Journal of Bodywork & Movement Therapies (2014) 18, 112—118

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.elsevier.com/jbmt

FASCIA SCIENCE AND CLINICAL APPLICATIONS: REVIEW

Connective tissue manipulation: A review of theory and clinical evidence

Liz A. Holey, MA , John Dixon, PhD*

School of Health and Social Care, Teesside University, Middlesbrough TS1 3BA, UK

Received 30 April 2013; received in revised form 20 August 2013; accepted 25 August 2013

KEYWORDS
Connective tissue massage;
Connective tissue manipulation;
Autonomic function

Summary Connective tissue manipulation or connective tissue massage (bindegewebsmassage) is a manual reflex therapy in that it is applied with the therapist's hands which are in contact with the patient's skin. The assessment of the patient and the clinical decision-making that directs treatment is based on a theoretical model that assumes a reflex effect on the autonomic nervous system which is induced by manipulating the fascial layers within and beneath the skin to stimulate cutaneo-visceral reflexes. This paper reviews the literature and current research findings to establish the theoretical framework for CTM and the evidence for its clinical effects. The rationale for the principles of treatment are discussed and the evidence for the clinical effectiveness assessed through an analytical review of the clinical research.

Introduction

Connective Tissue Manipulation (CTM) is a manual reflex therapy which was originally known as Bindegewebsmassage. It was developed in Germany from the 1930s onwards, spread throughout Europe and was introduced to the UK in the 1950s as Connective Tissue Massage (Holey, 1995a, 2000). It was subsequently, from the 1980s, referred to as Connective Tissue Manipulation (Ebner, 1980), as the term massage was thought to be misleading in this context. The terms are used synonymously in the literature and in this review.

CTM is a manual reflex therapy in that it is applied with the therapist's hands which are in contact with the patient's skin. The assessment of the patient and the clinical decision-making that directs treatment is based on a theoretical model that assumes a reflex effect on the autonomic nervous system which is induced by manipulating the fascial layers within and beneath the skin.

This paper reviews the literature and current research findings to establish the theoretical framework for CTM and the evidence for its clinical effects. The specificity of CTM as a treatment approach warrants some explanation, so for this purpose, reference to textbook literature has been

* Corresponding author. Tel.: +44 (0)1642 384125; fax: +44 (0) 1642 342983.
E-mail address: john.dixon@tees.ac.uk (J. Dixon).

1360-8592/$ - see front matter © 2013 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.jbmt.2013.08.003

included. The rationale for the principles of treatment will be discussed and. the evidence for its clinical effectiveness will be assessed through analysis of the clinical research.

CTM

CTM is used within the bodyworker's scope of practice, and, based on clinical experience, can be effective in treating four types of clinical problem. These are either zonal, where the autonomically-induced changes in the tissues of the reflex zone themselves are thought to be producing symptoms; hormonal/endocrine (such as menopausal or menstrual problems, diabetes if within the therapist's scope of practice); local mechanical/musculoskeletal (chronic nerve root pain, for example); or other symptoms, not fitting into these categories, resulting from a general autonomic imbalance (such as sleeplessness, restlessness and anxiety after screening for mental health problems). Several of these categories often co-exist and the problem often presents as a painful condition. Where pain is understood to have an autonomic component, this indicates the patient's suitability for CTM as an intervention. At the initial assessment, the signs and symptoms build into a picture of skin and fascial changes with diverse but autonomically linked symptoms. The connective tissue changes may appear in a region some distance away from the symptoms, in reflex zones which can be seen and palpated and also anatomically explained. CTM is therefore distinguished from other therapeutic approaches which involve manipulation of connective tissue, by being based on the reflex zones of Head (Ebner, 1980). It is also characterised by the specific principles which are followed by the practitioner and the type of manual stroke used.

Head's Connective Tissue Zones are areas of the skin and superficial connective tissue which appear to be indrawn and feel tight or adherent in chronic situations or 'puffy' and swollen in acute conditions. They share the same spinal segment as their related organ or physiological function although the downwards pull of gravity on skin makes them appear a little lower (Holey, 1995b). The heart zone covers the posterior skin area over the left side of the thorax, levels T1-5 and corresponds with the sympathetic innervation of the heart. (Holey, 1995a). Head identified these by linking the tissue changes to symptoms, and Tierich-Leube, in particular, added further clarification based on her experience of observing therapeutic effects of their manipulation. It has been postulated that a specific effect can be obtained on a structure by targeting treatment within the relevant zone via the cutaneo-visceral reflex, but also that a positive effect is obtained through stimulation of the suprasegmental cutaneo-visceral reflex. This could explain why patients often improve considerably by treatment of the 'Basic section' wherever the problem lies.

