



# The physiological basis of reflexology and its use as a potential diagnostic tool

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## KEYWORDS

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**Summary** Ill-health changes the anatomy and physiology of affected organs, some of which can be observed visually, elicited through physical examination or confirmed through biomedical analysis. Understanding how anatomical changes contribute to physiological signs and symptoms will help practitioners identify the pathology, appreciate its origin and development and justify prescribed interventions in a way which can be upheld by critical external scrutiny.

Reflexology contributes to an holistic approach to care and has recently improved its credibility as a discipline which supports orthodox care. Several research publications have identified possible theories and principles for the mechanism of action of reflexology, but more research to explain its contribution in identifying ill-health and diseases, as well as appropriate treatment modalities, is needed.

This paper explores the physiological basis of reflexology, some of the theories for the mechanism of action and its potential as a diagnostic tool.

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## Introduction

Reflexology is based on the principle that the feet represent a map of the whole body, so that by working manually on the feet, distal areas of the body can be treated. This principle, in which one small part of the body relates to the whole, can be extended to other areas, via which treatment of distal areas can be performed. Changes in the feet, hands, face, tongue, ear or even the eyes, as in iridology, appear to reflect the occurrence of

physiological changes elsewhere. Current knowledge suggests that the effectiveness of reflexology treatment may be explained in existing scientific concepts such as peripheral vasodilatation to remove local toxin accumulation and neural pathways related to the gate theory to explain the reduction of pain perception. Although reflexology should not be considered as a diagnostic tool in isolation, these changes may represent altered physiology or pathology, potentially contributing towards the formulation of a working diagnosis for the basis of treatment. This paper applies known physiological concepts to explain possible mechanisms of action to support our understanding of the basic principles of therapeutic reflexology.

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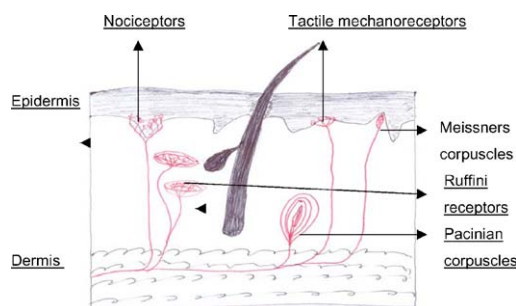
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## The mechanism of action of reflexology

It is unclear exactly how reflexology works, but it has certainly been shown to have profound physiological effects, which may be partly attributed to the relaxation derived from the placebo effect, the therapeutic interaction and the impact of touch.<sup>29</sup> However, immediate, short-term responses to treatment are also frequently reported, including localised or distal pain and tenderness, perspiration and skin flushing, shivering, pallor, increased heart rate and respiration, nausea and emotional release. Many of these clinical features do not commonly occur with touch alone, suggesting that reflexology may be having a more significant effect, possibly at a deeper level than simple massage. Treatment also induces, in some patients, a deep fatigue and a desire to sleep, thus possibly reducing stress-related conditions. As with massage, skin-to-skin contact triggers the release of endorphins and enkephalins,<sup>10</sup> which assists in relieving pain, thereby improving the sense of well-being. Additionally, analgesia may be achieved with pressure of specific reflex points, which effectively intercepts pain neural pathways via the gate control mechanism.<sup>17</sup>

Feet are sensitive to pressure, stretch and movement. The skin contains several types of sensory nerve receptors, each with different anatomical and physiological properties. Varying degrees of pressure, such as those generated by touch and massage, stimulate sensory nerve endings (corpuscles) attached to these receptors. Meissner's corpuscles, about 0.7 mm below the skin surface just beneath the epidermis of hairless skin, respond to fine touch and slow vibrations. Tactile cutaneous mechanoreceptors, which respond to touch and mild pressure, are located in the epidermis while the Ruffini cutaneous mechanoreceptors are located in the middle region of the dermis and respond to mild pressure. The Pacinian corpuscles are situated at a deeper level, about 2 mm below the skin surface in the dermis and in subcutaneous layers, joints, periosteum and some viscera and respond to stronger pressure and fast vibration<sup>18</sup> (Fig. 1).

