

IN BRIEF

- Lingual nerve damage is a common complication during oral and maxillofacial surgery procedures in the third molar region.
- The anatomy of the lingual nerve is variable; therefore precise anatomical knowledge of this nerve is important for decreasing the damage risk.
- The data presented in this paper should be a useful reference for surgical procedures undertaken by maxillofacial surgeons.

The relationship of the lingual nerve to the third molar region using radiographic imaging

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Objective Lingual nerve damage is a common complication during oral and maxillofacial surgery procedures to the third molar region. The anatomy of the lingual nerve is variable, therefore the precise knowledge of anatomy of this nerve is important for decreasing the damage risk. The purpose of this study was to determine the position and the shape of the lingual nerve in the third molar region using radiographic imaging. **Setting** The Anatomy Department of Cologne University in Germany. **Materials and Methods** Firstly, an anatomic dissection of the lingual nerve in the third molar region was done on 10 whole heads and one sagittal hemisection head specimen of adult cadavers. After marking the nerve, x-ray films were taken. Vertical and horizontal measurements were made from the radiographs with an electronic digital caliper. **Results** The mean vertical and horizontal distances of the nerve to the lingual crista and lingual plate of the mandible were found to be 9.5 ± 5.2 mm and 4.1 ± 1.9 mm respectively. Additionally, of the 21 lingual nerves examined, 17 (81%) were round and 4 (19%) were flat. **Conclusions** The results reflect the relationship of the nerve to this area and may help the clinician to avoid the damage risk.

INTRODUCTION

The proximity of the lingual nerve to the mandibular third molar region has an importance in clinical procedures. Lingual nerve damage may occur during oral and maxillofacial surgical procedures including third molar surgery, orthognathic surgery, salivary gland surgery, alveolar crest graft, excision of

a neoplastic lesion and injection of local anaesthesia. The reported incidence of lingual nerve damage during mandibular region surgery varies between 0.6% and 2.0% in the literature.¹⁻¹⁸ This injury results in some problems such as anaesthesia, hypoaesthesia or paraesthesia of the anterior two-thirds of the tongue and taste can also be affected. However, the damage is permanent in some cases.^{1,3,8,14,19-21} Previous studies have consisted of cadaveric dissections and clinical observations.^{2,6,7,11,22} Furthermore, in radiographic methods, the nerve could be seen in multiple planes. Additionally, it was confirmed that the distance between the lingual nerve and alveolar crest is variable.^{1,4,6-9,19,23} Therefore, precise knowledge of the location of the lingual nerve in the third molar region is necessary for planning and performing surgery in this area.

The purpose of this study was to present quantitative data describing the position and shape of the lingual nerve for determining the anatomical relationship of the nerve to the third molar region using radiographic imaging to view the nerve in different planes.

MATERIALS AND METHODS

Ten whole heads and one sagittal head hemisection specimens from adult cadavers (six females, five males, aged 52-98 years) were studied. The 10 whole heads were sectioned sagittally at the medical gross anatomy laboratory of the Institute of Anatomy, University of Cologne. The lingual nerve on each side was dissected by a 4 cm to 5 cm incision made over the lingual plate of the mandible. The nerve was identified at the point where it leaves the mandible to the mouth cavity that the nerve is in

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Table 1 Horizontal and vertical distances of the lingual nerve to the lingual plate and lingual crest of the mandible and the lingual nerve diameter (n = 21)

| Measurement | Mean \pm Standard Deviation (mm) | Minimum (mm) | Maximum (mm) |
|-------------|------------------------------------|--------------|--------------|
| Horizontal | 4.19 \pm 1.99 | 1.81 | 8.67 |
| Vertical | 9.56 \pm 5.28 | 1.13 | 17.04 |
| Diameter | 2.56 \pm 0.59 | 1.04 | 3.38 |

