Pain relief from peripheral conditioning stimulation in patients with chronic facial pain

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In a prospective study, 50 consecutive patients, referred to a pain treatment unit for surgery to alleviate various forms of facial pain, were all given transcutaneous nerve stimulation (TNS) therapy and followed for 2 years. Of the 44 patients remaining at the 2-year follow-up review, 20 (45%) reported satisfactory analgesia from conventional or acupuncture-like TNS. The latter technique markedly improved the overall results. No serious side effects were seen. Atypical facial pain of known etiology responded best to treatment, but satisfactory relief was often produced with tic douloureux. Duration of the pain condition as well as sex of the patient were predictors of treatment results. It is concluded that TNS therapy represents a valid alternative to surgery when pharmacological therapy fails, especially in the elderly and in patients with atypical facial pain.

KEY WORDS: pain, facial pain, trigeminal nerve, nerve stimulation, transcutaneous nerve stimulation

PATIENTS with chronic so-called intractable facial pain may present management problems. This is true for typical trigeminal neuralgia (tic douloureux) as well as for atypical forms of facial pain. In the treatment of tic douloureux, systemic administration of carbamazepine has for many years replaced alcohol blocks as the treatment of choice. About 70% of the patients are said to report good or excellent analgesia initially. However, side effects are frequent, often due to overdosage, and long-term follow-up studies have shown that only 25% to 35% of the patients enjoy excellent or good pain relief for more than 5 years as a result of carbamazepine treatment. In a few of the remainder systemically administered phenytoin is effective, but for the others surgical procedures have offered the only chance of relief. The early nonselective techniques carried a significant risk of general as well as local complications. The more selective techniques now used, such as controlled thermocoagulation of the trigeminal ganglion and retrogasserian glycerol injection, have fewer side effects and can be repeated if necessary.

A different line of therapy has developed from the hypothesis that trigeminal neuralgia is a result of vascular compression of the trigeminal nerve root. Decompression by microsurgical procedures has been reported successful in 70% to 80% of the patients so treated, even if the percentage of cases with significant compression found was low (46%). However, as with all surgical procedures, these operations involve potential hazards to the patients as well as a need for trained surgeons and in-patient facilities.

In cases of atypical facial pain, with or without an identifiable organic cause, antiepileptic drugs are generally ineffective. Alcohol injections or surgery, even if giving temporary relief, may later result in a considerable worsening of the condition. Conventional analgesics may be useful when there is an organic cause for the disorder, and tricyclic antidepressant drugs may help when there is not. The available therapeutic methods, however, leave many patients unaided and substantially handicapped by their chronic facial pain.

During the last decade, treatment by conditioning stimulation of peripheral nerves has become increasingly used for patients with acute and chronic pain conditions. A long-term follow-up study of the effect of two types of transcutaneous electrical nerve stimulation (TNS) showed that, after 2 years, 31% of patients referred to a neurosurgical department still experienced useful analgesia from daily TNS treatment. Among these successfully treated patients with chronic pain were several who had previously had intractable facial pain, some of whom had had to use a newly developed TNS technique (acupuncture-like TNS) to obtain pain relief.

Apart from the need for alternative therapeutic meth-
ods among patients with intractable facial pain, it seemed of great interest for the evaluation of the TNS techniques to test and follow a group of patients suffering from chronic pain that was less varied as to type and location than in previous studies. We therefore initiated a prospective long-term follow-up study of 50 patients with intractable facial pain, treated with conventional or acupuncture-like TNS. The facial pain conditions treated represent two types of pain; namely, acute intermittent (tic douloureux) and chronic continuous (atypical facial pain). The study and the results obtained are the subjects of this report.

Clinical Material and Methods

Patient Population

The series included 50 consecutive patients with intractable facial pain who were referred to the Department of Neurosurgery at Lund University Hospital for surgery. Twenty-one patients had been classified as having tic douloureux. To comply with the diagnostic criteria, the pain had to be: 1) truly paroxysmal; 2) unilateral; 3) provokable by non-nociceptive facial stimuli; 4) confined to the innervation area of one, two, or three trigeminal branches; and 5) not associated with sensory or other neurological deficit.