Stimuli, such as, touch or pressure, trigger an "action potential" in the cells, discharging an electrical current that is transmitted via sensory nerves to the brain for interpretation which motor nerves then carry to local muscles for a response. Signals from touch receptors are relayed to the brain by A-beta fibres at 30–70 m/s and those free nerve endings signalling cooling or pricking sensations are transmitted by A-delta fibres at 5–30 m/s while burning sensations travel by C-fibres at



**Figure 1** Diagram showing the anatomical location of sensory receptors in the skin.

0.5–2 m/s.<sup>7</sup> The exact force of stimulus applied through reflex therapy, the electrical impulses thus generated and the therapeutic effects in the skin or muscles are very difficult to measure objectively in order to identify and characterise the physiological processes involved. However, experimental work by Asamura et al.<sup>2</sup> seems to suggest that it may be possible, in the near future, to stimulate selectively the superficial skin receptors either by touch or vibration and record the generated impulses and thus identify the specific physiological routes.

Some of the variations in electrical changes can, however, be measured via an electroencephalograph, electrocardiograph or Myogram and often contribute to the medical diagnosis of various pathologies. For example, the Hoffmann reflex which measures the rate of change and the amplitude of neuromuscular excitability in direct response to a neural stimulus) can show how intense the stimulus is by measuring the changes in the amplitude of the muscle involved; the more intense the stimulus the bigger the changes will be.<sup>8</sup> Sullivan et al.<sup>28</sup> have shown the sedating/relaxing effects of massage (petrissage) to be due to a decrease in the high level of neural electrical activity of the motor neuron. Therefore, if petrissage has this calming effect on hyperactive muscles, it may be possible to confirm this by the Hoffman reflex. This would be similar to the confirmation of bradycardia on electrocardiograph indicating reduced stress.

## Nerve impulse theory

The nerve impulse theory,<sup>5</sup> or autonomic-somatic integration theory<sup>11</sup> suggests that the pressure applied to the feet during reflexology compresses the receptors in the cells opening ionic channels in the plasma membrane and triggering a local action potential to convey messages to the spinal cord and/or brain. Those impulses involving the spinal cord only may be similar in principle to those of the

involuntary spinal knee jerk reflex, which possibly relies on the inter-connecting neurons at the spinal level between sensory and motor nerves. Reflexology may thus have a direct effect on the muscles as a result of a combining of the sensory messages coming from the feet with the motor instructions going to the muscles via the interconnecting neuron in the spinal cord.

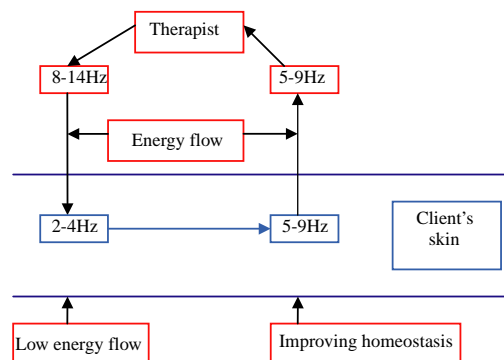
### Contemporary theories

Other more contemporary theories about the mechanism of action include that of electromagnetism (Bliss and Bliss, 1999), with alpha brain waves vibrating in tandem with Schuman resonance of the earth, producing the synchronisation needed for the human brain to function effectively as a biological organ.<sup>6</sup> While there is a general lack of understanding of this phenomenon, it is appreciated that biological rhythms, physical well-being and mental states are dependent on our electrical brainwave system interacting with the extremely weak electromagnetic fields generated by the Earth's radiation.<sup>25</sup>

