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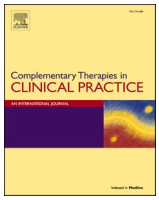

'Reflexology: Exploring the mechanism of action'

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A B S T R A C T

Reflexology is a complementary therapy focusing mainly on the application of pressure on the feet, hands and ears. A small but growing evidence base suggests that positive outcomes can be gained in the management and improvement of symptoms across a range of conditions. Biological plausibility is a key concept in the determination of the usefulness of therapies. Research which tests for safety and efficacy alongside the underpinning mechanism of action are therefore important.

This paper explores the potential mechanism of action for the outcomes associated with reflexology treatment as reflected in the current evidence. The influences of therapeutic touch, relaxation, placebo effects and the similarities with other therapeutic methods of structural manipulation are considered. The lack of clarity around the precise definition of reflexology and the challenges of researching the therapy as a treatment tailored to individual need are discussed.

A deeper understanding of the mechanism of action for reflexology may help to further develop research into safety and efficacy. Such an understanding may lead to the integration of knowledge which may provide both symptomatic support and longer term preventative health benefits.

1. Introduction

Anecdotally the complementary therapy of reflexology is reported to have a range of effects. Although large scale trials and well controlled methodology remains the exception rather than the rule, there is a small but growing evidence base suggesting the symptomatic relief of a range of conditions [1–5].

Despite reports of positive outcomes, the literature lacks clarity in both definition and parameters of reflexology which has hampered progress in building the evidence base. In practice, reflexology can vary from a gentle massage of the feet, hands or ears to a rather more robust deep manipulation of the tissues of the feet and legs using implements such as wooden tools.

Questions remain over the most appropriate setting for reflexology. Commonly found in spa settings as a tool for relaxation, a stronger evidence base for the safety and efficacy of reflexology is necessary before integration into clinical settings can be considered. The determination of the usefulness of therapies requires an understanding of their biological plausibility, before the development of appropriate research to test for safety and efficacy. The many forms of reflexology, the length of time and depth of pressure in a treatment, and the differences between single sessions or longer courses of treatment are all areas which warrant scrutiny before reflexology can be said to be a useful tool for health and healing. This exploration may shed valuable light on the mechanisms which underpin the outcomes of reflexology.

2. Reflexology

The main theoretical basis of reflexology is centred around the idea that all areas of the body are mapped on to areas of the feet and hands. Reflexology was developed from 'Zone therapy'- first theorised by the American physician William Fitzgerald in the early twentieth century. Fitzgerald suggested that the body could be divided into 10 vertical and equal zones [6]. Theorising that manipulation and pressure techniques conducted on the periphery of these zones in the feet and hands could have an effect on physio-pathological conditions elsewhere in the same vertical zones. Tenderness exhibited in the zones of the foot was thought to reflect a disorder elsewhere in the zone. The dissipation of tenderness in the foot after a short time was accompanied by an associated improvement in affected areas elsewhere in the zone.

This was further developed into 'compression massage' and then 'reflexology' by Eunice Ingham, a bodyworker and physical therapist working in the US in the early part of the twentieth century. Ingham developed highly coloured illustrated foot maps which were used on lecture tours to promote the therapy across the US and further afield.

In the intervening century since its inception, reflexology has grown into a complex therapeutic modality which is reported anecdotally to have a range of effects. In conjunction with these reported effects, a variety of different types of reflexology have developed which can vary from very light touching and stroking movements to much deeper work, akin to osteopathic stretching and manipulation.

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In its basic form, reflexology consists of a series of thumb and finger movements using applied pressure to the surface of the feet. The technique follows maps of the body which are said to represent every physical area of the body via 'reflexes' on the feet, which reflect from the distal phalanx of the great toe (the head) to the calcaneum (pelvis). A series of precise pressure movements are conducted until the whole surface area has been covered. Depth of pressure and patterns of movement allow for a variety of assorted styles of reflexology, all of which are descended from a common theory.

Perhaps complicated by this, the evidence base for the outcomes of reflexology has been slow to build. It is further hampered by a lack of researchers working in the field, and the complexities of establishing homogenous protocols in what is an individually tailored therapeutic approach [7–9].

