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REVIEW

A Systematic Review on the Effect of Mechanical Stretch on Hypertrophic Scars after Burn Injuries

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stretching exercise

Summary *Objective/Background:* To review the effect of mechanical stretch on hypertrophic scars after burn injuries.
Methods: A systematic review of all controlled trials related to the effect of mechanical stretch on post burn hypertrophic scars was conducted. Studies of conservative scar managements that applied mechanical forces parallel to the scar surface, including stretching exercise, massage, and splinting, were appraised. Eligible studies published in English between 1995 and 2016 were extracted from The Cochrane Library, MEDLINE, CINAHL, Science direct, SPORTDiscus, and Physiotherapy Evidence Database Scale (PEDro). The journals were further screened with inclusion and exclusion criteria. PEDro was selected for further analysis and appraisal.
Results: There were 853 articles identified. After a standardized screening mechanism stipulated, only nine full-text articles were selected for critical appraisal using PEDro. There were five articles of high quality, two of fair quality, and two of poor quality. Detailed training regime and outcomes of nine studies were summarised, including two studies with stretching exercise, six studies with massage, and one study with splinting. The physical parameters of scar assessments and the range of motion on affected areas were compared.
Conclusion: From extensive literature search, there was no strong evidence indicating the positive effect of mechanical stretch using stretching exercise, massage, or splinting on hypertrophic scars. A firm conclusion cannot be drawn for the discrepancy of outcome measures and varied effectiveness. Most of the included studies lacked objective

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evaluation or control group for comparison. Further high quality studies with larger sample size and using standardized measurements are needed.

Introduction

Hypertrophic scars are severe complications after burn injuries. The concomitant scar contractures will develop and expand to underlying connective tissue and muscles, resulting in limitation in joint range of motion (ROM) and participation of daily activities (Dewey, Richard, & Parry, 2011). Despite dedicating investigations in preventing hypertrophic scars, scar contractures, and subsequent impairments, the complex pathogenesis and prolonged dynamic process make the treatment marginally effective (Blakeney, Rosenberg, Rosenberg, & Faber, 2008; Stubbs et al., 2011).

Conservative treatments were preferred in clinical settings to restrain the progression of scar and contracture for their noninvasive and easy-operation properties (Anthonissen, Daly, Janssens, & Van den Kerckhove, 2016). In recent years, the concept of "mechanotherapy" has inspired professionals to implement treatments from a mechanobiological basis (Huang, Holfeld, Schaden, Orgill, & Ogawa, 2013). In substantial basic research related to wound, hypertrophic scar, or keloid, skin tension was reported to have a strong relationship with inflammatory process, collagen orientation, and construction remolding in epidermis and dermis (Bouffard et al., 2008; Du et al., 2013; Junker, Kratz, Tollbäck, & Kratz, 2008). These laboratory tests showed that the influence of stretch on scar proliferation process was dosage-, stage-, and orientation-dependent, suggesting the necessity to explore the effective protocol of "stretch" comprised treatments in corresponding magnitude to prevent hypertrophic scar and contracture in clinical application (Akaishi, Akimoto, Ogawa, & Hyakusoku, 2008; Ogawa et al., 2012; Roques, 2002).

Although many guidelines stressed the importance of implementing mechanical stretch to improve scar texture, prevent or correct scar contracture, and increase ROM, consensus has seldom been reached regarding the detailed protocol and the magnitude of the stretching force. Therefore, this systematic review was conducted to evaluate the quality of published studies and summarise the effectiveness and regime for building up the practical guidelines.

Methods

Search strategy

Articles published from 1995 to 2016 were searched from the electronic database: Cochrane Central Register of Controlled Trials CENTRAL (The Cochrane Library), MEDLINE (1965 to most recent date available), CINAHL (1982 to most recent date available), Science direct, SPORTDiscus (1830+) and the Physiotherapy Evidence Database (PEDro). "Mechanical stretch" after burn injuries was defined as conservative scar managements that applied tensile force parallel to the scar, and stretching exercise, massage, and splinting were included in the analysis. Search syntax following professional standards were developed as: #1: MeSH descriptor: [Burns] explode all trees; #2: burn* or scald* or thermal injur*:ti,ab,kw; #3: MeSH descriptor: [Cicatrix, Hypertrophic] explode all trees; #4: scar* or cicatrix: ti,ab,kw; #5: #1 or #2 or #3 or #4; #6: MeSH descriptor: [splints] explode all trees; #7: MeSH descriptor: [massage] explode all trees; #8: stretch* or splint* or massage*: ti,ab,kw; #9: #6 or #7 or #8; #10: #5 and #9.

To avoid publication bias, additional studies were detected through online clinical trials registered websites (ClinicalTrials.gov, 2000; World Health Organization International Clinical Trials Registry Platform) and bibliographies of relevant publications.

Screening criteria

Studies were included according to the following criteria: 1) prospective controlled trials with full text available in English, including randomized controlled trial (RCT), non-RCT controlled clinical trials (CCT); 2) outcome measures were physical parameters related to scar and scar contracture; 3) interventions were stretching-, splinting-, and massage related. Subjects after burn injuries were not specified in terms of age, race, severity of injury, and stage of scars. Review articles and studies on the aetiology, laboratory tests, and assessments of scars were excluded. Two review authors independently assessed the title and abstract of articles and selected eligible trials. Then, the full texts were reviewed by the same reviewers to include studies using the prestipulated criteria. The disagreement was resolved by consultation with a third reviewer. The process was summarised through Preferred Reporting Items for Systematic Reviews (PRISMA).

Data extraction and quality assessment

The data was extracted independently by reviewers using a standard form, which contained characteristics of subjects, area and depth of injuries, mode and regime of therapies, and outcomes of scar and contracture from all groups. Study design and analytical methods were also recorded for quality appraisal using the Oxford Centre for Evidence-Based Medicine level of evidence (Oxford Centre for Evidence-Based Medicine, 2009) and PEDro Quality Scale (Maher, Sherrington, Herbert, Moseley, & Elkins, 2003).