



Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology

ENDODONTOLOGY

Editor: Larz S.W. Spångberg

Medico-legal aspects of altered sensation following endodontic treatment: a retrospective case series

Navot Givol, DMD,^a Eyal Rosen, DMD,^b Lars Bjørndal, DDS, PhD,^c
Silvio Taschieri, MD, DDS,^d Ronen Ofec, DMD,^e and Igor Tsesis, DMD,^f Tel Hashomer and
Tel Aviv, Israel, Copenhagen, Denmark, and Milan, Italy
THE CHAIM SEBA MEDICAL CENTER, TEL AVIV UNIVERSITY, UNIVERSITY OF COPENHAGEN, AND
UNIVERSITY OF MILAN

Objective. The objective of this study was to analyze cases of liability claims related to persistent altered sensation following endodontic treatments so as to characterize the medico-legal aspects of this complication.

Study design. A comprehensive search of an Israeli professional liability insurance database was conducted to retrospectively identify and analyze cases of persistent altered sensation following endodontic treatment.

Results. Sixteen claims of persistent altered sensation following endodontic treatments were identified and analyzed. The typical profile of a claim was a female patient who underwent an endodontic treatment at a second mandibular molar, which was associated with overfilling. A significant correlation between the tooth location and the suggested cause of nerve injury was found. None of the claims were reported by the practitioners, and all cases were identified as a result of the patient's demand for financial compensation, either directly or by legal actions.

Conclusions. When a nerve injury is diagnosed, the treating practitioner should be encouraged to seek medical and legal assistance so as to prevent permanent damage and to enable a better medico-legal response. (*Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2011;112:126-131)

Nerve injuries, including injuries of the inferior alveolar nerve (IAN), represent a rare but serious complication of dental treatment.^{1,2} Trauma, tumors, connective

tissue diseases, infectious diseases, demineralization, or idiopathic diseases have been reported as possible causes of paresthesia of the IAN.³

Endodontic procedures that may lead to IAN injury include periapical surgery, overinstrumentation, irritating root canal chemicals, and overfilling by root canal filling materials.⁴ Most cases of IAN injuries have been reported in second mandibular molars, but also in first molars and in premolars.⁵ In a recent study, Garisto et al.⁶ evaluated the occurrence of paresthesia after dental local anesthetic administration in the United States. They reported 248 cases of paresthesia, of which 13 cases (5.8%) included an endodontic treatment.

Endodontic malpractice claims have been previously reported⁷⁻⁹ and they represent a common malpractice claim in dentistry. Altered sensation following endodontic treatment may result in liability claims. Thus, it is important to review and study past cases to know how to avoid future complications and litigation.

The aim of this case series was to retrospectively analyze all liability claims related to persistent altered sensation following endodontic treatments that resulted

^aAttending Dentist, Department of Oral & Maxillofacial Surgery, The Chaim Sheba Medical Center, Tel Hashomer, Israel; Medical Risk Management Company, Tel Aviv, Israel.

^bGraduate Student, Department of Endodontology, Maurice and Gabriela Goldschleger School of Dental Medicine, Tel Aviv University, Tel Aviv, Israel.

^cAssociate Professor, Department of Cariology and Endodontology, University of Copenhagen, Copenhagen, Denmark.

^dHead, Department of Odontology, IRCCS, Istituto Ortopedico Galeazzi, Department of Odontology, University of Milan, Milan, Italy.

^eBio-statistician, MSc Program, Department of Statistical and Operational Research, School of Mathematical Science, Tel Aviv University, Tel Aviv, Israel.

^fDepartment of Endodontology, Tel Aviv University, Tel Aviv, Israel.

Received for publication Oct 4, 2010; returned for revision Dec 20, 2010; accepted for publication Jan 6, 2011.

1079-2104/\$ - see front matter

© 2011 Mosby, Inc. All rights reserved.

doi:10.1016/j.tripleo.2011.01.007

in legal actions against the treating practitioner in Israel, so as to characterize the medico-legal aspects of this complication.