For example, Subrahmanyam et al.<sup>26</sup> measured physiological changes, such as sharp inhibition of the brain's electrical activity, in electroencephalograms of clients exposed to sinusoidally oscillating magnetic fields of 0.01–10 Hz with amplitudes of  $\pm 5$  and  $\pm 50$  nT against an ambient geomagnetic field of 40,000 nT. Conversely, geopathic stress zones, with artificially generated electromagnetic radiation, are associated with ill-health such as sick building syndrome.<sup>13</sup> Ill-health may cause either a reduction or increase in the alpha wave activity,<sup>20</sup> triggering distortions or blockages which may cause congestion in the feet, impeding their ability to transmit energy from the ground. Acupuncture has been also reported to improve the electromagnetic wave inside the body and promote health.<sup>33</sup>

Reflexology can have a similar effect, acting through the "sympathetic resonance", via which energy waves (normal ranges of 8–13 Hz) are exchanged between therapist and client (Fig. 2) where energy flows from a higher to a lower gradient, unblocking energy channels.

During treatment, energy flows from the healthy therapist, who acts as a conductor with a measurable energy level of 8–14 Hz, to the client who has a lower energy threshold of 5–9 Hz until a homeostatic balance is achieved.<sup>34</sup> This may be facilitated by local enzymatic reactions through the applied pressure on receptive fields or through an improved blood supply as a result of local skin temperature changes through the skin–skin contact.<sup>23</sup>



**Figure 2** Shows direction of electrical energy flow between therapist and client. (Higher energy levels in the therapist flow to the client who has lower energy levels, until the levels reach normal ranges i.e. homeostasis.)

### Mechanisms of action

In conventional medicine, external manifestation of an internal disease process can often be detected at a site distal to the affected organ. The principle of a link between one part of the body and another can be understood in terms of interactions of nerve, muscle and chemical pathways. For example, left shoulder pain radiating down the arm is a classical sign of cardiac angina, due to the sensory nerve fibres from the heart, the skin over the heart and the skin along the medial aspect of the left arm all entering the same spinal cord segments (the dermatomes or the somatic segmental nerve distribution). While many acupuncture meridians are known to be contained within one dermatome, signs and symptoms of illness related to one dermatome may be reflected in changes in neighbouring dermatomes. In reflexology, Marquardt<sup>16</sup> suggests a correlation between zones on the feet with spinal nerve segments of other organs, for example, the bladder zone, on the medial sides of both feet, on the proximal part of the calcaneus, has a link with nerve segments supplying other pelvic organs as well as the bladder.

### Acupuncture and reflexology

One of the most popular theories about the mechanism of action of reflexology is the concept of meridian pathways as used in Traditional Chinese Medicine, since many reflexology points correspond to known acupuncture tsubos<sup>9,14</sup> such as the Kidney 1 tsubo, often used for relaxation in acupressure, which corresponds to the solar plexus zone, according to the majority of reflexology charts. There is a close correspondence of acupuncture

points with superficial and deep cutaneous nerves, some correlation between tsubos and blood vessels and lymph vessels.<sup>4</sup> Correlation between the eyes and needling of eye-related acupuncture points on the feet has been demonstrated via magnetic resonance scanning showing a direct neural link between the feet and the central nervous system and the area of the visual cortex in the brain, acupuncture works by stimulating the hypothalamus, triggering the release of neurochemicals, and together with the autonomic nervous system, may assist in improving visual disorders.<sup>11</sup> Similarly, site specific neural responses can be evoked in different regions of the brain when related external ear points are stimulated, indicating possible neuro-endocrine and endorphinergic mechanisms in auriculotherapy/ear reflexology.<sup>22</sup>

The termination of some acupuncture meridians in the feet may indicate pathological changes in a related organ, rather than in the organ to which that part of the foot relates. For example, the end of the Gall Bladder meridian is found in the part of the foot relating to the hip zone, but can also suggest disease processes in the gall bladder rather than the hip joint.<sup>16</sup>

Physiological correlations between reflexology points on the feet and affected organs have also been shown. Mur et al.<sup>19</sup> found increased intestinal blood flow during stimulation of corresponding reflex points, compared to subjects who received reflex stimulation on unrelated points. Similarly, Sudmeier et al.<sup>27</sup> demonstrated increased renal blood flow, measured with Doppler sonography, during reflexology on the foot points related to the kidney, compared with subjects given placebo reflexology at points not associated with the kidney.

