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The role of touch in osteopathic clinical encounters – A scoping review

Alessio Gessa [a,*], Ian Greaves [a], Jerry Draper-Rodi [a,b]

[a] The University College of Osteopathy, 275, Borough High Street, London, SE1 1JE, UK
[b] National Council for Osteopathic Research, 275, Borough High Street, London, SE1 1JE, UK

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ABSTRACT

Objectives: This study aimed to scope the current scientific evidence about the role, use and effects of touch in the form of assessment and manual therapy intervention during osteopathic clinical encounters, in order to provide an up-to-date understanding of the use of hands-on modalities in the field of musculoskeletal (MSK) treatment. The primary research question was "what is the role of touch during osteopathic clinical encounters?".
Methods: A scoping review was undertaken including all types of research on the topic of touch within the manual therapy world; the neurophysiology of touch; the contextual factors and non-specific effects connected to that. PubMed, Ovid Medline, Ovid Amed, Ovid Emcare and PEDro were searched from 2001 to December 2021. The search was then updated in August 2022.
Results: 45 papers were included; much of the available literature revolved around the role of C-Tactile fibres and their interaction within the brain in relation to manual therapy; there is evidence about the non-specific and contextual factors' influence in this interaction and the communication established between patient and practitioner, as well as treatment outcomes.
Conclusions: Touch can be considered a means through which osteopaths can interact with the patient as a person in a way that goes above and beyond their MSK presentation to enhance better general health and adaptation. However, paucity of data, low quality of evidence and methodological flaws warrant caution in the interpretation of the findings.

Implications for practice

- Osteopathy is in a great position to exploit C-Tactile fibres (CTs), as the slow and soft modalities used in OMT seem to match the qualities to stimulate CTs
- The role of the insula may be crucial in considering the potential role of touch in communication
- Contextual factors play a major role in the perceived quality of touch
- Touch can be considered as a means through which osteopaths can interact with the patient as a person in a way that goes above and beyond their MSK presentation to enhance better general health and adaptation

1. Introduction

1.1. Definition of terms

Osteopathy is defined as a healthcare profession that bases diagnosis and treatment on hands-on and other modalities to provide well-being [1]. Most osteopathic clinical encounters include some form of touch and manual therapy, be it just for assessment or for treatment too [2].

Touch is defined as a sensory modality which transmits signals feeding into three different systems [3].

- Proprioception, the perception of the body's location, movement and position [4];
- Exteroception, the perception of stimuli external to the body (Kassab and Alexandre, 2015);
- Interoception, the perception of the body's internal state through stimuli internal to it (Kassab and Alexandre, 2015).

It can be further subdivided into discriminative and affective, based on the nerve fibres activated by the stimuli [5]. Discriminative touch allows for perception of pressure, vibration and all the critical information related to handled objects [5]; affective touch informs about feelings through the interoceptive system [5].

* Corresponding author. The University College of Osteopathy, 275, Borough High Street, London, SE1 1JE, UK.
E-mail addresses: alessio.gessa@uco.ac.uk (A. Gessa), ian.greaves92@gmail.com (I. Greaves), jerry.draper-rodi@uco.ac.uk (J. Draper-Rodi).

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Therapeutic touch is a nursing intervention which involves a process of energy exchange between the practitioner and the patient; it is based on the modern reinterpretation of ancient healing practices (Denison, 2004).

Touch is considered an integral feature of manual therapy [6]; it is used to evaluate, communicate with, and treat patients [7]. It plays a role in different aspects of clinical encounters and is key in establishing non-verbal communication; the latter will engender trust, a precursor for successful therapeutic relationship [6].

In recent years there has been an extensive debate on the use of manual therapy in the healthcare professions [8]; those against its use state that it offers low value compared to placebo, with elements of harmfulness and disempowerment of patients, alongside lack of evidence about its mechanisms and validity [9]. There exist alternatives to the use of manual therapy within the clinical setting, such as therapeutic exercise, acupuncture, Tai Chi, meditation, yoga [10], and psychosocial approaches [9].

The debate primarily originates from the inconsistency in the scientific literature in the report of the underpinning effects of touch and manual therapy within musculoskeletal (MSK) clinical encounters, with diverging opinions regarding the use of it. This might generate confusion among practitioners, students and educators with the potential to cause demarked divisions within osteopathy as a profession and manual therapy in general.

In their commentaries, Smith [11] and Tyreman [12] suggest that studying touch, and the human interaction that happens through it, is one of the most promising strategies to validate, and find something distinctive about, osteopathy.

This scoping review aimed to outline and critically assess the current scientific evidence about the role, use and effects of touch in the form of assessment and intervention during osteopathic clinical encounters, in order to provide an up-to-date understanding of the use of touch modalities in the management of musculoskeletal care.

2. Methods

Arksey and O'Malley framework (2005) and the recommended enhancements from Levac et al. [13] and Daudt et al. [14] were used for the conduction of this scoping review. This reporting followed the PRISMA Extension for Scoping Reviews (PRISMA-ScR). The protocol was retrospectively registered on the Open Science Framework [15].

3. Research questions

The primary research question was intentionally broad as per scoping review recommendations [16]. This allowed an ample variety of literature on the use of touch within osteopathic clinical encounter to be explored, concepts and themes to emerge and ensured a comprehensive analysis of evidence published in the last 21 years.

3.1. Primary

What is the role of touch during osteopathic clinical encounters?

3.2. Secondary

What are the neurobiological effects of touch?
What are the non-specific effects of touch?

4. Eligibility criteria

Population: studies discussing the concepts and implications of touch provided by professionals, and/or contextual factors in relation to hands-on therapy.

Concept: topics in relation to the neurophysiology of touch and the implications in the management of patients in clinical settings (osteopathy and other manual therapies), including the contextual factors.

Context: clinical and laboratory settings related to human studies.

The eligibility criteria are defined in Table 1.

4.1. Information sources and search

The initial search was conducted on PubMed database using the expanded search string in Pillastrini et al. [17]. The final literature search was expanded to five databases, electronically searched in September and December 2021, with a subsequent update in August 2022, for literature between 2001 and 2022 from PubMed, Ovid Medline, Ovid Amed, Ovid Emcare and PEDro. A combination of MeSH terms and keywords (see Appendix I) were used to retrieve publications in the last 21 years and in English. Additional papers were selected based on reference list screening and recommendations.

4.2. Selection of the sources of evidence

Electronic search results were downloaded on the online management software Rayyan (https://www.rayyan.ai). Duplicates, where possible, were removed. Two reviewers independently screened titles and abstracts applying the inclusion and exclusion criteria (Table 1). Any disagreement was resolved by discussion and consensus between the two reviewers.

The following step was full text review for eligibility carried out independently by two reviewers. Cohen's kappa statistic ("k") was used to measure inter-rater reliability during the title and abstract screening process and the intra-rater reliability during the selection process [18]. Doohoo et al.'s (2012) thresholds were used to assess the level of agreement [18].

Total suitable articles' reference lists where manually searched and relevant articles were then added to the final literature after a manual search of relevant articles. The flow of articles through identification to final inclusion is represented in the PRISMA flow diagram [19] (see Fig. 1).

Data were extracted independently by the author and by the independent reviewer.

4.3. Data charting process

Included articles were critically assessed independently by two reviewers using appropriate critical appraisal tools: AMSTAR 2 (systematic reviews); RoB 2.0 (RCT); CEBM (qualitative studies); JBI (Quasi Experimental Studies or for opinion and/or text papers or Cross-Sectional Studies); SIGN (cohort studies or case control studies); the 2018 version Mixed Methods Appraisal Tool (MMAT).

Inter-rater level of agreement was high for quality assessment (80 %).

5. Results

5.1. Selection of sources of evidence

1662 papers were identified with additional 64 records identified from experts' recommendations and reference screening. After removing the duplicates 1603 articles were screened and 1456 were excluded. 147 titles were screened on full-text leading to 45 papers being included in the review (see Fig. 1).

5.2. Characteristics of sources of evidence

Of the 45 studies included in this scoping review, 22 were opinion papers, 8 RCTs, 5 qualitative papers, 3 cross sectional studies, 2 cohort studies, 2 scoping reviews, 1 systematic review, 1 mixed-methods studies and 1 quasi-experimental study.

