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Systematic review

Assessment of skin blood flow following spinal manual therapy: A systematic review☆

Rafael Zegarra-Parodi [a, *], Peter Yong Soo Park [b], Deborah M. Heath [c], Inder Raj S. Makin [c], Brian F. Degenhardt [a], Matthieu Roustit [d, e]

[a] A.T. Still Research Institute, A.T. Still University, Kirksville, MO, USA
[b] A.T. Still University, Kirksville College of Osteopathic Medicine, Kirksville, MO, USA
[c] A.T. Still University, School of Osteopathic Medicine, Mesa, AZ, USA
[d] Clinical Pharmacology Unit, Inserm CIC1406, Grenoble University Hospital, Grenoble, France
[e] UMR 1042 – HP2, Inserm and University of Grenoble-Alpes, Grenoble, France

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ABSTRACT

Skin blood flow (SBF) indexes have been used to describe physiological mechanisms associated with spinal manual therapy (SMT). The aims of the current review were to assess methods for data collection, assess how investigators interpreted SBF changes, and formulate recommendations to advance manual medicine research. A database search was performed in PubMed, Cochrane Library, the Physiotherapy Evidence Database, and the Cumulative Index to Nursing and Allied Health Literature through April 2014. Articles were included if at least 1 outcome measure was changes in 1 SBF index following SMT. The database search yielded 344 records. Two independent authors applied the inclusion criteria. Twenty studies met the inclusion criteria. Selected studies used heterogeneous methods to assess short-term post-SMT changes in SBF, usually vasoconstriction, which was interpreted as a general sympathoexcitatory effect through central mechanisms. However, this conclusion might be challenged by the current understanding of skin sympathetic nervous activity over local endothelial mechanisms that are specifically controlling SBF. Evaluation of SBF measurements in peripheral tissues following SMT may document physiological responses that are beyond peripheral sympathetic function. Based on the current use of SBF indexes in clinical and physiological research, 14 recommendations for advancing manual medicine research using laser Doppler flowmetry are presented.

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1. Introduction

Spinal manual therapy (SMT) is a therapeutic procedure commonly provided by clinicians from several healthcare disciplines for the management of musculoskeletal and non-musculoskeletal conditions (Bronfort et al., 2010). Several underlying physiological mechanisms have been proposed for clinical outcomes associated with SMT, the most common being a possible influence on segmental and suprasegmental reflexes with a prominent role given to the peripheral sympathetic nervous system (PSNS) (Beal, 1985; Van Buskirk, 1990; Pickar, 2002; Bialosky et al., 2009). This neurophysiological hypothesis relies mainly on the interpretation of significant changes in skin blood flow (SBF) indexes following SMT (Chu et al., 2014; Kingston et al., 2014). Denslow, Korr, and Wright developed the use of SBF indexes in manual therapy (Wright, 1956) and considered these outcome measurements as potential markers for PSNS function and evaluation of vasomotor reactivity.

SBF changes are usually assessed through skin temperature (ST), skin conductance (SC), pulse plethysmography (PPG), and laser Doppler flowmetry (LDF) (Bolton and Budgell, 2012). These tools are valuable for manual medicine researchers because of their noninvasive nature and ease of use in clinical research. Further, outcomes may reflect changes in the skin and in deeper tissues, but these conclusions are now considered overly simplistic with regard to the complex regulation of the skin microcirculation (Bolton and Budgell, 2012). In thermoneutral environments, many local mediators are involved in skin microvascular reactivity (Roustit and Cracowski, 2013) with a low and transient involvement of

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* Corresponding author. A.T. Still Research Institute, A.T. Still University, 800 West Jefferson Street, Kirksville, MO 63501, USA. Tel.: +1 660 626 2267; fax: +1 660 626 2099.
E-mail address: rzegarraparodi@atsu.edu (R. Zegarra-Parodi).

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sympathetic vasoconstrictor response at rest (Krupatkin, 2008; Charkoudian, 2010). These specificities of skin sympathetic nervous activity (SSNA) and their influence on endothelial pathways regulating SBF have not been explicitly described in previous manual therapy publications (Bolton and Budgell, 2012; Chu et al., 2014; Kingston et al., 2014). Further, previous publications have used heterogeneous methods to assess SBF (Bolton and Budgell, 2012). All these physiological and methodological issues may challenge previous interpretations of SBF changes associated with SMT.

Local human cutaneous circulation has been proposed as a marker of systemic microvascular function. It has been studied in many diseases and with therapeutic interventions assessing microvascular function (Roustit and Cracowski, 2013). Recent advances include simple and noninvasive methods using LDF to assess skin microvascular function when coupled with reactivity tests. Although these methods provide an overall assessment of microvascular function, some are considered more specific for assessing different physiological pathways. Using LDF equipment, reactivity tests evaluating SSNA influence on SBF induce a vasoconstriction (Wilder-Smith et al., 2005), whereas tests evaluating microvascular endothelial function induce vasodilation with limited involvement of SSNA (Cracowski et al., 2006). However, these methods commonly used in physiological research have not been used in manual medicine research (Bolton and Budgell, 2012). Further, SBF combined with other outcome measures evaluating symptoms (e.g., pain scales) and musculoskeletal activity (e.g., electromyography) associated with SMT may provide useful information for clinicians (Sterling et al., 2001; Chu et al., 2014).