There were 11 men and 10 women in the tic douloureux group. Their mean age was 65 years (range 34 to 88 years), and the median duration of pain was 8 years (range 2 to 18 years). All had initially experienced pain relief with carbamazepine. However, diminishing effectiveness of the drug or marked side effects, including allergic reactions, had limited its usefulness or made use impossible. Repeated alcohol injections of one or several distal trigeminal nerve branches had given temporary pain relief to 12 of these 21 patients. Of these 12 patients, seven had also been subjected to surgery (in most cases fractionated heating of the Gasserian ganglion), but the procedures had only given short-term relief. As a result of repeated treatment with injections or surgery, three patients had over the years developed a more continuous aching pain. These three patients and five others had sensory deficits when they entered the present study.

Twenty-nine patients did not fulfill the criteria for tic douloureux and will be considered here as having "atypical facial pain." In 18 of these patients the pain resulted from accidental or surgical trauma (11 patients), cerebrovascular disease (five patients), or herpes zoster ophthalmicus (two patients). In 11 patients no organic cause of the pain could be found. There were 17 men and 12 women in this group; the mean age was 58 years (range 23 to 84 years) and their median duration of pain was 5 years (range 1 to 30 years). All patients but one reported their pain to be almost constantly present, with exacerbations lasting for several hours to days. It was described as deep, dull, aching, or burning. Treatment with carbamazepine, conventional analgesics, antidepressants, or sedatives had not significantly relieved the pain, and 17 patients had been subjected to repeated alcohol injections and/or surgery, in some cases with partial or temporary relief.

Method of Treatment

The treatment with TNS was fully described to the patients, and their consent was obtained. After the initial examination, including sensory testing of the head and neck area, stimulation treatment was tested in an out-patient unit according to the scheme described below and illustrated in Fig. 1. All patients were tested...
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Fig. 2. Upper: Electrode placements for acupuncture-like transcutaneous nerve stimulation (TNS). The anode (black electrode) was located anterior to the external meatus and the cathode (active electrode, hatched) over the center of pain. Lower: Conventional (Conv.) TNS and acupuncture-like (acup.-like) TNS stimulation patterns used as described in text.

If, after the first 2-week trial period, there was no significant pain relief, the patient was instructed how to use the stimulator for acupuncture-like TNS. The positive electrode was then placed in front of the ear and the negative electrode over the forehead, cheek, or chin. The stimulator was set for a train (7 pulses at 100 Hz) given at a repetition rate of 1.5 to 2 Hz,\textsuperscript{49} and the electrodes adjusted so that visible muscle contractions were produced in the area of pain (Fig. 2). If, after another 2-week trial period at home, there was still no report of significant pain relief, the TNS trial was recorded as a failure. If stimulation treatment was reported to reduce the intensity and frequency of pain paroxysms, or produced useful relief in patients with non-paroxysmal atypical intractable facial pain, the patient was instructed to continue with the treatment and was seen again 2 months later.

If the patients, when seen 3 months after their initial visit, reported useful pain relief and wished to continue TNS treatment, the outcome of therapy was recorded as successful. When patients continued to use small amounts of carbamazepine or other analgesic agents together with stimulation treatment, it was judged as moderately successful. All patients were seen at regular intervals for 2 years or until the treatment was terminated. When pain relief seemed stable or during periods of spontaneous remission, patients were instructed to try to reduce the duration and frequency of the stimulation periods as much as possible.

The stimulator used is a portable constant-current unit that delivers conventional or acupuncture-like TNS by monophasic square-wave pulses of 0.2-msec duration at a maximum of 60 mA into a load of 2500 ohm.\textsuperscript{*} The stimulation was given via standard square carbon rubber electrodes, usually 6 sq cm in size, coated with conductive gel. Stimulation intensity (Fig. 1) was 1.5 to 2.5 times the perception threshold in conventional TNS (usually 8 to 18 mA), and 2 to 4 times the perception threshold in acupuncture-like TNS (usually 12 to 25 mA).

Statistical Assessment

For evaluation of differences between groups the chi-square test was used. If any of the calculated expected numbers for the four fields was 5 or less, Yates' correction was used.

