Piezosurgical Management of Sealer Extrusion-Associated Mental Nerve Anesthesia: A Case Report

Abstract

The present report describes a case where sealer extrusion (Sealapex) occurred during root canal obturation of a left lower second premolar tooth, and the patient experienced sudden pain and then complete anesthesia of the lower lip. After three weeks of conservative therapy and an unaltered anesthesia period, piezosurgical removal of the extruded sealer and root end resection was performed despite the direct contact with the mental neurovascular bundle. At suture removal, one week after surgery, there was no improvement in sensation. Two weeks after the operation, the patient reported some changes, including a short paresthesia period alternating with anesthesia. At the fourth postoperative week, neurosensory function recovered completely. This case represents successful use of the piezoelectric technique for mental nerve decompression and periapical surgery of a lower second premolar with close contact of the mental nerve.

Keywords: mental nerve, paresthesia, sealer extrusion, piezosurgery

Introduction

The most frequent reasons for sensory loss of inferior alveolar (IAN) and mental (MN) nerves are surgical interventions, such as impacted third molar removals, dysgnathia operations, implantations and apical resections in the molar or premolar area (1). Less frequently, however, sensory loss can occur after inferior alveolar block injections (2) or in connection with endodontic treatments (3). Overfilling or sealer extrusion-related anesthesia and paresthesia may occur when root canals are prepared incorrectly and overextension allows material extrusions into the nerve canal (4).

The harmful mechanisms of the extruded material affecting the nerve is complex. Mechanical compression (4), cyto- and neurotoxicity of the material (4, 5), the generated local infection (6) and the possibility of thermal damage are all factors to consider (4, 7).

Minor extrusions are tolerated well by periapical tissues (8), however, when extrusion penetrates into the inferior alveolar canal (IAC), it may result in reversible or irreversible neurosensory disturbance. Functional changes to the nerve may manifest in different sensory qualities, such as anesthesia, paresthesia, hyperesthesia or dysesthesia (9), causing poorer quality of life (10). Since full recovery of sealer extrusion-related paresthesia/anesthesia cases was found to be between 46 and 63% in a recent review, the decision between conservative or surgical treatment is very complex and difficult (9). Surgical treatment does not guarantee full recovery and may add the chance for secondary injury to the nerve. The previously mentioned systematic review stated clearly that the related and relevant information on prognosis after nerve injuries relies mostly on case reports (9).

The aim of the present report was to describe a case with IAN and MN anesthesia caused by sealer extrusion and to propose removal of nerve-compressing excessive sealer and surgical resection with the help of the ‘soft tissue protective’ piezoelectric preparation technique to reduce the possibility of a secondary nerve injury.

Case presentation

A 74-year-old female patient reported sudden loss of sensation in her left lower lip and chin region during a root canal obturation procedure performed by her dental practitioner.

Immediately after the procedure, she reported this loss of sensation to her dentist. The dentist exposed a control periapical radiograph, prescribed vitamin B complex four times per day and recall observation. After a three-week period without any improvement in neurosensory function, and with clear signs of sealer extrusion, the dentist referred the patient to our oral surgery department (Dept. Oral Maxillofacial Surgery, University of Pécs, Pécs, Hungary) (*Figure 1*).

We performed pin prick and two-point discrimination tests to detect and monitor the size and localization of anesthetic areas on the lower lip, mentum and buccal premolar and front alveolar mucosa regions. The patient had complete sensation loss on the left side of the abovementioned regions. Furthermore, the lower canine and front teeth failed to show any response to the cold vitality test. The subjective impression of the patient was that, "it is a similar feeling as after a very good lower anesthetic injection" (i.e., inferior alveolar nerve block injection).

The dentist was contacted and reported a conventional root canal treatment procedure for the tooth with diagnosis of chronic periapical periodontitis. Without local anesthesia, he prepared the root canal chemomechanically with the step-back technique using hand files and 2.5% sodium-hypochlorite irrigation. The permanent root canal filling was performed employing the lateral condensation technique using gutta-percha and sealer. He applied a non-eugenol calcium hydroxide containing polymeric root canal sealer (Sealapex, Kerr, Bioggio, Switzerland) with a lentulo spiral (Dentsply, Maillefer, Tulsa, USA).

