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Does electrical stimulation improve motor recovery in patients with idiopathic facial (Bell) palsy?

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Clinical question: Does electrical stimulation improve motor recovery in patients with idiopathic facial (Bell) palsy?

The purpose of "Evidence in Practice" is to illustrate how evidence is gathered and used to guide clinical decision making. This article is not a case report. The examination, evaluation, and intervention sections are purposely abbreviated.

A 35-year-old woman was referred to our clinic with the diagnosis of Bell palsy, a unilateral facial palsy of unknown etiology. The patient reported that she first noticed the problem when she awoke 2 days ago and saw that her face "was distorted and deviated towards the right side." She stated that she was recovering from a recent respiratory tract infection and that the evening before the facial symptoms appeared, she experienced pain in the mastoid region. Upon observing the facial asymmetry, the patient was concerned that she was having a stroke. The patient saw her primary care physician who diagnosed her as having Bell palsy after having ruled out a tumor, stroke, and Lyme disease by physical examination, magnetic resonance imaging studies, and laboratory tests including blood work. The physician prescribed acyclovir and prednisolone and suggested a consultation with a physical therapist for management of her facial muscle weakness.

Upon arrival in our clinic, the patient expressed great concern that her facial weakness would interfere with her work as a lawyer and indicated that she was willing to adhere to any treatment regimen that would enhance her chances of early and optimal recovery. Our examination of the patient's vital signs revealed a heart rate of 76 bpm and blood pressure of 126/80 mm Hg.

The neurologic examination revealed facial asymmetry at rest with drooping of the corner of the mouth and some accumulation of saliva on the left side of the mouth and a decrease in the prominence of the nasal labial fold. Sensation over the left side of the face was intact; however, the patient reported a decreased sense of taste. When asked to perform volitional movement, the patient exhibited no motion of the left forehead and very slight movement of the left eyelid with maximal effort. The patient was able to produce a slight movement at the left corner of the mouth. When asked to close her eyes, there was an upward movement of the left eye itself, but the lid remained opened (Bell phenomenon). The patient also was unable to show her teeth on the left side or hold air in her left cheek. No facial muscle synkinesis or contractures were present. The patient's presentation was consistent with a House-Brackmann Facial Nerve Grading System[1] score of 5 (Tab. 1). The patient asked for information on her prognosis.

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Many patients with Bell palsy experience a spontaneous recovery. In a recent epidemiologic study examining the outcomes of facial palsies, 68% of patients with acute Bell palsy were reported to progress to complete recovery (House-Brackmann score=1), 27% to good recovery (House-Brackmann score=2), and 5% to partial recovery (House-Brackmann score=3).[2] Similarly, in a very large study of the natural progression of 1,701 patients with Bell palsy, 85% of these patients showed first signs of recovery (initial return of voluntary muscular activity) within the first 3 weeks; the remaining 15% experienced first muscle activity in 3 to 5 months.[3] Although two thirds of the patients progressed to full recovery within 3 months, residual symptoms persisted in about one third of the patients.[3]

Table 1.
House-Brackmann Facial Nerve Grading Scale[1]

Grade	Defined By
1 Normal	Normal facial function in all areas.
2 Mild dysfunction	Slight weakness noticeable only on close inspection. At rest: normal symmetry of forehead, ability to close eye with minimal effort and slight asymmetry, ability to move corners of mouth with maximal effort and slight asymmetry. No synkinesis, contracture or hemifacial spasm.
3 Moderate dysfunction	Obvious but not disfiguring difference between two sides, no functional impairment; noticeable but not severe synkinesis, contracture, or hemifacial spasm. At rest: normal symmetry and tone. Motion: slight to no movement of forehead, ability to close eye with maximal effort and obvious asymmetry, ability to move corners of mouth with maximal effort and obvious asymmetry. Patients who have obvious but not disfiguring synkinesis, contracture, or hemifacial spasm are grade 3 regardless of degree of motor activity.
4 Moderately severe dysfunction	Obvious weakness or disfiguring asymmetry. At rest: normal symmetry and tone. Motion: no movement of forehead; inability to close eye completely with maximal effort. Patients with synkinesis, mass action, or hemifacial spasm severe enough to interfere with function are grade 4 regardless of motor activity.
5 Severe dysfunction	Only barely perceptible motion. At rest: possible asymmetry with droop of corner of mouth and decreased or absence of nasal labial fold. Motion: no movement of forehead, incomplete closure of eye and only slight movement of lid with maximal effort, slight movement of corner of mouth. Synkinesis, contracture, and hemifacial spasm usually absent.
6 Total paralysis	Loss of tone; asymmetry; no motion; no synkinesis, contracture, or hemifacial spasm.

