

# Hypnotic imagery as a treatment for phantom limb pain: two case reports and a review

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**Objective:** To provide a theoretical background, to review existing literature and to present new case material relevant to the treatment of phantom limb pain using hypnotic imagery.

**Method:** This paper presents two new case reports involving the use of hypnotic imagery procedures in the alleviation of phantom limb pain and reviews 10 previous clinical studies which have involved a similar approach. The earlier studies were identified by electronic and manual searches of the relevant literature.

**Results:** Two main treatment strategies can be identified: (1) ipsative/imagery-based approaches and (2) movement/imagery-based approaches. A common finding is the need to treat the phantom limb as a 'real' body part, to accept its existence as a valid mental representation and to avoid treating the amputation stump as the sole source of the phantom pain sensations.

**Conclusion:** Hypnotic procedures appear to be a useful adjunct to established strategies for the treatment of phantom limb pain and would repay further, more systematic, investigation. Suggestions are provided as to the factors which should be considered for a more systematic research programme.

## Introduction

Traditionally, 'phantom limbs' (i.e. residual, non-visual experiences of the affected body part) have been reported following limb amputation<sup>1</sup> and brachial plexus avulsions,<sup>2</sup> though similar phenomena also occur after mastectomy<sup>3</sup> and removal of a variety of other body parts and internal organs as well as following stroke.<sup>4</sup> Post-

surgically the majority of amputees (between 50 and 85% according to Jensen *et al.*<sup>5</sup>) develop pain that they attribute to the phantom limb itself (phantom limb pain: PLP). The qualitative experience of PLP is very variable between individuals, and includes sensations of burning, cramping, stabbing and clenching spasms.<sup>6</sup>

Different accounts have been put forward to explain this debilitating phenomenon.<sup>6</sup> One view is that PLP represents a continuation, or 'memory', of normally transduced pain which was present prior to the amputation.<sup>7</sup> Other accounts for the origin of the pain include the release of spinal cord neurons from inhibition following loss of

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afferent impulses<sup>8</sup> and the reorganization of cortical maps following limb amputation.<sup>9,10</sup> The view that phantom limb pain is accompanied by remapping of cortical areas has received recent empirical support from clinical<sup>11</sup> and neurophysiological studies.<sup>12</sup> There is also neuroimaging evidence that phantom limb sensations, including PLP, are accompanied by activity in the same brain areas as when the body is intact.<sup>13</sup>

Even when present, the phantom experience is not static and several factors such as emotion, weather change, eating and fatigue can affect PLP.<sup>6</sup> There is also evidence that the nature of the phantom limb experience may be influenced by suggestion and expectation (e.g. refs 11 and 14).

The results achieved with PLP from surgical and pharmacological treatments are generally reported to be poor<sup>15–17</sup> though there is evidence that psychological interventions are more effective.<sup>18</sup> To the extent that PLP is variable and may correspond with past experience, current beliefs, expectations and fantasies one possible approach to its management may be via imagery and suggestion. This may be particularly effective if hypnosis is used as an adjunct to treatment,<sup>19</sup> as hypnosis procedures encourage focused attention and facilitate absorption in central imaginative processes.

Furthermore, hypnotic procedures using suggestion and imagery have a long and established history of alleviating a range of painful conditions<sup>20–22</sup> and recent brain-imaging studies have shown that changes in the subjective experience of pain produced by suggestions given in hypnosis are reflected in alterations in the activation of brain areas known to be involved in normal pain perception.<sup>13,23</sup>

No systematic research appears to have been carried out either to evaluate the effectiveness of hypnosis as an adjunct to the treatment of PLP or to determine the types of treatment with which hypnosis might be most effectively employed. There are, however, a number of single-case studies where hypnosis has been used with PLP and these provide useful insights into possible treatment strategies. We propose here that two basic treatment approaches can be identified: (1) ipsative/imagery-based and (2) movement/imagery-based.