## Reflexology as a diagnostic tool

Experienced practitioners of reflexology have repeatedly offered anecdotal accounts of their abilities to identify, from the feet, suspected areas of altered physiology or possible pathology elsewhere in the body. Many reflexologists detect clues from visual and manual examination of the feet and are able to make “educated guesses” about clients’ previous medical conditions, with no prior knowledge of their history. Setting aside the legal and ethical debate about whether or not reflexologists should diagnose, initiating treatment without a working diagnosis or relying on one made by another discipline compromises professional accountability and credibility.

Conventional medical diagnosis involves considering signs, symptoms, the patient’s history and the outcome of any specific investigations, which together with experience, enable the practitioner to make an assumption that a particular condition or illness is present. Similarly, past diseases may be assumed from the presence of scars, and the potential for future pathology can be suggested from a history of lifestyle factors or current conditions, such as diabetes mellitus. It is not then so implausible that reflexologists may incorporate in their basic theoretical knowledge and ongoing clinical skills the feasibility to determine current, previous or impending changes, which may indicate changing physiology or disease processes. This does not necessarily imply the attaching of a “disease label” in allopathic terms, but may enable the practitioner to identify certain changes suggestive of a differential diagnosis. For example, it would not be possible for a reflexologist to confirm a diagnosis of appendicitis but changes in the foot zone related to the appendix could be identified which might suggest the condition, although further medical investigations would be necessary to confirm the diagnosis.

Several studies have been undertaken to determine the extent to which reflexologists are able to diagnose. Raz et al.<sup>24</sup> suggest that it is a useful tool to diagnose at a systematic (structural), rather than a systemic, level, but is reliable only for systems, which have a precise anatomical location. There appears to be a tendency of therapists to “over-diagnose”, finding supposed changes in the foot zones where no related organ pathology exists,<sup>3</sup> although Marquardt<sup>16</sup> differentiates between symptomatic and background reflex zones and suggests a psycho-physical link with zones which appear initially to be unrelated to the presenting condition. This may indicate an over-enthusiastic practitioner rather than a weakness in the diagnostic process. Furthermore, various reports of accurate identification of previous medical conditions are found in the reflexology literature.<sup>30,31</sup>

### Case study

The complementary therapy midwife was asked to see a 31 year old primigravida admitted to the gynaecology ward at 17 weeks’ gestation for hyperemesis gravidarum, with vomiting 6–7 times daily. The woman reported a history of back problems, prompting the midwife to consider reflexology as a possible treatment for the sickness. On

inspection, the mother's feet showed a marked greyish tinge over the dorsal aspect of the large toes, at the junction of the foot, an area corresponding to the throat. Making an educated guess, based on her knowledge of the aetiology of hyperemesis gravidarum, the midwife suggested that there could be a thyroid implication in the woman's condition and advised the taking of blood samples, which later showed changes in the thyroid hormone levels which were then treated with conventional thyroxine.<sup>31</sup>

Although, White et al.'s<sup>32</sup> blinded investigation into the accuracy of reflexology charts found little evidence to support the therapy being used as a diagnostic tool, their small-scale study, with only three therapists, calls the validity of their methodology into question.

Consistency of reflexology charts has also been challenged by O'Hara,<sup>21</sup> using the examples of location of the pituitary gland and solar/coeliac plexus zones according to charts from various authorities. However, he points out that it is an integral part of clinical reflexology practice to attempt to identify zones of significance on the feet in order to individualise treatment. If this was not the case, with reflexology being merely a universally routine procedure as in the case of "salon" reflexology, the charts would be redundant. Despite the fact that reflexology alone cannot yet be considered a reliable diagnostic method, its potential to support other findings in making a definitive decision about proposed treatment strategies is worthy of further exploration.

Reflexology "diagnosis" includes a visual and manual examination of the patient's feet and the taking of a medical history. Changes in skin colour, tone, temperature and resistance of the feet are noticed and the patient is observed for verbal and non-verbal signs of tenderness or pain at any time during the manual examination.