We were interested in exploring management options that would enhance the potential for full and speedy recovery in our patient. Because electrical stimulation (ES) of paralyzed muscles has long been a popular intervention for patients with Bell palsy, we sought to review the literature to determine the efficacy of ES for both acute and chronic Bell palsy.

Databases used for search: MEDLINE, CINAHL, AMED, EBMR

We accessed MEDLINE through PubMed (www.pubmed.gov) and used Clinical Queries | Search by Clinical Study Category and Clinical Queries | Find Systematic Reviews to retrieve clinical studies related to the "therapy" category and systematic reviews, respectively. We also accessed CINAHL (Cumulative Index to Nursing and Allied Health Literature), AMED (Allied and Complementary Medicine), EBMR (Evidence-based Medicine Reviews) through Ovid† (www.ovid.com).

MEDLINE and CINAHL are familiar databases to most physical therapists. AMED is a database produced by the Health Care Information Service of the British Library and coverage dates back to 1985. EBMR consists of 4 databases: Cochrane Database of Systematic Reviews, Cochrane Central Register of Controlled Trials, ACP Journal Club, and Database of Abstracts of Reviews of Effects (DARE). Although there is some crossover of citations among MEDLINE, CINAHL, AMED, and EBMR, there are enough unique citations to make it worth searching each database.

Keywords used in search: We used the following keywords in our search:

PubMed: bell* palsy, bell palsy, facial paralysis, electr*, electric stimulation, electric stimulation therapy, physical therapy, physical therapy techniques, diagnos*

CINAHL: bell$ palsy, bell palsy, facial paralysis, electr$, electric stimulation, physical therapy, diagnos$

AMED: bell$ palsy, facial paralysis, electr$, electric stimulation, physical therapy, physiotherapy, diagnos$

EBMR: bell$ palsy, electr$, physical therapy, diagnos$

Because the content of these databases is developed by different providers each using different controlled vocabularies or subject heading thesauri, our search terms were, by necessity, different. The keywords, "Bell palsy" and "electrical stimulation," were derived from the main components of our clinical question. Using this strategy, our main keywords were bell* palsy or bell$ palsy and electr* or electr$, depending on the database that we were searching. (In PubMed, the asterisk is the symbol for truncation; in Ovid, it is the $.) Truncation will return articles with all possible endings for that keyword. For example, by using bell* palsy, the database retrieved all articles containing the keywords "Bell's palsy," "Bell palsy," or "Bells palsy." This process is identical in Ovid. However, in PubMed the use of the asterisk automatically disables mapping to subject headings. Therefore, when using truncation in PubMed, it

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is important to include the appropriate subject headings in the search string to ensure a complete search.

To identify the subject headings, we used the MeSH (Medical Subject Heading) Database accessed from the left-side menu of the PubMed home page. The MeSH term for Bell palsy is "bell palsy." However, the MeSH descriptor data indicated that the MeSH term for Bell palsy was "facial paralysis" from 1966 to 1999. We also included the term "facial paralysis" in our search. Similarly, we investigated the MeSH term for electrical stimulation and found that both "electric stimulation" and "electric stimulation therapy" are used. We included these 2 additional terms in our search. Finally, because ES is a modality that is most often employed by physical therapists, we included the keyword "physical therapy." When investigating the MeSH term for physical therapy we found that PubMed also used the term "physical therapy techniques."