The stroke is highly specific in two ways. Firstly, the hand positions are important to ensure that sufficient and appropriately-directed traction is exerted at the tissue interfaces. The most effective ways are through the pad of the longest (usually middle) finger or the ends of the thumbs.

Secondly, as the aim is to reach the fascial interface, patterns of strokes are used to enable access to the deep fascia where it lies directly under the skin (Fig. 1). This avoids uncomfortable side effects of treatment. Once the active (visible, palpable and symptomatic) or silent (visible, palpable but asymptomatic) Head's zones are identified, they are linked to the symptoms to build a hypothesis of causation. A treatment plan is developed and the contraindications of acute inflammation, active infection, malignancy, unstable blood pressure/heart conditions, haemorrhage, early or late stage pregnancy, menstruation and use of anxiolytic drugs are excluded.

The principles of treatment are:

1. **The skin must be displaced in relation to the underlying layer.** This creates a shear force at the tissue interface. This mechanical deformation stimulates mechanoreceptors. It also activates mast cell secretion, potentially of histamine, nitric oxide, vasoactive intestinal polypeptide (a vasodilator) and heparin. These cells are present in large numbers around blood vessels (Theoharides et al., 2010). An accurate, skilled, CTM fascial stroke will often produce a triple response reaction of reddening and swelling in a line (wheal) but excessive or inaccurate strokes may produce skin irritation and discomfort.
2. **Work caudad to cephalad** — treatment should start at the apex of the sacrum to desensitise the skin area which is reflexively linked to the parasympathetic nervous system (the "Bladder zone", as the bladder has a parasympathetic nerve supply). This reduces sympathetic activity and starts to rebalance the autonomic nervous system in the desired direction. It also reduces potential unwanted reactions, which, if the principles are not followed, can include dizziness and sweating, fainting, extreme tiredness or irritability and restlessness. These effects are often delayed and may occur when the therapist is out of access, so must be avoided. They are most likely to happen if the skin over dense sympathetically-supplied areas (such as between the scapulae) is stimulated without first de-sensitising by parasympathetic stimulation.
3. **Work superficial to deep.** It is the shear force applied to deep fascia of the fascial stroke which has the potent autonomic effect and this is the target tissue. However, most patients will have some oedema in the superficial fascia and skin, or some excess skin tension. If this is not dealt with first, the treatment will be painful as this type of skin is often tender to touch. The skin technique can reduce hypersensitivity. Pain increases sympathetic activity so will undermine achievement of the intended outcomes. Uncomfortable sensations may also occur such as itching, dull pressure or a prolonged sensation of the treatment strokes for several hours post-treatment. These can be avoided by clearing the skin of excess fluid and tension before moving to deeper layers. The subcutaneous and flashige strokes are used for this purpose.
4. **Target appropriate tissue interfaces to stimulate the fascia.** The strokes are undertaken in specific patterns. These patterns correlate to places where the deep fascia lies under the skin, rather than under muscle. This enables the fascia to be targeted at the correct tissue interface, so reducing unwanted reactions and also ensuring that the clinical effects can be produced in as few treatment sessions as possible, as this is

