ABSTRACT

Objective To describe the relationship between referred itch (mitempfundung) stimulus and referral points and acupuncture meridians, noting that the neuroanatomical mechanism of mitempfundung has never previously been satisfactorily explained.

Methods Analysis of clinical findings in the author as well as subjects in four previously described studies, comparing proportions in each of five groups.

Results Ninety-two per cent (range 85–94%) of mitempfundung point pairs (stimulus and referral) aligned to a recognised acupuncture meridian with no statistical difference (p<0.05) between the five data sources.

Conclusion While previous authors have speculated on an association between mitempfundung and acupuncture, this is the first description of a relationship between stimulus and referral points and acupuncture meridians. The author suggests that the transmission of mitempfundung along acupuncture meridians may involve a series of C-fibre–Merkel cell relays, with the final referred itch sensation caused by substance P release triggering mast cell degranulation.

While there is mounting evidence that acupuncture is a beneficial therapeutic modality for pain relief,¹ the traditional Chinese medicine concept of specific acupuncture points and meridians² has defied explanation.³

Similarly, referred itch, or mitempfundung, a curious phenomenon first described over 120 years ago, in which a stimulus applied to one cutaneous location is perceived as a pricking or tingling sensation in a different cutaneous location, has also yet to be satisfactorily explained.⁴ Proposed mechanisms have suggested either abnormal branching of afferent axons during development⁵ or spinocervical tract anomalies,⁶ the latter tract being a column of axons ascending from spinal cord segments, conveying pain information to neurons in the upper cervical cord.⁶ This tract, while prominent in cats, is of minimal size and importance in humans,⁦ and is unlikely to be involved in mitempfundung perception.⁷

Having experienced this phenomenon since childhood, the author had taken little interest in it until he accidentally happened upon a Wikipedia article in which it was described.⁸ The author had previously speculated on the nature of acupuncture meridians,⁹ and the subsequent perusal of mitempfundung point locations in published diagrams⁹,¹⁰ made him wonder whether there was a relationship between these and meridians. The author has given informed consent for his clinical data to be used and published.

MATERIALS AND METHODS

Subjects

Initially, the author mapped mitempfundung points on himself over a 3-month period, and then perused previously published diagrams and tables of points. Studies containing the words ‘mitempfundung’, ‘mitempfundungen’ or ‘referred itch’ in the title, abstract or keywords were identified in a Pubmed search. In addition, all available references cited in these published studies were examined for potential inclusion. Studies were included if mitempfundung point pairs were described—either on a labelled diagram, or in tabulated format—in sufficient detail to enable unbiased localisation.

Data collection

Each mitempfundung pair (stimulus and referral points) was designated as either located (positive) or not located (negative) on one of eight meridian groups, as defined below.

There are 14 main meridians (those that contain acupuncture points). Twelve are bilateral and may be grouped into six pairs, as described below, partly by linking upper-limb and lower-limb channels, and two (GV and CV) are midline, resulting in eight groups (GV and CV are each treated as a separate group).¹¹ The six pairs described above (three Yin and three Yang) are the same as Zhonjing Zhang’s six meridians, originally described almost 2000 years ago as forming the basis for the physical response to illness caused by exogenous agents.¹² While Zhang’s description encompasses the vast majority of acupuncture points, it omits those located on the CV and
GV meridians, which, for the purpose of this study, were added to Zhang’s six, resulting in the eight meridian sets used. Therefore, all traditional acupuncture points can be mapped to one of the following eight groups:¹¹ Shao Yin axis (HT/KI), Tai Yin axis (LU/SP), Jue Yin axis (PC/LR), Tai Yang axis (BL/SI), Shao Yang axis (TE/GB), Yang Ming axis (LI/ST), CV and GV.

If only one half of the mitempfindung pair was on one of these eight meridian groups, or each of stimulus and referral points was on a separate meridian group, the pair was designated negative. Points were excluded from assignment if the location was unclear on a diagram or published table.