CINAHL does not use the MeSH system, but uses its own subject headings. When combining keywords with OR, AND, or NOT using the Ovid interface (as was done with CINAHL), the database performs keyword searches only and does not map the keywords to subject headings automatically. Therefore, we looked up the subject headings for Bell palsy and found that both "bell palsy" (the current term) and "facial paralysis" (used prior to 2002) were used. Similarly, we found that the subject heading for electrical stimulation is "electric stimulation." CINAHL uses the term "physical therapy" to include physiotherapy, kinetotherapy, and physical therapies.

AMED also uses its own vocabulary and, therefore, we identified the appropriate subject headings for Bell palsy and electrical stimulation. We found that this database uses "facial paralysis" and "electric stimulation." AMED maps the keyword "physical therapy" to "physiotherapy." Therefore, we used these terms in conjunction with our truncated keywords.

EBMR does not have a unique vocabulary and searches using keywords only. Therefore we used only the truncated keywords and "physical therapy" for this search.

In all searches we used the truncated form of "diagnosis" to exclude articles that used electrical stimulation as a diagnostic tool.

■ **Final search strings:** Our final search strings were as follows:

PubMed (Clinical Study Category and Find Systematic Reviews): ((bell* palsy OR bell palsy OR facial paralysis) AND (electr* OR electric stimulation OR electric stimulation therapy OR physical therapy OR physical therapy techniques) NOT diagnos*)

CINAHL: ((bell$ palsy OR bell palsy OR facial paralysis) AND (electr$ OR electric stimulation OR physical therapy) NOT diagnos$)

AMED: ((bell$ palsy OR facial paralysis) AND (electr$ OR electric stimulation OR physical therapy OR physiotherapy) NOT diagnos$)

EMBR: ((bell$ palsy AND electr$) NOT diagnos$)

We searched all of our keywords and subject headings simultaneously using nesting and Boolean operators. Boolean logic is mathematical in nature; when using multiple terms in combination with AND, OR, and NOT, a specific order is applied. The parentheses indicate that the included operations should be performed first. The parentheses allowed us to "nest" like terms with OR and then to combine the resulting 2 sets with AND. We wished to eliminate all articles having the keyword diagnosis or diagnostic, so we combined our final set with NOT diagnos* or diagnos$, depending on the database. We then limited our search to articles published in English and studies of human subjects.

The number of citations retrieved from each search is shown in Table 2. Titles of the retrieved citations were scanned to determine relevance to our clinical question. A conservative approach was taken when scanning the citation titles, and, if there was any doubt about an article's content, the article was

Table 2. Results of Literature Searches and Initial Title Screening

Database	Number of Citations Retrieved	Number of Citations Eliminated	Number of Citations Kept for Further Review
PubMed | Clinical Queries | Clinical Study Category	46	20,[a] 14,[b] 7[c]	5
PubMed | Clinical Queries | Find Systematic Reviews	4	3[d]	1
CINAHL	46	16,[a] 14,[b] 10,[c] 3[d]	3
AMED	31	7,[a] 15,[b] 3,[c] 3[d]	3
EBMR	15	1,[a] 6,[b] 3,[c] 2[d]	3

[a] Facial palsy other than Bell palsy.
[b] Did not include electrical stimulation treatment.
[c] Did not include any treatment.
[d] Duplicate article because we were searching 4 databases.