3. Balance

The language used in non-mainstream therapies can sometimes be vague when it comes to explaining effects or reactions. A frequent explanation for the outcomes of reflexology is that of 'rebalancing', which might be understood as the means by which a person switches off, thereby restoring a state of equilibrium where the autonomic nervous system becomes more regulated. The way we live in this new century may have negatively impacted on the ability of our nervous systems to downregulate after a period of rest, to the extent that it is rest which has become that most elusive of panacea [10].

'Techno-stress' as it is sometimes called [10,11] has resulted in a heightened neurological sensitivity to the ever pinging and buzzing technology which surrounds us. Prevention of the demarcation of the working day and constant streams of consumer temptations and social chatter compete for our attention drowning out our physical and psychological cues that might otherwise indicate the need for rest. Constant technological stimulations are also linked with techno addictive behaviours which further add to the neurological load [11]. It is feasible therefore that the time and space in the reflexologists chair provides time to switch off which may thus become a mechanism for improvement during a reflexology session.

Taking hormonal balance as an example, there is evidence to suggest that menstrual functioning is disrupted by stressors that activate the hypothalamic-pituitary-adrenal (HPA) axis [12]. The hormonal response to stress is the release of cortisol, one of the glucocorticoids. Functional menstrual disorders such as polycystic ovary syndrome are associated with an increase in cortisol. There is some evidence to suggest that reflexology can have a positive impact on menstrual patterns [13,14]. It follows then, that reflexology may have potential for the correction of hormonal balance in the same way as mind-body approaches akin to mindfulness and exercise [15,16].

4. Relaxation and sleep

In its gentlest form reflexology can induce relaxation and improve the quality of sleep [17–19]. Research indicates there are brain alterations during a reflexology session, emitting cerebral activity in brain waves usually seen in a sleep state. Those undergoing reflexology treatment entered a sleep state within minutes of the treatment beginning [20]. Studies which reviewed reflexology and sleep in ill health appear to show beneficial outcomes [17–19,21]. Relaxation and the quality and quantity of sleep, has benefits for the immune system, for cognitive functioning as well as in anxiety and depression [22]. The adaptation to circadian rhythms and its effect on health and illness has also been well documented [23], and any help offered by reflexology to facilitate this might signify a powerful tool for positive outcomes in a range of related conditions.

Relaxation in itself has a range of healing benefits, including relief from anxiety, improvements in digestion and alleviation of pain. Reflexology can enhance this relaxation and demonstrates an effect on anxiety and related conditions [24–27].

The way that reflexologists perform their treatments may include the use of relaxing music, subtle lighting and perhaps some aromatic essential oils. These performances may instigate relaxation which in turn could influence the functioning of physical and emotional health. Reflexology alone may also influence outcomes and although attempts have been made to isolate foot reflexes which have a physiological effect [28], it is challenging to separate the effects of the reflex points used in treatment from those effects created by the ambience of such an environment. Indeed Jones (2012) has demonstrated that there may be an association between the reflex points of the feet and potential links to discrete areas of the body. What this amounts to in a complete reflexology treatment is less certain. To demonstrate that a single point on the foot appears to affect discrete areas of the body is different from saying that a full reflexology session would have a similar effect. The accuracy of the chosen point, the length of time and depth of activity on the point and the environmental factors are all likely to play a part. Controlling for such variables is critical in the design of appropriately designed research.

Another confounding variable is the diverse types of reflexology. A gentle foot rub may be easy to relate to as a pleasant interlude, but what of the deeper and sometimes painful pressure used in some forms of reflexology where tools are employed? Anecdotally, recipients of this kind of reflexology report similar relaxation effects and deep sleep, although these appear to be after-effects rather than occurring at the time of treatment. It is unlikely that the mechanism of action for each of these types of reflexology would be the same and although there is a paucity of studies examining this, there is a suggestion of difference between light pressure and a more standard pressure of reflexology in the measurement of pain tolerance and pain threshold [29].