**Statistical analysis**
The proportions of mitempfindung point pairs aligned with a single meridian group were calculated, and differences between each were compared pairwise using the Marascuillo procedure¹³ at a 0.05 significance level.

**RESULTS**
Four peer-reviewed articles were identified with either diagrammatic⁹ ¹⁰ or tabulated¹⁴ ¹⁵ mitempfindung point locations. The locations of these as well as the author’s own points, mapped to acupuncture meridian groups, are recorded in table 1. Alignment of mitempfindung point pairs with meridians ranged from 85% to 94% and, of a total of 273 point pairs, 252 (92%) aligned with an individual meridian group. Each proportion was then individually compared pairwise, yielding eight comparisons, with no significant difference demonstrated among any of the pairs at the 0.05 level. None of the mitempfindung points corresponded to recognised acupuncture points.

**DISCUSSION**
In his recent review of the history of mitempfindung, the neurologist John Pearce,⁴ noted the absence of any correlation between acupuncture points and mitempfindung points. As noted by Bean,¹⁰ Richter⁶ speculated that mitempfindung points may, in prehistoric times, have led to the development of acupuncture, but neither author was able to identify any relationship between these two entities. Yet, both mitempfindung and acupuncture involve cutaneous transmission of sensory information over long distances without definite anatomical correlates and, for each, only a proportion of the human population demonstrates susceptibility to responding.⁶ While Pearce⁴ is probably correct that there is no relationship between mitempfindung points and acupuncture points, no previous study has sought to determine whether mitempfindung points lie along acupuncture meridians, the lines that connect the points.

In demonstrating the alignment of over 92% mitempfindung point pairs with acupuncture meridians, this study offers a potential connection between two previously unexplained neurological phenomena. The author previously proposed that acupuncture might disrupt the bifurcation of C-fibre tactile afferent axons at acupuncture points, preventing communication between Merkel cells along acupuncture meridians.⁸ Subsequently, preliminary evidence was found of axonal branching at human acupuncture points.¹⁷ Merkel cells, also referred to as ‘touch cells’, are specialised sensory and neuroendocrine cells located in the basal epidermis in distinct disc-like structures called ‘touch domes’.¹⁸ At these sites, Merkel cells are found in close proximity to sensory nerve fibres, and touch domes are believed to have both mechanical and pain sensing roles.¹⁹ Both Richter⁹ and Sinclair¹⁵ have noted that mitempfindung stimulus points were located at touch domes. Given that Merkel cells in touch domes receive input from unmyelinated C-fibre afferents,¹⁹ the transmission of mitempfindung along acupuncture meridians may involve one or more C-fibre–Merkel cell relays, with the final referred itch sensation caused by substance P release²⁰ triggering mast cell degranulation (see figure 1).

This model raises two key questions: first, noting that Merkel cells are responsible for light touch perception,²¹ why is mitempfindung referral perceived at a considerable distance to the stimulus, as opposed to the next Merkel cell along the relay? At least part of the answer may relate to the heterogeneity of the granule composition of Merkel cells,²² such that the perception of mitempfindung would, according to this model, require both the presence of substance P and localisation near one or more mast cell. In addition, antidromic C-fibre stimulation, as would occur in this model, has been shown to inhibit Merkel cell mechanoreceptor activation²³ so that intervening Merkel cell activation along the relay would not be perceived. Second, why is there no weal or flare response at the mitempfindung referral point, at the site of mast cell degranulation?²⁰ The release of histamine by mast cells is known to be in direct proportion to the concentration of substance P²⁴, while the weal and flare response is proportional to the concentration of histamine released.²⁵ In contrast, there is a poor correlation between the subjective sensation of

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**Table 1 Alignment of mitempfindung point pairs with acupuncture meridians**

