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A pilot study on the effects of direct contact of two different surgical burs on the cadaveric lingual nerve

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Abstract. The lingual guttering technique for third molar surgery carries the risk of injury to the lingual nerve if the surgical bur comes into direct contact with it. This study investigated the extent of nerve injury caused by two different burs, a tungsten carbide bur and the Dentium implant bur; the latter is designed to be soft tissue friendly. This study also examined whether ultrasound and magnetic resonance imaging are able to detect any injury inflicted. This cadaveric research involved subjecting 12 lingual nerves to the drilling effect of two different burs at two different speeds. The amount of damage caused was measured using different imaging modalities to assess their ability to detect the injury inflicted. At high speed, the Dentium bur caused a deeper and wider laceration than the carbide bur. At low speed, the laceration depths and widths caused by the two burs did not differ significantly. Ultrasound scanning was able to detect the nerve laceration at damaged sites observed using optical coherence tomography. Thus, a carbide bur (at low speed) would be preferable for lingual bone guttering, as it causes less laceration to the lingual nerve. In the event of a suspected injury, ultrasound scanning would provide an objective evaluation of the amount of nerve damage in vivo.

Key words: lingual nerve; surgical bur; injury; ultrasound; optical coherence tomography.

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The lingual nerve provides general sensation to the mucosa of the anterior two-thirds of the tongue, the sublingual mucosa, the floor of the mouth, and the lingual gingiva. It also carries the chorda tympani nerve, which provides special taste sensation. This nerve can have a close relationship to the dentition in the mandibular third molar area, where it lies within 2.28–16.8 mm below the alveolar crest and 0.57–7.10 mm medial to the lingual Plate[1]. A disturbance in sensation in the area of innervation secondary to lingual nerve injury is considered a serious complication following procedures performed around the mandible[2]. Some of the unfortunate consequences of life, such as malignancy and tumour removal, may necessitate the sacrifice of the lingual nerve, resulting in permanent anaesthesia of the lingual tissue and tongue. Otherwise, damage to the lingual nerve can happen as a result of elective and iatrogenic procedures[3–5], such as the adminis-

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tration of local anaesthesia[6], the inadvertent instrumentation of the floor of the mouth, mandibular osteotomies[7,8] and surgical removal of the mandibular third molars[9,10].

Injuries to the inferior alveolar nerve and lingual nerve are serious neurological complications that may occur during the surgical removal of mandibular third molars. A prevalence of between 0.6% and 2.0% of lingual nerve injury has been reported to result from this procedure[11]. Many factors have been deemed to contribute to the incidence of lingual nerve injury. These include anatomical variations of the lingual nerve, the surgical technique adopted, and also the surgeon's skill. The techniques most commonly used for third molar extraction are (1) the removal of bone on the buccal side (termed the buccal approach) using a rotary cutting instrument (bur), and (2) the lingual split-bone technique using an osteotome and mallet[12,13]. The latter technique has been associated with a relatively higher incidence of lingual nerve injury than the former[14–19,20].

Recently, the lingual guttering technique has been advocated for the surgical removal of impacted mandibular third molars[21]. In a clinical trial involving only 20 subjects, Kale et al. concluded that this technique can be used safely in the extraction of mandibular third molars where there is a thick lingual cortical plate. They claimed that this is a relatively safe technique as it avoids fracturing of the lingual cortical plate for tooth removal. However, this technique carries the risk of injury to the lingual nerve when the bur used comes into contact with it. This is apparent in the fact that most reported lingual nerve injuries have been related to encroachment on the lingual aspect of the third molar where the lingual nerve is located[12].

Due to this concern, it was hypothesized by the present authors that the use of a 'soft tissue friendly' bur would cause less serious laceration in the event of the lingual nerve coming into contact with the rotary cutting instrument (bur) during the lingual guttering technique. This study investigated the extent of nerve injury caused by direct contact with two different dental burs, a tungsten carbide bur and the Dentium implant bur. The latter is designed to be soft tissue friendly and has been advocated for internal sinus lift, as it reduces the possibility of perforation of the thin Schneiderian membrane[22]. Furthermore, this study evaluated the validity of ultrasound and magnetic resonance imaging (MRI) for the detection of lingual nerve lacerations should the need arise.

