The Prognosis of Altered Sensation after Extrusion of Root Canal Filling Materials: A Systematic Review of the Literature

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Abstract

Introduction: The aim of this study was to systematically review and evaluate the literature regarding the prognosis of altered sensation after extrusion of root canal filling materials and the possible factors influencing it. **Methods:** A systematic search of the literature was performed to identify studies that reported on altered sensation after extrusion of root canal filling materials during endodontic treatments. The articles were evaluated for their relevance based on strict inclusion criteria, and the identified suitable articles were subject to data extraction and analysis. **Results:** Initially, 109 possibly relevant articles were identified. After screening and full-text evaluations, 28 articles that met the inclusion criteria were analyzed, reporting on a total of 84 patients with altered sensation after extrusion of root canal filling materials. All the included studies, except 1 case series, were case reports. Under the limited available data, the extracted data showed that 91% of the patients had fully or partially recovered over time. Most of the cases in the lower molars as well as most of the cases in which the obturation was performed using paraformaldehyde-containing sealer or cases in which an immediate treatment was not performed did not fully recover. **Conclusions:** The current scientific knowledge regarding the prognosis of nerve injuries caused by overextruded endodontic materials relies primarily on case reports. Within the limitations of the published data, it seems that the tooth locations, types of extruded materials and the obturation technique, and treatment after the injury may affect the nerve injury prognosis. *(J Endod 2016;42:873–879)*

Key Words

Altered sensation, nerve injury, root canal filling materials, root canal treatment

Nerve injury and an ensuing altered sensation represent a serious complication of endodontic treatments (1–9). Endodontic treatment–related nerve injuries result from mechanical, chemical, or thermal trauma to nerve bundles. These injuries may occur either by direct trauma during the treatment or after the treatment when secondary intra-alveolar edema develops with subsequent increased pressure inside the mandibular canal (5, 8, 10–14).

Three-dimensional obturation of the root canal system constitutes 1 of the goals of endodontic treatment. Ideally, the filling material should be confined to the root canal space without extending to periapical tissues or other neighboring structures (15, 16). However, if filling materials are accidentally extruded to neighboring neurovascular structures, nerve injury with an ensuing altered sensation may occur (3, 6–8, 15, 17, 18).

Numerous reports were published on the management of nerve injuries related to overextended filling materials, but they significantly vary in the cases' characteristics and treatment protocols and present inconsistent and confusing results (2, 3, 5, 7, 17, 19–23). Evidence-based dentistry is an approach to oral health care that integrates the best available clinical evidence to support the practitioner's clinical expertise for each patient's treatment needs and preferences (24–26). Thus, an evidence-based review of the available literature regarding the prognosis of altered sensation after extrusion of endodontic materials and its possible influencing factors is important.

The aim of this study was to systematically review and evaluate the literature regarding the prognosis of altered sensation after extrusion of root canal filling materials and the possible factors influencing it.

Materials and Methods

Criteria for Considering Studies for the Systematic Review

The inclusion criteria for the systematic review were as follows:

1. Clinical studies reporting the extrusion of endodontic root canal filling materials during an endodontic treatment (*root canal filling materials* defined as "any material or combination of materials placed inside a root canal for the purpose of obturating and sealing the canal space" [27])
2. Altered sensation diagnosed after the endodontic procedure

Reviews, animal studies, *in vitro* studies, and studies not relevant to the topic of this study were excluded.

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Search Methods for the Identification of Studies

The search covered all articles published in dental journals from 1976 to July 2015. The following electronic databases were searched: MEDLINE using the PubMed search engine (http://www.ncbi.nlm.nih.gov/sites/pubmed) and Scopus (http://www.scopus.com). The following gray literature databases were also searched: HealthInfonet (http://www.healthinfonet.ecu.edu.au), Closing the Gap Clearinghouse (http://www.aihw.gov.au/closingthegap), and OpenGrey (http://www.opengrey.eu).