The ipsative/imagery approach takes account of the way the individual represents their pain to themselves and then attempts to modify those representations in order to alleviate the pain experience. The movement/imagery-based approach encourages the PLP patient in hypnosis to 'move' the phantom limb and to take control over it.

We first of all describe two previously unpublished cases of our own and then present in the form of a table a review of ten other single-case studies in which hypnosis was used in the treatment of PLP classified according to the two treatment approaches we have identified.

## Previously unpublished case reports

### Mrs D – Application of an ipsative/imagery approach

Mrs D is a 76-year-old woman with a history of peripheral vascular disease that eventually led to an above-knee amputation of her right leg. It is worth noting that Mrs D was pain-free at the time of her operation and that her PLP did not begin until some two years after the amputation; two years after that she was referred to a local pain clinic. There were four different components to the pains in her missing lower limb:

- 1) pins and needles in her 'foot',
- 2) her 'toes' felt as though they were being held in a tight vice,
- 3) a slicing, cutting pain in the sole of her 'foot' and
- 4) a chiselling pain in her 'ankle'.

Over the next four years various treatments were tried, including injection of the stump with local anaesthetic, acupuncture, the use of a TENS (transcutaneous electrical nerve stimulation) machine, antidepressants and analgesics, including morphine, with little or no effect. Mrs D was then seen eight times on a weekly basis for one-hour counselling sessions, with approximately 25 minutes of each session being taken up with hypnosis.

Mrs D responded well to the hypnotic procedures that were introduced in the first treatment session. A modified Spiegel eye-roll<sup>24</sup> was used for induction, followed by progressive muscular

relaxation for deepening. This was followed by suggestions of visualization of a 'special place'. Her choice of Italy as her special place suggested imagery which might be used for the chiselling sensation in her phantom ankle, which she ranked as the most disturbing of her pains.

At the second session she was asked in hypnosis to return to her special place, to imagine Michaelangelo toiling and hammering away at a block of marble with a chisel to create a thing of lasting beauty. At the third session, the image of the sculptor was related to the pains in her ankle: 'Just as Michaelangelo sculpted David, imagine a little man with a chisel hammering away at your ankle'. It was then suggested that 'this man has been working so long and so hard and his work is done and it is time for him to go away on holiday'. Though she had initially found 'the little man' and his specific activities difficult to visualize, Mrs D later announced that the chiselling pain in her ankle had, in fact, completely gone. The disappearance of the pain had coincided with 'sending [him] off on holiday'.

Sessions 4 and 5 incorporated more general images of change and progress without any further specific pain-control imagery. Over this time Mrs D experienced a marked improvement in her mood but her other pains remained. She commented that the vice-like pain had become more noticeable since the chiselling pain had gone. Pressures on the hypnosis clinic were such that Mrs D was only able to have two more sessions and the final two sessions concentrated on the vice-like pain. In these sessions she was asked to imagine wading in the sea, with the tides loosening the vice around her toes. This image appears to have been a much less effective one for Mrs D.

Contacting Mrs D three months after the end of her treatment, she reported that the chiselling pain had not come back. 'The little fellow,' she wrote, 'is having a long holiday. Thank goodness! The toes are still in a vice but I am coping and I am not quite as jumpy as I was.'

### **NB – Application of a movement/imagery approach**

Our second case is a report of observations carried out with NB, a 46-year-old man who had experienced PLP since he suffered an avulsion of

his left brachial plexus some five years previously. He describes two types of PLP. The first is an intense cramp-like experience in his denervated left arm which occurs intermittently, approximately once per day, and lasts for 20 minutes. During this pain he feels his left hand become clenched and he experiences a burning sensation. The second type of pain occurs more frequently, every two to three minutes, is 'like small electric shocks' which shoot down from his upper arm and terminate in the little finger of his phantom left hand, and is accompanied by a throbbing sensation in the knuckles.