Table 1
Inclusion and exclusion criteria

Criteria	Inclusion	Exclusion
Types of literature	• Peer-reviewed literature • Opinion papers • Narrative reviews • Editorials • Papers that focus on or discuss the use of touch within osteopathic and manual therapy clinical encounters. This includes a vast array of manual therapy features, such as hands-on techniques, exercise movement techniques, therapeutic touch, palpation • Literature exploring the neurophysiological effect of touch and/or hands-on interventions/ palpation • Literature discussing placebo effect, contextual factors and therapeutic relationships in relation to manual therapy	• Non-peer-reviewed literature (grey literature) • Literature relating to the use of touch in non-clinical contexts • Literature looking solely at biomechanical outcomes • Literature looking solely at one physiological outcome • Literature not considering implications of touch and/or manual therapy beyond biomechanical effects • Literature looking at solely one specific intervention not related to touch • Literature not considering the use and effects of touch/touch receptors as part of the intervention and/or body of discussion
Date range	2001–2022	Pre 2001
Language	English	Other
Type of study	All	None

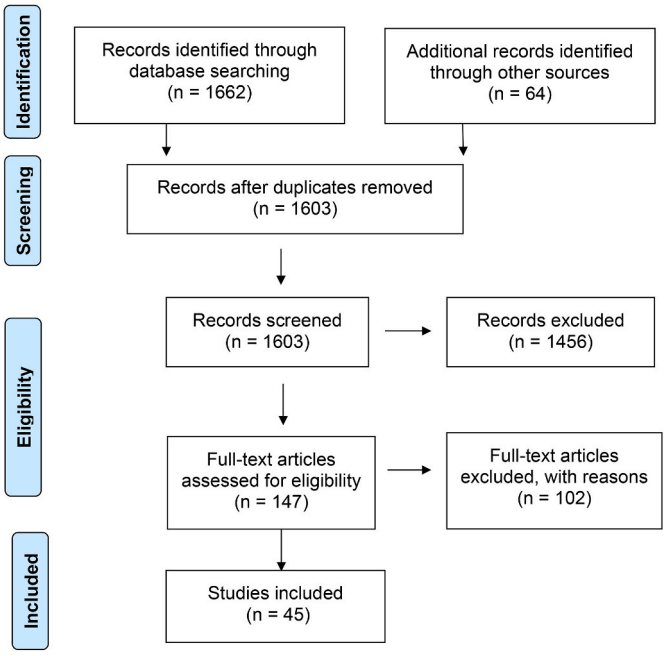

Fig. 1. Prisma flow diagram: search and final inclusion

Studies were conducted across different geographical areas: 17 were based in Europe, 13 in the USA, 8 in the UK, 4 between Australia and New Zealand, 2 in Canada and 1 in Japan. 20 studies were set in a clinical environment, including 8 RCTs.

Touch as an intervention was investigated in 34; 23 lab-based and opinion papers considered the neurophysiology of touch, 8 studies discussed touch as a communication tool between patient and practitioner in the context of a clinical encounter, and 4 discussed touch as a contextual factor contributing to manual therapy non-specific effects.

5.3. Critical appraisal

Critical appraisals summaries are shown in Table 2. A comprehensive review of the individual RoB is presented in Appendix II.

Out of 45 studies, 34 scored as high level of trust, meaning the data extracted from their results could be trusted. The 11 remaining papers included showed moderate risk of bias and strength.

There was some heterogeneity in the appraisal of the RCTs, with 3 studies out of 8 showing moderate risk of bias.

While most papers selected were of adequate quality, many of them were opinion papers which are traditionally more difficult to appraise [20].

Two articles could not be critically appraised (scoping reviews) as no reliable assessment tools were retrieved.

5.4. Results of individual sources of evidence

Results from individual sources of evidence were charted in Table 3.

4.5. Synthesis of results

Every paper contributed to answer the primary research question; seventeen papers (8 RCTs and 7 expert opinion papers) contributed to answer more than one of the secondary questions, whereas the remaining papers contributed to answer one of the questions.

Three main themes were identified; they will be discussed below with an accompanying table related to the studies which informed each of them and their critical appraisal summary.

- C-tactile fibres (CTs) and their central processing
- Touch as a two-way communication
- Effects of touch on interoception, musculoskeletal-immune-neuro-endocrine (MINE) system and autonomic nervous system (ANS) response to touch, placebo effects

6. CTs and their central processing

CTs are a class of afferent neuronal fibres of recent scientific discovery [30]; they are slow-conducting and do not convey discriminative information, but rather the emotional component of being touched [30]. They are present in hairy skin [5], but they have also been detected in glabrous skin [60].

CTs are velocity-, force- and temperature-tuned: they respond to harmless stimuli, mainly at stroking velocity and skin temperature, and at 0.3–2.5 mN of force [5]; the latter seem consistent with the pressure applied during gentle osteopathic manipulative treatment (OMT) [30]. Moreover, CTs and stroking movements stimulate the insula [5,22,52,54], an area of the brain which is fundamental for the emotional aspects of sensory process, such as pain and touch [56], and that is part of the interoceptive system [61].

Interoception is the perception of the physiological state of the entire body, including both visceral and somatic parts [61]. CTs seem to share several features with the interoceptive system, therefore contributing to the perception of the inner feelings of the body and maintenance of homeostasis [62]. Traditionally, diagnosis and treatment in manual therapy rely on a proprioceptive/exteroceptive model with reference to pain, posture and mobility [22]; the discovery of interoceptive receptors has sparked the interest in interoception within manual medicine [3].

It is to be noted that the stimulation of CT fibres is never exclusive since it is not possible to isolate them from Aβ fibres (responsible for somatic perception) in neurologically intact individuals [5]. As a result,

Table 2
Critical appraisal checklists – key

High quality paper
Moderate quality paper
Low quality paper

Quality Appraisal Summary Table

RCTs	Overall quality
Dugailly et al. (2013)	
Cerritelli et al. (2017)	
Manzotti et al. (2020)	
Cathcart et al. (2018)	
Kinkead, B., et al. (2018)	
Gay et al. (2014)	
Blankfield et al. (2001)	
Ruffini et al. (2015)	
Kamiya et al. (2021)	
Qualitative studies	
Bjorbækmo and Mengshoel (2016)	
Consedine et al. (2016)	
Cullen-Powell et al. (2005)	
Rutberg et al. (2013)	
Stöckigt et al. (2019)	
Systematic reviews	
Casals-Gutierrez and Abbey (2020)	
Text and opinion papers	
Bialosky et al. (2011)	
D'Alessandro et al. (2016)	
Elkiss and Jerome (2012)	
Fryer (2017) – part I	
Fryer (2017) – part II	
Gale (2011)	
Geri et al. (2019)	
Hinkeldey t al. (2020)	
Jull (2012)	
Khan and Quatman (2021)	
Lederman (2017)	
Liem (2014)	
McGlone et al. (2017)	
McGlone et al. (2014)	
Patterson (2012)	
Pelletier et al. (2018)	
Rossettini et al. (2020)	
Rossettini et al. (2018)	
Sagar et al. (2007)	
Serino and Haggard (2010)	
Testa and Rossettini (2016)	
Tyreman (2013)	
Zegarra-Parodi et al. (2019)	
Cross-sectional studies	
Lindgren et al. (2012)	
Morris et al. (2014)	
Rizkalla and Henderson (2018)	
Mixed methods	
Jones and Glover (2012)	
Cohort studies	
Haley et al. (2011)	
Nees et al. (2019)	
Quasi-experimental studies	
Denison (2004)	

sensory and emotional inputs constantly interact [46] with the insula acting as a hub for multimodal interoceptive integration [22].

This subtheme was informed by Table 4.

6.1. Touch as a 2-way communication

Touch seems to play a fundamental role in the communication between osteopaths and patients [6]. It seems to establish a physical, bi-directional conversation between the two parts, going from practitioner's hands to the patient's body and the reverse [6].

Baroni et al. [51] identified a psychosocial function of touch relating to communication and to reassurance; this seems to sit at the heart of the interaction between patient and practitioner, contributing to a strong rapport. The latter will influence the treatment's outcome, as demonstrated in a systematic review [63].

Bjorbækmo and Mengshoel [39] stated that touch ranges beyond cutaneous sensation, encompassing meanings that are affective, empathic and metaphorical. By analysing and reflecting on the direct experiences of both physiotherapists and patients, they identified a continuum between verbal and non-verbal communication; it seems that patient and practitioner keep talking but on a different level once the hands-on intervention begins. They also reflected on how the interpretations of the external observer were challenged by the patient when discussing the perceived velocity and abruptness of the techniques applied, which accounted for the emotional component of being touched as a major feature in processing the stimuli. It emerges that touch becomes a way of communication that is receptive, expressive and able to establish empathy which is the ability to embrace someone else's feeling through one's acts [64].

Reinforcing the link between empathy and osteopathy, Rizkalla and Henderson's [57] cross-sectional study investigated the impact of the use of OMT on the students' level of empathy and other behavioural subcomponents; their results show that the frequency of giving and receiving touch through OMT associate with better empathy and emotional behaviour scores. The increase in empathy matches with enhanced patient-practitioners communication, symptoms reporting, accuracy in diagnosing complaints, adherence satisfaction and patients' quality of life [57].

Touch is, therefore, one of the means to create an environment in which the therapeutic relationship can thrive over the clinical encounter (s). They suggest that touch goes beyond cutaneous sensation, creating the conditions in which healing possibilities can be explored through interactions.

Similarly, Consendine et al. [6] analysed the patients' experience of touch during osteopathic consultations. The emerging themes partly confirm the findings of Bjorbækmo and Mengshoel [39] and expand on those. The similar findings revolve around the role of touch in communication as a constant two-way conversation between the practitioner's hands and the patient's body. This is considered important for a successful therapeutic relationship, but also to create professional boundaries; touch must always be perceived as purely professional, making a clear statement of what is appropriate within the consultation [25]. Building on that, the paper explored trust as another key aspect engendered by touch; this is important for reassurance as it communicates academic and practical competence, making the patient feel confident in the way manual techniques are applied. Touching patients in the body part(s) they are complaining about can contribute to build trust and make them feel listened to [65]; also, being touched communicates a sense of being assessed, cared for, and listened to [7].

This subtheme was informed by Table 5.