The following key words were used for an initial search through MEDLINE: (((root canal filling) OR endodontic)) AND ((nerve injury) OR altered sensation). The Medical Subject Headings (MeSH) received were as follows: ((("root canal obturation"[MeSH Terms] OR ("root"[All Fields] AND "canal"[All Fields] AND "obturation"[All Fields]) OR "root canal obturation"[All Fields] OR ("root"[All Fields] AND "canal"[All Fields] AND "filling"[All Fields]) OR "root canal filling"[All Fields]) OR endodontic[All Fields]) AND (((("nerve tissue"[MeSH Terms] OR ("nerve"[All Fields] AND "tissue"[All Fields]) OR "nerve tissue"[All Fields] OR "nerve"[All Fields]) AND ("wounds and injuries"[MeSH Terms] OR ("wounds"[All Fields] AND "injuries"[All Fields]) OR "wounds and injuries"[All Fields] OR "injury"[All Fields])) OR (altered[All Fields] AND ("sensation"[MeSH Terms] OR "sensation"[All Fields]))) AND "humans"[MeSH Terms].

An additional search was then performed through Scopus databases using the same key words. Related articles and the reference lists of the literature reviews that were retrieved by the MEDLINE search engine were manually checked for possible further eligible articles. No language restriction was applied.

Data Collection and Analysis

Selection of Studies. The articles were initially evaluated for relevance based on their titles and abstracts by 2 reviewers independently (E.R. and I.T.). Possibly eligible studies were subject to a full-text evaluation. The full text of the relevant studies was obtained and reviewed for suitability based on the inclusion criteria described previously. Cases of disagreement were discussed together until agreement was reached. The identified suitable articles were subject to data extraction and analysis and were also assessed for their methodological quality and their suitability to inclusion in a meta-analysis.

Data Extraction. Data were extracted by 2 reviewers independently (E.R. and T.G.). Cases of disagreement were subject to joint evaluation by the reviewers until agreement was reached. The following variables were recorded:

1. *Preoperative variables:* The patients' demographics (age and sex) and the involved tooth location
2. *Intraoperative variables:* The type of sealer (16, 28, 29) and the obturation technique (16) (lateral condensation, vertical condensation, or sealer only technique)
3. *Postoperative variables:* The type of nerve injury (8, 30) (*anesthesia,* defined as insensitivity to all forms of stimulation; *paresthesia,* defined as a sensation such as burning, prickling, or partial numbness; and *hyperesthesia,* defined as increased sensitivity to all forms of stimulation [8]); the time of treatment (7, 8) (*immediate treatment,* defined as treatment within 48 hours of injury, and *delayed treatment,* defined as treatment performed later than 48 hours after the injury); the preformed treatment (surgical treatment, nonsurgical treatment, or no treatment); the follow-up time (in months); and the reported outcome (full recovery, partial recovery, or no recovery) (7, 8)

Assessment of the Studies' Methodological Quality and Suitability for a Meta-analysis of the Results. The studies were evaluated for the possibility of a meta-analysis of their results based on the assessment of their methodological quality (31) and heterogeneity.

Results

The search in the MEDLINE database using the PubMed search engine identified 77 articles. Through the other sources, 93 articles were identified, and after the removal of duplicates, the additional articles not previously identified in MEDLINE included 21 articles identified using Scopus databases and 11 possibly relevant articles identified by the manual search. No additional studies were found in the gray literature database search. Eventually, 109 studies were initially evaluated for relevance based on their titles and abstracts. Possibly eligible studies were then subject to a full-text evaluation as previously described. The diagram of the article selection process is presented in Figure 1 (32).

All the included studies (3, 12, 15, 19, 33–55), except 1 case series (7), were case reports. As a result, a meta-analysis could not be performed. The included articles were subject to data extraction and descriptive statistics. Table 1 presents data retrieved from the included studies.

The details regarding the evaluated variables were not fully reported in all included studies; thus, the results are presented as a percentage from the number of cases in which the particular variable was reported. There were 28 included articles that reported on a total of 84 cases of patients who presented with altered sensation after extrusion of root canal filling materials, including 26 (84%) female patients and 5 (16%) male patients, with an average age of 39 years (range, 16–70 years).

There was 1 (3%) case reported in the first lower premolar, 6 (19%) in the second lower premolar, 11 (36%) in the first lower molar, 11 (36%) in the second lower molar, and 2 (6%) in the third lower molar. There were no cases reported in other tooth locations.

