

of more than 100 to less than 120 mm Hg. Thus, it seems fair to call it normotensive. Nevertheless, in an older patient, a blood pressure under 120/80 mm Hg is often below its usual level and should be compared with previous readings. My concern with the definition of "acute kidney injury" is that it does not yet specify which causes of renal failure are included. For example, Zhou et al. do not include cases due to acute glomerulonephritis or systemic lupus erythematosus.<sup>3</sup> Although Bellomo et al. state that urinalysis lacks diagnostic value for renal failure due to sepsis, the report they cite<sup>4</sup> actually concluded that there were few data on this question and that good studies are needed. My experience is that urinalysis usually correlates well with the clinical picture. The finding of both high and low renal blood flows in studies of experimental septic acute renal failure<sup>5</sup> calls into question but does not rule out the

role of ischemia in the pathogenesis of this condition.

J. Gary Abuelo, M.D.

Rhode Island Hospital  
Providence, RI 02903  
jgabuelo@lifespan.org

1. Hou SH, Bushinsky DA, Wish JB, Cohen JJ, Harrington JT. Hospital-acquired renal insufficiency: a prospective study. *Am J Med* 1983;74:243-8.
2. Burt VL, Whelton P, Roccella EJ, et al. Prevalence of hypertension in the US adult population: results from the Third National Health and Nutrition Examination Survey, 1988-1991. *Hypertension* 1995;25:305-13.
3. Zhou H, Hewitt SM, Yuen PST, Star RA. Acute kidney injury biomarkers — needs, present status, and future promise. *Nephrology SAP* 2006;5:63-71.
4. Bagshaw SM, Langenberg C, Bellomo R. Urinary biochemistry and microscopy in septic acute renal failure: a systematic review. *Am J Kidney Dis* 2006;48:695-705.
5. Langenberg C, Wan L, Egi M, May CN, Bellomo R. Renal blood flow in experimental septic acute renal failure. *Kidney Int* 2006;69:1996-2002.

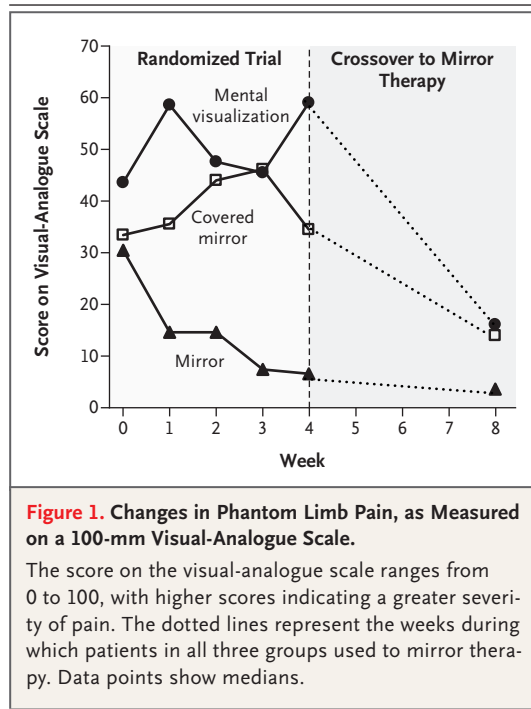
## Mirror Therapy for Phantom Limb Pain

**TO THE EDITOR:** Phantom limb pain occurs in at least 90% of limb amputees.<sup>1</sup> Such pain may be induced by a conflict between visual feedback and proprioceptive representations of the amputated limb.<sup>2</sup> Thus, illusions or imagery of movement of the amputated limb might alleviate phantom limb pain. Mirror therapy has been used with some success in patients who have had a hand or an arm amputated.<sup>3</sup> Since the critical component of mirror therapy may be the induction of limb imagery, we conducted a randomized, sham-controlled trial of mirror therapy versus imagery therapy involving patients with phantom limb pain after the amputation of a leg or foot.

We randomly assigned 22 patients to one of three groups: one that viewed a reflected image of their intact foot in a mirror (mirror group), one that viewed a covered mirror, and one that was trained in mental visualization. The patients were told that each therapy was being examined for efficacy, and each patient provided written informed consent. Eighteen subjects (six in each group) completed the study. Patients in the mirror group attempted to perform movements with the amputated limb while viewing the reflected image of the movement of their intact limb. Patients in the covered-mirror group attempted to perform movements with both their intact and amputated limbs when the mirror was

covered by an opaque sheet. Patients in the mental-visualization group closed their eyes and imagined performing movements with their amputated limb.