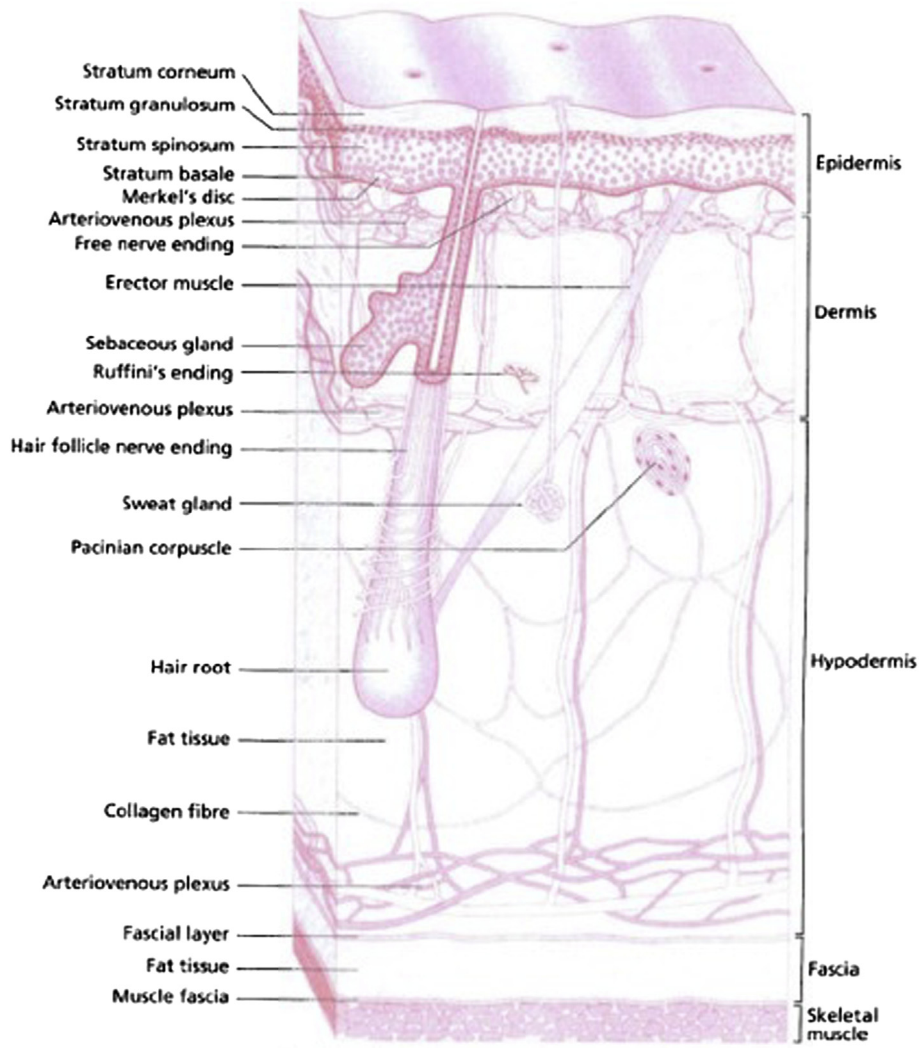

Figure 1 The fascial stroke of CTM Reproduced, with permission from Holey and Cook, p.172.

beneficial to the patient. Where the deep fascia is stimulated, a non-painful sharp or 'cutting' sensation is felt by the patient. Where CTM is applied this precisely, few stroke repetitions are needed so symptoms of overdosing are not induced.

Physiological effects

The technique aims to stimulate the autonomic nervous system to re-balance the parasympathetic and sympathetic systems, usually moving in a parasympathetic direction. It recognises changes in Head's zones to objectively establish causative factors and severity of autonomic imbalance, linking these with subjective symptoms. These zonal areas are then used as treatment points. They are most easily detected on the back (see Fig. 2), as this is where the gravitational pull on the skin in relation to its fascial underlayer is most apparent and practitioners have been found to be able to detect the zones with some reliability (Holey and Watson, 1995).

When the skin is moved on its fascial underlayer in a specific direction, a shear force is produced at the tissue interfaces. These are occupied by horizontal plexi of blood vessels and these blood vessels innervated by autonomic nerve endings. It is thought that this is how CTM produces its powerful autonomic stimulus (see Fig. 3).

The symptoms affected are both segmental and suprasegmental. This means that a generalised autonomic effect will occur and a more evenly balanced autonomic system will be shown by an improved sleep pattern, release of endorphins (Kaada and Torsteinbo, 1989) giving a raise of mood, feeling of relaxation and normalised energy levels. A segmental effect is seen in an improved functioning of the tissues supplied by the same spinal segment of the reflex zone under treatment. This may be improved hydration and texture of the skin, increased circulation to all the structures, improved muscle tone and enhanced visceral function. With these improvements, there is a reduction in pain and stiffness of tissue. This can be significant in conditions where there is intractable nerve root pain, stiff joints, chronic post-operative pain and vaginal atrophy, among others. Whilst similar claims may be made for other forms of soft tissue therapies, the accompanying autonomic effects of CTM can be powerful and overdosing must be avoided. The effects are often