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Data source</th>
<th>Point pairs</th>
<th>HT/KI</th>
<th>LU/SP</th>
<th>PC/LR</th>
<th>BL/SI</th>
<th>TE/GB</th>
<th>LI/ST</th>
<th>CV</th>
<th>GV</th>
<th>Proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>The author (1)</td>
<td>Clinical mapping</td>
<td>38</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td>3</td>
<td>0.889</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bean¹⁰ (1)</td>
<td>Diagrams</td>
<td>51</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>24</td>
<td>8</td>
<td>11</td>
<td>0.941</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evans¹⁴ (8)</td>
<td>Tabulated points</td>
<td>153</td>
<td>21</td>
<td>14</td>
<td>6</td>
<td>36</td>
<td>38</td>
<td>9</td>
<td>12</td>
<td>6</td>
<td>0.928</td>
</tr>
<tr>
<td>Richter⁹ (1)</td>
<td>Diagrams</td>
<td>13</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>0.846</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sinclair¹⁵ (4)</td>
<td>Tabulated points</td>
<td>18</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td>3</td>
<td>0.889</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
histamine-induced itch and the objective measurement of weal and flare. In the proposed model, only very small quantities of substance P are likely to be released at the referral point, triggering the release of a small quantity of histamine, sufficient for the perception of transient itch, but insufficient for a visible weal and flare response.

The model may also assist in explaining the inconsistent results for acupuncture encountered in the literature. Mitempfindung is only experienced by a proportion of people, with estimates ranging from 20% to 25%. Similarly, the response to acupuncture, especially for pain relief, is non-uniform. Perhaps this variability relates to the degree of connectivity of C-fibre–Merkel cell relays, with responders (to both mitempfindung stimulation and acupuncture) demonstrating better developed or more widespread connections (equating to acupuncture meridians).

This study is limited in three ways: first, the five groups examined comprise quite diverse data sources, including the author, two sets of diagrammed data and two sets of tabulated data; second, overall subject numbers are small, noting that few subjects have previously been described, despite a significant prevalence of mitempfindung in the general population; and third, the method used for meridian classification might appear to be somewhat arbitrary. In response, the classification used in this study is based on one specific traditional description. Some traditional Chinese medicine practitioners pair meridians in a different manner (eg, LU with LI) based on their location on the outer or inner surface of a limb, noting that the latter descriptions do not connect upper and lower-limb meridians as in Zhang’s classification, as used in this study.

Mindful of these limitations, has this study finally elucidated the mechanism of mitempfindung? The existence of the referred itch phenomenon is an indication that the central nervous system has important pathways about which we are still ignorant, and this is certainly relevant to acupuncture. Evans previously speculated that this phenomenon related to the arrangement of fibres in the thalamus or thalamocortical tracts, but no subsequent work has been published to support or refute this suggestion.

Finally, it is tempting to speculate on the implications of this study on acupuncture in general. Despite wide clinical use, acupuncture remains a controversial therapeutic technique, partly because its mode of action is not well understood, and there has previously been little, if any, strong scientific evidence for the existence of either meridians or acupuncture points. As noted by Ramey, if such structures could be shown to exist and be reliably demonstrated, this would revolutionise anatomy and physiology. If, indeed, there is a definite link between acupuncture and a recognised neurophysiological phenomenon, as suggested by the current study, this would open a new and exciting direction for acupuncture research.

In conclusion, this study, having found over 92% mitempfindung point pairs from five diverse data sources aligning with acupuncture meridians, offers a new model for mitempfindung in which stimulation at a touch dome is referred to a distant point along one or more C-fibre–Merkel cell relay along an acupuncture meridian. Additional studies, with larger numbers of subjects, will be required to confirm these conclusions.

### Summary points
- Mitempfindung means that touch refers a sensation of itch elsewhere
- Stimulus and referral sites were mapped and compared with published descriptions
- Locations of mitempfindung overlap acupuncture meridians

### Competing interests
None.

### Ethics approval
This study was approved by the institution’s research ethics committee (Curtin University human ethics approval no SMEC-60-09).

### Patient consent
Obtained.

### Provenance and peer review
Not commissioned; externally peer reviewed.

### REFERENCES