NB had previously used a Ramachandran mirror apparatus<sup>10</sup> which prevented him from seeing his right hand directly but allowed him to see it as a reflection where his left hand would be. He reported experiencing the reflected image as that of his phantom left hand, which he described as moving normally when he moved his right hand. Whilst viewing the mirror image both types of PLP disappeared. When NB closed his eyes the sensation of moving his left hand was lost, even though he continued to move his right hand as before. NB had used the mirror apparatus at home on a daily basis and he reported that his pains could be reduced for up to three hours afterwards. When he was tested by us in the clinic he rated his PLP as 7 out of 10 before the mirror test, during the mirror viewing test it was 0, and immediately afterwards it was 2.

One hour after testing with the mirror apparatus NB's pain had reached 4 and he was then taken through an eyes-closed hypnotic induction and deepening. He was asked to place his right hand in the (now removed) mirror apparatus and to 'see' his reflected right hand in the left of the mirror as usual. In reality his eyes were closed throughout but he made real movements with his right hand. He said he could see his 'left' hand clearly and was asked to try to move both hands in synchrony. He reported that he felt his left hand moving though the feeling was 'not as strong as usual' in the mirror apparatus. With further encouragement to watch closely 'the hand in the mirror' while he continued to make (actual) movements of his right hand, he reported that the sensation of movement in his left hand became clearer, though he said it was still not as strong as usual. Nevertheless he did report freedom

from pain in his phantom left arm and hand (a rating of 0 out of 10) as he 'watched' the mirror hand moving. Shortly after the end of the hypnosis session NB rated his pain at 2.5 on the 10-point scale.

These tests with NB were not carried out as part of a therapeutic intervention and consequently he was not instructed in how to use the techniques for his own pain control and no information is available on any long-term effect they may have had. They do however, support the view that movement/imagery-based strategies in hypnosis might be used in the treatment of PLP. Initially they might be employed for alleviating PLP during self-hypnosis routines but ultimately the therapeutic aim would be to extend the effect into everyday situations.

## Review

We have limited our review of PLP to cases involving limb amputation and brachial plexus avulsion as these are the most common causes. In preparing the review, seven reports were identified electronically via Ovid/MEDLINE using 'hypnosis and phantom' as the target and searching keywords, abstract and heading word from 1966 to the present. Of these, three were excluded: Two because they concerned other phantom organs<sup>25,26</sup> and one because it was insufficiently detailed to classify in terms of the hypnotic procedures used.<sup>14</sup> One report not identified by this search<sup>27</sup> is included in the review and was identified again via Ovid/MEDLINE by using 'phantom limb' from 1966 to the present as the target (661 citations). A manual search of private and institutional libraries in London under the headings 'hypnosis' and 'hypnotherapy' yielded six additional reports; three as parts of chapters in edited volumes, two in very recent issues of journals, and one in a single-author text book. One of these<sup>28</sup> was not used in the review as it contained insufficient detail. Salient points from all of the reports excluded from the review are included in the Discussion section.

A structured summary of the remaining 10 previously published cases using hypnosis in the treatment of PLP plus the two new cases reported here is shown in Table 1.

Table 1 summarizes five cases (plus our case Mrs D) in which a ipsative/imagery-based approach was used and a further five cases (plus our case NB) where a movement/imagery-based approach was involved.

## Discussion and conclusions

Two main treatment strategies for PLP have been identified: an ipsative/imagery-based approach and a movement/imagery-based approach. Both appear to have promise though there is insufficient evidence to say which is likely to be the more effective for any given patient or whether they should be administered singly, in combination or perhaps at different stages of treatment. It is possible, however, that a movement/imagery-based approach would be particularly relevant where a cramped or unusual posture of the phantom is an important component of the patient's description of their PLP. Of the six cases using an ipsative/imagery approach reported in Table 1 only two included posture of the limb as part of the PLP description, whereas it was present in five of the six cases which adopted a movement/imagery based.