Table 3. Results of Abstract or Article Review[a]

Author	Decision	Rationale
From PubMed[b]		
Harney and McConn Walsh,[4] 2003	Excluded	Editorial comment
Huizing et al,[5] 1981	Excluded	Review article, reference for ES is Mosforth and Taverner.[17]
Staal et al,[6] 1979	Excluded	Review article, reference for ES is Mosforth and Taverner.[17]
May,[7] 1978	Excluded	Research article about prognostic indicators.
Lathrop,[8] 1976	Excluded	Review article, ES is not included as a treatment.
From PubMed[c]		
Buttress and Herren,[9] 2002	Excluded	Review article, reference for ES is Farragher et al.[15]
From CINAHL		
Quinn and Cramp,[10] 2003	Excluded	Review article, references for ES are Farragher et al[15] and Targan et al.[12]
Holland and Weiner,[11] 2004	Excluded	Review article, ES is not included as a treatment.
Targan et al,[12] 2000	Included	Pre-post study of ES for patients with chronic Bell palsy (1–7 years).
From AMED		
Shrode,[13] 1993	Excluded	Case report of 2 patients with acute Bell palsy and use of ES.
Frach et al,[14] 1992	Excluded	Case report of 2 patients: one pregnant and one with onset 3.5 weeks prior to treatment.
Farragher et al,[15] 1987	Included	Crossover study of ES for patients with chronic Bell palsy (0.5–29 years)
From EBMR		
Taverner et al,[16] 1966	Excluded	Clinical trial of ACTH gel.
Mosforth and Taverner,[17] 1958	Included	Clinical trial of ES for patients with acute Bell palsy.
Centre for Reviews and Dissemination,[18] 2005	Excluded	Expert commentary on the review article by Quinn and Cramp, 2003

[a] ES=electrical stimulation, ACTH=adrenocorticotropic hormone.
[b] Clinical Queries | Clinical Study Category.
[c] Clinical Queries | Find Systematic Reviews.

included for further review. All of our searches were performed on May 16, 2006.

■ **Selection of articles for review:** We identified 15 articles[4–18] to consider further in answering our clinical question. Abstracts and articles were reviewed to determine the relevance of their content. When an article was a review, its reference list was scanned to identify primary sources of information pertaining to ES. The results of our review are shown in Table 3. We were able to identify only 3 articles[12,15,17] that could potentially inform our clinical decision on the use of ES for Bell palsy.

Mosforth J, Taverner D. Physiotherapy for Bell's palsy. *BMJ.* 1958;2:675–677.

In this randomized controlled trial, 83 patients with Bell palsy of less than 14 days' duration as confirmed by clinical examination were randomly assigned to a control group that performed daily facial massage (n=40) or an experimental group that performed massage and received daily ES ("interrupted galvanism" in which 100-millisecond pulses were applied to each of 11 facial muscles to evoke 3 sets of 30 minimal contractions; n=43). Patients were treated until recovery was nearly complete or for 6 months. All patients were followed until recovery was complete or for at least 1 year.

All patients underwent electrical examination of the facial muscles over the course of the study. Denervation of facial muscles was established by the presence of fibrillations on electromyograms (EMG) and abnormalities in strength-duration curves. Conduction block was established by clinical presentation and absence of EMG indicators of denervation. At the conclusion of the study, review of patients in the control group revealed that 27 patients had conduction block and 13 had denervation, whereas, in the experimental group, 23 patients had conduction block and 20 had denervation. Electrical stimulation was provided daily until active contractions returned and then 3 times per week until recovery or a plateau in function. Treatment for patients with denervation lasted from 2 to 6 months. The outcome measure used for recovery was a visual estimate of recovery of function of the affected side expressed as a percentage of the unaffected side.

At the beginning of the trial, the experimental and control groups were similar with respect to age (mean=39.5 vs 35.6 years), sex (22 vs 18 males), and duration of symptoms (both group means were 5.2 days). All patients in the conduction block subgroup recovered completely (ie, they regained facial muscle function equivalent to that of the unaffected side) regardless of group assignment. Average time to initial movement in the conduction block subgroup was about 10 days, and average time to full recovery was about 41 days. In contrast, no patients with denervation recovered completely. For patients with denervation, time to initial movement averaged 53 days for those receiving ES, and 66 days for those in the control group. Patients were followed for at least 1 year or until they reached a plateau in recovery. Among patients with denervation, ES had no apparent effect relative to the extent of recovery or the development of facial muscle contractures. When considering all patients with denervation, 18% experienced less than 25%

recovery, 52% experienced 25% to 75% recovery, and 30% experienced greater than 75% recovery. Twenty-three percent of patients in the denervation subgroup developed contracture of the facial muscles.