MATERIAL AND METHODS

Most of the dental practitioners in Israel ($n = 5234$, 85% of the total population of the Israeli dental practitioners) are obligated to report any incidence or suspicion of a legal action against them to the Medical Consultants International Company (MCI) as part of their professional liability insurance terms. All dental malpractice complaints related to persistent altered sensation following dental treatment that were reported to MCI between 1992 and 2010 were retrospectively identified. The related medical records, including radiographic evaluation, dental CT scans, and clinical description that were included in each case file were obtained, reviewed, and analyzed by 2 authors (N.G. and I.T.) independently. Cases of disagreement were jointly discussed until an agreement was achieved. A total of 262 cases of altered sensation related to dental treatment were found, of which 16 (6.1%) cases were related to an endodontic treatment.

The type of nerve injury, the suspected injured nerve, and a suggested cause of injury were determined based on the legally proclaimed data as presented in the legal case file. The type of proclaimed nerve injury was categorized as anesthesia—insensitivity to all forms of stimulation¹⁰; paresthesia—a sensation, such as burning, prickling, or partial numbness¹¹; or hyperesthesia—increased sensitivity to all forms of stimulation.¹⁰

The variables of interest in this study were the patient's age and gender; the practitioner's gender; location of the involved teeth and type of endodontic treatment; time of appearance of the nerve injury (immediate, defined as appearance within less than 48 hours following the endodontic treatment, or delayed, defined as appearance within more than 48 hours following the treatment); the proclaimed injured nerve; and the proclaimed cause of injury.

The reports to MCI were classified as primary (reported by the dental practitioner without prior involvement of the patient), secondary (patient's demand for a financial compensation without legal actions), or tertiary (filed lawsuits).

Descriptive analyses have been performed to describe the categorical variables of interest. The χ^2 test was used to evaluate the distribution of the variables across the categories; P less than .05 was considered statistically significant.

RESULTS

Out of 262 cases of altered sensation that resulted in legal actions against the treating practitioner, 16 cases (6.1%) were following endodontic treatments. Other

cases were following implant placement ($n = 113$, 43%), tooth extraction ($n = 92$, 35%), local anesthesia ($n = 27$, 10%), bone-grafting procedures ($n = 7$, 3%), periodontal soft tissue procedures ($n = 5$, 2%), and cases in which the reason for the altered sensation could not be determined based on the records as appeared in the case file ($n = 2$, 1%). The endodontic treatment-related patients included 13 females and 3 males, at an age range of 21 to 66 years, with a mean of 37.8 years. The practitioners included 10 males and 6 females. There were 2 cases of hyperesthesia, 1 case of anesthesia, and 13 cases of paresthesia (Table I).

The most common type of endodontic treatment involved was a primary nonsurgical endodontic treatment of a vital tooth ($n = 15$, 94%). Most cases ($n = 11$, 69%) occurred following nonsurgical endodontic treatment of second mandibular molars. The remainder were similarly distributed among first and second mandibular premolars. All 5 cases located at the premolar area were associated with an injury to the mental nerve as proclaimed in the legal case file.

Altered sensation associated with overfilling (Fig. 1) was observed in 10 (63%) cases. In all cases, AH-26 was used as the filling material. In 2 (13%) cases the altered sensation resulted from a sodium hypochlorite accident, and in 4 (25%) cases no apparent cause could be identified. A statistically significant correlation was found between the location of the involved tooth and the proclaimed cause of the altered sensation: altered sensation associated with overfilling was more prominent following the treatment of second mandibular molars ($P < .05$).

In 12 cases (75%) the altered sensation occurred immediately, i.e., within the first 48 hours following the treatment. Eight cases were reported to MCI as secondary reports (patient's demand for a financial compensation) and 8 cases as tertiary reports (lawsuits). No reports were submitted by the dental practice staff (primary reports).

DISCUSSION

The aim of this case series was to assess the medico-legal aspects of altered sensation following an endodontic treatment. A comprehensive search and analysis of the MCI professional liability insurance database was conducted. Of 262 cases with altered sensation that resulted in legal actions against the treating practitioner, 16 cases (6.1%) were following endodontic treatments. In the investigation by Garisto et al.,⁶ a comparable proportion of paresthesia cases following dental treatment (5.8%) were reported to be related to endodontic treatment.