Results

After 3 months of treatment, 16 (32%) of the 50 patients experienced successful or moderately successful pain relief with conventional TNS only (Fig. 3). Of the 34 patients who did not benefit from conventional TNS, acupuncture-like TNS proved to be satisfactory in 13

\textsuperscript{*} Stimulator manufactured by Cefar Medical Products, Lund, Sweden.
patients. Thus, in all, 29 (58%) of the 50 patients experienced pain relief from TNS. Twenty patients used stimulation only and were considered a success, and nine patients who added small amounts of adjuvant pharmacotherapy were considered a moderate success. Seven patients who had not been working for a long time because of their facial pain went back to work.

At 12 months, two patients had died from unrelated disease and one had a period of spontaneous remission and was not using the stimulator. Of the remaining 47 patients, 24 (51%) were still using TNS and achieving satisfactory pain relief. At 24 months, three patients had a spontaneous remission of their pain and one more had died; 20 (45%) of the remaining patients reported satisfactory analgesia from TNS (Fig. 3).

Treatment results at 3 months were evaluated in relation to the TNS technique used, etiology, and duration of the intractable facial pain condition, sex, main complaint of pain, and results of sensory examination at the time when TNS treatment was started (Table 1). Of the 21 patients with tic douloureux, 11 were in the successful or moderately successful group. Five of these had to use acupuncture-like TNS to achieve satisfactory pain relief (Table 1). Among the patients with atypical facial pain, 11 had pain of unknown etiology; four of these experienced satisfactory relief, two with acupuncture-like TNS. Similarly, among the 18 patients with known etiology of their pain, 14 were in the successful or moderately successfully treated group, and six of these employed acupuncture-like TNS. There was no significant difference in treatment success between patients with tic douloureux (11 of 21 patients) and atypical facial pain (18 of 29 patients). However, significantly (0.025 < p < 0.05) better results were obtained in patients who had atypical facial pain with a known organic cause as compared to all other patient groups (Table 1). The median duration of pain for all patients was 6 years. The success rate of TNS was significantly (0.025 < p < 0.05) higher among patients who had atypical facial pain with a known etiology as compared to all other patient groups (Table 1). The mean duration of pain was similar among men (7 years) and women (8 years).

We found a significantly (0.025 < p < 0.05) higher number of men than women in the successfully treated group. This is further illustrated in Fig. 5, where it can be seen that with atypical facial pain of unknown and known origins the representation of men and women in relation to success or failure is proportional to their total numbers in the diagnostic groups. On the other hand, among patients with tic douloureux, the representation of men in the successful group was higher than in the unsuccessful group.

There was a nonsignificant tendency for truly paroxysmal facial pain to be more resistant to stimulation treatment (11 of 19 patients) than pain of the more continuous type (10 of 31 patients, Table 1). In an earlier report, acupuncture-like TNS was noted to be of special value when destructive surgery had been performed with resulting cutaneous hypesthesia or dysesthesia within the area of pain. In the present group of patients with facial pain, the difference between those with normal sensitivity (three of 11 patients) and those with hypesthesia or dysesthesia (10 of 18 patients),

**TABLE 1**

<table>
<thead>
<tr>
<th>Clinical Data</th>
<th>Success</th>
<th>Failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>20 (8)</td>
<td>8</td>
</tr>
<tr>
<td>female</td>
<td>9 (5)</td>
<td>13</td>
</tr>
<tr>
<td>initial diagnosis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>typical trigeminal neuralgia</td>
<td>11 (5)</td>
<td>10</td>
</tr>
<tr>
<td>other forms of intractable facial pain</td>
<td>4 (2)</td>
<td>7</td>
</tr>
<tr>
<td>unknown etiology</td>
<td>14 (6)</td>
<td>4</td>
</tr>
<tr>
<td>known etiology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>previous treatment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>pharmacological treatment only</td>
<td>13 (5)</td>
<td>8</td>
</tr>
<tr>
<td>alcohol blocks or surgery</td>
<td>16 (8)</td>
<td>13</td>
</tr>
<tr>
<td>duration of pain (yrs)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 6</td>
<td>19 (7)</td>
<td>7</td>
</tr>
<tr>
<td>≥ 6</td>
<td>10 (6)</td>
<td>14</td>
</tr>
<tr>
<td>main complaint</td>
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<tr>
<td>pain paroxysms</td>
<td>8 (4)</td>
<td>11</td>
</tr>
<tr>
<td>continuous pain</td>
<td>21 (9)</td>
<td>10</td>
</tr>
<tr>
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<tr>
<td>normal</td>
<td>11 (3)</td>
<td>8</td>
</tr>
<tr>
<td>hypesthesia or dysesthesia</td>
<td>18 (10)</td>
<td>13</td>
</tr>
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</table>