In 3 (11%) cases, zinc oxide eugenol–based sealer was used; in 1 (4%) case, a calcium hydroxide–based sealer was used; in 8 (29%) cases, a resin-based sealer was used; in 11 (39%) cases, a paraformaldehyde-containing sealer was used; in 4 (13%) cases, core materials only were used; and in 1 (4%) case, another sealer type was used.

In 6 (33%) cases, lateral condensation was used as the obturation technique; in 3 (17%) cases, vertical condensation was used; and in 9 (50%) cases, a sealer-only technique was used.

In 11 (33%) cases, anesthesia alone was diagnosed; in 7 (21%) cases, paresthesia alone was diagnosed; in none of the cases, hyperesthesia alone was diagnosed; in 2 (6%) cases, other types of nerve injury were reported; and in 13 (40%) cases, a combination of more than 1 type of altered sensation was reported.

In 7 (8%) cases, immediate treatment was performed; in 27 (32%) cases, delayed treatment was performed; and in 50 (60%) cases, no treatment was performed. From the treated cases, a surgical treatment was performed in 23 (68%) cases, and in 8 (24%) cases a nonsurgical treatment was performed. In 3 (9%) cases, both surgical and nonsurgical treatments were performed.

The average follow-up time was 10 months (range, 0–42 months). In 18 (53%) cases, a full recovery was reported; in 13 (38%) cases, a partial recovery was reported; and in 3 (9%) cases, no recovery was reported.

The distribution of the evaluated pre-/intra-/postoperative variables according to the type of outcome reported, with "full

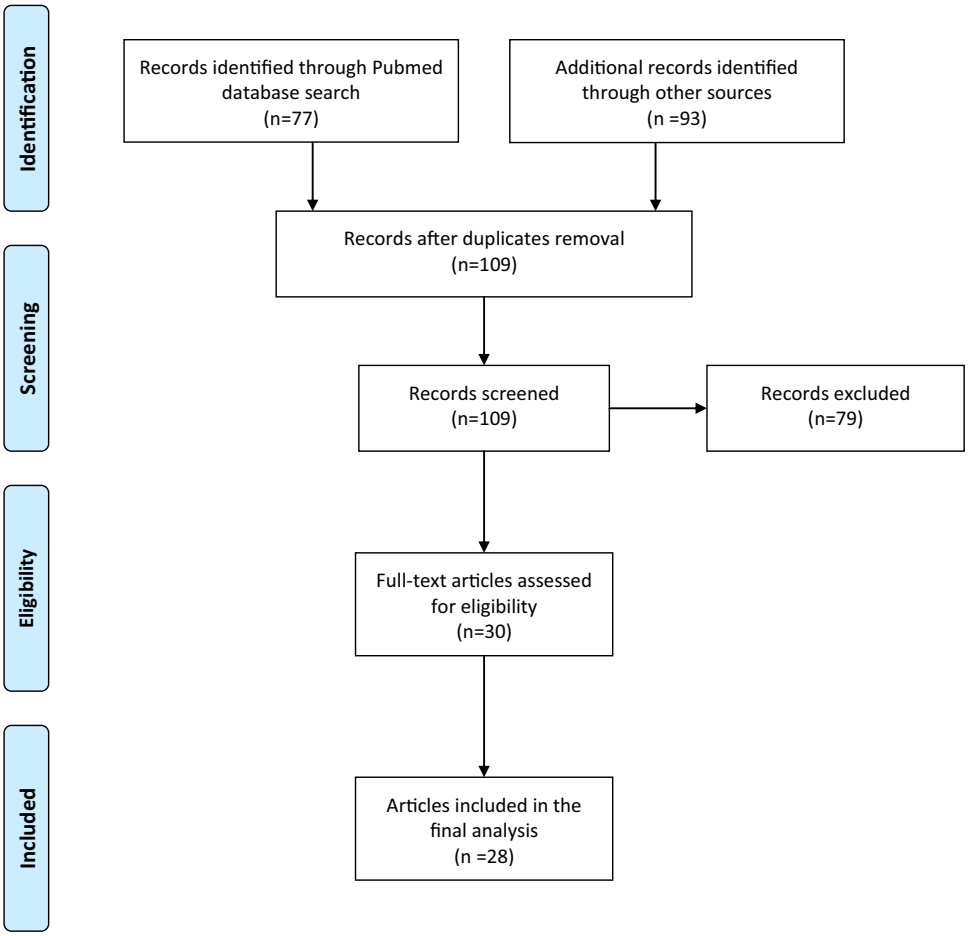

Figure 1. A flowchart of the systematic search process.

recovery" used as the comparison variable, is presented in Table 2.