Under direct observation, patients performed their assigned therapy for 15 minutes daily. They also recorded the number and duration of pain episodes and the intensity of pain with the use of a 100-mm visual-analogue scale; they also recorded the number and duration of pain episodes. The primary end point was the severity of pain after 4 weeks of therapy. Baseline scores on the visual-analogue scale were similar among the groups ( $P=0.62$ ). Pain intensity decreased with mirror treatment (Fig. 1), as did the number and duration of pain episodes. After 4 weeks of treatment, 100% of patients in the mirror group reported a decrease in pain (median change on the visual-analogue scale,  $-24$  mm; range,  $-54$  to  $-13$ ), but two patients had brief reactions ( $<2$  minutes) of grief on viewing the reflected intact lower limb. In contrast, in the covered-mirror group, only one patient (17%) reported a decrease in pain, whereas three patients (50%) reported worsening pain. In the mental-visualization group, two patients (33%) reported a decrease in pain, whereas four patients (67%) reported worsening pain. In a comparison of changes in the score on the visual-analogue scale at 4 weeks, the mirror group differed



significantly from both the covered-mirror group ( $P=0.04$ ) and the mental-visualization group ( $P=0.002$ ). Phantom limb pain decreased in eight of nine patients (89%) who switched to mirror therapy from either a covered mirror or mental visualization ( $P=0.008$  for both comparisons of scores on the visual-analogue scale at 4 weeks with those at 8 weeks).

Our findings showed that mirror therapy reduced phantom limb pain in patients who had undergone amputation of lower limbs. Such pain was not reduced by either covered-mirror or mental-visualization treatment. Pain relief associated with mirror therapy may be due to the activation of mirror neurons in the hemisphere of the brain that is contralateral to the amputated limb. These neurons fire when a person either performs an ac-

tion or observes another person performing an action.<sup>4</sup> Alternatively, visual input of what appears to be movement of the amputated limb might reduce the activity of systems that perceive propathic pain.<sup>5</sup> Although the underlying mechanism accounting for the success of this therapy remains to be elucidated, these results suggest that mirror therapy may be helpful in alleviating phantom pain in an amputated lower limb.

Brenda L. Chan, B.A.

Richard Witt, P.A.-C.

Alexandra P. Charrow, B.A.

Amanda Magee, P.A.-C.

Robin Howard, M.A.

Paul F. Pasquina, M.D.

Walter Reed Army Medical Center  
Washington, MD 20307

Kenneth M. Heilman, M.D.

Malcom Randall Veterans Affairs Medical Center  
Gainesville, FL 32608

Jack W. Tsao, M.D., D.Phil.

Uniformed Services University of the Health Sciences  
Bethesda, MD 20814  
jtsao@usuhs.mil

Supported by a grant (W81XWH-06-2-0073, to Dr. Tsao) from the Military Amputee Research Program and a grant (to Dr. Pasquina) from the Defense Advanced Research Projects Agency.

The views expressed in this letter are those of the authors and do not reflect the official policy of the Department of the Navy, the Department of the Army, the Department of Defense, or the Department of Veterans Affairs.

1. Melzack R. Phantom limbs and the concept of a neuromatrix. *Trends Neurosci* 1990;13:88-92.
2. Ramachandran VS, Hirstein W. The perception of phantom limbs. *Brain* 1998;121:1603-30.
3. Ramachandran VS, Rogers-Ramachandran D. Synaesthesia in phantom limbs induced with mirrors. *Proc Biol Sci* 1996; 263:377-86.
4. Rossi S, Tecchio F, Pasqualetti P, et al. Somatosensory processing during movement observation in humans. *Clin Neurophysiol* 2002;113:16-24.
5. Henson RA. Henry Head: his influence on the development of ideas on sensation. *Br Med Bull* 1977;33:91-6.

Correspondence Copyright © 2007 Massachusetts Medical Society.

#### INSTRUCTIONS FOR LETTERS TO THE EDITOR

Letters to the Editor are considered for publication, subject to editing and abridgment, provided they do not contain material that has been submitted or published elsewhere. Please note the following: •Letters in reference to a *Journal* article must not exceed 175 words (excluding references) and must be received within 3 weeks after publication of the article. Letters not related to a *Journal* article must not exceed 400 words. All letters must be submitted over the Internet at <http://authors.nejm.org>. •A letter can have no more than five references and one figure or table. •A letter can be signed by no more than three authors. •Financial associations or other possible conflicts of interest must be disclosed. (Such disclosures will be published with the letters. For authors of *Journal* articles who are responding to letters, this information appears in the published articles.) •Include your full mailing address, telephone number, fax number, and e-mail address with your letter.

Our Web site: <http://authors.nejm.org>

We cannot acknowledge receipt of your letter, but we will notify you when we have made a decision about publication. Letters that do not adhere to these instructions will not be considered. Rejected letters and figures will not be returned. We are unable to provide prepublication proofs. Submission of a letter constitutes permission for the Massachusetts Medical Society, its licensees, and its assignees to use it in the *Journal's* various print and electronic publications and in collections, revisions, and any other form or medium.