7. Effects of touch on interoception, MINE and ANS response to touch, placebo effects

Considering its important role in communication and, therefore, in personal connections, touch seems a biologically necessary form of stimulation [5]. It plays a vital role in forming and maintaining social bonds and psychological wellbeing [66–68]; its role may therefore be considered fundamental in approaching patients from a bio-psychological viewpoint, since it may involve aspects of theories of

Table 3
Data extraction summary

Expert opinion	Primary focus of literature	Key Concepts Addressed	Sub-Concepts Addressed	Main Findings/Conclusions
Bialosky et al. [21]	Placebo-related hypoalgesia and role of placebo in MT for MSK pain	Placebo hyperalgesia Descending inhibition	Expectations Prior experience Non-specific effects	Maximise placebo effect during interventions
D'Alessandro et al. [22]	Interoception and sensitisation into manual therapy, specifically osteopathy	Interoception Central sensitisation Efferent system	Autonomic Nervous System (ANS) Brain interoceptive system C-Tactile fibres (CTs) Central sensitisation Vegetative and somatic integration	Interoceptive paradigm in clinical practice CTs and therapeutic touch Osteopathic touch may produce positive feedback effects on sensitisation state
Elkiss and Jerome [7]	Encourage use of touch in osteopathy	Subjective interpretation of peripheral stimuli Touch as differentiating feature of osteopaths Bidirectional dialogue	Therapeutic interaction Musculoskeletal-Immune-Neurological-Endocrine (MINE) system	Touch deepens therapeutic relationship
Fryer I [23]	Framework and likely mechanisms for therapeutic effect of osteopathic treatment	Biological and psychological mechanisms in treatment	Pain mechanisms Therapeutic, biological and psychosocial mechanisms Specific therapeutic effects	Complaints typically multifactorial, Neurophysiological pain modulation of manual therapy well established but non-specific
Fryer II [23]	Mechanisms for therapeutic effect, clinical reasoning and treatment approach	Biological mechanisms of MT Nature of symptoms	Short-term analgesia Pain characteristics and clinical approach Positive language, reassurance	Need to identify type of pain MT based on presentation
Gale (2011)[24]	Body work in complementary and alternative medicine (CAM) education – osteopathy and homeopathy	Touch and palpation Body awareness in health and illness	Dis-ease manifesting in body and embodiment	Body-stories starting from body co-produced through embodied interaction between patient and practitioner
Geri et al. [25]	Different dimensions of touch and implications for physiotherapy	Analgesic touch Affective touch Somatoperceptual touch	Massage/myofascial techniques Spinal manipulative therapy (SMT)	SMT to be used in treatment of acute, subacute and chronic MSK spinal pain Touch to build trust and validate complaint MT generally low risk
Hinkeldey et al. (2019)[26]	Current evidence on mechanisms of touch	Analgesic touch Affective touch Somatoperceptual touch	Interaction between pain pathways CTs Conscious perception of intact body	Ensure touch is sympathetic Touch to establish emotional communication Research on affective touch Promote use of hands-on techniques
Khan and Quatman (2020)[27]	Role of palpation in MSK medicine	Touch to form a bond between provider and patient	Therapeutic and healing properties of touch Patient preference	Incorporate the meaningful and purposeful use of touch into practice
Lederman (2017)[28]	To present the Process Approach to osteopathy	Need for new clinical model Environment and self-healing Multidimensionality of osteopathy	Repair, adaptation and alleviation of symptoms Modelling environment in different phases Soothing alleviation of symptoms through touch Role of touch in Process Approach	Environments supporting patient's recovery are multidimensional and treatment should reflect that. Process Approach directly supports the recovery process
Liem (2014)[29]	Habitual and contextual factors in palpation	Paraedolia Cognitive ease Perceptual bias Intuition Inattentional blindness Cultural and social influences	Confirmation bias Unreliability of palpation One-sided information exposure Heuristic strategies Social/group pressure Language and communication challenge	Sympathetic approach Considering pitfalls may improve palpation
McGlone et al. [30]	Explore sense of touch in broader sense through CTs	Touch and development CTs	Touch/CTs and ANS	Anti-inflammatory properties of osteopathic manipulative treatment (OMT) with the use of CT-tailored touch
McGlone et al. [5]	CTs and substrate for development and function of social brain	Affective touch and CTs afferents CTs Central processing CTs and pain CTs and touch as social mediators	Rewarding properties of gentle touch CTs and pleasure – hedonia CTs and neurodevelopment	Interoceptive purpose of touch Affective touch hypothesis – provide or support emotional, hormonal and behavioural responses CTs as afferent system guarding well-being
Patterson (2012) [31]	Touch and influence on patient-doctor relationship	Touch and emotions/feelings Touch and its importance in OMT	Endocrine effects Psychological effects Integration of MINE concepts	Multimodal effects of touch – 2-way system
Pelletier et al. (2017)[32]	Neurophysiological changes in chronic MSK disorders in sensorimotor and cognitive-affective-motivational areas	Sensitisation and different pain systems OMT and pain/neuroplasticity	Descending modulation Autonomic nervous and neuroendocrine systems Non-specific and specific effects of OMT	Osteopathic multimodal treatment renormalises neurophysiological process and provide better outcome
Rossettini et al. (2020)[33]	Placebo, nocebo and context-related effects	Psychobiological determinants Neurophysiological mechanisms	Patient personality Neurobiological pathways Contextual factors and	Positive healthcare context Psychologically appreciative treatments and growth of the profession

(*continued on next page*)

Table 3 (*continued*)

Expert opinion	Primary focus of literature	Key Concepts Addressed	Sub-Concepts Addressed	Main Findings/Conclusions
		Clinical, managerial and educational implications	modalities Healthcare settings/context Contextual factors in teaching programs	
Rossettini et al. (2018)[34]	Contextual factors' role in MSK medicine	Contextual factors and placebo/nocebo Neurobiology of contextual factors (CF) MSK pain and CF	Therapeutic context role Patient history, expectations and baseline pain Patient centred approach	Global process of care influenced by suitability of therapy and its delivery Conscious use of CFs
Sagar et al. (2007)[35]	Early and later effects of massage interventions in cancer patients	Touch and oxytocin Chronic pain and central sensitisation Touch and central nervous system (CNS) processes	Local and distant effects of massage Tactile, somatosensory attention and reduction in anxiety Local and central (emotional) effects of touch and massage	Massage and biochemical, electrical and physiological changes in local area with subcortical neurologic activity
Serino and Haggard (2010)[36]	To link physical body, sense of touch and mental representation of own body.	Physical body. Tactile sensation. Interaction body representation-primary tactile processing. Object representation from primary tactile sensation.	Topographic representation in S1 represents perception of tactile events. Changing tactile afferent input changes body schema. Visual enhancement of touch (VET) accelerates and improves tactile acuity. Mental body representations (MBRs) mediate tactile perception and tactile perception is body-referenced	Sense of touch has a close and interactive relation with higher cognitive representations of the body. Touch is a crucial agent in construction of self-consciousness.
Testa and Rossettini [37]	Neurobiology of placebo and nocebo Contextual factors and clinical outcomes	Placebo and nocebo Contextual factors	Physiotherapist's/patient's features Therapeutic relationship Treatment features Healthcare setting	Clinical success depends on art component of profession – placebo and nocebo
Tyreman [12]	Relevance of osteopathic principles in modern healthcare	Distinctiveness of osteopathy? Lack of details Osteopathic values	Principles are one of good healthcare No mention of palpation/touch	Palpation and touch lead to benefits that are not just physical, but they need to sit within a rational and justified framework
Zegarra-Parodi et al. (2019) [38]	To document influence of Native American healing traditions on osteopathic principles and modern neuroscientific interpretation of OMT	Holistic approach in osteopathy Spirituality vs bodily Mind-body-spirit and manual therapy Shamanic concepts and touch in modern neuroscience	Native American traditions – self healing facilitation Differences in shamanic and osteopathic approaches	Western MSK practice should address religious and spiritual beliefs in professional and ethical way. Neuroscience may offer theoretical frameworks for osteopathic practices and body-mind-spirit

Qualitative studies	Participant info	Primary study aim	Themes constructed/sub themes	Main findings	Highlights/implication for practice
Bjorbækmo and Mengshoel [39]	6 physiotherapists, 9 patients in close observation. 3 physiotherapists not in observational part	Exploring touch in physiotherapy	Conversation in process Physiotherapy as a "silent touching, moving, dance"	Touch more than exteroceptive sensation; opens the way for trustful, respectful co-existence between physiotherapist and patient	Additional healing possibilities other than pure mechanical application of touch-based approaches
Consedine et al. (2016) [6]	5 patients (2 M 3 W) > 25 years old. English first language. Recruited among patients' lists of 3 experienced osteopaths	Exploring patient's experience and interpretation of osteopathic touch	The process – a physical interaction: Engagement Dialogue Support Professionalism – the practitioner's responsibility: Care Trust Boundaries Reassurance – a therapeutic necessity: Knowledge Competence Confidence	Touch: Central in communication and in enhancing therapeutic relationship Perceived as a support favouring healing Engenders trust Palpation and reassurance role	Centrality of touch in osteopathic practice to communicate, support, enhance trust, create boundaries and show competence
Cullen-Powell et al. (2005) [40]	Convenience sample of 14 parents (1 M 13F) with children (13 M 2 F) within autistic spectrum	Meaning of touch between patient and children before and after a massage intervention. Parents' perception that children have changed	Emotional bonding	Connection through touch Enjoyment and sense of closeness Feeling "part of the child"	Touch as a means of communication other than speech

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Table 3 (*continued*)

Qualitative studies					
	Participant info	Primary study aim	Themes constructed/ sub themes	Main findings	Highlights/implication for practice
Rutberg et al. (2013)[41]	11 migraine sufferers (9F 2 M) with experience of different types of intervention in the past	Lived experience of physical therapy of persons with migraine	Meeting a physical therapist with professional tools and a personal touch	Investing time and energy to health Relying on the competence of the physical therapist Treatment and to involvement as an individual Respect and trustful relationship	Importance of being respected and treated as an individual. Confidence in the physical therapist whilst being treated
Stöckigt et al. (2019)[42]	3 nurses applying InTouch and 5 patients with chronic pain	Subjective experience of nurses and elderly patients with chronic pain relative to InTouch	Perceived effects of InTouch Interplay, empathy and being taken seriously Active non-verbal listening	Exchange of warmth Relaxation Activation and empowerment	InTouch can induce relaxation, well-being and pain relief in elderly suffering from chronic pain; it seems to enhance therapeutic relationship.

