

# Long-Term Outcome of Trigeminal Nerve Injuries Related to Dental Treatment

*M. Anthony Pogrel, DDS, MD, FACS, FRCS,\**

*Ryan Jergensen, DDS,† Eric Burgon, DDS,‡ and Daniel Hulme§*

**Purpose:** There is little information available on the long-term effects on patients of permanent involvement of the inferior alveolar or lingual nerve because of dental treatment. This study has attempted to document this information from patients who were reviewed between 3 and 9 years after injury.

**Materials and Methods:** All patients with an ICD-9 diagnosis of 951.2 (injury to the trigeminal nerve) because of dental treatment, seen in the Oral and Maxillofacial Surgery Clinic at the University of California, San Francisco between January 1, 2001 and December 31, 2006, were contacted in an attempt to complete a telephone survey of long-term effects.

**Results:** Of the 727 patients who were eligible for the study, 145 patients (95 female and 50 male) completed the telephone surveys. Many patients had sought both conventional and alternative treatments after consultation at University of California, San Francisco. A small number of patients had undergone subsequent surgery elsewhere. Many patients reported significant life changes, including adverse effects on employment (13%), relationship changes (14%), depression (37%), problems speaking (38%), and problems eating (43%). In general, however, patients reported improvement over time, often using a number of different coping mechanisms. Males had a greater decrease in symptoms than females, and those older than 40 years reported more pain in the long term than those under 40. Lingual nerve symptoms improved more than inferior alveolar nerve symptoms.

**Conclusions:** Although most patients continue to have long-term problems that affect the overall quality of life, for most patients there has been improvement in symptoms over time.

© 2011 American Association of Oral and Maxillofacial Surgeons

*J Oral Maxillofac Surg* 69:2284-2288, 2011

Involvement of, and damage to, the inferior alveolar and lingual nerves can occur after several types of dental treatment, including local anesthetic injections,<sup>1,2</sup> endodontic treatment,<sup>3</sup> implant placement,<sup>1</sup> and dentoalveolar surgery, particularly involving the removal of mandibular third molars.<sup>1,4</sup> These dental treatments can cause permanent nerve damage resulting in anesthesia, paresthesia, and dysesthesia.<sup>5</sup>

Many patients are referred to a neurologist or pain clinic and patients also seek alternative or complementary treatments to cope. Patients for whom dysesthesia is a daily presence experience the significant impact of daily pain and may suffer a decline in their quality of life. There are no published data relating to the long-term outcome of these patients. This study attempts to determine the treatments patients use and the long-term outcome for patients seen with injuries to the inferior alveolar and lingual nerves because of dental treatment.

Received from the Department of Oral and Maxillofacial Surgery, University of California, San Francisco, San Francisco, CA.

\*Professor and Chair.

†Dental Student.

‡Dental Student.

§Dental Student.

Address correspondence and reprint requests to Dr Pogrel: University of California, San Francisco, Department of Oral and Maxillofacial Surgery, Box 0440, Room C-522, 521 Parnassus Ave, San Francisco, CA 94143-0440; e-mail: [tony.pogrel@ucsf.edu](mailto:tony.pogrel@ucsf.edu)

© 2011 American Association of Oral and Maxillofacial Surgeons

0278-2391/11/6909-0006\$36.00/0

doi:10.1016/j.joms.2011.02.023

## Materials and Methods

Appropriate University of California, San Francisco (UCSF) Institutional Human Research Committee approval was obtained for this study. All patients presenting to the Oral and Maxillofacial Surgery Clinic at UCSF between January 1, 2001 and December 31, 2006 (6 yrs) with a diagnosis of injury to the trigeminal nerve because of dental treatment (ICD-9 code 951.2) were identified by running a search in the

departmental patient database. These dates were chosen because the current surgery database was installed in 2000 and we wanted to review patients with 3 years or more since their initial consultation. The UCSF Oral and Maxillofacial Surgery Clinic will see all patients with nerve injuries caused by dental treatment, although the referring dentist or physician is often told that it is unlikely that the patient will be offered surgery or long-term treatment, depending on the time since injury, the etiology, and the symptoms. Therefore, some patients elect not to attend, and others do attend for an opinion and to discuss the issues, even if they are referred late.