Electrical stimulation as applied in this study, when added to a regimen of daily massage, resulted in neither harm nor therapeutic benefit for patients with Bell palsy. That is, ES represented an additional clinical cost in terms of time and utilization of resources, but resulted in no demonstrable benefit to patients in either the conduction block or denervation subgroups.

Farragher D, Kidd GL, Tallis R. Eutrophic electrical stimulation for Bell's Palsy. *Clin Rehabil.* 1987;1:265–271.

This "crossover study" investigated the use of ES on the recovery of motor activity in muscles affected by Bell palsy. The authors chose to apply "eutrophic" stimulation (ie, ES designed to mimic the frequency and pattern of motor activity characteristic of healthy facial muscles). The authors hypothesized that the use of eutrophic ES would help to maintain the flaccid muscles and exert a trophic effect that would enhance reinnervation. Forty patients who had been diagnosed with facial palsy (Bell palsy n=39; herpes zoster infection n=1) without "significant improvement" for at least 6 months (time since onset was a year or more in all but 2 patients) were recruited and allocated to either the ES group (n=20) or the control (n=20) group. Subsets of patients in the control group were crossed over; that is, they began to receive ES at 6 weeks (n=15), 12 weeks (n=3), or 18 weeks (n=2).

At the beginning of the trial, the ES and control groups were similar with respect to time since onset of facial paralysis (ES group: mean=74 months, range=0.5–29 years; control group: mean=80 months, range=0.5–50 years), age (ES group: mean=42 years, range=12–88 years; control group: mean=43 years, range=24–64 years), and sex (ES group: 17 women; control group: 12 women).

In order to establish ES parameters for eutrophic stimulation of each muscle, the authors examined 15 volunteers who were healthy. Average motor unit action potential (MUAP) frequencies for selected facial muscles of expression (frontalis, orbicularis oculi, levator labii, zygomaticus major, and orbicularis oris) ranged from 6.7 to 13.8 MUAPs per second. Electrical stimulation was then applied to each of the selected facial muscles using the previously determined mean firing frequency for that muscle.

Validated measures—the Facial Paralysis Recovery Profile (FPRP) and the Facial Paralysis Recovery Index (FPRI)[19]—were used to determine clinical outcomes. The FPRP is a protocol for estimating volitional movement, whereas the FPRI accounts for complications such as synkinesis, ptosis, facial spasm, and "crocodile tears." Initial FPRI score was 1.55, indicating that, on average, patients had less than 25% volitional movement. This finding was consistent with partial denervation.

Both groups of patients were instructed to perform daily facial exercises (with visual feedback via a mirror) and massage to the facial muscles. Electrical stimulation was provided by a stimulator that the patient used in his or her home twice a day (totaling 3–5 hours per day). Surface stimulation was delivered via 3-cm diameter unipolar carbon-rubber electrodes; stimulation parameters were set for each muscle using previously acquired MUAP firing frequencies. Stimulation voltage was set at visible motor threshold using 80-μs compensated rectangular monophasic pulses.

Volitional movement of the facial muscles improved substantially, as evidenced by increases in mean FPRI scores from 1.55 to 3.85 after 6 weeks of treatment. Following 18 weeks of treatment, there was continued improvement in volitional movement as well as a reduction in complications associated with Bell palsy. These improvements were substantiated by an increase in mean FPRI score from 1.35 to 7.40. All patients with ptosis (4/4), and about 50% of patients with "crocodile tears" (18/32), or facial muscle spasms (11/20) experienced resolution of these problems. Unfortunately, only about 10% of patients with contractures (3/32) and only 1 of 34 patients with synkinesis (3%) showed improvement. Three independent therapists performed follow-up examinations 6 months after treatment concluded. These evaluations confirmed maintenance of the recovery that had been previously observed.