Systematic reviews					
	Population/intervention/ outcome	Literature reviewed	Primary study aims and question	Results	Highlights/implication for practice
Casals-Gutierrez and Abbey [3]	Peer-reviewed SRs Investigating neural correlates associated with interoception, mindfulness or touch fMRI studies All population types Previous 5 years English literature	5 systematic reviews containing three meta-analyses	Evaluate current fMRI studies on neural correlates of interoception, mindfulness and touch	Processing of interoception, mindfulness and touch in insular cortex; role for interventions combining bottom up and top-down approaches (manual therapy and psychological), especially where symptoms cannot be explained through proprioceptive/ exteroceptive lens	Neural mechanisms for mindfulness and touch show functional convergence at interoceptive cortex. Further investigations into effects of integrating top-down with bottom-up approaches needed

RCTs					
	Study Aim	Population	Intervention and outcome measures	Results	Conclusion
Blankfield et al. (2001) [43]	Whether therapeutic touch (TT) can improve objective indices of median nerve function in carpal tunnel syndrome (CTS) patients	21 participants with electrodiagnostically confirmed CTS	Random allocation to TT or sham therapeutic touch once weekly for 6 weeks. Distal latency of median nerve, visual analog scale (VAS) and relaxation measured before and after each session.	No significant difference in distal latencies, pain scores and relaxation scores between TT and sham, either immediately after each session or cumulatively. Immediately post-intervention, improvements from baseline among all outcome variables in both groups.	TT no better than placebo in influencing median motor nerve distal latencies, pain scores and relaxation scores. Changes in outcome variables in both groups suggest a possible physiologic basis for placebo effect
Cathcart et al. [44]	Biomechanical, systemic and interoceptive effects of myofascial release (MFR). Hypothesis: increase in range of motion (ROM) and pain point threshold (PPT) and baseline interoceptive sensibility (IS) will predict ROM and PPT	Purposive sample – 12 asymptomatic students, ages 18–55, no systemic disease or long-term medications, no recent or long-term spinal MSK injury/pathology	MFR applied to thoracic erector spinae (TES) T6-12 for 120 s; sham – balanced ligamentous tension (BLT) unilateral to rib cage; control – lay supine with head supported for 2 min all participants subjected to all three conditions	MFR has positive effect on PPT and ROM (significant difference); IS increased in all interventions, but more so in MFR (small, non-significant)	MFR produces biomechanical and systemic changes, but not IS – ANS mechanisms seem more complicated. IS as a predictors of treatment outcomes – correlation with ROM and PPT
Cerritelli et al. [45]	Influence of cognitive status of who administers touch on brain functional connectivity of touched subjects	40 healthy individuals aged 18-30	Static touch applied to external malleolus of subjects with operator engaged with focused tactile/non-tactile attention whilst subjects scanned with fMRI	fMRI scan showed significantly increase of anticorrelation between posterior circulate cortex (PCC) and right insula (INS) and inferior frontal gyrus (IFG) with touch applied by operator engaged with focused tactile attention. Effect was present only after 15 min	A particular cognitive status of operator sustained over time is able to elicit significant effects in subjects' functional connectivity – interoceptive and attentional touch areas
Dugailly et al. [46]	Effect of single session of general osteopathic treatment (GOT) on psychological feature	34 asymptomatic female volunteers	GOT vs control group (restful state); baseline questionnaires (QSCPGS and STAI) before and after	GOT had larger effect over control for anxiety and global self-perception ($p < 0.02$)	Osteopathic approach (articular and soft tissue) has a short-term effect on anxiety and global body perception
Gay et al. (2014) [47]	Functional connectivity between pain brain regions following 3 types of MT using fMRI	24 healthy participants (17F, 7 M) aged 18–44 who completed an exercise-injury protocol to induce low back pain	3 groups: Chiropractic spinal manipulation (SMT) (6) Spinal mobilisation (MOB)	Treatment dependent changes: SMT – strength of connection S1-aINS, S1-PAG, anterior	Manual therapies have an immediate effect on FC between brain regions involved in processing and modulating

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Table 3 (*continued*)

RCTs					
	Study Aim	Population	Intervention and outcome measures	Results	Conclusion
			(8) Therapeutic touch (TT) (10) Primary outcome: functional connectivity (FC) on fMRI between brain areas S1&2, thalamus, anterior cingulate cortex (ACC), posterior cingulate cortex (PCC), insula and periaqueductal grey (PAG) Secondary outcomes: change in numeric rating scale (NRS) and pain sensitivity (dynamometer)	INS-PCC MOB – decreased S1-aINS; increased aINS-PCC, S1-PAG TT: decreased S1-aINS, S1-PAG, aINS-PCC Pain intensity significantly decreased overtime ($p < 0.001$) regardless of intervention. No difference between groups in pain intensity change or pressure pain sensitivity	pain experience; neurophysiological changes following MT mat be an underlying mechanism of pain relief
Kamiya et al. (2021) [48]	Investigating effects of massage velocities on ANS of healthy infants	22 infant-mother dyads. Infants – snowball sample, 2–7 months old (mean 4.4 ± 1.3), no illness on the day of testing and no vaccination in the previous 48h. Mothers – mean age 29.6 ± 3.0	4 phases: 1–5 min before (control); 15 min (massage phase, each phase 5 min duration) at one of three velocities (5.0, 7.5, 10.0 cm/s). Order computer randomised – ABC, ACB, BAC, BCA, CAB, CBA. Controlled environment. Infants' heart rate (HR) and heart rate variability (HRV) as outcome measures.	% HR changes: 0 (5 cm/s), −2 (7.5 cm/s), −2 (10.0 cm/s). % high frequency (HF) changes: 29, 71, 15. % low frequency/high frequency LF/HF changes: 26, 30, 20. Changing the sequence of velocities had no significant effect on the above. Parasympathetic nervous system (PNS) most active at 7.5 cm/s	Range of stroke significant because infants receive CT touch from mother and not artificially. CT optimal velocity for infant massage important for neurological development.
Manzotti et al. [49]	Immediate effects of OMT on physiological measurements on oxygen saturation (SpO2) and heart rate (HR)	100 preterm infants with gestational age between 28.0 and 36.6 weeks	20 min protocol receiving either OMT or Static Touch	OMT group showed reduction in HR and increase in SpO2	Single session of OMT may induce beneficial effects on preterm physiological parameters
Ruffini et al. [50]	Effect of OMT on ANS using HRV	66 adults aged between 18 and 45, no chronic pain or acute symptomatology in previous 72h; no systemic pathology	Pragmatic trial: 25 min patient's need based OMT; sham group contact sequence of body areas for 2min; control group	OMT group showed significant reduction of HF ($p < 0.01$) and LF ($p < 0.05$) compared to sham and control	OMT varies ANS by modulating parasympathetic output of healthy subjects. Clinical effects may relate to trophotropic tuning – shift to ANS tonic activity

Scoping reviews				
	Aims	Key Concepts Addressed	Sub-concepts Addressed	Findings/Clinical Implications
Baroni et al. [51]	Clarify role of touch in osteopathic clinical reasoning and its biological and psychological effects	Biological and psychological effects of touch Touch in osteopathic clinical reasoning	Interoceptive and endocrine implication of touch Role of palpatory findings in decision making	Integrative approach – not palpation alone Shared decision-making process with patient
Kerr et al. [52]	Neurophysiological impacts of human touch and eye gaze; possible links and implications for therapeutic relationship and healing	Touch and patient-centred care Different types of touch Endocrine response to intervention	Light and gentle affective touch Physiological responses to direct gaze Environment impact on intervention	Fundamental care involving touch positively influenced by trusting relationship Beneficial impact of touch and eye gaze in therapeutic relationships