After an exhaustive discussion with the patient about the probability of full neurosensory recovery, she elected to submit for a decompression procedure with periapical surgery. The surgery was performed with infiltrational local anesthesia (4 ml of 2% lidocaine with 0.001 mg adrenalin). A triangular (sulcular and mesially placed vertical releasing incisions) mucoperiosteal flap was raised with careful identification of the mental foramen and MN (*Figure 2a*). The flap was protected by a Williger raspatory, and no flap retractors were used.

Bone removal was initiated superior to the mental foramen (*Figure 2b*) with a diamond sphere piezoelectric tip (SG7D, NSK Europe GmbH, Eschborn, Germany) and VarioSurg Optic handpiece and VarioSurg3 device (NSK Europe GmbH). When the root tip became visible (*Figure 2c*), the apical resection was performed by the saw-like piezoelectric tip (H-SG1, NSK Europe GmbH) (*Figure 2d-e*). The energy level of the unit was set to 80% (SG7D) and 100% (H-SG1), and the irrigation was set to maximum (75 mL/minute). The temperature of the cooling liquid was set to 7°C (11). After removing the root tip (*Figure 2f, 3e*), the walls of the defect were extensively curetted except for the soft apical area, which was curetted with great caution and mild movements (*Figure 3a-b*). The 3 mm deep root-end preparation was completed with the E32D-S retrograde endo tip (NSK Europe GmbH) (*Figure 3c*). For hemostasis, 3% hydrogen peroxide-soaked sterile cotton-wool pellets were used. After disinfection and drying of the retrograde cavity, white MTA retrofilling was performed (MTA+, Cerkamed, Stalowa Wola, Poland) (*Figure 3d*).

After disinfection (povidone-iodine solution) of the operation field and flap re-approximation, single, interrupted, non-resorbable monofilament sutures were placed (4.0 Prolene, Johnson & Johnson Kft., Törökbálint, Hungary). The patient was prescribed non-steroid analgesics (50 mg diclofenac-sodium) and asked to continue taking the vitamin B complex.

Similar to the first and second postoperative days, on the seventh postoperative day, when sutures were removed, the patient reported no changes in sensory innervation. Two weeks later, at the regular post-operative recall, significant changes were observed. The anesthesia changed to paresthesia several times, which was reported as a tingling feeling of the lower lip. At the fourth postoperative week, the patient reported almost entirely normal sensations, which was also supported by our pin prick and two-point discrimination tests. At that time, there was no difference between the left and right sides during testing. Five months later, the patient was clinically symptom-free, and the premolar tooth showed no sensitivity to percussion, while the X-ray control showed significant periapical bone healing (*Figure 4*).

Discussion

The close anatomical proximity of the lower premolar and molar apices to the inferior alveolar canal may have neurosensory consequences. When planning an apical resection, third molar removal, implantation or endodontic treatment in this region, IAN or MN injuries should be considered.

Endodontic-related injuries originate principally from physical, chemical or infection-related factors (3, 12-14). However, nerves in the mandibular canal are surrounded and protected by cortical bone, and this cortex can be perforated by endodontic files or infections originating from premolar or molar apices. Microorganisms or the toxins generated from such an infection can invade the perineurium of the nerves, causing sensory alterations (12, 14).

During endodontic treatment, irrigation solutions, such as sodium hypochlorite or EDTA, can cause chemical irritation when penetrating into the IAC (12). The extruded sealer can further act as a neurotoxic agent, mainly when containing paraformaldehyde, eugenol or calcium-hydroxide (6, 13). A slow and incomplete recovery of nerves was observed after sealer-induced chemical stimuli that contained paraformaldehyde or eugenol (13), and irreversible nerve damage was also shown in a case of calcium-hydroxide containing sealers (15). According to