The objective of the current systematic review was to critically review the different methods used to evaluate changes in SBF indexes following SMT. We focus on how SBF measurements have been performed and interpreted, and discuss which methodological approaches could be incorporated to advance manual medicine research.

2. Methods

2.1. Search strategy

Guidelines from the PRISMA statement (Moher et al., 2009) were followed in the current review. A search for articles was performed without date and language limitations in PubMed, Cochrane Library, the Physiotherapy Evidence Database (PEDro), and the Cumulative Index to Nursing and Allied Health Literature (CINAHL) through April 2014 using the following search terms: “spinal manipulation” and “spinal mobilization” for SMT in combination with “blood”, “cardiovascular”, “conductance”, “microcirculation”, “sympathetic”, and “temperature” for SBF indexes (Appendix). “Sympathetic”, “conductance”, and “temperature” were used in our initial search because ST and SC were originally used as markers of PSNS activity and the SBF wording was not always in the titles of those studies. The search was limited to human studies. Articles were included in the current review if at least 1

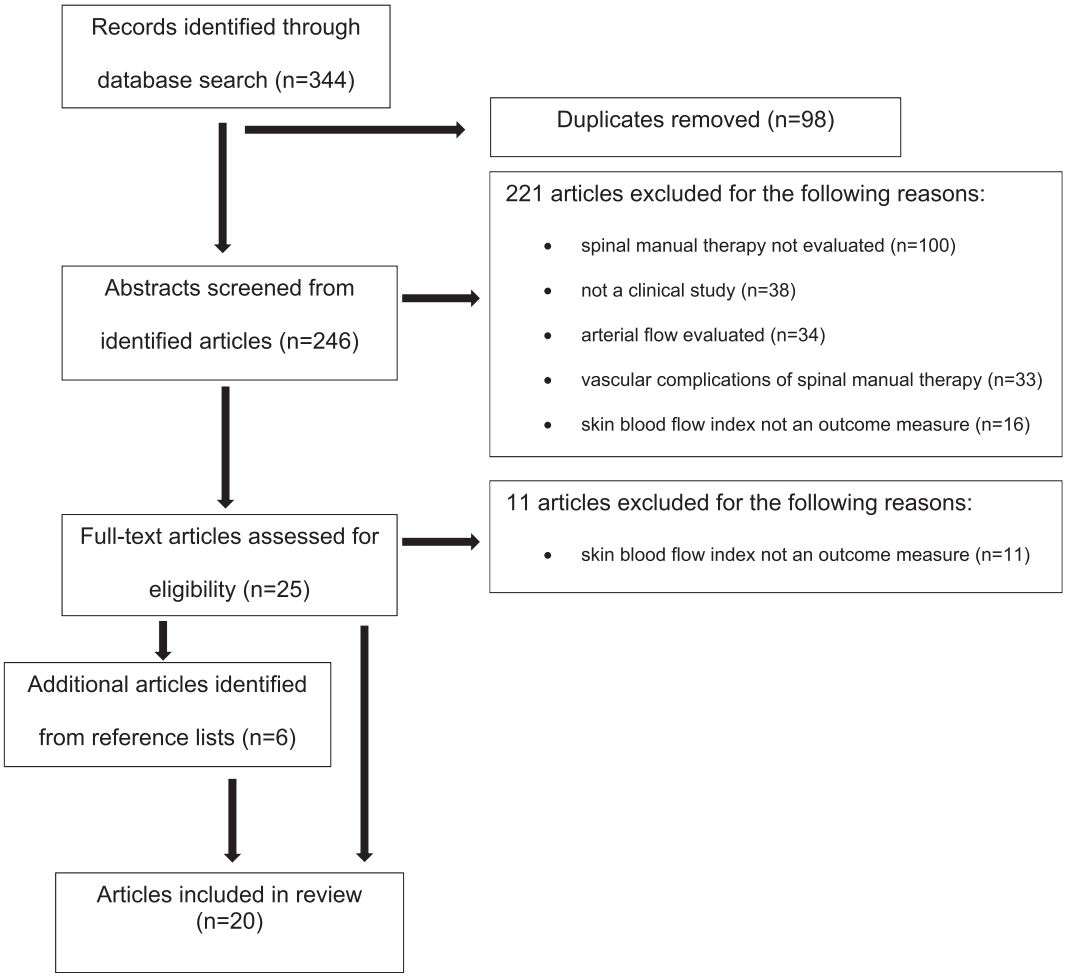

Fig. 1. PRISMA flowchart of the literature search for the current review.

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