Observational studies					
	Aim	Population	Intervention	Outcomes	Main findings/conclusions
Haley et al. [53]	MTS & attenuation of long-term negative impact of neonatal stress on bone growth and development	3 × 10 pups (5 M 5 F) randomly assigned to naïve control (CTL), neonatal stress control (STRESS) and neonatal stress with mechanical/tactile stimulation (MTS)	Intervention d6-d10 of neonatal life. CTL: no stress treatment. STRESS and MTS: needle puncture, hypoxic challenge, hyperoxic challenge, 60 min maternal separation. MTS received 10 min tactile stimulation in last phase.	Early development stressful stimuli impact on bone quality; MTS may benefit bones, with lower osteoclast and higher osteoblast	MTS appears to attenuate negative impact of early life stress on bone development, with IGF-1 as a potential participating mechanism; similar setting to neonatal intensive care unit (ICU)
Lindgren et al. [54]	Brain response to pleasant human touch with force and velocity of touch massage	18 healthy individuals, 18–45; no psychiatric/neurological conditions	4 types of touch: Human hand with and without movement Rubber glove with and without movement	Significant difference between pleasantness of moving hand and rubber glove ($p < 0.001$) and human stationary ($p = 0.002$). Greater response in insula and	Human touch with movement is the most pleasant; stimulation of pgACC; same area activates during opioid analgesics and placebo

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Table 3 (*continued*)

Observational studies					
	Aim	Population	Intervention	Outcomes	Main findings/conclusions
			Closed eyes and awake with real time fMRI	contralateral somatosensory cortex for moving vs stationary. Human touch movement activated pregenual ACC (pgACC)	
Morris et al. (2014)[55]	Frequency of expressive and instrumental touch by occupational therapists during sessions	33 occupational therapy professionals (occupational therapists and assistants)	Interaction between client and practitioner >15 min. Occupational Therapy Interaction Assessment (OTIA) used to collect data regarding type, location and frequency of expressive and instrumental touch	Vast majority of touches (80 %) in occupational therapy were instrumental. Expressive touch F:M 2:1	Lack of expressive touch may impact rapport or connectedness between therapist and client
Nees et al. [56]	Brain responses to touch stimulation and rating of pleasantness during fMRI in chronic back pain (CBP), sub-acute back pain (SABP) and healthy controls (HC)	CBP = 20 (9 W, mean age 46.25) SABP = 19 (10 W, mean age 45.37) HC = 30 (16 W, mean age 40.23)	MR-compatible robotic tactile stimulator; 6 touch stimuli with 8–12s interval. Touch stimuli rated with Self-Assessment Manikin (SAM)	CBP significantly less pleasant ($p = 0.048$; $p = 0.049$). Significant main effect of pain status for orbitofrontal cortex (OFC), insula, S1, S2. Positive correlation between pain-related interference and insula responses in CBP ($p = 0.038$) a and negative correlation between ventral striatum (VS) and affective distress scores in SABP ($p = 0.033$)	Brain differentially engaged in processing of pleasant touch in relation to chronic and subacute pain. Deficient processing of pleasant touch in CBP and alterations of response in SABP
Rizkalla and Henderson [57]	Students' interest and use of OMT on their overall level of empathy and cognitive, emotional and behavioural subcomponents by using Jefferson Scale of Empathy medical student version JSE-S	801 students recruited, 598 completed the survey. No significant difference in age and gender across the sample	Interest + practice of OMM during associated with greater JSE-S scores ($p < 0.01$); frequency of giving and receiving non-specific touch associated with greater JSE-S scores ($p < 0.01$). Egalitarianism positively associated with greater JSE-S scores ($p < 0.01$) and authoritarianism and elitism negatively correlated with all empathy scores ($p < 0.05$)	Favourable impressions of OMT positively correlated with empathy and its subcomponents. Students who embraced osteopathic philosophy and provided frequent OMT had higher levels of empathy than those who did not.	Devotion to early hands-on work with patients would foster empathy and student maturation. Cognitive empathy can be trained. Inclusion of OMT in training may influence students' level of empathy throughout osteopathic training and beyond.

Quasi-experimental studies					
	Study Aim	Population	Intervention and outcome measures	Results	Conclusion
Denison (2004) [58]	To determine whether people with Fibromyalgia syndrome (FS) experience decreased pain and improved quality of life (QoL) when therapeutic touch (TT) is added to treatment plan	Convenience sample of people with FS randomly assigned to TT treatment (n = 10) or control group (CG) (n = 5)	6 TT treatments CG: quietly sitting and listening to information tape. Both groups rested 5min before post-measurements were taken. Short Form McGill Pain Questionnaire (SF-MPQ), Fibromyalgia Health Assessment Questionnaire (FHAQ) as outcome measures	TT significantly decreased experience of pain from before to after individual TT treatments. Significant decreased in FHAQ (p = 0.044)	TT may be an effective treatment for relieving pain and improving QoL in FS patients

Mixed ethod studies					
	Participant info	Primary study aim	Themes and sub-themes emerging from interviews	Survey findings	Highlights/implication for practice
Jones and Glover [59]	Interviews – 6 AT pupils (5F 1 M), mean age 57 Survey – 111 pupils (26 M, 79F 6 unknown)	To explore the psychological processes underlying touch in Alexander Technqiue (AT) and to further understand the implications of touch in psychological therapies	Incompatibility between touch and the spoken word. Touch as a nurturing process. Touch as a relational experience – the power of touch in external relationships and with the self But … - "I am comfortable	High comfort scores with touch. Touch helping understand techniques. Touch for pupils' benefit not their teachers'. Relaxation, increased feeling of body connectedness and increasing self-awareness. Touch enhances trust in teacher, helping communication	Touch as nurturing – makes one safe, looked after and able to explore. Touch helps two-way communication. Apparent physiological benefits of touch delivered through one-to-one, professionally defined relationships supported relevance of touch in interventions, especially when holistic

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Table 3 (*continued*)

Mixed ethod studies	Participant info	Primary study aim	Themes and sub-themes emerging from interviews	Survey findings	Highlights/implication for practice
			with touch, others might not be; gender reservation"		

Table 4
Studies informing sub-theme

	Overall quality
Dugailly et al. (2013)	
Casals-Gutierrez and Abbey (2020)	
D'Alessandro et al. (2016)	
McGlone et al. (2017)	
McGlone et al. (2014)	
Lindgren et al. (2012)	
Nees et al. (2019)	
Kerr et al. (2019)	N/A

Table 5
Studies informing sub-theme

	Overall quality
Bjorbækmo and Mengshoel (2016)	
Consedine et al. (2016)	
Elkiss and Jerome (2012)	
Geri et al. (2019)	
Hinkeldey t al. (2020)	
Rizkalla and Henderson (2018)	
Baroni et al. (2021)	N/A

Table 6
Studies informing sub-theme

	Overall quality
Dugailly et al. (2013)	
Manzotti et al. (2020)	
Cathcart et al. (2018)	
Ruffini et al. (2015)	
Casals-Gutierrez and Abbey (2020)	
Bialosky et al. (2011)	
Fryer (2017) – part I	
Fryer (2017) – part II	
Geri et al. (2019)	
Hinkeldey t al. (2020)	
McGlone et al. (2017)	
McGlone et al. (2014)	
Testa and Rossettini (2016)	
Haley et al. (2011)	
Kerr et al. (2019)	N/A

embodiment [2].

The potency of being touched is shown in preterm infants, whose growth may be compromised by the lack of skin-to-skin maternal contact [30]; there is extensive evidence for the use of touch and massage during peri- and post-natal periods to stimulate growth and reduction in stress-related markers [30]. These findings were confirmed in Haley et al. [53] cohort study, which found that the application of mechanical tactile stimulation on mice seemed to mitigate the stress produced by an environment comparable to a post-natal ICU.

CTs-tuned touch seems to trigger a bottom-up neurophysiological response altering the interoceptive pathway, which is driven by the ANS response to the stimulus provided by CT fibres [22]. This process may be due to the modulatory effects that touch appears to have not only locally, but also globally through the ANS, including pain reduction, improved perception of self-esteem, wellbeing, self-actualisation, social processes, relaxation, reduction of stress response and anxiety, and positive hedonia [3,52,46,25,65,49,23].

The areas of the brain involved in these processes include the ventromedial prefrontal cortex (vm-PFC) and the periaqueductal grey (PAG), both linked to the descending inhibition [5]. Pain modulation is mediated by the production of natural opiates, such as endorphins and oxytocin, both boosted by touch [5]. In addition to that, there is evidence showing that OMT may tune down sympathetic activity and the release of cytokines, starting a cascade of physiological processes that modulate inflammation and algesia [30]. Manzotti et al.'s [49] RCT demonstrated a reduction in heart rate and SpO2 immediately after the application of OMT in preterm infants; this metabolic change is believed to induce a bottom-up effect, which in made the ANS produce a parasympathetic response [49].

Another RCT by Ruffini et al. [50] confirmed the impact of OMT on the ANS by evaluating the heart rate variability (HRV) response in patients. They showed a statistically significant variation both in high frequency and low frequency measurements, suggesting a parasympathetic, anti-inflammatory, analgesic and trophotropic shift [50].

The positive effects on the physiological processes linked to touch just explored could also cause a reduction in the allostatic load experienced by critically ill patients [52], suggesting applications that go beyond musculoskeletal ailments.

It is important to say that the mechanical and physiological effects of touch (and OMT in general) are multifaceted and not entirely specific [21]. Evidence suggests that gentle touch may produce comfort or distress based on contextual factors; these can include gender of the practitioner, the environment where the clinical interaction takes place, the communication of what the intervention will involve [52]. As a result, these are believed to play a role in the manual therapy's effects observed in clinical practice [44]; the evidence is, however, confounded by the reciprocal and repetitive neurophysiological nature of the interaction between patient and practitioner [69]. Traditionally viewed as a confounding and inert factor, in recent years placebo has been recognised as an active component of any type of therapeutic intervention [21].