* TNS = transcutaneous nerve stimulation. Numbers in parentheses indicate successful acupuncture-like TNS therapy.
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TNS result

Success

Moderate success

Failure

<table>
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<tr>
<th>Pain duration (years)</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
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<tr>
<td>30</td>
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</table>

Fig. 4. Results of transcutaneous nerve stimulation (TNS) given in relation to pain duration and TNS technique used. "Success" and "moderate success" are defined in text. Dotted line denotes median pain duration among these patients. Conv. TNS = conventional TNS; acup.-like TNS = acupuncture-like TNS.

as regards method of stimulation, was not significant, however.

Side effects were few. Four patients with typical trigeminal neuralgia reported intensified pain when TNS was used during the actual pain paroxysms. Four patients had marked skin reactions which could be controlled by change of electrodes and tapes. Side effects did not warrant termination of treatment in any of these patients.

Discussion

The present study has confirmed our initial observations that TNS may be a worthwhile choice of therapy in patients with intractable facial pain. After about 3 months of TNS therapy, about half of the patients with tic douloureux, whose symptoms were often of considerable duration, and two-thirds of those with atypical facial pain achieved satisfactory pain relief.
Even after 2 years, 45% of the 44 patients remaining in the study used TNS regularly and experienced satisfactory relief. No serious side effects were seen. All of these patients had severe conditions and were judged to be failures as regards conservative treatment; however, the results of this study show that TNS therapy may well be a relevant alternative to surgical procedures. This may be so for elderly tic douloureux patients, in whom surgical risks are more serious, and for all patients with atypical facial pain, where surgical results are not encouraging.

Interestingly, the newly introduced technique of acupuncture-like TNS seems to have improved the results considerably as compared to the use of conventional TNS. This may well explain why our results with intractable facial pain are superior to those reported by others, but see the report of Ihalainen and Perkki. The treatment success seen after 2 years in this study (45%) is higher than that reported by us in a previous group of patients consecutively referred for chronic pain to the same pain treatment unit. One possible explanation for this difference is the relative ease with which the men in this sample adjusted better to the occasionally unpleasant stimulation, which could also be considered a social handicap due to the facial electrodes, even if used only 30 to 90 minutes a day. Moreover, psychogenic factors may have been more important among the women.

Among factors predictive for the outcome of TNS, a short duration of the painful condition favors a good result, so did a known precipitating cause among the patients with atypical facial pain. However, the tendency for atypical facial pain to be more amenable to TNS therapy than tic douloureux was not significantly different. Interestingly, men with intractable facial pain, notably those with tic douloureux, enjoyed better treatment results than did women. This might indicate that the men in this sample adjusted better to the occasionally unpleasant stimulation, which could also be considered a social handicap due to the facial electrodes, even if used only 30 to 90 minutes a day. Moreover, psychogenic factors may have been more important among the women.

As regards the possible mechanisms of action of conventional and acupuncture-like TNS, it is interesting that both techniques seem to relieve painful conditions of acute intermittent (tic douloureux) as well as of chronic continuous (atypical facial pain) character. This appears to be true for pain of presumed peripheral as well as of presumed central origin. Thus, successfully treated atypical facial pain was in some instances due to peripheral lesions (herpes zoster neuritis, trauma), in others to cerebrovascular disease. Tic douloureux has been ascribed to peripheral (nerve root compression, segmental demyelination, exaggerated dorsal root reflexes) as well as to central causes. Taken together, these observations favor a central mechanism of action for TNS. This is in agreement with the observation that analgesia from acupuncture-like TNS is usually reversible by naloxone, indicating an opioid link. However, analgesia from conventional TNS cannot be reversed by naloxone. On the other hand, both techniques change sensory thresholds of healthy subjects on both sides after unilateral stimulation, supporting the concept of a central mechanism.

References
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Manuscript received July 27, 1983.
This work was supported by grants from the Swedish Medical Research Council (Nos. 5658 and B3-04X-00084-19B) and by the Medical Faculty, University of Lund.
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