The UCSF Oral and Maxillofacial Surgery Clinic does not offer medical treatment for nerve injuries, but does refer patients to the UCSF Pain Clinic and to the Neurology Clinic when appropriate.

The etiology of the injury and initial symptoms were recorded. This information was gathered from the patients' existing medical records.

The patients were sent a written communication stating that they would be contacted and asked to participate in a telephone survey. Patients who did not respond negatively to the postal survey were then contacted by telephone (Table 1). If they were recruited, the caller asked whether their symptoms had changed in any way since they were last seen in the clinic. Sensation was quantified on a scale of 0 to 10, where 0 is normal sensation and 10 is complete anesthesia, with increments of 0.5 (analogous to the visual analog scale) to allow a similar scale to that of the Von Frey's Hairs used at the initial consult in the clinic. Dysesthesia was assessed on a scale of 0 to 10, where 0 is normal sensation and 10 is the worst pain imaginable, with increments of 0.5. Changes in the quality of life and significant life changes occurring because of injury were recorded. We also determined whether patients had sought outside opinions and treatments since last being seen at UCSF, or used alternative coping mechanisms, and what the results of those treatments were.

The data on the patients' symptoms at the time of initial consultation in the UCSF Oral and Maxillofacial Surgery Clinic had been recorded using Von Frey's Hairs<sup>6</sup> on a scale of 20 hairs of varying thickness for fine touch and direction sense, Minnesota thermal discs<sup>7</sup> for temperature sensation, and calipers used to measure 2-point discrimination.<sup>8</sup> Patients were also asked at the initial consultation appointment to rate their dysesthesia, if any, on the same 0 to 10 scale.

Paired *t* tests were used for significance to determine relative amounts of paresthesia and dysesthesia at the time of consult and at the time of follow-up during this study. All analyses were performed using SAS/XP version 9.1 (SAS Inc, Gary, NC). *P* values less than .05 were considered significant.

### Table 1. TELEPHONE QUESTIONNAIRE SCRIPT: LONG-TERM EVALUATION OF TRIGEMINAL NERVE INJURIES

#### Introduction

Hello. My name is Daniel Hulme. I am a researcher for UCSF School of Dentistry and am following up on your visit to our clinic on \_\_\_\_\_ (Date), concerning numbness of your face and mouth. We would like to simply gather some information to help us serve you and future patients.

#### Consent

Did you receive the letter we sent to you concerning this study? Do you have any further questions?

#### Questions

Would you be willing to simply answer a few questions?

1. What nerve was damaged?
  - a. Right tongue (right lingual nerve)
  - b. Left tongue (left lingual nerve)
  - c. Right lip, chin, jaw, and/or gums (right inferior alveolar nerve)
  - d. Left lip, chin, jaw, and/or gums (left inferior alveolar nerve)
  - e. Other
2. How was it originally damaged?
  - a. Administration of local anesthetic
  - b. Wisdom tooth removal or other dental surgery
  - c. Root canal
  - d. Implant placement
  - e. Periodontal surgery
  - f. Other
3. What were your symptoms when you originally presented to our clinic?
  - a. Totally numb (anesthesia)
  - b. Partially numb (paresthesia)
  - c. Painfully numb (dysesthesia)
  - d. Normal
4. What treatment was completed at University of California at San Francisco (UCSF)?
  - a. None
  - b. Nerve surgery
  - c. Medications
5. Have you sought care anywhere else after coming to UCSF?
  - a. Primary care physician
  - b. Neurologist
  - c. Pain clinic
  - d. Alternative medicine clinic
  - e. Other
6. If you sought care elsewhere, was any additional treatment given?
  - a. None
  - b. Surgery elsewhere
  - c. Medications
  - d. Alternative treatment (explain)
7. Please list any medications you have taken for your nerve injury:
8. Has your injury caused any significant life changes affecting your quality of life?
  - a. Job changes
  - b. Relationship changes
  - c. Depression
  - d. Speech problems
  - e. Eating problems
  - f. Appearance
  - g. Other
9. On a scale from 1 to 10, with 1 being minimal impact and 10 being the worst numbness (paresthesia) or worst pain (dysesthesia) imaginable, how would you rate your condition when it FIRST happened?  
1 2 3 4 5 6 7 8 9 10
10. On a scale from 1 to 10, with 1 being minimal impact and 10 being the worst numbness (paresthesia) or worst pain (dysesthesia) imaginable, how would you rate your condition NOW?  
1 2 3 4 5 6 7 8 9 10
11. What would you attribute to any change in condition from then to now?
  - a. No change
  - b. Spontaneous return of sensation
  - c. Treatment rendered
  - d. Getting used to it
  - e. Coping mechanisms (please explain any and all techniques)
12. Have you ever been diagnosed as having diabetes?
13. Have you ever had any other nerve injuries or nerve pain?