close proximity to the bone of mandible with blunt dissection. But it was not dissected free in order to prevent changing the anatomic relationship to the adjacent structures. After the demonstration of the nerve, an approximately 3 mm metal wire was placed on the nerve for determining the nerve at radiographic imaging (Fig. 1). The application of the wire was made with great attention and it was not the cause of the nerve distortion. At the same time, the diameter and the shape of the nerve were recorded. Then, the radiographs were taken from both superior and lateral planes of all the specimens with a standard parameter (Faxitron 2-12s 65 kV, Hewlett-Packard, USA/film: Agfa Structurix). In positioning the specimens directly on the film, distortion is negligible. While the specimens were performed for radiography, a scale was used for determining the real dimensions. Moreover, during the taking of the radiographs, tube-to-object distance was small enough to eliminate the magnification errors. There was no need for using a positioning jig. From these radiographs, vertical and horizontal measurements were performed by using an electronic digital caliper. At the lateral plane, the vertical distance of the lingual nerve to the lingual crest of the mandible was measured (Fig. 2). And at the superior plane, the horizontal distance of the nerve to the lingual plate of the mandible was measured (Fig. 3).

The program SPSS 10.0 was used in the statistical evaluation of the measurement results. From these measurements means, standard deviations, minimum and maximum values were calculated.

RESULTS

The mean horizontal and vertical distances of the lingual nerve to the lingual plate and lingual crest are shown in Table 1.

From the 21 radiographs, the horizontal and vertical distances of the lingual nerve to the lingual plate and lingual crest of the mandible were measured (Figs 2-3). The mean horizontal distance of the lingual nerve to the lingual plate was 4.19 mm with a standard deviation of 1.99 mm. The distances ranged from 1.81 mm to 8.67 mm. The mean vertical distance of the nerve to the lingual crest was found to be 9.56 mm with a mean deviation of 5.28 mm. The measurements ranged from 1.13 mm to 17.04 mm. Of the 21 lingual nerves identified, 17 (81%) were round and 4 (19%) were flat. Moreover, the mean nerve diameter was 2.56 mm (range: 1.04 mm to 3.6 mm; standard deviation: 0.59 mm). Additionally, in the third molar region, there was only one case out of 21 (4.7%) in which the nerve was found to be superior to the lingual crest. There was no correlation between the right and left lingual nerve measurements. The results were analysed in the whole group without taking into account gender.

DISCUSSION

The lingual nerve is a terminal branch of the posterior division of the mandibular nerve and an important anatomical structure in the infratemporal fossa. This nerve lies anterior to the inferior alveolar nerve. Moreover, it is sensory to the anterior two-thirds of the tongue, the floor of the mouth and lingual gingiva. It enters the mouth between the medial pterygoid muscle and the ramus of mandible and then passes anteriorly under cover of the oral mucosa, just inferior to the third molar tooth.²⁴ Therefore, lingual nerve damage is possible during a variety of oral and maxillofacial surgical procedures like third molar extractions, orthognathic surgery, ramus osteotomies and excision of neoplastic lesions. A 0.6% to 2.0% incidence of lingual nerve

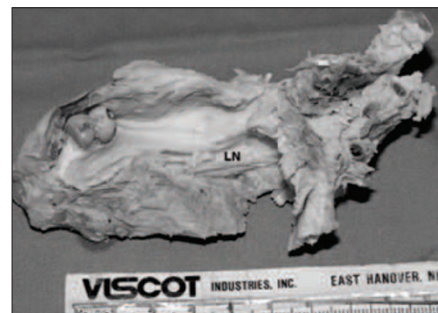


Fig. 1 The specimen prepared for the radiography, a metal wire placed on the lingual nerve. LN = Lingual Nerve

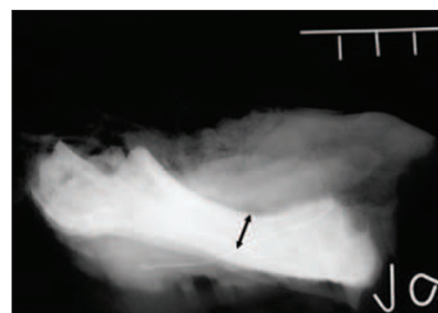


Fig. 2 The vertical distance (arrow) of the lingual nerve to the lingual crest of the mandible from the lateral radiograph of the specimen