Although this report suggests that individuals with long-standing Bell palsy (6 months to 50 years) may benefit from "eutrophic" ES added to a regimen of facial exercises and massage, the absence of a true control group makes it impossible to determine whether therapeutic benefits were related to ES. Patients in the control group were lost to follow-up as they "crossed over" to receive ES after 6, 12, or 18 weeks, so the effect of ES cannot be ascertained. We also note that applying 80-μs pulses at the visible motor threshold would not likely activate denervated muscles. Muscle contractions related to ES would result from activating the healthy motor units of fully or partially innervated muscles, so no induced exercise effect would be anticipated in the dysfunctional muscle fibers.

Targan R, Alon G, Kay SL. Effect of long-term electrical stimulation on motor recovery and improvement of clinical residuals in patients with unresolved facial nerve palsy. *Otolaryngol Head Neck Surg.* 2000;122:246–252.

This study aimed to extend the findings of Farragher et al[15] and was designed to investigate the efficacy of using pulsed ES to reduce neuromuscular conduction latencies and minimize clinical impairments in patients with long-standing facial nerve damage. Data in the original article were grouped for patients with Bell palsy and excision of acoustic neuromas; we discuss here only those data associated with Bell palsy. Twelve patients (7 women, 5 men) with Bell palsy of at least 1 year's duration who had shown no change in House-Brackmann scores or nerve conduction latencies for at least 3 months were enrolled. The mean age of patients was 50.4±12.3 (±SD) years and average time since onset of Bell palsy was 3.7 years (range=1–7). The mean initial House-Brackmann score was 4.4±0.7, indicating that these patients had chronic denervation ranging from "obvious weakness" to "no movement."

Electrical stimulation was delivered via a 2-channel stimulator (4 electrodes) that produced monophasic 86-μs pulses at submotor intensity once every 700 milliseconds (pulse rate=about 1.4 pps). In the initial protocol, each of 4 facial muscles was targeted for 30 minutes of stimulation per day for the first month, 1 hour daily for the second month, and 2 hours daily during the third month. Starting with the fourth month, patients stimulated each muscle for 6 hours while they slept. During the fifth and sixth months, an additional 4 muscles were targeted for similar stimulation.

Measurements of motor nerve conduction latencies associated with 6 facial muscles (frontalis, orbicularis oculi, orbicularis oris, zygomaticus major, nasalis, and triangularis) were obtained 3 months prior to and immediately prior to the commencement of ES treatment and after 6 months of ES treatment. Combined average motor nerve latencies of all 6 muscles were 6.43±0.6 milliseconds, 6.42±0.6 milliseconds, and 5.3±0.4 milliseconds, at each respective measurement period, demonstrating a significant improvement (P=.0001) after ES treatment.

Similarly, after 6 months of ES, the mean (±SD) House-Brackmann scores of patients with Bell palsy decreased from 4.4±0.7 to 2.3±1. The number of clinical impairments was determined by the Clinical Residuals Score, which assesses 12 clinical abnormalities associated with Bell palsy (synkinesis, tearing, drooling, etc) and grades each item from 0 (normal) to 10 (most severely impaired) yielding scores from 0 (no impairment) to 120 (all abnormalities displaying severe impairment). Following 6 months of ES, patients improved significantly from a mean Clinical Residuals Score of 74.1±21.5 to 45.3±26.0 points (P=.0005). Patients were not followed beyond 6 months.