Endodontic treatment-related nerve injuries represent a rare but serious complication.^{1,2} However, the available literature assessing this complication is scarce; thus our

Table I. The identified cases

Case no.	Gender	Age	Tooth location ^a	Type of treatment	Injury cause	Nerve injury type	Injured nerve	Time of appearance ^b	Report ^c
1	F	37	37	PNSRCT	Overfill	An	IAN	Immediate	Tertiary
2	M	29	37	PNSRCT	Unknown	Hyper	IAN	Delayed	Tertiary
3	F	31	37	PNSRCT	Overfill	Par	IAN	Immediate	Secondary
4	F	45	45	PNSRCT	Unknown	Par	Mental	Immediate	Secondary
5	F	29	37	PNSRCT	Overfill	Par	IAN	Immediate	Tertiary
6	F	37	47	SNSRCT	Overfill	Par	IAN	Delayed	Secondary
7	F	66	34	PNSRCT	NaOCl	Par	Mental	Immediate	Tertiary
8	M	29	47	PNSRCT	Overfill	Par	IAN	Immediate	Tertiary
9	F	21	37	PNSRCT	Overfill	Par	IAN	Immediate	Tertiary
10	F	56	47	PNSRCT	Unknown	Par	IAN	Delayed	Secondary
11	F	27	47	PNSRCT	Unknown	Par	IAN	Immediate	Tertiary
12	F	40	45	PNSRCT	Overfill	Par	Mental	Delayed	Secondary
13	F	44	44	PNSRCT	Overfill	Par	Mental	Immediate	Secondary
14	M	24	47	PNSRCT	Overfill	Hyper	IAN	Immediate	Secondary
15	F	30	44	PNSRCT	NaOCl	Par	Mental	Immediate	Secondary
16	F	60	47	PNSRCT	Overfill	Par	IAN	Immediate	Tertiary

M, male; F, female; PNSRCT, primary nonsurgical endodontic treatment; SNSRCT, secondary nonsurgical endodontic treatment; NaOCl, sodium hypochlorite accident; An, anesthesia; Par, paresthesia; Hyper, hyperesthesia; IAN, inferior alveolar nerve; Mental, mental nerve.

^aTooth location: by FDI (Fédération Dentaire Internationale).

^bImmediate: <48 hours post treatment; Delayed: >48 hours post treatment.

^cPrimary: reported by the dental practitioner; Secondary: patient's demand for a financial compensation; Tertiary: filed lawsuits.

understanding of its clinical and medico-legal aspects is insufficient. The current study analyzes a series of legal cases in a given community in Israel so as to focus on the medico-legal aspects of this complication. Because most dental practitioners in Israel are obligated to report any incidence or suspicion of a legal action against them to MCI, the collected cases in this article represent a true medico-legal scenario, which may be applicable for other communities. Although limited in extent, the present article is a valuable opportunity to improve our understanding of this undisclosed medico-legal concern.

Most of the identified patients in this case series were females, which is comparable with previous reports.^{8,9,12} A female predominance was described in several other nerve injury studies, such as nerve injury related to local anesthesia injection, third molar surgery, lingual nerve repair, and nerve injury caused by dental treatment and traumatic injuries.^{9,10} The reason for this gender discrepancy may be explained by the fact that relatively more female patients are seeking dental treatment.^{8,13}

Male dentists were most often involved in the identified claims in the present case series, which is comparable with previous reports.⁹ Female physicians were reported to be more frequently involved in communication that was considered patient-centered and allowed more time for the visits than their male colleagues.¹⁴ In addition, the ratio of male/female dentists in Israel is 62% males and 38% females of 5234 insured dentists. Thus, this may also explain the overrepresentation of male dentists claimed for malpractice in dental practice.⁹

In this case series, 11 cases were related to an injury of the IAN, and 5 cases to an injury of the mental nerve. Several mechanisms have been suggested as possible etiologies to IAN injury following an endodontic treatment: mechanical trauma from overinstrumentation; pressure caused by the presence of the endodontic point or sealant within the inferior alveolar canal; a neurotoxic effect of the endodontic medicaments or sealant materials⁵; nerve injury following the administration of local anesthesia⁶; and nerve injury following an accidental injection of sodium hypochlorite into periapical tissues.^{15,16}