5. Therapeutic relationship

The therapeutic relationship and associated support offered within a reflexology session is considered a crucial part of the benefits gained. When the client is lying supine (face up) they have the opportunity to talk to the therapist whilst the session is ongoing. The space and time offered during this treatment has been shown to be an opportunity for the client or patient to share their worries and concerns [30]. Expressing these concerns is the first stage in acceptance or recognition of an issue which can then lead to individual clarity and calm. The psychological support offered by a friendly ear is considered part of the whole treatment, but in research terms it would be something to be controlled, a variable which might usefully be excluded to better understand the 'active ingredient' in any improvement.

Under these circumstances it is feasible that improvement in health concerns may be elicited by merely talking through those particular personal challenges with the reflexologist whilst treatment is ongoing. Coupled with a relaxation response, it is possible that this alone is responsible for improvements in health and wellbeing [31].

6. Therapeutic touch

Part of any reflexology treatment is the hands-on touch. Usually pleasant and welcomed by the client this might include stroking, massaging, and manipulation of soft tissue.

The beneficial nature of human touch has been well documented as a tool to promote healing and bring comfort [32–34]. Whether that is the sole trigger for outcomes in a reflexology session is less certain. Research which removes the human factor is necessary to explore all variables within a reflexology treatment. For example, researchers developed a robotic device engineered to deliver the same amount of pressure on foot reflexes in the same pattern as a standard reflexology session [35]. Results showed that the machine delivered reflexology could still yield positive outcomes despite the removal of the human factor, with symptom severity scores reducing in a small sample of breast cancer

patients undergoing chemotherapy. As with many studies into reflexology the numbers participating were small (n = 13), and no control group was used. It is not possible to determine cause and effect in these circumstances and further studies in which mechanical reflexology and manual reflexology are directly compared with one another will provide a better measure of the therapist's role in treatment.

Other research showed that a mechanical stimulus could increase the nociceptive effect in an ice pain threshold and tolerance experiment when compared to a sham TENS control [36]. This was in direct contrast to results expressed in a manually applied technique, suggesting that the therapist is an important part of the whole treatment effect. As always, other influences like patient expectation and the presence of Hawthorne effects may have contributed to the outcomes [37].

7. Placebo effects

The dictionary definition of the placebo effect is 'A positive therapeutic effect claimed by a patient after receiving a placebo believed by him/her to be an active drug' [38]. Yet healers and shaman of many cultures over many centuries have used a combination of techniques to harness the individual's power to heal, including deception and placebos.

Used commonly in experiments as a control for the participant's expectation of positive outcomes, there is also evidence of their use as a tool by medics to pacify or reassure those who really need no pharmaceutical drug [39]. There have been a number of well documented cases of profound physiological effects occurring through the power of suggestion alone [40]. Positive outcomes in reflexology could be considered to be placebo driven. In a therapeutic setting, there is the potential for expectation and conditioning to create the conditions for improvement in outcomes. Trust in the reflexologist along with acceptance of their frameworks of explanation and the expectation of a beneficial outcome are all important factors.

8. Environment

There is a certain ceremony in the cleansing of the feet, the taking of a medical history, and the explanatory discourse used by the reflexologist, that creates an encouraging and reassuring environment. Healing rituals may have profound power in the practitioner client exchange [41], and it is worth noting that it is not only in the complementary therapy world that rituals exist. They are just as present in biomedicine, albeit in a more familiar order [42]. But whilst in the physician's surgery there may be anxiety at the anticipation of bad news, in the world of alternative and complementary healthcare there is no biomedical diagnostic process. Instead there may be the expectation of a pleasant interaction which enables the client to relax.

9. Reflexology and fascia

Fascia is a thin membrane or fibrous sheath which covers and separates organs in the human body. It has long been considered to be an inert structure, but there is growing interest in the capacity of fascia and fascial manipulation to facilitate a range of effects on discrete areas of the body [43–45].