Shrinking of the phantom occurred spontaneously in one case (case 10<sup>36</sup>) and in response to suggestion in two cases (case 3<sup>31</sup> and case 7<sup>34</sup>). In common with some mirror box studies<sup>36</sup> this appeared to be associated with recovery from PLP. In another of the case reports (case 5<sup>33</sup>) indirect suggestions for phantom shrinkage were used, though the effectiveness of these sugges-

### Clinical messages

- Phantom limbs should be regarded as 'real' body parts and treatment of phantom limb pain (PLP) should be directed to the phantom itself.
- Hypnotic imagery-based approaches are worthy of further consideration for the treatment of PLP.
- The imagery used should be based on the client's own perception of their pain or may involve 'movement' of the missing limb.

**Table 1** Summary of 12 cases using ipsative/imagery-based approaches (cases 1–6) or movement/imagery-based approaches (cases 7–12)

Case	Problem	Treatment	Outcome
<b>Ipsative/imagery-based</b>			
1) Siegel (1979) <sup>29</sup>	Left above-knee amputation (pain before)  PLP for 'several weeks' – nature of pain not described	10 sessions (7 of hypnosis). Relaxation, self-hypnosis, transfer of hypnotic ('cold' imagery) glove anaesthesia	2 months after treatment, patient using pain control for herself  Pain medication reduced to 50%
2) Chaves (1986) <sup>30</sup>	Amputation of arm (pain before)  PLP for 5 months felt as 'tension' and frustrated movement in 'hand' & 'fingers' ('hand/arm' in uncomfortable posture)	3 hypnosis sessions. Relaxation, tension reduction suggestions. Warmth imagery. Home use of hypnosis audiotape	Free of PLP over 5-year follow-up  Using tape once per month
3) Chaves (1993) <sup>31</sup>	Mid-thigh amputation of right leg (pain before)  PLP for 4 years felt as a) 'biting ants', b) tight bands c) muscle tension ('leg' in uncomfortable posture)	Number of sessions not specified. In hypnosis – relaxation & suggestions of phantom shrinking. Hypnotic images: 'decapitate ants', 'cut bands'. Daily use of hypnosis audiotape	At end of therapy discomfort down to 30% of previous level  Occasionally pain-free  Phantom reported to be shrinking
4) Sthalekar (1993) <sup>32</sup>	Avulsion of right brachial plexus (no pain before)  PLP for 3.5 months felt as constant tingling in right 'arm' and intermittent localized stabbing, burning pains in 'arm' and 'hand'	21 sessions over 8 weeks. Self-hypnosis relaxation training plus imagery of beach/garden/woods. Healing warmth flowing through arm. Positive, future-oriented suggestions	At 2-week follow-up, pain under control. No longer interfering with daily activity. Returned to work  Right arm no longer in a sling  Optimistic about future
5) Brown <i>et al.</i> (1996) <sup>33</sup>	Amputation of right leg at the knee (pain status before not reported)  Details of PLP not reported, but 'severe'	Three sessions (5 hours in total)  Hypnotic metaphor or tree damaged by flood water, losing branches, then regrowing stronger	At 12 month follow-up – wearing prosthesis and engaging in mountain biking  No report of pain status