In the present case series, 13 cases of paresthesia, 1 case of anesthesia, and 2 cases of hyperesthesia that resulted in legal actions against the treating practitioner were identified. Most of those legal cases (68.8%) followed a nonsurgical endodontic treatment of the second mandibular molar. Furthermore, in those legal cases, a significant correlation was found between the tooth location and the proclaimed cause of injury: altered sensation associated with overfilling was more prominent following the treatment of the second mandibular molar ($P < .05$). The anatomical structure of the IAN and its relations to the surrounding anatomical structures may have a significant role in this finding: the trabecular pattern of the cancellous bone in the mandibular molar region is characterized by a consistently loose appearance, often presenting numerous vacuoles, and often without any cortical bone protecting the pedicle. In the second mandibular molar, the distance between the

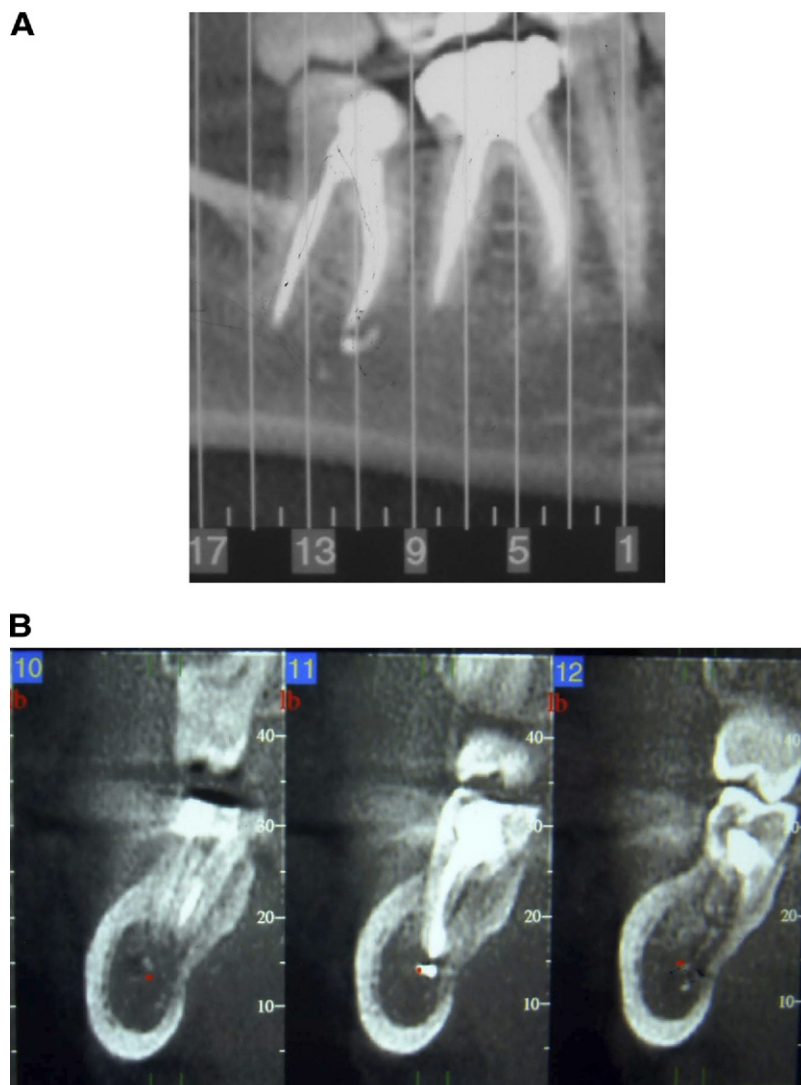


Fig. 1. A dental CT scan of a 40-year-old female patient, demonstrating a gross overfill of root canal sealing material (AH-26) following root canal treatment of the second mandibular molar. The overfill is located at the mesial root and vertical lines are superimposed reflecting the tomographical slices along the perpendicular plane (A). Details of slices 10 to 12 disclose extruded root canal sealing material into the inferior alveolar canal (B). The patient has permanent paresthesia.

apices and the pedicle of the IAN is often less than 1 mm, compared with a more variable distance observed in the first molar teeth (1 to 4 mm).¹⁷ The artery usually follows the IAN, running along the superomedial side from the mandibular foramen to the first molar, then skirting around the nerve on the upper side and becoming lateral, right up to the mental foramen.¹⁷ However, it is conceivable to assume that possibly in some of the identified legal cases, there was no correspondence between the actual and the proclaimed nerve injury and cause of injury, as presented in the legal case file.