#### Thank You and Comments

Thank you for your time in helping us with this study.

## Results

Of the 727 subjects identified as being eligible for this study, 145 patients (20%) completed the telephone surveys. Of those 145 patients, 95 were female and 50 were male. For statistical purposes, patients were divided into 2 age groups consisting of those greater than 40 years old and those less than or equal to 40 years old. Table 2 shows the nerve affected and the age and gender of the subjects. A small number of patients had more than 1 nerve involved, including nerves other than the inferior alveolar and lingual nerve in 8 cases.

Of the 95 females in the study, 85 received no treatment at UCSF, 7 received nerve surgery, and 3 were given medications to treat the symptoms. Of the 50 males in the study, 44 received no treatment, 5 underwent nerve surgery, and 1 received medication. Many patients sought care elsewhere after coming to UCSF. Of the 95 females, 10 consulted their primary care physician; 17 saw a neurologist; 11 went to a pain clinic; and 5 went elsewhere. Of the 50 males, 6 consulted their primary care physician; 6 saw a neurologist; 3 went to a pain clinic; and 2 went elsewhere. Of those subjects who sought additional treatment outside UCSF, 5 patients (4 females, 1 male) underwent surgery; 20 (16 females, 1 male) were given medications, and 24 (18 females, 6 males) had some type of alternative medicine treatment. Of the 5 that underwent surgery elsewhere, after being seen at UCSF and not offered surgery at UCSF, 1 was improved; 3 were unchanged, and 1 had worse symptoms after surgery.

The current authors have previously published their criteria for offering surgery to patients, and the results of such surgery.<sup>9</sup> These have not altered over the last 10 years and indicate that surgical exploration and possible nerve repair is offered to the following patients:

- Patients with a witnessed transection
- Patients who are still totally anesthetic at 8 weeks postinjury, with no signs of recovery
- Patients with severe dysesthesia at 8 weeks postinjury, who are showing no improvement
- Patients at 4 months postinjury, who have less than 30% return of function (or do not have protective reflexes), or have severe dysesthesia

In general, surgery is not offered to patients who are more than 9 months postinjury because it has not been shown to give acceptable results in our hands. In this study, 12 patients had received surgery, none of them as a witnessed transection, and all were carried out around 2 to 4 months postinjury. Most had some relief from the surgery, but none were completely cured, so they were included in this study.

From the chart review, it did appear that a discussion of surgery had taken place with a further 12 patients who had not then proceeded with surgery. This is in line with our previously published figures showing that only about 11% of patients we see are ever offered surgery, and of those who are offered surgery, only about 50% accept the offer. The reasons for declining surgery are multiple, including patient fatigue with the issues, the possibility that they will not be improved, or financial issues.

Patients reported many significant life changes due to the nerve damage. Nineteen patients (14 females, 5 males) reported that their employment was adversely affected. Twenty-one patients (17 females, 4 males) reported relationship problems at home, with a spouse or significant other. Fifty-three patients (40 females, 13 males) reported depression, and 55 (35 females, 20 males) reported problems speaking and pronouncing words correctly. Sixty-three patients (44 females, 19 males) reported problems eating, and 1 patient (0 females, 1 male) reported significant changes in their appearance. These changes are summarized in Table 3.