In relation to this, functional coupling of PFC, PAG, insula and other brain areas seems associated with placebo analgesia [37]; these may also be stimulated by touch [5], which makes the latter one of the means that clinicians can use in therapeutic setting to enhance positive responses in patients [37]. Expectations are regarded as a causative factor in placebo-related hypoalgesia, so clinicians should consider this to maximise the placebo effect [21]; linked to this, 89.5 % of patients expects osteopaths to diagnose their ailments by touch [2]. It is important to remember that touch does not influence the disease status, but rather the subjective illness perception [37]; there is evidence that touch, especially therapeutic touch, may have a role in reducing mental health symptoms, such as depression and anxiety [70]. Therefore, it may follow that therapists need to combine the so-called soft skills to the actual

delivery of manual therapy if best outcomes are to be achieved.

This subtheme was informed by Table 6.

8. Discussion

The aim of this study was to investigate the role of touch in osteopathic and manual therapy clinical encounters. 45 articles with a mixture of designs were included in this scoping review.

The stroking velocity and skin temperature necessary to stimulate CTs [5] seem to make them interesting when considering osteopathic hands-on interventions. McGlone et al.'s [5] is an opinion paper, bearing low value of evidence, and their conclusions warrant more research to better understand the precise location and projections of CTs. However, it is reasonable to think that soft and slow touch modalities used in OMT match the quality necessary to stimulate these fibres [30,49].

The impossibility to isolate a pure stimulation of CTs and their processing by the insula makes the latter extremely clinically significant; it can be considered the convergence point of internal and external milieus, combining emotional inputs coming from within and outside [22]. It may be viewed as the area where the person constructs an interpretation of the world by mixing internal and external stimuli and seen as the fundamental part where one creates their *"umwelt"*. *"Umwelt"* is regarded as the sensory interpretation of the wider environment one lives in [71]. This line of reasoning ties in with the view of the anthropo-ecological medicine, with internal and external worlds considered in constant interaction [72].

The integration of internal and external stimuli in the insula, including the emotional component relayed there by CTs, may suggest that it bears a central influence in the osteopathic holistic view of how the body works and self-organises in response to the different inputs.

Insula-related networks seem also responsible for ANS-related homeostatic functions [51], which may explain the role of touch in influencing the ANS.

These concepts relate to information emerging from D'Alessandro et al. [22], McGlone et al. [30] and McGlone et al. [5], which are all opinion papers; therefore, these need to be cautiously considered, even though they scored well in the critical appraisal. Despite narrative reviews having low level of evidence, Baroni et al.'s [51] detailed analysis of the literature seems to lead to this reasonable conclusion considering that OMT may include some of the characteristics of the stroking movements included in the observational study by Lindgren et al. [54].

In view of the emotional component of touch, two qualitative studies by Bjorbækmo and Mengshoel [39] and Consendine et al. [6] were regarded important. In fact, they present interesting perspectives on the experience of both patients and practitioners in relation to the use of touch during physiotherapy and osteopathic clinical encounters.

The creation of ideal therapeutic conditions, boundaries and reassurance may all relate to the way practitioners communicate through their hands, being in keep with the emotional integration in the insula discussed above.

Bjorbækmo and Mengshoel [39] and Consendine et al. [6] qualitative papers use phenomenology, so results cannot be generalised from their studies. However, the implications may be very significant to the osteopathic profession as it keeps in line with the biopsychosocial model of medicine [73]. Caution needs to be exercised in the case of Consendine et al.'s [6] study because the interview questions and the interviewer's position are not reported, so there exists a strong possibility for biased answers promoting the role of touch. On the contrary, Bjorbækmo and Mengshoel [39] study is well conducted and only lacks details on sample demographic.

A theme not addressed by those two papers is patients' expectations; it has been reported that 89.5 % of patients expect osteopaths to touch them to identify their complaint(s) [2]. Meeting patients' expectations can influence their satisfaction [37] and previous experience and context seem capable of impacting on the patient perception [51,21], with empathic and affective touch thought to generate a positive response to therapeutic interactions [25].

Rizkalla and Henderson's [57] study suggests that osteopathic students are well placed to be able to develop the empathic characteristics of touch which seem to positively influence patients [25]. Their conclusions must be taken cautiously since their survey data are specific to an educational institution and may not be applicable to the whole osteopathic community.

Nevertheless, the capacity of the practitioner's touch to generate an emotional reaction in the patient [25] may be an important concept since, in case of conflicting verbal and non-verbal communication, non-verbal cues seem to prevail [6]. The latter aspect seems to be confirmed in the psychology field [59].

The processing of tactile stimuli in the insula and the latter's influence on the ANS seem to suggest that touch may have a widespread physiological effect orchestrated by that brain region. Both McGlone et al. [30] and Haley et al. [53] seem to confirm this, but with some caution needed in the interpretation of their conclusions. Whilst McGlone et al. [30] is an opinion paper, they use reputable sources of evidence to support their views and present opposite views to the discussion. It was rated as good quality. Haley et al. [53] studied mice but their laboratory settings are such to make the findings relevant for humans. Their results must be taken cautiously though since there is no indication as to whether the assessors were blinded and confidence intervals are not provided.

Manzotti et al. [49] expand on that by demonstrating a reduction in heart rate and oxygen saturation (SpO2) in preterm infants with OMT. Despite scoring high in the RoB 2.0 checklist (see Table 3), they use an arbitrary sample size, which is below the a priori power calculation; it also lacks a control group and long-term follow ups making their conclusions meaningful but not totally reliable.

Another RCT by Ruffini et al. [50] seems to link ANS response to manual therapy by tracking heart rate variability (HRV). However, their study focuses on healthy subjects and is restricted to balanced ligamentous techniques, balanced membrane techniques and cranio-sacral techniques, therefore making it hard to generalise the findings. Despite that, the type of techniques used were gentle ones, making them suitable to activate the CTs due to the soothing touch provided.

Based on the above, there seems to be some evidence calling for an effect of CT-tuned touch on the ANS, although the low value of the evidence collected and the related risk of bias impact on the significance of the findings. It is also worth remembering that mechanical and physiological effects of touch are likely to be multifaceted and not entirely specific [21] and that contextual factors may also have an influence [37]. Both Testa and Rossettini [37] and Bialosky et al. [21] are opinion papers, ranking low in the hierarchy of evidence; nevertheless, they provide an extensive reference list which seems to support their thesis and most statements seem consistent in both papers.

Considering the brain areas activated by both the act of touching and the contextual factors (primarily PFC, PAG, insula), it is likely that the whole person adapts to the inputs coming from both ends and the outputs are driven by the central nervous system's (CNS) areas where the touch system resides [7]. The continuous adjustment resulting from the interaction of input-output seems reasonable based on the interconnection between the Musculoskeletal, Immune, Neurological and Endocrine system, which form the MINE supersystem [7]. The MINE system, which seems to respond to structural and functional interactions in response to touch, is the main driver of the physiological output through the ANS [51]. Despite being an opinion paper, Elkiss and Jerome's work's quality (2012) scores high; and their position aligns with Baroni et al.'s narrative review (2021) which includes an extensive selection of sources and opposing views on the topic.

Touch may, therefore, represent a way for osteopaths to contribute to patients' health in a way that resonates with the holistic view which has historically been one of the features of the profession. However, the low level of evidence and the methodological flaws identified in the relevant literature warrant a cautious interpretation of the findings and more

research to validate the points identified in this scoping review.

8.1. Strengths and limitations

This scoping review is the first one to have systematically searched the literature on touch in manual therapies and to have independently screened, data extracted and assessed qualities of studies with mixed designs. It is the first study presenting the current knowledge in different fields on touch in osteopathy and other manual therapies.

One limitation of this project is the reliance on many opinion papers, which sit lower in the hierarchy of scientific evidence. Due to the extent of the evidence included coming from this type of source, an attempt was made not to skew the results with inaccurate/misleading data by accurately appraising these studies.

Another one is represented by the lack of evidence specific to osteopathy and the heterogeneity of the data pooled; even though most results are transferable from other contexts, this may alter the specificity of the findings.

Most studies included report limitations themselves, ranging from underpowered samples to blinding limitations; to limit the risk of bias, the author conducted a critical appraisal for each paper, but there remains a risk of influencing the overall discussion.

Additional limitations may be represented by the inclusion of English language studies only and the exclusion of non-peer reviewed literature.

9. Conclusion

Light (affective) touch is conveyed to the CNS through the CTs to be processed via the interoceptive system in the emotional areas of the brain, with the insula playing a central role in it. The involvement of CTs in the processing of touch places osteopathy in a great position to exploit it, as the slow and soft modalities used in OMT seem to match the quality necessary to stimulate CTs.

The role of the insula in integrating internal and external milieus may be very relevant in considering the potential role of touch in communication; touching patients helps meeting their expectations. Also, empathic and affective touch are believed to improve the response to the therapeutic interaction, which links to the processing of touch in the insula. Touch can produce comfort or distress based on contextual factors; therefore, practitioners should pay attention to the therapeutic setting and the use of touch to avoid adverse outcomes.

Touch can be considered as a means through which osteopaths can interact with the patient as a person in a way that goes above and beyond their MSK presentation to enhance better general health and adaptation.