6) Mrs D	<p>Above-knee amputation of right leg (no pain before)</p> <p>PLP for 6 years – began 2 years after amputation, felt as:</p> <p>a) 'pins and needles' in 'foot',</p> <p>b) 'toes' in a vice</p> <p>c) cutting pain in 'foot'</p> <p>d) chiselling pain in 'ankle'</p>	<p>8 weekly sessions of 1 hour (25 mins of each was hypnosis)</p> <p>Hypnotic imagery: 'chiseller on holiday', 'sea water loosening vice'</p> <p>Positive images of change and progress</p>	<p>At end of treatment 'chiselling' pain had gone and had not returned at 3-month follow-up. Other pains still there</p> <p>Coping better and 'less jumpy'</p>
<b>Movement/imagery-based</b>			
7) Muraoka <i>et al.</i> (1996) <sup>34</sup>	<p>Above-knee amputation of left leg (no pain before)</p> <p>PLP for 25 years felt as intermittent burning pain and constant dull pain ('leg' &amp; 'foot' in uncomfortable posture and 'leg' too short)</p>	<p>64 hypnosis sessions over 3 years.</p> <p>3 phases:</p> <p>a &amp; b) suggested movements of 'leg' and becoming normal size</p> <p>c) suggested shrinking of phantom</p>	<p>At end of treatment phantom had disappeared for most of time with intermittent bursts of pain. Overall pain had been reduced from 8 to 1 on a scale 0–10</p>
8) Le Baron and Zeltzer (1996) <sup>35</sup>	<p>Amputation of left leg (pain status before not reported)</p> <p>PLP felt as 'jerking' in 'leg', 'cracking' in 'toes', 'stabbing' pain in sole of 'foot'</p> <p>Highly hypnotizable</p>	<p>3 hypnosis sessions. Relaxation, suggestion in hypnosis to relax and contract muscles in both legs.</p> <p>Patient experienced free movement in 'toes' and 'leg'.</p> <p>Transfer of suggested numbness in hand to left 'leg'</p>	<p>At 2-week follow-up 50–100% pain relief from self-suggestion, or by listening to hypnosis audiotape.</p> <p>Less bothered by residual PLP &amp; sleeping normally</p>
9) Ersland <i>et al.</i> (1996) <sup>27</sup>	<p>Above-elbow amputation of right arm (pain status before not reported).</p> <p>PLP for 18 months in 'fingers' and 'wrist' ('fingers' and 'wrist' in uncomfortable posture)</p>	<p>Hypnosis for part of rehabilitation programme – number of sessions not specified.</p> <p>Relaxation &amp; hypnotic suggestions for finger movement and uncramping</p>	<p>Reduction in PLP (not quantified)</p> <p>Feeling of control made residual pain more tolerable</p>
10) & 11) Rosen <i>et al.</i> (2000) <sup>36</sup>	<p>10) Traumatic amputation of right arm (no pain before)</p> <p>PLP for 5 years. Radiating heat pain in arm &amp; fingers. Abnormal posture/contraction in 'fingers' and arm. 'arm'. Highly hypnotizable</p>	<p>Both 10 &amp; 11: Approx. 12 sessions over 6 months</p> <p>Cognitive/behavioural treatment with hypnosis</p>	<p>10) Pain-free during 1st hypnosis session – lasted 1 day then pain returned intermittently. At end of treatment pain intensity down from 80 to 50</p> <p>Pain frequency reduced by 55%</p>

**Table 1** Continued

Case	Problem	Treatment	Outcome
	11) Traumatic amputation of fingers on left hand (no pain before)	In hypnosis imagined phantom in a comfortable position or moving in a comfortable way	Phantom reported to be shrinking
	PLP for 3 years		11) At end of treatment pain intensity was down from 40 to 20 and pain frequency reduced by 50%
	Severe pain in left hand, 'cutting' pain in 'fingers', especially during uncomfortable movements. Moderately hypnotizable	10) Also imagined skiing, both arms moving in rhythm 11) Also imagined pain area shrinking	These gains maintained at 2.5 years follow-up
12) NB	Avulsion of left brachial plexus (no pain before)	Previous experience of pain control and subjective movement of left hand in mirror apparatus	During experience of moving left hand in hypnotic virtual 'mirror' and during age-regression PLP was lost. Experience of left hand movement not as strong as in real mirror apparatus
	PLP for 5 years felt as intermittent cramping in 'hand' and burning sensation. More frequent 'shooting' pains through arm & 'throbbing' in knuckles ('hand' in uncomfortable 'clenched' posture)	One session of hypnosis with suggestions of a return to the mirror experience and of age-regression to a time before the injury	Pain was rated 4 out of 10 before hypnosis, 0 during hypnotic mirror and regression experiences and 2.5 after hypnosis

tions is not reported. These observations suggest a third possible therapeutic approach in which hypnotic imagery may be a useful adjunct.