Sodium hypochlorite (NaOCl) is an important adjunct commonly used as irrigation solution during

endodontic treatments, and is aimed for pulpal tissue dissolution and disinfection.¹⁵ However, if NaOCl is accidentally injected into periapical tissues it may cause inflammation that clinically manifests as pain and localized or widespread swelling,¹⁵ which may be followed by a nerve injury.¹⁶ NaOCl accidents are considered as relatively rare in endodontic practice, although their true rate is unknown.¹⁵ However, when occurring, they may be extremely traumatic for both the patient and the practitioner.

The overfill of different endodontic materials causing IAN damage has been reported in the literature.¹⁸⁻²¹ AH 26 was a sealer used in 10 cases of overfilling in the present study. The AH 26 is a

synthetic resin in which neurotoxicity is related to the formaldehyde formed from hexamethylenetetramine.²² Paraformaldehyde is a polymeric hydrate of formaldehyde, which when in contact with water releases formaldehyde gas, and may cause permanent damage to the nerve. We therefore recommend an appropriate treatment technique, to reduce the risk of displacing filling material in the vicinity of adjacent nerves, as well as an appropriate filling material selection. In this context, filling materials with the fewest possible neurotoxic effects are advised so as to reduce the risk of neurotoxicity-related nerve injury.²³

In the present case series, the proclaimed nerve injury occurred immediately or within the first 48 hours following the treatment in most of the cases ($n = 12, 75\%$). It is of great importance to follow-up on cases of suspected NaOCl accidents or overfills, because the nerve injury may manifest itself at a later time.

Both nonsurgical and surgical clinical modalities have been suggested for the treatment of endodontically induced symptomatic IAN injuries. However, all techniques are primarily based on case reports and small case-series studies.^{5,24} Nevertheless, the common knowledge from the current available literature is that the nerve damage may increase with duration of the injury. Thus, in case a nerve injury is suspected, a timely mannered clinical approach is advised to minimize long-term damage.²² If a radiographic evaluation after treatment reveals an endodontic material within the confines of the inferior alveolar canal (Fig. 1), careful monitoring of the patient during the postoperative period is crucial. If nerve injury-associated symptoms appear, aggressive treatment, including decompression, debridement, irrigation, and cleaning of the nerve may be indicated, and should be considered in a timely manner.⁵

In the study by Chaushu et al.,²⁵ only 3 of 16 cases of nerve injury were reported by the treating dentists. In the present case series, there were no reports by the treating dentists and all cases were identified as a result of a demand of financial compensation from the patient, either directly or through court. Furthermore, none of the nerve injury cases that resulted in legal actions against the treating practitioner were treated by the practitioners and none were referred to a specialist for consultation. Thus, all cases presented an increased risk of a long-lasting nerve injury because of the lack of an early intervention, and a medico-legal increased risk because of the lack of early reporting.

When a nerve injury is diagnosed, the treating practitioner should be encouraged to seek medical

and legal assistance so as to prevent permanent damage and to enable a better medico-legal response.