Author contribution statement

Alessio Gessa was the main researcher of this review.

Ian Greaves contributed to data acquisition, data analysis and interpretation.

Dr Jerry Draper-Rodi contributed to the conception and design of the review, drafting of manuscript and critical revision of the content of it.

All authors edited and approved the final version of the manuscript.

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Ethical approval

Ethical approval from UCO REC was obtained on December 10, 2021.

Declaration of competing interest

No conflict of interest needs to be declared.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijosm.2023.100704.

References

[1] General Osteopathic Council. About osteopathy. [Online] Available at: https://www.osteopathy.org.uk/visiting-an-osteopath/about-osteopathy/; 2021. 31st October 2021.
[2] Concammon M, Lidgley S. How is touch communicated in the context of manual therapy? A literature review. *General Osteopathic Council* [Online}. Available at: https://www.osteopathy.org.uk/news-and-resources/news/how-touch-is-communicated-in-the-context-of-manual-therapy-new/; 2019.
[3] Casals-Gutierrez S, Abbey H. Interoception, mindfulness and touch: a meta-review of functional MRI studies. Int J Osteopath Med 2020;35(3):22–33. https://doi.org/10.1016/j.ijosm.2019.10.006.
[4] Ju Y-Y, Liu Y-C, Cheng H-YK, Chang Y-J. Rapid repetitive passive movement improves knee proprioception. Clin BioMech 2011;26(2):188–93. https://doi.org/10.1016/j.clinbiomech.2010.09.015.
[5] McGlone F, Wressberg J, Olausson H. Discriminative and affective touch: sensing and feeling. Neuron 2014;82(4):737–55. https://doi.org/10.1016/j.neuron.2014.05.001.
[6] Consendine S, Standen C, Niven E. Knowing hands converse with an expressive body – an experience of osteopathic touch. Int J Osteopath Med 2016;19:3–12. https://doi.org/10.1016/j.ijosm.2015.06.002.
[7] Elkiss ML, Jerome JA. Touch – more than a basic science. J Am Osteopath Assoc 2012;112(8):514–7.
[8] Jull G, Moore A. Hands on, hands off? The swings in musculoskeletal physiotherapy practice. Man Ther 2012;17(3):199–200. https://doi.org/10.1016/j.math.2012.03.009.
[9] Kerry R. Hands-on, hands-off: is that even a thing? In touch. Summer 2019;167. 2019, https://www.physiofirst.org.uk/uploads/assets/uploaded/f6d27b15-f124-46d5-9b1efc3a7c2b5cb1.pdf. 1st February 2022.
[10] Carneiro KA, Rittenberg JD. The role of exercise and alternative treatments for low back pain. Phys Med Rehabil Clin 2010;21(4):777–92. https://doi.org/10.1016/j.pmr.2010.06.006.
[11] Smith D. Reflecting on new models for osteopathy – it's time for change. Int J Osteopath Med 2019;31(3):15–20. https://doi.org/10.1016/j.ijosm.2018.10.001.
[12] Tyreman S. Re-evaluating "osteopathic principles". Int J Osteopath Med 2013;16(1):38–45. https://doi.org/10.1016/j.ijosm.2012.08.005.
[13] Levac D, Colquhoun H, O'Brien KK. Scoping studies: advancing the methodology. Implement Sci 2010;5(69). https://doi.org/10.1186/1748-5908-5-69.
[14] Daudt H, van Mossel C, Scott S. Enhancing the scoping study methodology: a large, inter-professional team's experience with Arksey and O'Malley's framework. BMC Med Res Methodol 2013;13(1). https://doi.org/10.1186/1471-2288-13-48.
[15] Gessa A, Greaves I, Draper-Rodi J. The role of touch in osteopathic clinical encounters – a scoping review. October 12. 2022. Retrieved from: osf.io/6zxsh.
[16] Arksey H, O'Malley L. Scoping studies: towards a methodological framework. Int J Soc Res Methodol 2005;8(1):19–32. https://doi.org/10.1080/1364557032000119616.
[17] Pillastrini P, Vanti C, Curti S, Mattioli S, Ferrari S, Violante F, Guccione A. Using PubMed search string for efficient retrieval of manual therapy research literature. J Manipulative Physiol Therapeut 2015;38(2):159–66. https://doi.org/10.1016/j.jmpt.2014.11.005.
[18] Cohen J. A coefficient of agreement for nominal scales. Educ Psychol Meas 1960;20(1):37–46.
[19] Prisma-statement.org. *PRISMA*. [Online]. Available from: https://prisma-statement.org/> 2009. 26th October 2021.
[20] Hutchison BG. Critical appraisal of review articles. Can Fam Physician 1993;39(5):1097–102. PMID: 8499790, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2379630/pdf/canfamphys00111-0101.pdf. [Accessed 30 January 2022].
[21] Bialosky JE, Bishop MD, George SZ, Robisnon ME. Placebo response to manual therapy: something out of nothing? J Man Manip Ther 2011;19(1):11–9. https://doi.org/10.1179/2042618610Y.0000000001.
[22] D'Alessandro G, Cerritelli F, Cortelli P. Sensitization and interoception as key neurological concepts in osteopathy and other manual medicines. Front Neurosci 2016;10(March). https://doi.org/10.3389/fnins.2016.00100. article 100.
[23] Fryer G. Integrating osteopathic approaches based on biopsychosocial therapeutic mechanisms. Part 1: the mechanisms. Int J Osteopath Med 2017;25(9):30–41. https://doi.org/10.1016/j.ijosm.2017.05.002.
[24] Gale NK. From body-talk to body-stories: body work in complementary and alternative medicine. Sociol Health Illness 2011;33(2). https://doi.org/10.1111/j.1467-9566.2010.01291.
[25] Geri T, Viceconti S, Minacci M, Testa M, Rossettini G. Manual therapy: exploiting the role of human touch. Musculoskeletal Science and Practice 2019;44(12). https://doi.org/10.1016/j.msksp.2019.07.008.

[26] Hinkendly N, Okamoto C, Khan J. Spinal Manipulation and Select Manual Therapies: Current Perspectives. Phys Med Rehabili Clinics N Am 2019;34(4). https://doi.org/10.1016/j.pmr.2020.07.007.

[27] Khan I, Quatman C. What's important: the power of touch. J Bone Joint Surg 2020; 103(10):947–8. https://doi.org/10.2106/JBJS.20.

[28] Lederman E. A process approach in osteopathy: beyond the structural model. Int J Osteopathic Med 2017;23:22–35. https://doi.org/10.1016/j.ijosm.2016.03.004.

[29] Liem T. Pitfalls and challenges involved in the process of perception and interpretation of palpatory findings. Int J Osteopathic Med 2014;17(4):243–9. https://doi.org/10.1016/j.ijosm.2014.04.005.

[30] McGlone F, Cerritelli F, Walker S, Esteves G. The role of gentle touch in perinatal osteopathic manual therapy. Neuroscience and Biobehavioural Reviews 2017;72 (1):1–9. https://doi.org/10.1016/j.neubiorev.2016.11.009.

[31] Patterson, M.M. (2012). Touch: vital to patient-physician relationships. J Am Osteopathic Assoc 112 (8) 485. PMID: 22904245.

[32] Pelletier, R., Bourbonnais, D., Higgins, J. (2017). Nociception, pain, neuroplasticity and the practice of Osteopathic Manipulative Medicine. Int J Osteopathic Med; 27 (1); pp. 34-44. doi: https://doi.org/10.1016/j.ijosm.2017.08.001.

[33] Rossettini, G., Camerone, E.M., Carlino, E., Benedetti, F., Testa, M. (2020). Context matters: the psychoneurobiological determinants of placebo, nocebo and context-related effects in physiotherapy. Archiv Physiother; 10 (11). doi: https://doi.org/10.1186/s40945-020-00082-y.

[34] Rossettini, G., Carlino, E., Testa, M. (2018). Clinical relevance of contextual factors as triggers of placebo and nocebo effects in musculoskeletal pain. BMC Musculoskeletal Disorders; 19 (27). doi: https://doi.org/10.1186/s12891-018-1943-8.

[35] Sagar, S.M., Dryden, T., Wong, R.K. (2007). Massage Therapy for Cancer Patients: A Reciprocal Relationship between Body and Mind. Curr Oncol; 14 (2): pp. 45-56. doi: https://doi.org/10.3747/co.2007.105.

[36] Serino, A., Haggard, P. (2010). Touch and the body. Neurosci Biobehaviour Rev; 34 (2): pp. 224-236. doi: https://doi.org/10.1016/j.neubiorev.2009.04.004.

[37] Testa M, Rossettini G. Enhance placebo, avoid nocebo: how contextual factors affect physiotherapy outcomes. Man Ther 2016;24(8):65–74. https://doi.org/10.1016/j.math.2016.04.006.

[38] Zegarra-Parodi, R., Draper-Rodi, J., Haxton, J., Cerritelli, F. (2019). The Native American heritage of the body-mind-spirit paradigm in osteopathic principles and practices. Int J Osteopathic Med; 33 (1): pp. 31-37. https://doi.org/10.1016/j.ijosm.2019.10.007.

[39] Bjorbækmo WS, Mengshoel AM. "A touch of physiotherapy" – the significance and meaning of touch in the practice of physiotherapy. Physiother Theory Pract 2016; 32(1):10–9. https://doi.org/10.3109/09593985.2015.1071449.