Discussion

The fundamental of evidence-based dentistry is the use of the best available clinical evidence to support the practitioner's daily practice (24–26). It is based on the process of systematically finding, apprizing, and using research findings as the basis for clinical decision making (24, 25, 56–61). The present systematic review of the literature revealed that, to date, the current scientific knowledge regarding the prognosis of nerve injuries caused by overextruded endodontic materials relies primarily on case reports (3, 12, 15, 19, 33–55) and 1 case series (7), which are considered as a low level of evidence (24–26, 56, 58–60, 62–65).

In this systematic review of the literature, a total of 84 cases of patients who presented with altered sensation after extrusion of root canal filling materials were described. In 53% of the cases, a full recovery was reported; in 38% of the cases, a partial recovery was reported; and only in 9% of the cases, no recovery was reported in an average follow-up time of 10 months (range, 0–42 months).

It had been previously suggested that the prognosis of altered sensation after endodontic treatments may be related to the type and extent of injury, to the intervention timing, and to the selected treatment protocol (7, 8, 14, 66–68). Based on previous publications, most patients, especially with a relatively low extent of injury and with an appropriate early intervention treatment, tend to improve with time, sometimes using coping mechanisms (8, 68). However, some of the patients may suffer from long-term or permanent disability with a destructive effect on their quality of life and with significant medical and medicolegal consequences (7, 8, 14, 66–68).

A female predominance was described in several nerve injury studies, such as nerve injury related to local anesthesia injection, third molar surgery, and nerve injury caused by traumatic injuries (8, 30, 69, 70, 71). The reason for this sex discrepancy may be explained by the fact that relatively more female patients are seeking dental treatment (8, 71, 72). Sex anatomic variation is another possible explanation. Females have significantly shorter vertical distances between the inferior alveolar nerve (IAN) and the root apices of mandibular molar teeth, which may potentially pose an increased risk of nerve injury during endodontic treatments of posterior mandibular teeth compared with male patients (8, 73). The findings of female predominance in nerve injuries are consistent with the results of the current systematic review; 84% of the reported cases (in which gender was reported) were in female patients, and only 16% were in male patients. However, almost equal percentages of the female (42%) and male (40%) patients reported full recovery during follow-up. In addition, the percentage of full recovery among young patients <30 years old (29%) and older patients ≥30 years old (43%) was comparable. Thus, it seems that although there were more reported cases in female patients, the patients' demographics did not play a crucial role in the prognosis of the nerve injury.

The present systematic review of the literature revealed that most of the cases of nerve injuries caused by overextruded endodontic materials