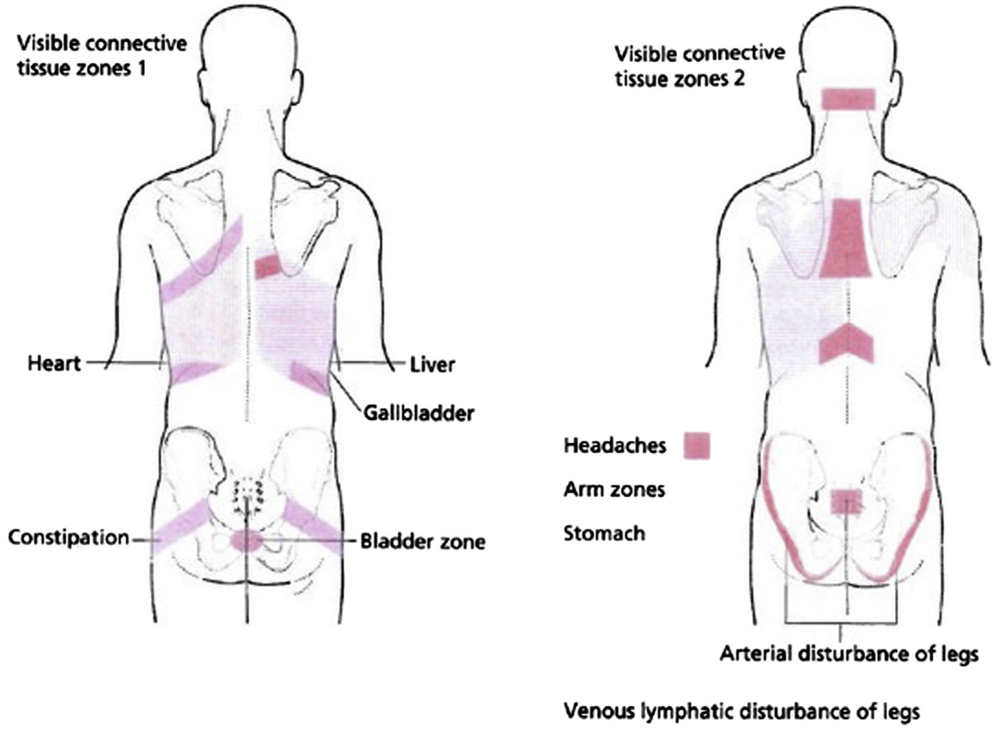

Figure 2 Head's zones Reproduced, with permission, from Holey and Cook p. 40.

Figure 3 Layers of the skin and circulatory plexi Reproduced, with permission, from Holey and Cook p. 11 Reproduced from Holey (1995a,b) Originally published in Schuh 1994 Bindegewebsmassage Fishcer-Verlag, Stuttgart.

achieved at some distance from where the therapy is applied and can be predicted through an understanding of the reflex mechanisms and controlled by application of sound clinical decision-making.

Evidence for a physiological response

There is some experimental evidence that CTM produces a measurable physiological response. CTM has been shown to affect peripheral blood flow in a study of 18 men (Horstkotte et al., 1967), producing an immediate reduction in blood flow, followed by an increase after two weeks. Another study has shown that CTM produced an increased level of plasma beta-endorphins in 12 people with pain of various types (Kaada and Torsteinbo, 1989).

Holey et al. (2011) reported evidence of CTM producing an immediate moderate increase in diastolic blood pressure (BP), but not in systolic BP, heart rate or foot temperature. Kisner and Taslitz (1968) also provided evidence that CTM produces increased sympathetic activity, and their data also suggest that the main effect was on diastolic BP rather than systolic. Reed and Held (1988) reported no CTM effect on mean arterial BP, however they did not report any actual data, and they did not differentiate between diastolic and systolic BP. Clinicians often subjectively observe immediate sympathetic increases, followed by reductions over multiple sessions.

Holey et al. (2011) reported that the area in which a fascial technique was applied demonstrated an observable reddening of the skin and a significant increase in skin temperature (measured by thermography), at 15 min after treatment, which was maintained for at least an hour (the end of data collection). This was not observed where the flashige technique was applied. This evidence of a physiological difference in the effects of the two stokes confirms the assumptions which inform CTM.