This report suggests that patients with chronic Bell palsy who receive ES as described in the article may show improvements from moderately severe facial motor dysfunction (disfiguring asymmetry) to mild dysfunction (normal symmetry with only slight muscle weakness) at rest with slight mouth asymmetry and synkinesis during active contraction), but with little improvement in associated clinical problems (eg, synkinesis, tearing, drooling). The sample size was small, and because all patients in this study received ES, the clinical improvements reported cannot with confidence be attributed to ES. Despite this, clinical improvements were observed in patients with Bell palsy whose function had not changed for at least 3 months prior to intervention; at a minimum, this suggests a need for a randomized controlled trial that would rigorously test this ES protocol.

■ **Clinical decision:** Our literature review revealed only 3 clinical trials with good potential to inform our clinical decision, and only one of those was a randomized controlled trial.[17] In that controlled trial, ES was applied to induce exercise of muscles affected by Bell palsy, but outcomes demonstrated neither benefit nor harm. Although positive associations between ES and clinical outcomes were shown by Farragher et al[15] and Targan et al,[12] and those authors at least suggested causality, we could not with confidence attribute the reported clinical improvements to ES because there were no control groups in those studies. Thus, our decision to use or avoid ES would be based in part on theory and underlying concepts of anatomy and physiology.

The popular and long-established practice of electrically stimulating facial muscles rendered paralyzed or paretic by Bell palsy is likely grounded in (1) the simple observation that visible contractions can be electrically evoked in these muscles and (2) the underlying assumption that "induced exercise" would be beneficial. Because of the basic electrophysiology of nerve fibers, "induced exercise" necessitates use of relatively long pulse durations that will satisfy the prolonged chronaxies of denervated muscle fibers (pulse durations of at least 1 millisecond, but often 10–40 milliseconds and even up to 200 milliseconds are reported).[20,21] But Farrager et al[15] and Targan et al[12] used very short-duration pulses (80 μs and 86 μs, respectively) and low intensities (at or below visible motor threshold), ES parameters that are likely safer than those used in the clinical trial by Mosforth and Taverner,[17] but which could not induce contractions in muscle fibers affected by Bell palsy. Electrical stimulation at motor threshold as applied by Farragher et al[15] would not elicit contractions in wholly denervated muscles; therefore, this stimulation almost certainly elicited contractions only in those muscles supplied by healthy motor nerves of the face (ie, the trigeminal nerve, which innervates nearby muscles of mastication) or facial nerve fibers unaffected by a partial Bell palsy. If the stimulation as applied by Farragher et al,[15] in fact, did evoke slight contractions in nearby healthy muscles, this might do no harm, but neither would it be expected to result in clinical benefit. The ES methods adopted by Farragher et al[15] and Targan et al[12] were probably quite safe because they applied short-duration pulses at relatively low intensities. But if the reported clinical improvements accrued from ES, they were almost certainly the result of mechanisms other than "induced exercise."

It was reasonable to conclude that the clinical improvements noted by Farragher et al[15] and Targan et al[12] were associated with the natural tendency for spontaneous recovery from Bell palsy. It is at least possible, however, that stimulation of intact nerve fibers within the affected muscles enhanced patients' capacity to voluntarily activate involved (but not fully denervated) facial muscles. In this regard, all 3 of the cited studies included volitional or induced exercises in the treatment program. Thus, it was possible to speculate that activation of involved muscles contributed to the observed clinical improvements.

Our ultimate decision was to defer use of ES for 3 months, because, in an observational study of the natural course of Bell palsy in 1,701 patients, Peitersen[3] reported that 64% of patients will have "regained normal function" within this time frame.[3] This observation is consistent with and substantially extends the findings of Mosforth and Taverner,[17] and we believed that a conservative approach was more likely to be both cost-effective and safe. In the meantime, we discussed with our patient the natural course of Bell palsy (including prognostic factors) as discussed by Peitersen.[3] We also monitored our patient's facial motor function using House-Brackmann scores and discussed with her the possible use of massage or active exercise of recovering muscles of facial expression. However, because there was no evidence to support massage or active exercise as recommended by Mosforth and Taverner[17] for patients in the acute phase of Bell palsy, we involved our patient in the decision to use or avoid use of those interventions. After 3 months, if full resolution of our patient's Bell palsy were not imminent, we would further discuss our professional insights with her and her physician in an attempt to reach a collaborative decision about a further course of action.