TABLE 1. Data Retrieved from the Included Studies

Article details	Number of cases	Age (y)	Sex	Tooth location	Type of sealer	Obturation technique	Time of treatment	Nerve injury	Treatment	Follow-up (months)	Outcome
Coskunses et al, 2015 (33)	1	30	M	2nd M	PFA	NA	Del	Ansths, Other	Surg	12	Part
Alonso-Ezpeleta, 2014 (34)	1	36	F	2nd PM	Res	LC	Del	Ansths, Other	Non Surg	1.5	Full
Scala et al, 2014 (35)	1	70	M	3rd M	Core	NA	Del	Parsth, Other	Surg, Non Surg	<1	Full
López-López et al, 2012 (36)	1	37	F	2nd M	Res	LC	Imm	Ansths	Non Surg	1	Full
Gambarini et al, 2011 (37)	1	59	F	2nd M	ZOE	LC	Imm	Parsth	Non Surg	6	Full
González-Martín et al, 2010 (15)	1	32	F	2nd M	Res	LC	No	Ansths, Parsth	No	42	Part
Brkic et al, 2009 (38)	1	30	F	2nd PM	PFA	NA	Del	Ansths	Surg	2	Full
Scarano et al, 2007 (39)	1	52	F	2nd PM	ZOE	NA	Del	Ansths	Non Surg	15	Full
Escoda-Francoli et al, 2007 (3)	1	41	F	1st M	NA	NA	Del	Parsth	Surg, Non Surg	9	Full
Blanas et al, 2004 (19)	1	62	F	1st M	Core	VC	No	Parsth	No	12	Part
Pogrel, 2007* (7)	42	NA	NA	NA	NA	NA	No	NA	No	NA	NA†
	5	NA	NA	NA	NA	NA	Imm	Other	Surg	<1	Full
	6	NA	NA	NA	NA	NA	Del	Other	Surg	NA	Part/none‡
Koseoglu et al, 2006 (40)	1	32	F	1st M	PFA	SO	Del	Ansths	Surg, Non Surg	18	Part
Poveda et al, 2006 (41)	1	40	F	1st PM	PFA	SO	No	Ansths,Parsth	No	7	Part
Scolozzi et al, 2004 (42)	1	21	F	1st M	Res	NA	Del	Parsth, Other	Surg	6	Full
	1	32	M	3rd M	ZOE	NA	Del	Parsth, Other	Surg	12	Part
	1	51	F	1st M	Other	NA	Del	Ansths,Parsth	Surg	12	Part
	1	66	M	2nd M	NA	NA	Del	Parsth	Surg	12	Part
Yatsuhashi et al, 2003 (43)	1	27	M	2nd M	PFA	NA	Del	Ansths	Non Surg	3	Full
Gallas-Torrieira et al, 2003 (12)	1	45	F	1st M	Core	NA	Del	Parsth, Hyper	Surg	1	Full
Blanas et al, 2002 (44)	1	29	F	2nd M	Core	VC	No	Ansths, Parsth	No	12	Part
Fanibunda, 1998 (45)	1	28	F	2nd M	CH	VC	Del	Ansths, Parsth	Surg	12	Part
Neaverth, 1989 (46)	1	42	F	1st M	NA	NA	Del	Ansths, Hyper	Surg	12	Part
Orstavik et al, 1983 (47)	1	36	F	2nd M	PFA	SO	No	Ansths, Parsth	No	36	None
Tamse et al, 1982 (48)	2	28	F	2nd PM	Res	LC	No	Ansths	No	12	Full
		45	F	1st M	Res	LC	No	Ansths	No	24	Part
Speilman et al, 1981 (49)	1	37	F	2nd PM	Res	NA	Del	Ansths	Surg	5	Full
Kaufman and Rosenberg, 1980 (50)	1	40	F	2nd M	PFA	SO	Del	Ansths	Non Surg	6	None
Pyner, 1980 (51)	1	NA	F	2ndM	Res	SO	No	Ansths, Parsth	No	3	Part
Grossman, 1978 (52)	1	16	F	1st M	PFA	SO	Del	Parsth	Surg	NA	NA
Grossman and Tatoian, 1978 (53)	1	47	F	1st M	PFA	SO	Del	Parsth	Non Surg	NA	NA
Forman and Rood, 1977 (54)	1	35	F	1st M	PFA	SO	Del	Ansths	Surg	3	Full
Montgomery, 1976 (55)	1	23	F	2nd PM	PFA	SO	Del	Parsth	Non Surg	12	None

1st M, first lower molar; 2nd M, second lower molar; 3rd M, third lower molar; 1st PM, first lower premolar; 2nd PM, second lower premolar; Ansths, anesthesia (insensitivity to all forms of stimulation); CH, calcium hydroxide–based sealer; Core, core materials (other); Del, delayed treatment (later than 48 hours from time of injury); F, female; Full, full recovery; Hyper, hyperesthesia (increased sensitivity to all forms of stimulation); Imm, immediate treatment (within 48 hours of injury); LC, lateral condensation; M, male; NA, not available; N, no treatment; No, no treatment; None, no recovery; Non Surg, nonsurgical treatment; Parsth, paresthesia (a sensation such as burning, prickling, or partial numbness); Part, partial recovery; PFA, paraformaldehyde-containing sealer; Res, resin-based sealers; SO, sealer only; Surg, surgical treatment; VC, vertical condensation; ZOE, zinc oxide eugenol–based sealer.