Overall, there is evidence that CTM produces effects on the autonomic nervous system, exhibited by various changes in physiological variables. Clearly, more physiological research is needed to fully understand the detailed mechanisms occurring during CTM, enhance the effectiveness of treatment, and reduce potential risks associated with this treatment.

Clinical studies

The aim of this section is to determine the clinical effectiveness of CTM by reviewing the evidence for the effect of CTM in clinical populations. In order to do this, a literature search was conducted in the electronic databases AMED, CINAHL, MEDLINE, from inception to Feb 2013, using the terms connective tissue manipulation, and connective tissue massage. In addition, hand searches were undertaken using references taken from articles. In the search process for this section, studies were included if they were: full length peer-reviewed articles written in English; trials applying CTM in adult clinical populations. Single case reports were excluded. A total of 133 titles were retrieved in the search (AMED 27, CINAHL 37, MEDLINE 69), the number reducing to 114 when exact duplicates were removed by the EBSCO search system. Papers relevant to this area were reviewed to synthesise an evaluation of current knowledge regarding CTM and the clinical relevance of this treatment.

Studies of the effect of CTM (only) with a controlled comparison group

Castro-Sanchez et al. (2011) carried out a trial in which 98 people with type 2 diabetes and stage I or II Peripheral Arterial Disease (58F, mean [SD] age 53.6 [11.7] years) were randomised to a CTM treatment group and a control group (each $n = 49$). CTM was given (2 × 1 hour session per week) for a duration of 15 weeks. The CTM consisted of initial lumbosacral and pelvic strokes, a standardised series of strokes to the spinal axis, then a series of strokes to the lower limbs. A placebo control of sham magnetotherapy to the lower back and popliteal region was used. In post-intervention comparisons, the CTM group displayed significant improvements in numerous variables such as differential segmental BP, improved blood flow, foot temperature and oxygen saturation, and walking distance scores. The between-group comparisons also showed significant differences and these improvements did not occur in the placebo control group. The improvements in most measures remained statistically significant at 6 months and 1 year time-points.

Ulger et al. (2002) carried out a trial in which 34 lower limb amputees (mean age 55 years, gender not stated) with thromboangiitis obliterans (Buerger's disease) were randomised to 3 groups: CTM; interferential therapy; or control. CTM was applied to all three groups who received the control treatment of standard exercises and prosthetic training. The CTM and interferential therapy group received 20 sessions of daily treatment, 10 min per session. CTM was applied to the lumbo-sacral area for the first 2–3 sessions and then also to the lower extremities (no detail is given). No between-group statistical comparisons were carried out. The reduction in pain (VAS) was statistically significant in all three groups after treatment. The mean (SD) VAS pain values (pre & post) were: CTM 7.5 (1.9), 1.4 (0.9); interferential therapy 8.2 (1.0), 0.8 (0.8); control 7.8 (1.1), 2.5 (1.0), and provide tentative evidence that the addition of CTM to the exercise treatment was beneficial. However, as a potential confounding variable, it should also be noted that the while the latter 2 groups had an equal balance of trans-tibial and trans-femoral amputees (50%), the CTM group were 2/3 trans-tibial amputees (8 of 12).

Brattberg (1999) evaluated the effect of 10 weeks of CTM (15 treatments) in a trial of 48 people with fibromalgia (mean [SD] age 40.9 [7.7] years, headache duration 14.2 [5.5] years). Participants were randomised to a CTM treatment group ($n = 23$) and a "reference" group ($n = 25$). This study is difficult to evaluate because it states it had two stages, and the reference group appear to have received CTM in the second stage. The author reports that immediately after the 10 week intervention, current pain was significantly better in the CTM group, but average pain did not differ between groups. Quality of life as measured by the Fibrositis Impact Questionnaire was significantly better in the CTM group. Scores on the Hospital Anxiety and Depression Scale showed a trend for a difference between the groups. The author noted that the CTM treatment effect did fade: after 6 months, pain had returned to 90% of baseline values. These results show positive CTM effects, but it is not clear whether the study had a true control group.