Patients were also evaluated based on their previous symptoms and present symptoms with respect to paresthesia, dysesthesia, or anesthesia. At their last clinic visit, 6 patients (6 females, 0 males) reported experiencing no symptoms (they had essentially recovered by the time of their last clinic visit), 61 (39 females, 22 males) reported paresthesia, 34 (26 females, 8 males) reported dysesthesia, and 47 (28 females, 19 males) reported anesthesia. When surveyed for this study, 18 (13 females, 5 males) reported experiencing no symptoms; 60 (39 females, 21 males) reported paresthesia; 37 (29 females, 8 males) reported dysesthesia; and 31 (19 females, 12 males) reported anesthesia. This means that 12 patients (8.2% of the total) had gone on to make a late full recovery, with the decrease coming in the number of subjects reporting anesthesia.

**Table 2. RESPONDENTS CATEGORIZED BY AGE, GENDER, AND THE NERVE AFFECTED**

	Lingual		Inferior Alveolar		Other
	Right	Left	Right	Left	
Female (n = 95)	18	18	30	29	6
>40 years of age (n = 45)	6	10	15	13	4
≤40 years of age (n = 50)	12	8	15	16	2
Male (n = 50)	10	12	9	24	2
>40 years of age (n = 31)	6	2	6	18	1
≤40 years of age (n = 19)	4	10	3	6	1

**Table 3. SIGNIFICANT LIFE CHANGES CATEGORIZED BY AGE AND GENDER**

	Job Changes	Relationship Changes	Depression	Speech Problems	Eating Problems	Appearance
Female (n = 95)	14	17	40	35	44	0
>40 years of age (n = 50)	7	11	20	19	19	0
≤40 years of age (n = 45)	7	6	20	16	25	0
Male (n = 50)	5	4	13	20	19	1
>40 years of age (n = 31)	3	2	5	9	8	1
≤40 years of age (n = 19)	2	2	8	11	11	0

Pogrel et al. Long-Term Outcome of Trigeminal Nerve Injuries. *J Oral Maxillofac Surg* 2011.

The data reported that there was no statistically significant difference on the pain scale for the initial symptoms when based only on gender, indicating that males and females reported roughly the same thing. Specifically, females (n = 95) reported an average score of 7.47 (95% CI: [6.94, 8.00]) and males (n = 50) reported an average score of 7.26 (95% CI: [6.57, 7.93]), which led to a nonsignificant *P* value of .62. The data from the initial symptoms were further analyzed by gender and age with no significant results. The following 3 groups were cross-analyzed to evaluate the association between age and gender: all patients 40 years of age and younger, all female patients, all male patients. All 3 groups shared roughly the similar mean pain score between 7.15 and 7.50 with *P* values ranging from .67 to .89.

The data reported that the pain scale for current symptoms, although not statistically significant with *P* values ranging from .11 to .25, did present some interesting findings. When based on gender only, the data indicate a trend that females (mean, 4.59) report higher pain and numbness scores than males (mean, 3.88). When comparing previous to present conditions, the data suggest that although both males and females report a decrease of pain over time, males report a greater decrease in pain over time than females. Specifically, the mean change in pain scores between previous and present symptoms for females is 2.88, and for males is 3.38. When based on both gender and age, the data indicate that the older the patient, the more pain is reported. Although not statistically significant with *P* values ranging from .16 to .25, the data of the previous symptoms seem to suggest that the older someone is, the more likely they are to report more pain. Patients with lingual nerve damage had an initial pain score of 7.55, which improved to 3.6 when surveyed for this study. Patients with inferior alveolar nerve damage had improved to 4.62 at the time of this survey from an initial average pain score of 7.7. This does tend to show that although all scores improved over time, the lingual nerve showed better recovery than the inferior nerve but the results were not statistically significant (*P* = .117).

When asked what may have caused a change in symptoms over time, patients responded with a vari-

ety of therapies, including a long list of coping mechanisms that they had used, including the following: getting used to it (64), prayer and meditation (7), ice and heat packs (3), pressure on teeth (3), exercise and yoga (3), antidepressants (2), chewing gum (2), relaxation and acupuncture (2); other methods include keeping a journal, alcohol, massage, and herbal medicines. There did not seem to be one particular coping mechanism that worked best. Many patients tried them all, and others simply did not.