In more general terms it seems that the phantom limb should be treated as 'real' and the same pain management strategies applied as with a physically present limb. The 'reality' of the missing limb as a continuing central representation is underlined by recent neuroimaging studies showing activations in precentral cortex during phantom finger tapping<sup>27</sup> and the involvement of normally activated brain areas during the experience of both phantom limb movement and PLP.<sup>13</sup> In our own case of Mrs D and also in case 1<sup>30</sup> the patients specifically said that they expected psychological treatment of PLP to be directed

towards their phantom limb and not to the amputation stump. Similarly, in one study,<sup>28</sup> hypnotic glove anaesthesia applied to the stump produced only a temporary alleviation of the 'burning' PLP; a later suggestion to visualize 'a stream of cooling anaesthetic agent' coursing through the phantom leg produced long-term pain reduction.

Closely related to the movement/imagery-based approaches, the Ramachandran mirror procedure appears to produce a dramatic, but short-lived, effect of experiencing movement in the missing limb and of eliminating PLP.<sup>10</sup> Our own observations with NB indicate that it is possible to create a similar effect using a hypnotically suggested hallucination of a mirror in a patient with previous experience of the mirror

apparatus. It remains to be seen if a similar effect could be produced in a mirror-naïve patient. For NB the hypnotic mirror effect was less powerful than that produced by the actual mirror so far as the subjective experience of movement in the missing limb was concerned. This may mean that actual peripheral visual feedback of limb movement is more effective in this regard than self-generated feedback through imagery. Nevertheless the elimination of PLP by the 'hypnotic', virtual mirror seems to have been similar to that achieved using the actual mirror. A major potential advantage of the hypnotically produced mirror is that patients could recreate the imagery themselves and use it on a continuous basis for pain relief. The fact that the experience of movement was not as striking for our patient using the hypnotic mirror compared to the actual mirror whilst the PLP reduction effect was maintained may mean that he was experiencing indirectly suggested pain reduction based on his prior experience and expectations rather than it being attributable to subjective movement in his phantom limb.

Whilst they have been helpful in thinking about different approaches to the problem of PLP, the cases reviewed here (including our own) have a number of shortcomings which need to be addressed in future studies. A major problem is that of the small numbers of patients involved and consequently there is a need for randomized control trials with well-defined (and clearly reported) hypnosis and treatment protocols to evaluate the efficacy of the various approaches which have been suggested. There is also a need for standardized measures of the PLP to be taken pre and post intervention along with other measures of psychological and social adjustment. Also, hypnotizability was measured in only three of the cases reviewed here (case 8,<sup>35</sup> case 10<sup>36</sup> and case 11<sup>36</sup>). It is perhaps significant that in two of these three cases hypnotizability was found to be high. This is potentially an important issue in selecting patients for hypnosis-based PLP treatment as a recent meta-analysis has shown greater hypno-analgesic effects in those moderate to high in suggestibility compared with those scoring low on hypnotizability.<sup>21</sup>

Equally, it is important to determine the role of hypnosis *per se* in the outcomes achieved in

systematic trials with appropriate controls for the hypnotic procedure. Particularly in the case of ipsative/imagery-based strategies it will be informative to investigate the relationship between specific suggestions or images and the alleviation of particular types of pain. In our own case (Mrs D), for instance one of the images (for the 'chiselling' pain) appeared to be much more effective for her than the other (for the 'vice-like' pain) and it may be important to encourage the patient to supply his/her own imagery rather than it originating with the therapist. One way of investigating the specificity of the effects of imagery would be to use a multiple baseline, single-case approach with different pain types being targeted sequentially. A similar question for the movement/imagery-based approach concerns the modality of the suggested imagery in relation to outcome. In our own case (NB), we encouraged visual as well as kinaesthetic and somaesthetic feedback from the moving 'limb'. In the other movement/imagery cases the type of imagery employed was not clearly specified but seems to have been primarily proprioceptive, though in one case (case 8)<sup>35</sup> the patient was also asked to 'visualize' his leg.

