclear.

## RESULTS

### Selected Studies

The search strategy and hand-searched references generated 960 studies for potential inclusion in this review (refer to **Fig. 1**). After duplicate records were removed, 331 records remained. Two hundred seventy-one articles were subsequently excluded after reviewing titles and abstracts, leaving 60 articles eligible for full-text review. Twelve studies met the selection criteria and were included in this review (justifications for exclusions are detailed in **Fig. 1**).[13–24] More specifically, six studies used a pretest-posttest design in which each patient's scars were assessed before and after laser treatment,[14,18–21,23] whereas one study used a proxy pretest-posttest design in which patients were given a posttreatment questionnaire and asked to recall how they felt before receiving laser therapy.[17] In addition, five studies used a controlled clinical trial design, which included a matched untreated scar area for comparison.[13,15,16,22,24]