Fig. 3 The horizontal distance (arrow) of the lingual nerve to the lingual plate of the mandible from the superior radiograph of the specimen

damage has been reported following third molar extraction.¹⁻¹⁸ Lingual nerve damage can result in anaesthesia, paraesthesia, dysaesthesia or hypoaesthesia. Furthermore, depending on the type and severity of nerve disturbance, this damage can cause drooling, tongue biting, a burning sensation of the tongue, pain and a change in speech pattern.^{14,19-21}

In a study¹⁵ that observed the frequency of trigeminal nerve injuries following third molar removal by 535 oral and maxillofacial surgeons (OMFS), representing 86% of all OMFS in California, it was estimated that nearly all (94.5%) of the surgeons reported some cases of inferior alveolar nerve injury and 53% of surgeons reported cases of lingual nerve injury.

The anatomic localisation of the lingual nerve is variable and this is an important factor in the aetiology of the nerve damage.^{1,4,6-9,19,23} Some attempts to determine the anatomic relationships of the lingual nerve consisted of cadaveric dissections and clinical observations in the third molar region.^{2,6,7,11,22} Moreover, the radiographs would have provided useful information for the localisation of the nerve in this area. The variability of the localisation emphasises the problem of safe surgery in this area. In the present study, the mean horizontal distance of the lingual nerve to the lingual plate of the mandible was 4.19 mm with a standard deviation of 1.99 mm. It contrasts with 0.58 mm \pm 0.90 mm reported by Kiesselbach and Chamberlain.⁷ Pogrel *et al.*¹¹ found the same distance to be 3.45 mm \pm 1.48 mm whereas using magnetic resonance imaging,⁹ this horizontal measurement was estimated to be 2.53 mm \pm 0.67 mm. The horizontal distance was greater in this study than in previous studies. It is possible that most of the cadavers in the present study were edentulous and the mylohyoid muscle could be more superiorly. So, the nerve would be lying on the muscle. Moreover, the greater values may also be due to the thickness of the muscle.

When the vertical relationship of the nerve is considered in relationship to the lingual crest of the mandible in the third molar region, in most of our cases, the nerve lies inferior to the crest of the mandible and is protected by the crest. In one case, however, the nerve was superior to the lingual crest. The mean vertical distance of the lingual nerve to the lingual crest of the mandible was found to be 8.32 mm \pm 4.05 mm in adult Caucasian cadavers¹¹ whereas this measurement was reported as 2.75 mm \pm 0.97 mm in young, healthy people with using magnetic resonance.⁹ However, it was 15.5 mm in Korean adult cadavers.²² In

the present study, this vertical distance was 9.56 mm \pm 5.28 mm in adult cadavers in Cologne. Our results are more similar to adult Caucasians than Koreans' values.

The mean nerve diameter was reported to be from 1.58 mm to over 4.5 mm in several studies.^{6-9,11} In our study, the mean diameter was 2.56 mm. Additionally, the nerves were round in 81% of the cases and flat in 19%. The shape of the nerve did not have a correlation with the distance from the mandible.

Due to analysing similar studies in the literature with this study, there are similarities between the mean values of vertical distance of the lingual nerve to the lingual crest of the mandible and the data of Pogrel *et al.*¹¹ But some differences are found comparing Koreans²² and our results. There are also some differences in the mean values of horizontal distance of the nerve to the lingual plate of the mandible with this study and the data of other studies. We consider that these discrepancies could be a result of such factors as race, genetic variables, individual constitution and also measurement method. Moreover, there is often a loss of muscle tone and connective tissue tension with age.

In conclusion, we think that the anatomic close relationship of the lingual nerve to the third molar region plays an important role in planning and performing surgical procedures in this area. Furthermore, the variable position of the nerve in this area is also a risk factor for the lingual nerve damage. Therefore, this study demonstrates the mean values of the horizontal and vertical distances of the lingual nerve to the lingual plate and crest in the third molar region. As a result, we believe that the data presented in this paper have developed useful references for surgical procedures. Precise knowledge about the localisation of the lingual nerve in the third molar region may help the maxillofacial surgeon decrease nerve damage.

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