There are reflexology points within and around the feet and hands that appear to correspond with areas of meridian lines, and which correspondingly map to fascial planes [46]. The various reactions of clients who receive reflexology, could be instigated by changes in the structure and mechanism of fascia in its many guises. Impacts which range from mechanical to electrical, and from musculoskeletal to molecular. Given that the number of effects of reflexology are claimed to be as wide ranging, from relief from pain to improvements in digestive or hormonal functioning, the potential influence of fascial changes instigated during a reflexology session warrants further scrutiny.

Fascia has been considered the "Cinderella" of body tissues with little scientific research in the musculo-skeletal field to fully understand it's anatomical structure and physiology [47]. There has been exponential growth of research in this area supported by the advancement of imaging techniques, thereby removing the sole reliance on anatomical dissection. After much discussion and dissent, a complete anatomical definition was arrived at in 2017 which described fascia as a system that "surrounds, interweaves between, and interpenetrates all organs, muscles, bones and nerve fibres, endowing the body with a functional structure, and providing an environment that enables all body systems to operate in an integrated manner." [48]. Such a definition provides a picture of a much larger multi-directional network of fascia and its inter-connectedness [49].

10. Lessons from osteopathy

Osteopathy is a manual therapy which uses stretching, massaging and manipulation techniques on muscles and joints with a view to preventing ill health and restoring function and wellbeing. Osteopaths use techniques of correction and release with an underpinning understanding of the relationship between pain and tension that can be traced back to fascial structures. In 1899 the founder of Osteopathy A.T.Still described fascia as "the probable matrix of life and death."

It has been suggested that pressure on the foot could convert mechanical force into biochemical changes; this change is termed mechanotransduction. This process facilitates changes between the cytoskeletal structure and the extracellular matrix, producing cellular responses across membranes [50]. The mechanosensitive cells which respond to mechanical forces on the skin involve both physical and chemical communication processes [51].

In 2006, Langevin proposed a body-wide signalling system via the connective-tissue network that could be affected by pain from injury, posture and tissue damage [52]. It is conceivable that changes in the cell or the extracellular matrix could disrupt mechanotransduction and lead to altered tissue states and disease [53]. This theory is supported by further research investigating the possibility of stiffness in the extracellular membrane which is thought to have an influence on tumour growth [54].

Therapists could use the special properties of fascia by means of sustained pressure through compression, stretching or twisting of the myofascial system to effect a change in the tissues in other systems throughout the body. Furthermore, the conversion of mechanical force into piezoelectric energy via fascia has implications for neural transmission and interactions with the autonomic nervous systems [55], which may lead to intriguing potential mechanisms for action of reflexology.

The conversion of a mechanical force into a cellular response is an essential part of cellular processing and an increase in mechanical stimuli can trigger the release of Ca++ entry in excitable cells [56,57]. The rapidly adapting type I and II Meissner and Pacinian corpuscles account for 70% of the receptors found in the sole of the foot and these receptors are thought to respond better to an on/off stimulus [58–60]. This type of on/off dynamic pressure is typically applied during a reflexology treatment. Indeed, mechanical force influences a range of cellular and molecular activity within biological tissues. Piezo2 ion channels expressed in Merkel cells for example, release proteins that transduce basic stimuli into nerve impulses, along with the $A\beta$ neurons that are critical in the sensation of light-touch. Many reflexologists support the use of light-touch, and this may well produce a new avenue for the exploration of the mechanism of action of reflexology [61].

Whilst there is scant evidence to detect how sensory cells adjust to mechanical stimuli [62], recent research [63] proposes that the investing visceral fascia that closely relates to organs and supports them, may be richly innervated by fibres from the autonomic nervous system, and thereby affect metabolic behaviour. Further studies have supported this view of manual manipulation of fascia globally affecting the autonomic nervous system [64,65].

The variety of ways in which pressure on the fascia of the foot can alter functionality in the body it supports could serve as an explanation as to why the resulting changes after a reflexology session can be so individual and wide-ranging. As users of reflexology claim benefits which range from improvements in muscular tension and pain to hormonal balance and digestive functioning, it is feasible that what happens within a reflexology session is akin to mechanotransduction.