*Eight cases were excluded because they were not involved with nerve injury.

†Fewer than 10% of these patients experienced any resolution of symptoms.

‡Four achieved partial improvement in sensation, and 2 experienced no improvement at all.

TABLE 2. The Relation between Full Recovery from the Nerve Injury and Possible Influencing Factors

	Preoperative factors						Intraoperative factors					Postoperative factors			
	Age (y)		Sex		Tooth location		Type of sealer		Obturation technique			Time of treatment		Treatment	
	<30	≥30	F	M	PM	LM	PFA	Res	LC	VC	SO	Imm	Del	Non Sur	Sur
Full recovery*	2 (29%)	10 (43%)	11 (42%)	2 (40%)	5 (83%)	8 (33%)	3 (27%)	5 (62%)	4 (67%)	0 (0%)	1 (11%)	7 (100%)	10 (37%)	1 (2%)	5 (63%)	12 (46%)

Del, delayed treatment (later than 48 hours from time of injury); F, female; Imm, immediate treatment (within 48 hours of injury); LC, lateral condensation; LM, lower molar; M, male; No, no treatment; Non Sur, nonsurgical treatment; PFA, paraformaldehyde-containing sealer; PM, lower premolar; Res, resin-based sealers; SO, sealer only; Sur, surgical treatment or both nonsurgical and surgical treatment; VC, vertical condensation

*Full recovery is the number (%) of cases that reported on complete resolution of the nerve injury symptoms during follow-up.

were reported in first or second lower molar teeth (72%) followed by second lower premolar teeth (19%), rarely in other posterior mandibular teeth, and never in maxillary teeth. In addition, most of the reported cases in mandibular premolar teeth fully recovered (83%), whereas only 33% of the reported cases in mandibular molars fully recovered. Specific tooth locations were previously reported as possible risk factors for nerve injury after endodontic treatment (8, 74). The anatomic structure of the IAN and its relations to the surrounding anatomic structures may have a significant role in this finding; the trabecular loose pattern of the cancellous bone in the mandibular molar region, often without any cortical bone protecting the pedicle, and the short and variable distance between the root apices and the IAN (1–4 mm), may increase the risk for nerve injury during endodontic treatments of mandibular molar teeth (8, 74). It is important to know in advance the individual relation of the root apices and the surrounding neurovascular bundles in order to prevent nerve injury during the endodontic procedures in this region as well as to know the innervation map of the IAN in order to be able to make an accurate and specific diagnosis of any such damage (8, 75, 76).

In half (50%) of the cases, the sealer-only technique was used followed by lateral condensation in 33% of the cases and vertical condensation (69) in 17% of the cases. Most of the reported cases (67%) with lateral condensation fully recovered compared with none of the cases with vertical condensation and only 11% of the cases in which sealer-only obturation technique was used. Regarding the obturation materials, the majority of reported cases occurred in teeth obturated with paraformaldehyde-containing sealers (39%) or resin-based sealers (29%). Most cases with resin (62%) fully recovered, but only 27% of the paraformaldehyde cases fully recovered. Paraformaldehyde is a polymeric hydrate of formaldehyde, which, when in contact with water, releases formaldehyde gas and may cause permanent damage to the nerve (5). To reduce the risk of neurotoxicity-related nerve injury, it is advised to apply an appropriate treatment technique to reduce the risk of displacing filling material in the vicinity of adjacent nerves and to select an appropriate filling material with the fewest possible neurotoxic effects (5).