We conclude that, despite the relative paucity of published reports, hypnotic procedures hold the promise of being an effective adjunct to other strategies for the treatment of PLP and other phantom body part conditions and would repay further, more systematic, investigation. Hilgard and LeBaron<sup>38</sup> selected PLP to illustrate the research opportunities which exist in the area of hypnosis and persistent pain. It is unfortunate that some 15 years later these opportunities still do not appear to have been explored.

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## References

- 1 Cronholm, B. Phantom limbs in amputees: A study of changes in the integration of centripetal impulses with special reference to referred sensations. *Acta Psychiatr Neurol Scand Suppl* 1951; **72**: 1–310.
- 2 Reynolds, OE, Hutchins, HC. Reduction of central hyper-irritability following Block anesthesia of peripheral nerve. *Am J Physiol* 1948; **152**: 658–62.
- 3 Aglioti S, Cortese F, Franchini C. Rapid sensory remapping in the adult brain as inferred from phantom breast perception. *NeuroReport* 1994; **5**: 473–76.
- 4 Halligan PW, Marshall JC, Wade DT. Three arms: a case study of supernumerary phantom limb after right hemisphere stroke. *J Neurol Neurosurg Psychiatry* 1993; **56**: 158–66.
- 5 Jensen TS, Krebs B, Nielsen J, Rasmussen P. Immediate and long-term phantom limb pain in amputees: incidence, clinical characteristics and relationship to pre-amputation limb pain. *Pain* 1985; **21**: 267–78.
- 6 Grouios G. The phantom limb. *Phys Ther Rev* 1999; **4**: 29–36.
- 7 Melzack R. *The puzzle of pain*. New York: Basic Books, 1973.
- 8 Carlen PL, Wall PD, Nadvorna H, Steinbach T. Phantom limbs and related phenomena in recent traumatic amputations. *Neurology* 1978; **28**: 211–17.
- 9 Flor H, Elbert T, Knecht S *et al*. Phantom-limb pain as a perceptual correlate of cortical reorganization following arm amputation. *Nature* 1995; **375**: 482–84.
- 10 Ramachandran VS, Hirstein W. The perception of phantom limbs. *Brain* 1998; **121**: 1603–30
- 11 Halligan PW, Marshall JC, Wade DT, Davey J, Morrison D. Thumb in cheek? Sensory reorganization and perceptual plasticity after limb amputation. *NeuroReport* 1993; **4**: 233–36.
- 12 Flor H, Mühlnickel W, Karl A *et al*. A neural substrate for nonpainful phantom limb phenomena. *NeuroReport* 2000; **11**: 1407–11.
- 13 Willoch F, Rosen G, Tolle TR *et al*. Phantom limb pain in the human brain: unraveling neural circuitries of phantom limb sensations using Positron Emission Tomography. *Ann Neurol* 2000; **48**: 842–49.
- 14 Solomon GF, Schmidt KM. A burning issue: phantom limb pain and psychological preparation of the patient for amputation. *Arch Surg* 1978; **113**: 185–86.
- 15 Loeser JD. Selection of patients for neurosurgical procedures for the relief of pain. In: Loeser JD, Eagan KJ eds. *Managing the chronic pain patient*. New York: Raven Press, 1989: 201–14.
- 16 Loeser JD. Pain after amputation: phantom limb pain and stump pain. In: Bonica JJ ed. *The management of pain*. Philadelphia: Lea and Febiger, 1990: 244–56.
- 17 Sherman RA, Sherman CJ, Parker L. Chronic phantom and stump pain among American veterans: results of a survey. *Pain* 1984; **18**: 83–96.