Rosen et al. (9), 62% of nerve injuries fully recovered when a resin-based sealer was used, in contrast with paraformaldehyde sealers, where full recovery was only 27%.
The other effect of the extruded material was mechanical compression (16). Compression of the vasa nervorum can cause edema and ischemia of the nerve, leading to fibroblast invasion, scarring and fiber degeneration (16). The extent and duration of the compression can also determine the chances of regeneration. Earlier decompression may facilitate recovery. The success rate from immediate treatment was found to be 100%, while late or delayed treatment was successful only in 37% of cases (9). It is important to note that only 2% of cases without treatment recovered fully (9). Additionally, the prognosis for the full recovery of non-surgically induced cases was better than the recovery of surgically treated cases (63% vs 46%, respectively) (9). It is still an important observation that a difference was found in full recovery when paresthesia was observed and induced by premolars (83%) or molars (33%) (9). To decrease the chance of sealer extrusion, lentulo spirals and injection under pressure in the apical third are not recommended (4).
Nonsurgical treatment of this complication usually involves the use of steroids (17), carbamazepine (5), pregabalin (18, 19) and vitamin B complex (12). Surgical treatment aims to decompress the nerve and remove the extruded materials. For decompressing a nerve bundle, bone removal is mandatory, either by removing the buccal cortical plate above the IAN (4, 20) or using a sagittal split technique (16). An alternative treatment is the removal of the tooth, extraoral management of the extruded material and then intentional tooth replantation (21). This option was not considered in the current case because of the intact fixed bridge.
In this case, the mental foramen and the mental nerve branch dictated the method of bone removal since it was performed only with piezosurgical tips. Piezosurgery works with vibrations around ~28-38 kHz, it can prepare only hard tissues, while soft tissues (i.e., nerves, vessels) are able to vibrate together with the tip (11). In contrast, with rotating instruments, piezosurgery is much safer for the IAN (22). This technique allowed bone removal in direct contact with the mental neurovascular bundle, removing only the minimally necessary amount of bone while simultaneously reducing the chance for secondary iatrogenic nerve damage. As our earlier in vitro study proved, application of the piezoelectric tip near the IAN mandates only mild pressure (<400 g) with intermittent movements to limit accumulating heat in the IAC (11). In addition, the cooling of the irrigation liquid to 7°C has significant benefits by reducing maximum intraosseous and intracanal temperatures (11).
When performing lower premolar apico surgeries, certain techniques may improve success rate. An optimal flap design may avoid stretching of the mental nerve (23). A resting groove,

prepared in the bone above the foramen, may help to fix the retractor and avoid involuntary slipping of the retractor toward the bundle (23, 24). However, in the current case, it was not adequate since we had to secure the flap deeper than the mental foramen. Further improvement can be expected with consideration of modern surgical endodontic theory (25). This concept includes retrograde preparation with the piezoelectric method, use of magnification devices (i.e., operating microscope), an apical cut with a slight bevel and application of a reliable retrofilling material. However, the authors could not use an operating microscope in this case, only a loupe (with a magnification of 3.5x), and avoiding the use of drills for the procedure reduced the possibility of secondary iatrogenic nerve damage.

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Figure legends

Figure 1. The region of interest in the preoperative panoramic radiograph shows the extruded sealer in the periapical zone of the second premolar next to the mental foramen.

Figure 2. (a) The mental nerve was carefully isolated during flap retraction. (b) Bone removal was performed superior the nerve bundle with a diamond sphere piezoelectric tip. (c) The apex became visible. (d) The root-end resection was performed with a saw tip. (e) With an adequately deep cut, the apex was mobilized. (f) The apex was removed with a scaler from the cavity.

Figure 3. (a) After removal of the apex, sealer aggregate (black filled arrow) was visible on the top of the nerve branch (empty arrows). (b) The sealer was curetted carefully. (c) Root-end cavity preparation with an endodontic piezo-tip. (d) The white MTA retrofilling. (e) The removed debris, sealer, infected tissue and cut root tip.

Figure 4. While the root-end filling was not perfectly compact (a), the bony defect showed significant improvement 5 months later (b), and the patient was clinically symptomless.

Figure 1.