For these three studies, we used the PEDro scale (http://www.pedro.org.au/) to evaluate the quality (internal validity) of the studies. A PEDro score was already available at the PEDro website for Brattberg (1999), and was checked by the authors. The score was calculated by the authors for Ulger et al. (2002) and Castro-Sanchez et al. (2011). The scores were: Castro-Sanchez et al. (2011) 6/10; Brattberg (1999) 5/10; Ulger et al. (2002) 4/10. All had random allocation, low levels of drop-out, but a lack of blinding which can be common in rehabilitation research.

Combination studies, or studies without a control group

In the context of the aim of determining the clinical effect of CTM, unfortunately most of the studies retrieved in the search show particular limitations, specifically having either no control group, or having CTM applied as an experimental treatment in combination with another treatment (i.e. the experimental intervention was not *only* CTM). The former is problematic because a control group is a vital part of any trial, either using usual care or no treatment (Altman, 1991; Domholt, 1993; Pocock, 1983), with both and new treatments being compared concurrently (Bland, 2000). The latter type of design (CTM plus another treatment) means that inferences can only be made about that joint treatment, not about CTM alone: it cannot isolate the treatment effect of CTM (Domholt, 1993). The following studies fit into these categories. They are discussed briefly as, although the true effect of CTM cannot be inferred from these studies, they nevertheless provide some information on CTM as a treatment and the state of the evidence in CTM research.

Citak-Karakaya et al. (2006) reported improvement in the symptoms of 20 women with fibromyalgia following CTM in combination with ultrasound therapy (ultrasound and high-voltage pulsed galvanic stimulation). The study incorporated no control group, and additionally because the CTM was applied in combination with other treatments, the true effect of the actual CTM is difficult to ascertain. The authors point out how ultrasound and galvanic stimulation may both have positive effects, and do state that it is difficult to determine which treatment produced the improvements. Furthermore, they do make clear that placebo effects or natural history may be confounding variables in their findings.

Akbayrak et al. (2001) investigated the effect of CTM in conjunction with classical massage and hot pack application on women with migraine. They found improved VAS pain scores. However as this study has no control group, and also a mixed treatment, it is difficult to be certain of the actual CTM effect in the study. Akbayrak et al. (2002) found four weeks (20 treatments) of CTM produced improvements in pain intensity, duration and frequency at 6 month follow-up in 20 people with tension type headache. However, the lack of a control group means that isolating the CTM effect from other effects such as placebo is difficult.

Maddali-Bongi et al. (2009) investigated the effect of a combination of CTM and McMennell joint manipulation. They randomised 40 people with systemic sclerosis to receive this combination treatment and home exercise, or a home exercise control treatment, for 9 weeks. There were statistically significant improvements in various outcome measures such as SF-36 and Health Assessment Questionnaire in the intervention group, but not in the control group. Hand opening improved in both groups. In similarly designed study by Maddali-Bongi et al. (2011), 40 people with systemic sclerosis were randomised to receive a combination of CTM, Kabat's technique, kinesitherapy (facial exercises), and home exercises, or to receive home exercises alone. The intervention treatment was significantly better than the control home exercises for face and mouth-related symptoms, but neither group showed improvements in quality of life (SF36) or disability (Health Assessment Questionnaire). However in both of these studies, the combination of various treatments means that any CTM effect cannot be determined.

Five other studies have investigated CTM without any control group in the study design. Demirturk et al. (2002) carried out a randomised trial in which 35 patients with chronic tension-type headache were randomised to receive either CTM or Cyriax vertebral mobilisation for 20 sessions over 4 weeks. The study reported post-treatment improvements for both groups in headache index values, pain pressure threshold, and active cervical ROM, and also found no difference between groups. However there was no control group of standard care or no care to give a true comparison. In a study of similar design, Yagci et al. (2004) randomised 40 people with cervical myofascial pain syndrome to receive either CTM (15 sessions, intervention duration unclear) or a spray-stretch technique, with both groups also having an exercise intervention. Both groups showed a statistically significant improvement in pain (VAS), number of trigger points, and cervical range of motion after the treatment. In similar manner, Ekici et al. (2009) carried out a trial in which 50 women with fibromalgia were randomised to receive either CTM or manual lymph drainage 5 times per week for 3 weeks. This study was described as an RCT but it had no control group. Positive findings were reported for both groups in pain, health-related quality of life, and health status (Turkish Fibromalgia Impact Questionnaire). McKechnie et al. (1983) described the effect of CTM in 5 patients with pain of varying sorts. There was no control group and no statistical analysis of group data, but some reductions in heart rate were observed. These studies show some evidence of beneficial effects from CTM but, without any control group, isolating the true CTM effect is problematic. In an experimental single case study, where collecting baseline data prior to the intervention being applied means that the patient acts as his/her own control, Holey and Lawler (1995) showed CTM to be better than classical abdominal massage at reducing constipation and improving consistency of stool. Although this methodology identified a trend for improvement through statistical comparison of the pre-intervention and intervention phases, there was no generalisation to other individuals, so the results should be treated with caution.