- 18 Sherman RA, Sherman CJ, Bruno GM. Psychological factors influencing chronic phantom limb pain: an analysis of the literature. *Pain* 1987; **28**: 287–95.
- 19 Kirsch I, Montgomery G, Sapirstein G. Hypnosis as an adjunct to cognitive-behavioural psychotherapy: a meta-analysis. *J Consulting Clin Psychol* 1995; **63**: 214–20.
- 20 Chaves JF. Hypnotic control of clinical pain. In: Spanos NP, Chaves JF eds. *Hypnosis: the cognitive-behavioral perspective*. Buffalo, New York: Prometheus Books, 1989: 242–72.
- 21 Montgomery GH, DuHamel KN, Redd WH. A meta-analysis of hypnotically induced analgesia: how effective is hypnosis? *Int J Clin Exp Hypnosis* 2000; **48**: 138–53.
- 22 Tan S-Y, Leucht CA. Cognitive-behavioral therapy for clinical pain control: a 15 year update and its relationship to hypnosis. *Int J Clin Exp Hypnosis* 1997; **45**: 396–416.
- 23 Rainville P, Duncan GH, Price DD, Carrier B, Bushnell MC. Pain affect encoded in human anterior cingulate but not somatosensory cortex. *Science* 1997; **277**: 968–71.
- 24 Spiegel H. An eye roll test for hypnotizability. *Am J Clin Hypnosis* 1972; **15**: 25–28.
- 25 Baker SR. Amelioration of phantom-organ pain with hypnosis and behaviour modification: brief case report. *Psychol Reports* 1984; **55**: 847–50.
- 26 Weiss MF. Ericksonian hypnotherapy for pain control during and following cancer surgery. *Aust J Clin Hypnother Hypnosis* 1993; **14**: 53–74.
- 27 Ersland L, Rosén G, Lundervold A *et al*. Phantom limb imaginary finger tapping causes primary motor cortex activation: an fMRI study. *NeuroReport* 1996; **8**: 207–10.
- 28 Weitzenhoffer AM. *The practice of hypnotism*, second edition. New York: Wiley: 2000.
- 29 Siegel EF. Control of phantom limb pain by hypnosis. *Am J Clin Hypnosis* 1979; **21**: 285–86.
- 30 Chaves JF. Hypnosis in the management of phantom limb pain. In: Dowd T, Healy J eds. *Case studies in hypnotherapy*. New York: Guilford Press, 1986: 198–209.
- 31 Chaves JF. Hypnosis in pain management. In: Rhue RH, Lynn SJ, Kirsch I eds. *Handbook of clinical hypnosis*. Washington, DC: American Psychological Association, 1993: 511–32
- 32 Sthalekar, H.A. Hypnosis for relief of chronic phantom pain in a paralysed limb: a case study. *Aust J Clin Hypnother Hypnosis* 1993; **14**: 75–80
- 33 Brown GW, Summers D, Coffman B, Riddell R, Poulsen B. The use of hypnotherapy in school-age children: five case studies. *Psychother Private Practice* 1996; **15**: 53–65.

- 34 Muraoka M, Komiyama H, Hosoi M, Mine K, Kubo C. Psychosomatic treatment of phantom limb pain with post-traumatic stress disorder: a case report. *Pain* 1996; **66**: 385–88.
- 35 LeBaron S, Zeltzer LK. Children in pain. In: Barber J ed. *Hypnosis and suggestion in the treatment of pain: a clinical guide*. New York: Norton, 1996: 305–40
- 36 Rosen G, Willoch F, Bartenstein P, Berner N, Rosjo S. Neurophysiological processes underlying the phantom limb pain experience and the use of hypnosis in its management: an intensive examination of two patients. *Int J Clin Exp Hypnosis* 2000; **49**: 38–55.
- 37 Ramachandran VS, Blakeslee S. *Phantoms in the brain: human nature and the architecture of the mind*. London: Fourth Estate, 1998.
- 38 Hilgard JR, Le Baron S. *Hypnotherapy of pain in children with cancer*. Los Altos, California: William Kaufmann, 1984.