Materials and methods

The necessary ethical approval for the use of human cadavers was obtained from the Institutional Board of Study of the Faculty of Medicine and the Faculty of Dentistry of the University of Malaya. In addition, the use of cadavers for research was performed in accordance with a strict protocol set by the government, which is adhered to by the University of Malaya when bodies are donated for teaching/research purposes.

Six human cadavers (all elderly males) stored in 10% formalin were obtained from the Department of Anatomy, Faculty of Medicine of the University of Malaya. The mandibles were checked to determine that they were free of lesions and had not undergone any surgery or reconstructive procedure in the area of investigation. Twelve lingual nerves measuring 2.54 cm in length were harvested for the purpose of this study.

These 12 lingual nerves had previously been dissected in an experiment that measured their morphometric course between the pterygomandibular space and the insertion into the tongue[1]. Following the first study, the nerves were carefully removed and examined for the presence of any iatrogenic laceration before being tagged for the current study. All of the nerves were found to be intact and fit for this study.

During the experiment, each nerve was fixed between two flexible transparent strips, with one having four window openings (front side strip). These windows provided drilling access to the mounted nerve. The strips covering the nerve were fixed to a special mobile holder that formed part of a module fabricated to hold a constant force device (Fig. 1). The device was secured firmly to a mobile plastic plate, which had two openings, one for the constant force device and the other to hold the dental hand-piece. This set-up ensured that constant movement of the hand-piece was achieved during all steps of the study procedure (Fig. 2). The remaining anterior and posterior segments of the nerves were secured and tagged with a suture to the floor of the mouth.

Two types of dental surgical bur were used in this study: a 3.3-mm diameter

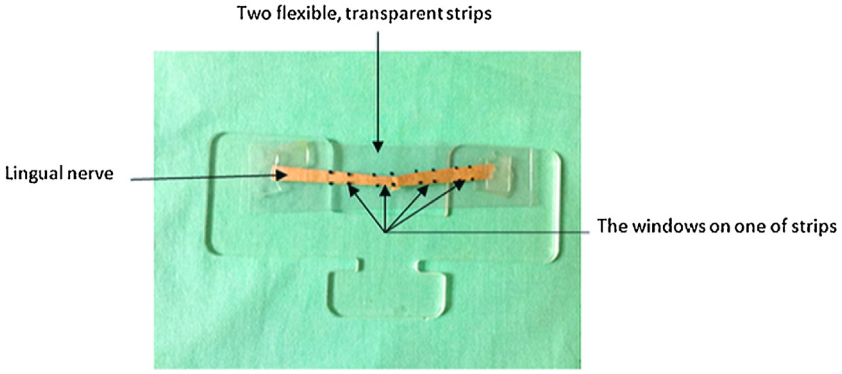

Fig. 1. The lingual nerve is fixed on a holder using flexible strips.

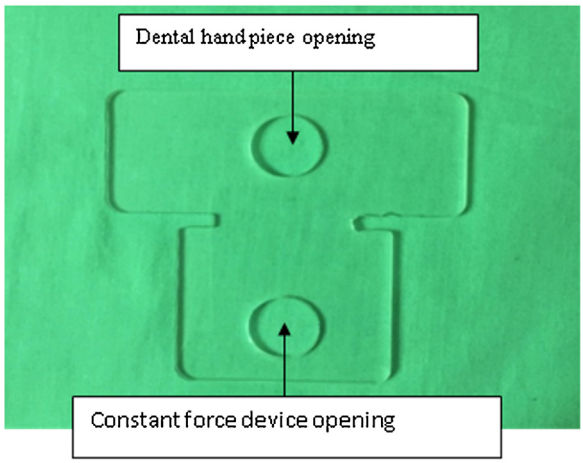

Fig. 2. The mobile plastic plate with two openings.

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