Summary of clinical evidence

In clinical research there are only a very small number of well-designed controlled trials with *definitive* evidence regarding CTM treatment effects. That small body of evidence does indicate a positive treatment effect, and seems to indicate CTM may be beneficial, perhaps as an adjunct to standard treatments. However most of the studies published in the area either have no control group or are studies of CTM in combination with other interventions, which markedly affects what can be generalised about actual CTM treatment. These uncontrolled studies can be viewed as phase I or II trials that seem to show evidence of effect, and which need following up with trials using a control group (Pocock, 1983). This scarcity of controlled studies of CTM is disappointing. If the aim of a study is to determine the effect of a treatment, it is essential to have a comparison control group (Altman, 1991). Without a control group it is hard to determine if a new treatment has a real effect, and what the magnitude is (Friedman et al., 2010). This is because trials without a control arm such as a pre-post design can overestimate benefits due to factors such as temporal changes, regression to the mean, Hawthorne effects or any factors producing a bias (Torgerson and Torgerson, 2008). Trials with a no-treatment control arm may be unethical, but trials comparing CTM against standard or usual care would not be problematic and would provide the answers needed about CTM. The studies of mixed interventions do not help answer the question posed, as generalisations about the true effect of CTM cannot be made from them. Nevertheless, these combined treatment studies do suggest potentially positive benefits.

Overall, there is a small amount of evidence that CTM is beneficial. Further uncontrolled studies or investigations of combined interventions also indicate potential for positive benefits, and suggest that at least pilot exploratory RCTs are warranted in those areas. Clearly, further well-designed RCTs are needed to determine the true clinical effect of CTM in various populations.

Overall conclusions

CTM appears to work via a reflex effect on the autonomic nervous system which is induced by manipulating the fascial layers within and beneath the skin. There is some evidence that CTM produces physiological effects on the body. Regarding clinical effectiveness however, very few well designed controlled trials have been published using CTM, but these studies do indicate clinical benefit in relation to pain and peripheral circulation. This reflects the clinical experience of CTM users and the physiological understanding of how CTM works. The majority of published clinical studies in to CTM unfortunately contain no control groups or are of combined treatments. Further research is needed to fully understand the mechanisms and effectiveness of CTM in practice.

Conflict of interest statement

The authors have no conflicts of interest.