11. Force transmission through the body

In the 1990's Structural Integration therapist and Rolfer, Tom Myers, proposed the idea of lines of myofascial chains rather than single muscles and levers. These kinetic chains could allow for the transmission of force through the myofascia [66]. Myers initially presented six 'anatomy train' lines. Research has supported the superficial back line, back and front functional lines [67,68]. The findings provide an inter-connectedness between different myofascial structures that form patterns of tension and support and affect the individual's functioning and mobility.

The plantar fascia on the sole of the foot manipulated during reflexology, links to the Achilles tendon which sits within the superficial back line of fascia, tracing up the back of the leg, onwards to the spine and then over the back and top of the head to the brow [66]. The myofascial transition of plantar fascia-gastrocnemius; gastrocnemius-hamstrings; hamstrings-lumbar fascia/erector spinae/occipito-frontalis [69] is of particular interest for the reflexologist. Working the reflexes on and around the plantar fascia may have an effect on those body parts, as adjustment and release occurs all the way up from foot to head.

The network of collagenous tissues that make up the variety of fascial matrices allow the dissipation of mechanical forces throughout the body [70]. Whilst it is accepted that physical therapies can have a direct effect on muscular tension just beneath the skin and proper functioning restored, there appears to be much more to the impact of pressure on skin, both in terms of the transmission from surface to deep tissues, and further into the cells themselves [71]. This suggests that all varieties of manual therapy, including reflexology could have an effect on cellular activities.

Studies into fascia-therapy have indicated positive changes can be brought about in vascular parameters, such as blood turbulence within the arteries [43,72]. Blood turbulence can occur when arteries are affected adversely by the accumulation of plaques associated with cardiovascular diseases like atherosclerosis. These plaques on the sides of the artery act like buffers in a pinball game, pushing the blood from one side to the other impeding smooth flow. There is evidence that haemodynamic effects can be brought about through reflexology points in the feet [28]. It is feasible that both reflexology and osteopathy are activating mechanical forces to achieve similar outcomes in discrete areas of the body.

One of the founding osteopathic principles identified by A.T. Still in 1910 is the "*rule of the artery is supreme*", such that any obstruction of blood supply may lead to disease. Osteopathic manipulation can affect blood flow via the autonomic nervous system, and by a reduction in tension via the fascia [64,65,73]. Arteries and veins pass through the fascia [74] and may be compromised by fascial restrictions. Osteopathic manipulation of fascial restrictions can aid fascial sliding and improve blood flow dynamics [75].

12. Fascia and proprioception

Proprioception is the body's ability to sense where all of its body parts are relative to each other and to objects in the immediate environment. It is suggested that reflexology may involve correction of proprioception, as part of the rebalancing process. The originator of the theory of proprioception Charles Sherrington is often cited in reflexology text books [76], with no further explanation of how the two may be connected, or what mechanism may be involved in this rebalancing. In fascia however, we may have an explanation for the connection [77].

Studies have shown that the retinacula of the ankle and foot are rich in nerve fibres and proprioceptors because of their attachments to bone, muscle and to fascial expansions as well as tendons [78]. This activity in the foot and ankle delivers signals to the brain about spatial positioning and effective movement in space, so working on the foot and ankle during reflexology may have potential for instigating change and affecting balance.

Indications from research into the structure of the ankle retinaculum are suggesting that far from being a separate structure involved only in stabilising the ankle and lower limb, the retinaculum which wraps around the ankle is a thickened part of a much greater whole. This whole fascial system from the plantar surface of the foot, through the ankle and onwards up the skeleton is crucial in the balancing and stability of the whole musculo-skeletal system [78]. People who visit reflexologists for the relief of pain may be benefitting from this process of structural realignment.

Recent discoveries have given researchers a deeper understanding of the mechanisms involved in our ability to sense touch and pressure [79].

Researchers exploring the mechanisms involved in touch identified that two ion channels (Piezo1 and Piezo2) are directly activated by the exertion of pressure on cell membranes [80–82]. Essential for the sense of touch, these ion channels have been shown to play a key role in proprioception – the sense of body position and motion, and in regulating additional important physiological processes including blood pressure and urinary bladder control.

