Clin Oral Invest (1998) 2: 73–76

ORIGINAL ARTICLE

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Treatment of injuries to the inferior alveolar nerve after endodontic procedures

Received: 15 October 1997 / Accepted: 10 March 1998

Abstract Overextension of filling material into the mandibular canal after root treatment in the lower jaw is a rare but serious complication. Mechanical compression, chemical neurotoxicity and local infection may cause irreversible nerve damage. A report on 11 patients with neurological complaints of the inferior alveolar nerve after endodontic treatment is summarised. The neurological findings are dominated by hypaesthesia and dysaesthesia. Half of the patients reported pain. Hyperaesthesia is found much more rarely. Nearly all the patients had a combination of one or more symptoms. Initial X-rays showed root filling material in the area of the mandibular canal. Nine cases were treated with apicectomy and decompression of the nerve; in two cases, extraction of the tooth was necessary. Only one patient reported persistent pain after surgery. If neurological complaints appear after root filling in the lower jaw, a nerve injury due to root filling material should be ruled out. In cases of overfilling, immediate apicectomy and decompression of the nerve with conservation of the tooth is often the treatment of choice; the tooth may be preserved and the best chance of avoiding permanent nerve damage is provided.

Key words Inferior alveolar nerve · Complications · Endodontic treatment · Surgical therapy · Apicectomia

Introduction

Injuries of the inferior alveolar nerve following an overextension of a root canal filling are among the most serious endodontic complications. Damage of the nerve due to mechanical compression is influenced by the volume and the application pressure of the filling material and by the resulting inflammatory oedema in the mandibular canal [16, 20, 26]. In addition, chemical toxicity has been described for various root canal filling materials in animal experiments as well as in cell cultures [1–3, 5, 9, 13, 17, 20, 22, 24, 25]. Animal experiments with 14 different filling materials for definitive and temporary application in root canals showed neurotoxic effects in all cases [26]. Periapical lesions with overextended root canal filling cause an imunological response, consisting mainly of T-lymphocytes and macrophages with birefringent antibodies [4]. With the help of light and electron microscopy, demyelinisation could be demonstrated after application of the filling material directly in contact with the nerve. Interaxonal and perineural oedema and finally a destruction of the axon follows. The compression of the nerve followed by the oedema leads to a local necrosis because no expansion inside the mandibular canal is possible. The cicatrical healing causes a functional defect of all qualities of a sensitive nerve [2, 26]. Furthermore, nerve damage may be caused by a local infection after overextension of the root filling material [28]. Some root filling materials are reported to stimulate the growth of certain microorganisms [19].

The first clinical sign after root canal overfilling into the mandibular canal is often sudden pain reported by the patient despite local anaesthesia and which may persist after local anaesthesia [18]. The pain may be accompanied either by local inflammatory signs with percussion pain of the treated tooth, or palpation pain at the vestibule alveolar process, or a combination of mechanical and inflammatory nerve damage with pain in the lower lip or otalgia [10–12, 16, 30]. Some patients describe persistence of the local anaesthesia [23]. Par- and dysaesthesia are reported to be rarer symptoms [11, 16]. In some cases, paroxysmal neuralgia-like pain attacks are described [12]. Rarely, hyperaesthesia can be found in one half of the lower lip [11].

For treatment, neurobion and carbamazepine or vitamin B complex are suggested [7, 21]. However, without surgery, it may take several months, if ever, for recovery. Today, nearly all authors hold the opinion that the complete surgical removal of the overfilled root filling material is

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Table 1 Clinical data of the patients. Grading of the neurologic findings: 0 no complaints, 1 moderate complaints, 2 moderate to severe complaints, periodical, 3 severe complaints, without interruption (*m* male, *f* female)

Age (years)	Sex	Tooth	Time from root treatment to surgical decompression	Preoperative neurological findings				Treatment	Symptom free after operation	Time of follow-up
				Pain	Hyp-aesthesia	Dys-aesthesia	Hyper-aesthesia			
26	m	47	A few hours	0	1	1	0	Apicectomy	2 weeks	4 years
19	m	46	1 day	0	2	2	0	Apicectomy	2 weeks	5 years
33	f	45	1 day	0	2	2	0	Apicectomy	3 months	2 years
50	f	37	2 days	3	1	1	0	Apicectomy	2 weeks	1 year
24	m	47	4 days	3	0	0	0	Apicectomy	3 weeks	5 years
21	f	47	6 days	0	2	0	1	Apicectomy	3 months	5 years
52	f	44	1 week	3	0	2	3	Apicectomy	2 months	3.5 years
34	f	37	1 week	1	3	1	0	Extraction	Persistant dysaesthesia	1.5 years
36	f	46	4 weeks	3	0	0	1	Apicectomy	3 months	5 months
51	f	47	7 months	0	3	1	0	Apicectomy	1 year	5 years
53	f	37	18 months	0	3	1	0	Extraction	6 months	2 years