References

Akbayrak, T., Akarcali, I., Karabudak, R., et al., 2002. The results of connective tissue manipulation in the treatment of tension type headache. Pain Clin. 13, 343–347.
Akbayrak, T., Citak, I., Demirturk, F., et al., 2001. Manual therapy and pain changes in patients with migraine - an open pilot study. Adv. Physiother. 3, 49–54.
Altman, D.G., 1991. Practical Statistics for Medical Research. Chapman & Hall, London.
Bland, M., 2000. An Introduction to Medical Statistics, third ed. Oxford University Press, Oxford.
Brattberg, G., 1999. Connective tissue massage in the treatment of fibromyalgia. Eur. J. Pain (Lond. Engl.) 3, 235–244.
Castro-Sanchez, A.M., Moreno-Lorenzo, C., Mataran-Penarrocha, G.A., et al., 2011. Connective tissue reflex massage for type 2 diabetic patients with peripheral arterial disease: randomized controlled trial. Evid. Based Complement. Altern. Med. (eCAM) 8, 1–12.
Citak-Karakaya, I., Akbayrak, T., Demirturk, F., et al., 2006. Short and long-term results of connective tissue manipulation and combined ultrasound therapy in patients with fibromyalgia. J. Manip. Physiol. Ther. 29, 524–528.
Demirturk, F., Akarcali, I., Akbayrak, T., et al., 2002. Result of two different manual therapy techniques in chronic tension-type headache. Pain Clin. 14, 121.
Domholt, S., 1993. Physical Therapy Research: Principles and Applications. WB Saunders, Philadelphia.
Ebner, M., 1980. Connective Tissue Manipulations. Krieger, Florida.
Ekici, G., Bakar, Y., Akbayrak, T., Yuksel, I., 2009. Comparison of manual lymph drainage therapy and connective tissue massage in women with fibromyalgia: a randomised controlled trial. J. Manip. Physiol. Ther. 32, 127–133.
Friedman, L., Furberg, C., DeMets, D., 2010. Fundamentals of Clinical Trials, fourth ed. Springer, London.
Holey, E.A., 1995a. Connective tissue manipulation: towards a scientific rationale. Physiotherapy 81, 730–739.
Holey, E.A., 1995b. Connective tissue zones: an introduction. Physiotherapy 81, 366–368.
Holey, E.A., 2000. Connective tissue massage: a bridge between complementary and orthodox approaches. J. Bodywork Mov. Ther. 4, 72–80.
Holey, E., Cook, E., 2011. Evidence-based Therapeutic Massage: a practical guide for therapists, third ed. Churchill Livingstone, Elsevier, Edinburgh.
Holey, E.A., Lawler, H.L., 1995. The effects of classical massage and connective tissue manipulation on bowel function. Br. J. Ther. Rehabil. 2, 627–631.
Holey, E.A., Watson, M.J., 1995. Inter-rater reliability of connective tissue zones recognition. Physiotherapy 81, 369–372.
Holey, L.A., Dixon, J., Selfe, J., 2011. An exploratory thermographic investigation of the effects of connective tissue massage on autonomic function. J. Manip. Physiol. Ther. 34, 457–462.
Horstkotte, W., Klempien, E.J., Scheppokat, K.D., 1967. Skin temperature and blood flow changes in occlusive arterial disease under physiological and pharmacological therapy. Angiology 18, 1–5.
Kaada, B., Torsteinbo, O., 1989. Increase of plasma beta-endorphins in connective tissue massage. General Pharmacol. 20, 487–489.
Kisner, C.D., Taslitz, N., 1968. Connective tissue massage: influence of the introductory treatment on autonomic functions. Phys. Ther. 48, 107–119.
Maddali-Bongi, S., Del Rosso, A., Galluccio, F., et al., 2009. Efficacy of connective tissue massage and Mc Mennell joint manipulation in the rehabilitative treatment of the hands in systemic sclerosis. Clin. Rheumatol. 28, 1167–1173.
Maddali-Bongi, S., Landi, G., Galluccio, F., et al., 2011. The rehabilitation of facial involvement in systemic sclerosis: efficacy of the combination of connective tissue massage, Kabat's technique and kinesitherapy: a randomized controlled trial. Rheumatol. Int. 31, 895–901.
McKechnie, A.A., Wilson, F., Watson, N., Scott, D., 1983. Anxiety states: a preliminary report on the value of connective tissue massage. J. Psychosom. Res. 27, 125–129.
Pocock, S., 1983. Clinical Trials: A Practical Approach. John Wiley & Sons, New York.
Reed, B.V., Held, J.M., 1988. Effects of sequential connective tissue massage on autonomic nervous system of middle-aged and elderly adults. Phys. Ther. 68, 1231–1234.
Theoharides, T.C., Zhang, B., Kempuraj, D., et al., 2010. IL-33 augments substance P-induced VEGF secretion from human mast cells and is increased in psoriatic skin. Proc. Natl. Acad. Sci. 107, 4448–4453.
Torgerson, D., Torgerson, C., 2008. Designing Randomised Trials in Health, Education and the Social Sciences. Palgrave Macmillan, Basingstoke.
Ulger, O.G., Yigiter, K., Sener, G., 2002. The effect of physiotherapy approaches on the pain patterns of amputees for Buerger's disease. Pain Clin. 14, 217.
Yagci, N., Uygur, F., Bek, N., 2004. Comparison of connective tissue massage and spray-and-stretch technique in the treatment of chronic cervical myofascial pain syndrome. Pain Clin. 16, 469–474.

FASCIA SCIENCE AND CLINICAL APPLICATIONS: REVIEW