REFERENCES

- Escoda-Francoli J, Canalda-Sahli C, Soler A, Figueiredo R, Gay-Escoda C. Inferior alveolar nerve damage because of over-extended endodontic material: a problem of sealer cement biocompatibility? *J Endod* 2007;33:1484-9.
- Grotz KA, Al-Nawas B, de Aguiar EG, Schulz A, Wagner W. Treatment of injuries to the inferior alveolar nerve after endodontic procedures. *Clin Oral Investig* 1998;2:73-6.
- Gallas-Torreira MM, Reboiras-Lopez MD, Garcia-Garcia A, Gandara-Rey J. Mandibular nerve paresthesia caused by endodontic treatment. *Med Oral* 2003;8:299-303.
- Yatsuhashi T, Nakagawa K, Matsumoto M, Kasahara M, Igarashi T, Ichinohe T, et al. Inferior alveolar nerve paresthesia relieved by microscopic endodontic treatment. *Bull Tokyo Dent Coll* 2003;44:209-12.
- Pogrel MA. Damage to the inferior alveolar nerve as the result of root canal therapy. *J Am Dent Assoc* 2007;138:65-9.
- Garisto GA, Gaffen AS, Lawrence HP, Tenenbaum HC, Haas DA. Occurrence of paresthesia after dental local anesthetic administration in the United States. *J Am Dent Assoc* 2010;141:836-44.
- Selbst AG. Understanding informed consent and its relationship to the incidence of adverse treatment events in conventional endodontic therapy. *J Endod* 1990;16:387-90.
- Givol N, Rosen E, Taicher S, Tsesis I. Risk management in endodontics. *J Endod* 2010;36:982-4.
- Bjørndal L, Reit C. Endodontic malpractice claims in Denmark 1995-2004. *Int Endod J* 2008;41:1059-65.
- Hillerup S, Jensen R. Nerve injury caused by mandibular block analgesia. *Int J Oral Maxillofac Surg* 2006;35:437-43.
- American Association of Endodontists. Glossary of Endodontic terms. 7th ed. Chicago, IL: American Association of Endodontists; 2003.
- Givol N, Taicher S, Halamish-Shani T, Chaushu G. Risk management aspects of implant dentistry. *Int J Oral Maxillofac Implants* 2002;17:258-62.
- Manski RJ, Moeller JF, Maas WR. Dental services. An analysis of utilization over 20 years. *J Am Dent Assoc* 2001;132:655-64.
- Roter DL, Hall JA, Aoki Y. Physician gender effects in medical communication: a meta-analytic review. *JAMA* 2002;288:756-64.
- Kleier DJ, Averbach RE, Mehdipour O. The sodium hypochlorite accident: experience of diplomates of the American Board of Endodontics. *J Endod* 2008;34:1346-50.
- Motta MV, Chaves-Mendonca MA, Stirton CG, Cardozo HF. Accidental injection with sodium hypochlorite: report of a case. *Int Endod J* 2009;42:175-82.
- Tilotta-Yasukawa F, Millot S, El Haddioui A, Bravetti P, Gaudy JF. Labiomandibular paresthesia caused by endodontic treatment: an anatomic and clinical study. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2006;102:e47-59.
- Giuliani M, Lajolo C, Deli G, Silveri C. Inferior alveolar nerve paresthesia caused by endodontic pathosis: a case report and review of the literature. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2001;92:670-4.
- Gatot A, Tovi F. Prednisone treatment for injury and compression of inferior alveolar nerve: report of a case of anesthesia following endodontic overfilling. *Oral Surg Oral Med Oral Pathol* 1986;62:704-6.
- Lambrianidis T, Molyvdas J. Paresthesia of the inferior alveolar nerve caused by periodontal-endodontic pathosis. *Oral Surg Oral Med Oral Pathol* 1987;63:90-2.

21. Spielman A, Gutman D, Laufer D. Anesthesia following endodontic overfilling with AH26. Report of a case. *Oral Surg Oral Med Oral Pathol* 1981;52:554-6.
22. Scolozzi P, Lombardi T, Jaques B. Successful inferior alveolar nerve decompression for dysesthesia following endodontic treatment: report of 4 cases treated by mandibular sagittal osteotomy. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2004;97:625-31.
23. Schmalz G, Hørsted-Bindslev P. Root canal filling materials. In: Bergenholtz G, Hørsted-Bindslev P, Reit C, editors. *Textbook of endodontology*. Oxford: Wiley-Blackwell; 2010. p. 193-218.
24. Graff-Radford SB, Evans RW. Lingual nerve injury. *Headache* 2003;43:975-83.
25. Chaushu G, Taicher S, Halamish-Shani T, Givol N. Medicolegal aspects of altered sensation following implant placement in the mandible. *Int J Oral Maxillofac Implants* 2002;17:413-5.

Reprint requests:

Igor Tsesis, DMD
Department of Endodontology
P.O. Box 39040
Tel Aviv University
Tel Aviv 69978, Israel
dr.tsesis@gmail.com