References

1 House JW, Brackmann DE. Facial nerve grading system. *Otolaryngol Head Neck Surg.* 1985;93:146–147.

2 Ljostad U, Okstad S, Topstad T, et al. Acute peripheral facial palsy in adults. *J Neurol.* 2005;252:672–676.

3 Peitersen E. Bell's palsy: the spontaneous course of 2,500 peripheral facial nerve palsies of different etiologies. *Acta Otolaryngol Suppl.* 2002;549:4–30.

4 Harney M, McConn Walsh R. Treatment controversies in Bells palsy. *Ir Med J.* 2003;96:197–198.

5 Huizing EH, Mechelse K, Staal A. Treatment of Bell's palsy: an analysis of the available studies. *Acta Otolaryngol.* 1981;92:115–121.

6 Staal A, Huizing EH, Mechelse K. Bell's palsy: a discussion of treatment. *Clin Neurol Neurosurg.* 1979;81:141–147.

7 May M. Bell's palsy: progressive ascending paralysis, therapeutic implications. *Laryngoscope.* 1978;88(1 Pt 1):61–72.

8 Lathrop FD. A critical analysis of current trends in the management of Bell's palsy. *Laryngoscope.* 1976;86:1209–1217.

9 Buttress S, Herren K. Electrical stimulation and Bell's palsy [Best Evidence Topic Report]. *Emerg Med J.* 2002;19:428.

10 Quinn R, Cramp F. The efficacy of electrotherapy for Bell's palsy: a systematic review. *Physical Therapy Reviews.* 2003;8(3):151–164.

11 Holland NJ, Weiner GM. Recent developments in Bell's palsy. *BMJ.* 2004;329:553–557.

12 Targan RS, Alon G, Kay SL. Effect of long-term electrical stimulation on motor recovery and improvement of clinical residuals in patients with unresolved facial nerve palsy. *Otolaryngol Head Neck Surg.* 2000;122:246–252.

13 Shrode LW. Treatment of facial muscles affected by Bell's palsy with high-voltage electrical muscle stimulation. *J Manipulative Physiol Ther.* 1993;16:347–352.

14 Frach JP, Osterbauer PJ, Fuhr AW. Treatment of Bell's palsy by mechanical force, manually assisted chiropractic adjusting and high-voltage electrotherapy. *J Manipulative Physiol Ther.* 1992;15:596–598.

15 Farragher D, Kidd GL, Tallis R. Eutrophic electrical stimulation for Bell's Palsy. *Clin Rehabil.* 1987;1(4):265–271.

16 Taverner D, Fearnley ME, Kemble F, et al. Prevention of denervation in Bell's palsy. *Br Med J.* 1966;5484:391–393.

17 Mosforth J, Tavrener D. Physiotherapy for Bell's palsy. *Br Med J.* 1958;46:675–677.

18 Centre for Reviews and Dissemination. The efficacy of electrotherapy for Bell's palsy: a systematic review [provisional record]. Database of Abstracts of Reviews of Effectiveness. 2005; issue 4.

19 Kervavaz RJ, Hilsinger RL Jr, Adour KK. The facial paralysis prognostic index. *Oto Larynogol Head Neck Surg.* 1983;88:787–801.

20 Neumayer C, Happak W, Kern H, Gruber H. Hypertrophy and transformation of muscle fibers in paraplegic patients. *Artific Organs.* 1997;21:188–190.

21 Spielholz NI. Electrical stimulation of denervated muscle. In: Nelson RM, Hayes KW, Currier DP, eds. *Clinical Electrotherapy.* 3rd ed. Stamford, Conn: Appleton & Lange; 1999:chapter 9.