necessary [10–12, 16, 21, 26]. The primary aim of surgical treatment should be the entire removal of the foreign body and protection of the nerve. To achieve these goals, a very clear exposure of the field of operation is mandatory.

Here, we present 11 cases of injuries to the inferior alveolar nerve after overextension of a root canal filling, all of which were treated by surgical therapy.

Cases

Eleven patients who suffered from neurological complaints following overextension of a root filling in teeth of the lower jaw are listed in Table 1. The preceding endodontic treatment included two premolars, two first molars and seven second molars. The youngest patient was 19 years, the oldest 53 years, with a median of 34 years. Most of the patients were female. The time since root treatment and the onset of symptoms ranged from a few hours to 18 months. Preoperative neurological findings are distinguished between pain, hypaesthesia, dysaesthesia and hyperaesthesia. The intensity of the neurological alteration, as reported by the patients, is documented in grades from 0 to 3 (Table 1). Sensitivity was additionally tested by reduced two-point discrimination (>10 mm) compared with the untreated side.

Ten of the 11 patients suffered from two or more neurological complaints. Nearly half of the patients reported severe pain, only one had moderate pain. Eight out of the 11 patients had symptoms of hypaesthesia and dysaesthesia of moderate grade, mostly in combination. Hyperaesthesia was found only in three cases. In all the cases, the complaints were located in the corresponding side of the lower lip, intra- and extraorally. Hypaesthesia could also be found in the teeth anterior to the nerve injury. This was tested by sensitivity tests of the teeth, but was not graded systematically.

In nine cases, treatment consisted of apicectomy with surgical exposition of the nerve and liberation from contact with the root filling material. Under local anaesthesia, the apices of the tooth responsible were resected from a vestibular access. If necessary, an operation microscope was used to detect the root filling material next to the nerve or between the nerve fibres. Pre-, intra- and postoperative X-rays were used to prove the surgical success of the treatment (Fig. 1). The clinical intraoperative condition at the site of the overfilled root correlated in every case with the findings on the preoperative X-ray films. The shape of the overfilled root filling material in the dental X-ray films

Fig. 1 X-rays of overextended root filling on tooth 46 before and after apectomia and neurolysis

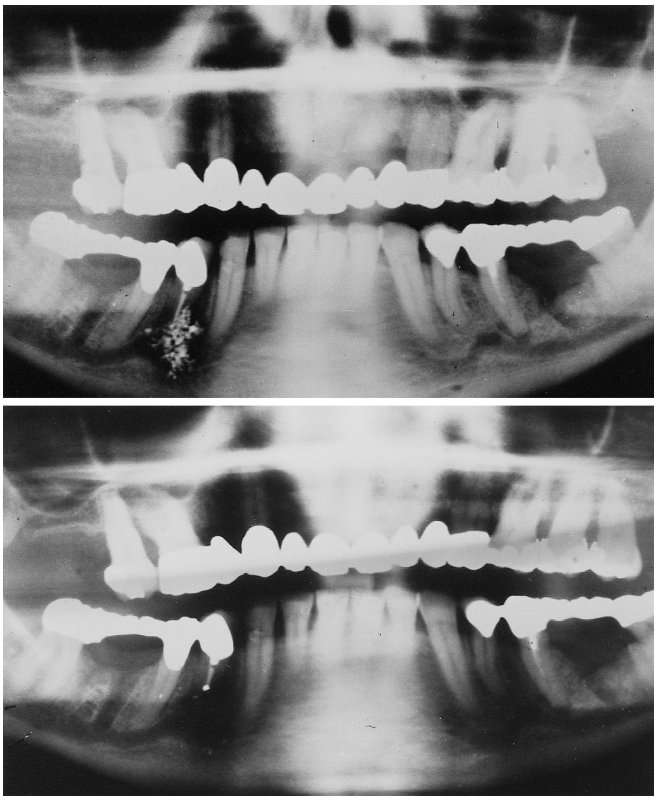

Fig. 2 X-ray of overextended root filling material into a large radicular cyst close to the foramen mentale on tooth 44 before and after apectomia and neurolysis