The reported clinical presentation of the altered sensation was variable, and in 40% of the cases, a combination of more than 1 type of altered sensation was reported. The classification of nerve injuries during dental treatments is based on the extent of nerve damage, the time course, and the potential sensory recovery after the injury (5, 8, 14, 67). The clinical presentation of altered sensation after dental treatments is variable and complex, and many definition schemes have been proposed to classify it (4, 5, 8, 14, 30, 67, 68, 77–80). In addition, because the pathological process after the initial nerve injury is a dynamic process, the clinical presentation may often change after the initial injury, thus introducing additional challenges to the practitioner for the clinical diagnosis (3–5, 7, 8, 12, 67). Extrusion of filling materials, even into the inferior alveolar canal, will not necessarily result in altered sensation. Pogrel (7) reported on 61 patients with evidence of sealant in the inferior alveolar canal, including 8 patients who had a clear radiographic evidence of sealant within the canal, but these patients were asymptomatic and remained so indefinitely (7).

In only in 8% of the cases, an immediate treatment was performed; in 32% of the cases, a delayed treatment was performed; and in most of the cases (60%), no treatment was performed. This may have had a relation to prognosis; all cases that were immediately treated fully recovered. On the other hand, only 37% of delayed treatment cases and 2% of the cases with no treatment after the injury fully recovered. If a nerve injury is suspected, a timely mannered clinical approach is advised, aimed at determining the sensory disturbance, quantifying the sensory

disturbance, determining treatment needs, and monitoring recovery (7, 8, 13, 14, 42, 43, 67, 80). In addition, the nerve damage may increase over the duration of the injury. Thus, in case a nerve injury is suspected, a timely mannered clinical approach is advised in order to minimize long-term damage (8, 42). It is important to note that endodontic procedures are usually performed under local anesthesia. Thus, the clinical symptoms of related nerve injuries will usually be evident only after the completion of the endodontic procedure when the local anesthesia wears out (8). Early symptoms that may suggest a possible nerve injury are acute pain during or after the procedure or neurosensory alterations such as paresthesia, anesthesia, or hyperesthesia (8, 17). Even in the absence of a definitive nerve injury diagnosis, an early intervention approach to prevent/minimize further damage and symptoms may be considered, including the use of corticosteroids and nonsteroidal anti-inflammatory drugs (5, 7, 8, 14, 71, 81, 82).

In the majority (77%) of the treated cases, a surgical treatment or a combined nonsurgical and a surgical treatment was performed. In only 24% of the cases, a nonsurgical treatment alone was performed. However, the full recovery rate of the reported nonsurgically treated cases was higher than the recovery rate of the reported surgically treated cases (63% and 46%, respectively). There is no guarantee for a full recovery of sensation after a surgical treatments (8, 66), and these procedures bear the risk of secondary damage to the nerve (8, 75, 76).

Modern endodontic surgery includes the use of magnification and illumination devices to enable proper management of the root end in a minimally invasive and highly accurate manner (65, 83, 84). Thus, it is conceivable to assume that for cases with nerve injuries caused by significant filling overextension, modern surgical endodontics would facilitate a more predictable and complication-safe procedure (65, 83, 84) compared with the traditional invasive surgical procedures (7, 14, 66) and may provide an effective and safe alternative to remove extruded root filling materials and infected debris that can cause periapical inflammation (85) and at the same time allow a proper root end management and obturation (84, 86).

In conclusion, to date, the current scientific knowledge regarding the prognosis of nerve injuries caused by overextruded endodontic materials relies primarily on case reports and 1 case series that are considered as a low level of evidence. Therefore, the clinical implications of the current analysis of the literature should be adopted cautiously and reassessed in the future as new data accumulate. Based on the currently available literature, it seems that most cases of altered sensation after extrusion of root canal filling materials fully recover or at least partially recover over time. Specific tooth locations, types of extruded materials, the obturation technique, and the timing and type of treatment after the injury may affect the nerve injury prognosis.

Despite the limitations in the quality of data, the current systematic review is probably the "best available clinical evidence," (24–26) and the following recommendations may be considered: preoperative evaluation of the anatomy in order to know in advance the relation of the root apices to the surrounding neurovascular bundles; using an appropriate obturation technique; selection of a filling material with the fewest possible neurotoxic effects; early diagnosis of the nerve injury; and when diagnosed, an early intervention approach, including the use of corticosteroids and nonsteroidal anti-inflammatory drugs.

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The authors deny any conflicts of interest related to this study.

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