The usefulness of reflexology in bladder control has been identified in other research [83] leading to speculation that the mechanism of action in this case may be related to the activation of these ion channels and mechanical force being converted into initiation of the nervous system.

There are many physiological changes at work in the human body that relate to pressure and force [84]. Some [85] have reported that pressure of between 4 and 8 kPa impairs cutaneous blood flow and others [86] have reported that an exchange of ions or electrical activity in the cell membrane is generated by tissue deformation that is directly related to the degree of compression. The stronger the stimulus, the higher the frequency and the greater are the chances of initiating an action potential [87]. Further research has reported that mechanical loads induced within or outside the body could increase or decrease the properties of living cells [57]. The type of loading exerted at tissue level is transmitted to individual cells to affect physiological function. Some of the smaller nerve fibres (A∂ and C-fibres) are known to respond to pressures of between 6 and 24 kPa and these are typical of the values exerted during a reflexology session [36,88].

To further explore the relationship between mechanotransduction and cellular response one has to delve into the connection between the different cell types, proteins, and pressure. The Piezo2 channel is a stretch-gated ion channel, responsible for light touch, vibration, and proprioception. The Piezo1 channel on the other hand is responsible for detecting and transducing subtle changes in force. We use proprioceptive mechanisms on a daily basis to ensure the position of our joints in space and it would be reasonable to assume that the mechanistic approach of reflexology has a bearing on those processes. Piezo2 receptors are present in sensory neurons and the fascial tissue has a rich supply of sensory neurons that evaluate mechanical forces from both the external and internal environment [89]. This is a new field of research for reflexology and early evidence has shown that applied pressures in reflexology may have a definitive benefit for health and wellbeing [36].

13. Pain and inflammation

Pain can be negatively influenced by emotional stresses, and conversely any relaxation response may have the reverse effect. The alleviation of pain may also be linked to the empathy shown by the therapist, for example empathetic comments were shown to modulate

the effects of pain [90]. Other factors which may influence the alleviation of pain are the effects of touch [91] or distraction [92] or even the discussion about the anatomical processes giving rise to the pain [93].

The manipulation of fascial layers during reflexology may also have something to add about the alleviation of pain, especially pain associated with inflammation. Cells known as fibroblasts exist in deep fascial structures, which play an essential part in the regulation of inflammation, and the dysregulation of these fibroblasts has been implicated in chronic inflammation [44]. Fibroblasts produce collagen which is a pre-requisite for remodelling and for tissue repair. Researchers have discovered specialised fibroblasts which have been called fasciacytes [94]. The fasciacytes produce hyaluronan, a glycosaminoglycan which helps to lubricate joints and allow for sliding between layers of fascia. The quantity of hyaluranon varies throughout the body with greater amounts surrounding joints, the ankle retinaculum for example where greater movement is necessary. Hyaluranon regulates inflammation and tissue repair but its role is variable depending upon its molecular weight, thus it may act as pro or anti-inflammatory [95].

Manipulative treatments, and the use of mechanical transduction which instigates a piezoelectric response, may stimulate the activity of fibroblasts causing them to proliferate and potentially reduce the pain associated with inflammatory conditions such as fibromyalgia [96].

In addition, the technique of Positional Release (initially known as Strain-Counterstrain) developed by American osteopath Lawrence Jones in 1955, in conjunction with fascial release has been shown to reverse inflammatory cell behaviour within 60 s of application [97–99]. Reflexologists who use twisting and stretching reflexology techniques on the foot and ankle may well be tapping into the same processes.

14. Wound healing and the movement of fluid

Research has shown that lower leg wound healing can be improved by osteopathic treatment [100]. This improves the removal of inflammatory mediators such as cytokines, bradykinin, and prostaglandins. Lymphatic drainage also decreases autonomic nervous system activity due to decreased afferent input to the spinal cord [101]. Interstitial fluid movement has been shown to be activated by osteopathy, and changes in the quality and viscosity of fluid have also been demonstrated within the fascial network [102].

Lymphatic flow is facilitated through the deep fascial layers [103], and improvements in the flow of lymph have been demonstrated after reflexology treatment. It is feasible that the movement of lymph in breast cancer related lymphoedema is propelled through the deep fascial layers when encouraged by reflexology on the feet and ankles [104].