[40] Cullen-Powell LA, Barlow JH, Cushway D. Exploring a massage intervention for parents and their children with autism: the implications for bonding and attachment. J Child Healthc 2005;9((4). doi:). https://doi.org/10.1177/1367493505056479.

[41] Rutberg S, Kostenius C, Öhrling K. Professional tools and a personal touch –experiences of physical therapy of persons with migraine. Disability Rehabilit 2013;35(19):):1614–21. https://doi.org/10.3109/09638288.2012.748838.

[42] Stöckigt B, Suhr R, Sulman D, Teut M, Brinkhaus B. Implementation of Intentional Touch for Geriatric Patients with Chronic Pain: A Qualitative Pilot Study. Complement Med Res 2019;26(3):):195–205. https://doi.org/10.1159/000496063.

[43] Blankfield, R.P., Sulzman, C., Fradley, L.G., Tapolyai, A.A., Zyzanski, S.J. (2001). Therapeutic touch in the treatment of carpal tunnel syndrome. J Am Board Fam Pract; 14 (5): 335-342. PMID: 11572538.

[44] Cathcart E, McSweeney T, Johnston R, Young H, Edwards DJ. Immediate biomechanical, systemic, and interoceptive effects of myofascial release on the thoracic spine: a randomised control trial. J Bodyw Mov Ther 2019;23(1):74–81. https://doi.org/10.1016/j.jbmt.2018.10.006.

[45] Cerritelli F, Chiacchiaretta P, Gambi F, Ferretti A. Effects of continuous touch on brain functional connectivity is modified by the operator's tactile attention. Front Hum Neurosci 2017;11(368). https://doi.org/10.3389/fnhum.2017.00368.

[46] Dugailly PM, Fassin S, Maroye L, Evers L, Klein P, Feipel V. Effect of a general osteopathic treatment on body satisfaction, global self perception and anxiety: a randomized trial in asymptomatic female students. Int J Osteopath Med 2013;17 (2):94–101. https://doi.org/10.1016/j.ijosm.2013.08.001.

[47] Gay CW, Michael DC, Robinson E, George SZ, Perlstein WM, Bishop MD. Immediate Changes After Manual Therapy in Resting-State Functional Connectivity as Measured by Functional Magnetic Resonance Imaging in Participants With Induced Low Back Pain. J Manipulat Physiol Therapeut 2014;37(9):):614–27. https://doi.org/10.1016/j.jmpt.2014.09.001.

[48] Kamiya, C., Miyake, M., Yamada, T., Ohmi, M., Watanabe, H. (2021). The effects of massage velocity on heart rate and heart rate variability in healthy infants: A randomized crossover study. Infant Behav Develop; 64, 101604. doi: https://doi.org/10.1016/j.infbeh.2021.101604.

[49] Manzotti A, Cerritelli F, Lombardi E, La Rocca S, Chiera M, Galli M, Lista G. Effects of osteopathic treatment versus static touch on heart rate and oxygen saturation in premature babies: a randomized controlled trial. Compl Ther Clin Pract 2020;39: 101116. https://doi.org/10.1016/j.ctcp.2020.101116. 2020.

[50] Ruffini N, D'Alessandro G, Mariani N, Pollastrelli A, Cardinali L, Cerritelli F. Variations of high frequency parameter of heart rate variability following osteopathic manipulative treatment in healthy subjects compared to control group and sham therapy; a randomized controlled trial. Front Neurosci 2015;9(272). https://doi.org/10.3389/fnins.2015.00272.

[51] Baroni F, Ruffini N, D'Alessandro G, Consorti G, Lunhi C. The role of touch in osteopathic practice: a narrative review and integrative hypothesis. Compl Ther Clin Pract 2021;42:101277. https://doi.org/10.1016/j.ctcp.2020.101277. February.

[52] Kerr F, Weichula R, Feo R, Schultz T, Kitson A. Neurophysiology of human touch and eye gaze in therapeutic relationships and healing: a scoping review. JBI Database of Systematic Reviews and Implementation Reports 2019;17(2):209–47. https://doi.org/10.11124/jbisrir-2017-003549.

[53] Haley S, O'Grady S, Gulliver K, Bowman B, Baldassarre R, Miller S, Lane RH, Moyer-Mileur LJ. Mechanical-Tactile Stimulation (MTS) intervention in a neonatal stress model improves long-term outcomes on bone. J Musculoskelet Neuronal Interact 2011;11(3):234–42. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3228307/pdf/nihms338956.pdf. 11th January 2022.

[54] Lindgren L, Westling G, Brulin C, Lehtipalo S, Andersson M, Nyberg L. Pleasant human touch is represented in pregenual anterior cingulate cortex. Neuroimage 2012;59(4):3427–32. https://doi.org/10.1016/j.neuroimage.2011.11.013.

[55] Morris D, Henegar J, Khanin S, Oberle G, Thacker S. Analysis of touch used by occupational therapy practitioners in skilled nursing facilities. Occup Ther Int; 21 2014;3:133–42. https://doi.org/10.1002/oti.1374.

[56] Nees F, Usai K, Löffler M, Flor H. The evaluation and brain representation of pleasant touch in chronic and subacute back pain. Neurobiology of Pain 2019;5 (January-July):100025. https://doi.org/10.1016/j.ynpai.2018.10.002.

[57] Rizkalla MN, Henderson KK. Empathy and osteopathic manipulative medicine: is it all in the hands? J Am Osteopath Assoc 2018;118(9):573–85. https://doi.org/10.7556/jaoa.2018.131.

[58] Denison B. Touch the Pain AwayNew Research on Therapeutic Touch and Persons With Fibromyalgia Syndrome. Holistic Nursing Practice. 2004. p. 142–50. https://doi.org/10.1097/00004650-200405000-00006.

[59] Jones T, Glover L. Exploring the psychological processes underlying touch: lessons from the Alexandre technique. Clin Psychol Psychother 2012;21(2):140–53. https://doi.org/10.1002/cpp.1824.

[60] Watkins RH, Dione M, Ackerley R, Backlund Wasling H, Wessberg J, Löken LS. Evidence for afferent C-tactile afferents of glabrous human hand skin. J Neurophysiol 2021;125(1):232–7. https://doi.org/10.1152/jn.00587.2020.

[61] Craig AD. Interoception: the sense of the physiological condition of the body. Curr Opin Neurobiol 2003;13(4):500–5. https://doi.org/10.1016/s0959-4388(03)00090-4.

[62] Björnsdotter M, Morrison I, Olausson H. Feeling good: on the role of C fibre mediated touch in interoception. Exp Brain Res 2010;207(3–4):149–55. https://doi.org/10.1007/s00221-010-2408-y.

[63] Kinney M, Seider J, Beaty AF, Coughlin K, Dyal M, Clewley D. The impact of therapeutic alliance in physical therapy for chronic musculoskeletal pain; A systematic review of the literature. Physiother Theory Pract 2018;36(8):886–98. https://doi.org/10.1080/09593985.2018.1516015.

[64] Wyschogrod E. Empathy and sympathy as tactile encounter. J Med Philos: A Forum for Bioethics and Phylosophy of Medicine 1981;6(1):25–44. https://doi.org/10.1093/jmp/6.1.25.

[65] Hinkeldey N, Okamoto C, Khan J. Spinal manipulation and select manual therapies. Phys Med Rehabil Clin 2020;31(4):593–608. https://doi.org/10.1016/j.pmr.2020.07.007.

[66] Walker SC, Trotter PD, Swaney WT, Marshall A, McGlone FP. C-tactile afferents: cutaneous mediators of oxytocin release during affiliative tactile interactions? Neuropeptides 2017;64:27–38. https://doi.org/10.1016/j.npep.2017.01.001.

[67] Walker SC, Trotter PD, Woods A, McGlone FP. Vicarious ratings of social touch reflect the anatomical distribution & velocity tuning of C-tactile afferents: a hedonic homunculus? Behav Brain Res 2017;320:91–6. https://doi.org/10.1016/j.bbr.2016.11.046.

[68] Goldstein P, Shamay-Tsoory SG, Yellinek S, Weissman-Fogel I. Empathy predicts an experimental pain reduction during touch. J Pain: Official Journal of American Pain Society 2016;17(10):1049–57. https://doi.org/10.1016/j.jpain.2016.06.007.

[69] Lindgren L, Lehtipalo S, Winso O, Karlsson M, Wiklund U, Brulin C. Touch massage: a pilot study of a complex intervention. Nurs Crit Care 2013;18(6): 269–77. https://doi.org/10.1111/nicc.12017.

[70] Sujianto M, Johan A. Effects of therapeutic touch to reduce anxiety as a complementary therapy: a systematic review. KnE Life Sciences 2019:162–75. https://doi.org/10.18502/kls.v4i13.5237.

[71] von Uexküll J. A foray into the worlds of animals and humans. Minneapolis: University of Minnesota Press; 2010.

[72] Tyreman S. How to work with the anthropo-ecological narrative in clinical use. In: Mayer, Standen, editors. Textbook of osteopathic medicine. Munich: Elsevier; 2018. p. 159–67.

[73] Engel GL. The need for a new medical model: a challenge for biomedicine. Science 1977;196(4286):129–36. https://doi.org/10.1126/science.847460.