Two of the 145 respondents were diabetic (1 type 1 insulin-dependent diabetic and 1 type 2 diabetic on oral therapy). Nationally up to 8% of the US population may be diabetic. It would not appear that there is any increase in the incidence of nerve damage associated with dentistry in diabetic patients (who may have a propensity to diabetic neuropathy) than in other patients. No patients had reported any other neuropathies or nerve-type illnesses, which might indicate a susceptibility to nerve problems.

## Discussion

Despite letters being sent to all patients, followed by up to 3 phone calls, we were able to trace only 20% of the potential study subjects. However, this is in line with other studies carried out in North America, which has a very mobile population that values and guards its privacy. One can only speculate as to what the outcome may be for the 80% of patients we could not contact. We do, however, feel that the patients that were contacted are representative of the group as a whole. It does appear that many patients did seek professional advice after being discharged from the UCSF Clinic, with many receiving help from primary care physicians, neurologists, and pain clinics. A small number of patients also received microneurosurgery elsewhere, after not being offered this treatment at UCSF. Although studies have shown that over 40% of patients such as these may contemplate legal action,<sup>1</sup> it appears that this did not apparently apply to any of the respondents. In this study, the encouraging news is that in general terms, patients did tend to improve with time, with over 8% going on to full recovery, although it is unclear in some cases whether this recovery was a true neurological improve-

ment or the development of coping mechanisms. Older patients tend to report higher long-term pain levels than younger patients (possibly because of more effective coping mechanisms in younger patients) and males show better long-term recovery than females. The lingual nerve may show better long-term recovery than the inferior alveolar nerve, whereas short-term studies tend to show better recovery for the inferior alveolar nerve, possibly because it is contained within a bony canal for guidance.<sup>10</sup> In the long term, however, it is possible that if the inferior alveolar nerve has not recovered, then the lingual nerve may have better potential for recovery.

Although most patients continue to have long-term problems that may affect their overall quality of life, it also appears to be true that overall there is a modest, but not statistically significant, improvement in symptoms over time, although this could be due to adaptation rather than true medical improvement. It was not possible to separate out any subgroups of patients who may do better than others. Patients with nerve damage, however, should be referred appropriately for a microneurosurgical opinion when indicated.

## References

1. Pogrel MA, Thamby S: The etiology of altered sensation in the inferior alveolar, lingual, and mental nerves as a result of dental treatment. *J Calif Dent Assoc* 27:531, 1999
2. Pogrel MA, Thamby S: Permanent nerve involvement resulting from inferior alveolar nerve blocks. *J Am Dent Assoc* 131:901, 2000
3. Pogrel MA: Damage to the inferior alveolar nerve as the result of root canal therapy. *J Am Dent Assoc* 138:65, 2007
4. Robert RC, Bacchetti P, Pogrel MA: Frequency of trigeminal nerve injuries following third molar removal. *J Oral Maxillofac Surg* 63:732, 2005
5. Pogrel MA: Complications of Third Molar Surgery. *Oral Maxillofac Surg Clin North Am* 2:441, 1990
6. Weinstein S: Tactile sensitivity of the phalanges. *Percept Mot Skills* 14:351, 1962
7. Dyck PJ, Curtis DJ, Bushek W, et al: Description of "Minnesota Thermal Disks" and normal values of cutaneous thermal discrimination in man. *Neurology* 24:325, 1974
8. de Beukelaer JG, Smeele LE, van Ginkel FC: Is short-term neurosensory testing after removal of mandibular third molars efficacious? *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 85:366, 1998
9. Pogrel MA: The results of microneurosurgery of the inferior alveolar and lingual nerve. *J Oral Maxillofac Surg* 60:485, 2002
10. Alling CC 3rd: Dysesthesia of the lingual and inferior alveolar nerves following third molar surgery. *J Oral Maxillofac Surg* 44:454, 1986