Osteopaths have been concerned with fluid dynamics and fascia from the outset of the profession. Recent research has investigated the role and importance of fluid dynamics and water in fascia. The body is composed of 60% water; as we age, we lose water. At birth the percentage of water in the body is 75–80%, by age 25 it is 60% and by the age of 80 years of age, it is only 50% [105]. Water is a prerequisite for homeostasis as a result of nutrients being conveyed to the cells and cellular waste being evacuated [106]. Water also acts as a solvent, a thermoregulator, a shock absorber and a lubricant [107]. All systems of the body rely on sufficient hydration to operate at an optimum level [106]. Stagnation of dynamic fluid health has been associated with poor tissue health and aging with water being bound to inflammatory cytokines.

Research has demonstrated densification of the thoracolumbar fascia and decreased shear in patients with chronic low back pain and [108], supported the use of fascial release to effect change at the cellular level [109].

The hyaluranon molecule is extremely hydrophilic. Osteopathic manipulation of fascia involves a very slow shearing motion in multi-directional vectors; this promotes hyaluranon production and consequent increased water content which promotes fascial sliding and decreases fascial densification [110–112].

15. Researching reflexology

The randomised controlled trial, widely considered the gold standard of research in medicine, presents unique challenges in the field of CAM. Single blind studies into reflexology are more common [26,113], double blind studies rarer due to the difficulties of selecting appropriate sham groups [114,115]. Challenges relating to the heterogeneity of treatment protocols are common, as reflexologists tend to adapt treatment to client need depending on the client's requirements on the day. These individualised treatment plans which may deliver satisfactory outcomes for the service user, cause an issue in research when homogeneity of protocols is necessary for the measurement of outcomes. The complexities inherent in the selection of an appropriate sham control group is beyond the scope of this paper but it continues to pose a challenge for CAM research in general and reflexology research in particular [9,116].

Whole systems research is an emerging discipline which may offer a new approach to measuring outcomes and mechanisms in reflexology. The development of research methodologies which allow a focus on both the whole system and components of the system in context is essential to take us towards a broader understanding of what is possible for the therapy of reflexology [8].

Connecting with reflexology at all stages of health and illness could provide immediate benefits such as improvements in pain, anxiety, restorative sleep and general wellbeing. While researchers have focused on the immediate measurement of such factors as these [17–19,115], the downstream benefits should not be neglected and these are likely to sit within the framework of preventative health, rehabilitation and motivation. Cost benefit analyses of the impact of complementary approaches such as reflexology should be developed to capture the broader picture, both in the immediate aftermath of treatment and later on.

16. Conclusion

In summary, the mechanism of action for the outcomes of reflexology treatment is likely to be complex.

- Different kinds of reflexology are likely to have different mechanisms
- Therapeutic touch, environment and placebo all play a part in outcomes
- Mechanotransduction is likely to be involved with a range of outcomes
- The influence of fascia in structural, cellular, and movement of lymph has important clues for the understanding of reflexology outcomes.
- More research is needed to evaluate these theories

The mechanism of action for reflexology is highly dependent upon what kind of reflexology is being undertaken. It is likely to be a complex interplay of therapeutic touch, placebo, personal empathy and physical pressure and manipulation. Whilst it is essential to consider aspects of placebo and therapeutic touch as agents in the outcomes of reflexology, the role of fascia should be given consideration as a potential theory of mechanism for the deeper manipulative techniques of reflexology treatment, both in the maintenance of structural integrity in the musculoskeletal system and in the potential impact on pain modulation, fluid movement and cellular activity.

The explanatory frameworks around reflexology have long been vague, with much talk of 'rebalancing' without further explanation. This has undermined the credibility of a therapy which has much to offer. Each of the types of reflexology and their associated mechanism of action are likely to have value in their own right for client outcomes.

Further research is recommended into the activation of fascia from the reflex points of the foot and ankle, such that the mechanisms at work can be more clearly understood.

Declaration of interest

None declared.

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