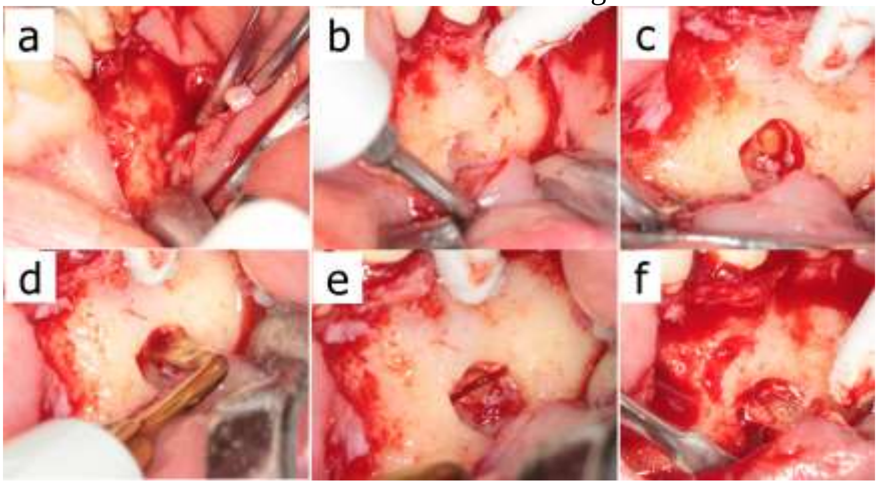

Figure 2.

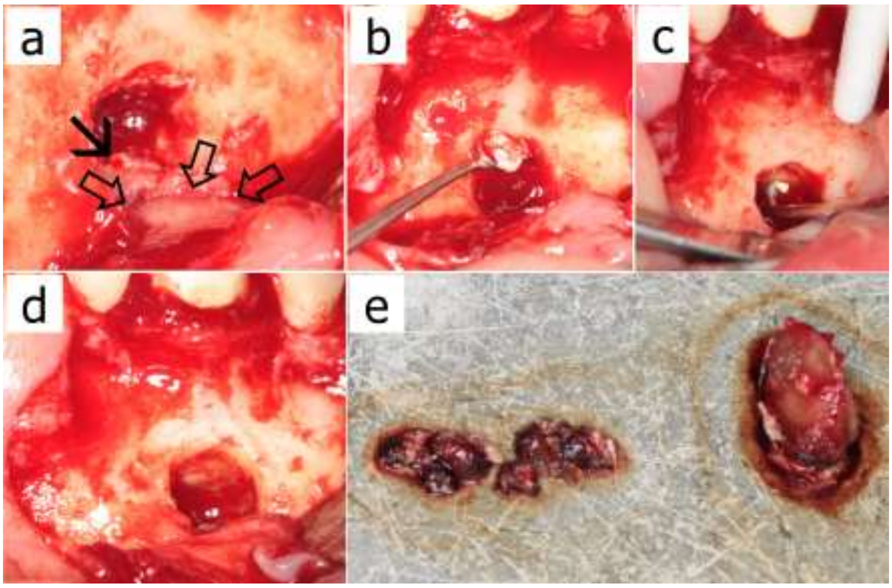

Figure 3.

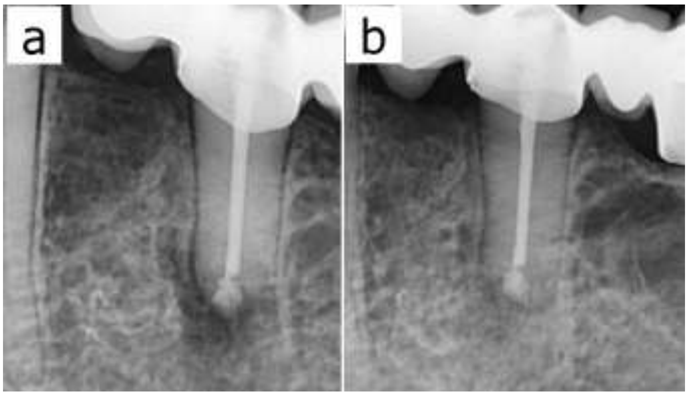

Figure 4.