In acupuncture theory too, it is generally held that, during altered physiology or in the presence of pathological changes, specific tsubos relative to the patient's condition are tender when pressed,<sup>12</sup> in much the same way as relevant points on the feet are tender in reflexology.

Acupoints have been found to have a lower electrical skin resistance than surrounding tissues, probably as a result of autonomic control of blood vessels, with tenderness of points related to the presenting condition, possibly due to toxin accumulation beneath the skin,<sup>22</sup> although this may not

be sufficiently reliable to identify accurately the site of needle insertion for treatment.<sup>1,15</sup>

Similarly, some reflexologists subscribe to the theory of gravitational effects on the feet, in which accumulation of serum deposits of calcium and uric acid is thought to occur subdermally in the foot zones related to the affected organ (Bliss and Bliss, 1999). (This was previously considered to be due to lactic acid deposits but this theory has now been largely dismissed.) Reflexology diagnosis is based partly on detecting these deposits, although Marquardt<sup>16</sup> affirms that the painful areas indicate only the location for treatment, which is thought to break down and disperse them, to aid a return to homeostasis.

Variations in the accuracy of reflexology diagnosis may, in some cases, be due to lack of experience on the part of the practitioner, particularly in their ability to differentiate between normal physiology, abnormal pathology and merely coincidental disparities in the feet. Additionally, progress of the disease may contribute to the sensation of tenderness experienced by the patient at the relevant reflex point. An acupuncture example of this is easily observed at the Pericardium 6 tsubo on the inner wrist, with the degree of tenderness varying according to the severity of nausea.

In reflexology, two main types of tenderness at relevant points are reported by patients: a precise, sharp, pin-pricking sensation or a diffuse bruised feeling. A sharp precisely located superficial sensation, often described as being "like the therapist sticking her nail in the skin", appears to reflect an acute, current condition and is synonymous with "fast" pain which occurs very quickly after application of the stimulus and travels along the A-delta nerve fibres which are medium-diameter myelinated nerves. A bruised feeling, on the other hand, occurs at a deeper level, appears to indicate either a past or chronic condition, and reflects "slow" pain, which is more diffused over a larger area with impulses travelling along small-diameter unmyelinated C fibres.

Tenderness also varies according to the area of the foot, and is usually more intensely sharp where the periosteum is close to the surface, such as parts of the toes, deep and contoured in muscular areas on the plantar surface, or a cutting sensation induced by specific techniques around the fifth metatarsal or the lateral surfaces of the toes.<sup>16</sup> Furthermore, glabrous skin has an epidermal layer of about 1.5 mm thick and a dermis of about 3 mm, while hairy skin has an epidermal layer of 0–0.7 mm and a dermis of 1–2 mm. This may also depend on the innervation density and size of the receptive

field in the area, for example, Meissner's corpuscles have a receptive field of only a few millimetres across while Pacinian corpuscles fields are over 1 cm.<sup>2</sup>

Differences in patient reporting of this subjective tenderness may also relate to the techniques and style of reflexology used, for example, the light touch of the Morrell technique or the firm pressure of reflex zone therapy, with the precise location at which significant changes can be detected dependent on the depth of pressure, in the same way as the depth at which the therapeutic effect of acupuncture—or deqi—is variable.

## Conclusion

The application of physiological concepts to increase our understanding of the mechanism of action of reflexology and facilitating its use as a possible diagnostic tool, or as a means of providing additional information to assist in confirming a medical diagnosis, should be enhanced through evidence-based practice in order to be more fully integrated into orthodox healthcare. While reflexology is increasingly being integrated into conventional healthcare, its effectiveness as a therapy has yet to be underpinned with conventional scientific understanding. Although reflexology is established as an adjunct to holistic care, its contribution in aiding diagnosis is still embryonic. Independent controlled standardised clinical research, which can be replicated, is needed in order to promote the potential role of reflexology as an aid to diagnosis. This may be in the form of studies comparing diagnostic accuracy of reflexologists with that of conventional healthcare practitioners.

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