proved its location inside the mandibular canal, thus no three-dimensional pictures were necessary. In two cases we found larger periradicular osteolysis, which was not diagnosed by dental X-ray film before endodontic treatment. Pre- and postoperative X-rays of overfilling into a large apical cyst at tooth 44 are shown in Fig. 2. In another case, a "via falsa" in the lower part of the root after the overfilling may be suspected from the dental X-ray film. In two cases, root filling material was found inside the perineurium, which had to be opened in the neurosurgical procedure to remove the root filling material. In all other cases, the perineurium remained undamaged. In two cases, alveolar bone-loss due to periodontitis was progressive, so that extraction of the tooth responsible had to be performed.

Observations of the neurological findings were taken after 2 days, after 1 and 2 weeks, after 1, 2, 3, 6 and 12 months and, if possible, annually up to 5 years. A complete recovery of all symptoms was seen after 2 weeks to 3 months after surgery in most cases. Only one patient, who was treated with extraction of the tooth, had persistent dysaesthesia over the complete observation time of 1.5 years. During the observation time in this study, all apicectomies were clinically and radiologically successful. As the root fillings were not performed in our unit, it was not possible to determine exactly which kind of filling material was used.

Discussion

Most authors have found pain and hypaesthesia as the predominant complaints in patients with root canal sealer in contact with the inferior alveolar nerve [10–12, 16, 18, 30]. In our study we also find dysaesthesia as one of the principal symptoms. It should be noted that pain is reported to be more intensive than dysaesthesia or hyperaesthesia. Neurological complaints after overextension of a root filling in the lower jaw may persist for years without surgical treatment. The reasons for overfilling into the mandibular canal may be overinstrumentation or a high application pressure of the root canal sealer. This is avoided by determination of the length of the canal and the working length of the filling by dental X-ray prior to mechanical reaming. Also, a via falsa and large periradicular cyst should have been ruled out by dental X-ray pictures prior to the definitive filling.

There are different estimations of the time of absorption of root canal filling materials in the mandibular canal without surgery: jodoforme paste should be absorbed completely after 2 months with a return to normal sensitivity of the mental nerve [5, 15]. For AH 26, conflicting data are found. Absorption after 12 months is reported by one group [29]; other authors find the root filling material in X-rays at the same position even 15 years later [27]. Animal experiments show that disturbances may be reversible if the root filling material consists of calcium hydroxide, iodoform or silicone oil and is removed soon [14, 15]. Biocompatibility analyses of root canal filling materials in fibroblast cultures show differences in neurotoxicity; N2 and AH26 seem to be very cytotoxic, Apexit seems to be more biocompatible [20]. We suggest those root canal sealers known to contain potentially neurotoxic substances should be avoided.

As nerve injuries are found to be reversible if the toxic material is removed soon and as in most cases the root filling material is unknown, treatment should consist of surgical removal of the root filling material [2, 6, 10–12, 16, 20, 26, 30]. After an endodontic procedure in the lower jaw, the dentist should be aware of neurological symptoms for possible nerve damage that exceed the common discomfort. Dyssensation of the inferior alveolar nerve, presenting as pain, hypaesthesia, dysaesthesia or hyperaesthesia in the lower lip, should be subjected to special attention. If these complaints go together with overfilled sealer in the dental X-ray, further treatment is required to avoid irreversible nerve damage.

In the cases presented, apectomy with surgical decompression of the nerve carried out under X-ray control show high success rates. However, extraction of the tooth may be necessary because of progressive periodontitis or a via falsa, but should be considered as "*ultima ratio*". Some authors also report a sagital split osteotomy of the mandibular bone may achieve a good exposure over the nerve canal [8]. To determine the exact location of the root canal filling material in the mandibular canal before the operation, lateral tomography [10] or computed tomography

may be used [11, 30]. An X-ray before and after the operation, together with a precise documentation of the sensory disturbance before and after the operation, have forensic importance.

Conclusions

If neurological complaints appear after root filling in the lower jaw, a nerve injury due to the root filling material should be ruled out. It should be borne in mind that complaints are not limited to pain and hypaesthesia. In cases of overfilling, immediate apicectomy and surgical decompression of the nerve with conservation of the tooth is often the treatment of choice, probably preserving the tooth and providing the best chance of avoiding permanent nerve damage.

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