YBJOM-5339; No. of Pages 6
ARTICLE IN PRESS

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ScienceDirect

British Journal of Oral and Maxillofacial Surgery xxx (2017) xxx–xxx

BRITISH Journal of Oral and Maxillofacial Surgery
www.bjoms.com

Assessment of the anterior loop of the inferior alveolar nerve using reformatted computed tomography: a retrospective study

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Accepted 12 January 2018

Abstract

The anterior loop of the inferior alveolar nerve (IAN) is an important landmark in the anterior mandible that must be considered during the placement of dental implants. We measured the length and prevalence of loops of the IAN in 188 consecutive, dentate patients using reformatted computed tomography (CT). A total of 158/188 (84%) had at least one anterior loop; 111/188 (59%) had bilateral loops. The mean (SD) length of the loops in the third quadrant was 1.4 (0.7) mm; 95% CI 1.3 to 1.6; (range 0.3 – 4.0 mm). The mean (SD) length of the loops in the fourth quadrant was 1.5 (0.9) mm; 95% CI 1.4 to 1.6; range 0.3 – 5.5 mm. In total 42/188 (22%) had loops that were longer than 2 mm in quadrants three and four. CT images that have been reformatted with specialised software may be useful to identify loops in the IAN, particularly when recent cone-beam CT images are not freely available. The prevalence of these loops is high while their length varies, which makes meticulous assessment necessary before the placement of implants.

Keywords: Anterior loop; Mandibular nerve; Multi-slice computed tomography; Dental implant surgery

Introduction

The placement of endosseous dental implants to replace lost teeth is effective, (more than 95% are successful),[1] and dental implantion has become the gold standard of care for tooth loss in the anterior mandible (interforaminal area)[2] being generally regarded as safe.[3] However, there are anatomical risks in the anterior mandible that should be considered, such as possible damage to the anterior loop of the inferior alveolar nerve (IAN) just before it emerges through the mental foramen.[4]

The terminal portion of the IAN may pass in front of the anterior rim of the mental foramen before it curves back to exit the foramen as the mental nerve, and the portion of the IAN anterior to the mental foramen is termed the anterior loop of the IAN.[5] In the treatment of an edentulous mandible, a viable option is a full arch implant-supported restoration that involves four to five implants in the interforaminal area. The implant closest to the mental foramen is the key factor for increasing the anterior-posterior spread and reducing distal cantilever.[6] During preparation of this most distal site, the drill may come into contact with the anterior loop of the IAN and result in iatrogenic damage, which may present as anaesthesia, paraesthesia, dysaesthesia, or even overt pain in the area innervated by the mental nerve.[4] The nerve supplies sensation to the labiomental area and the gingiva from

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https://doi.org/10.1016/j.bjoms.2018.01.007
0266-4356/

Please cite this article in press as: Todorovic VS, et al. Assessment of the anterior loop of the inferior alveolar nerve using reformatted computed tomography: a retrospective study. *Br J Oral Maxillofac Surg* (2017), https://doi.org/10.1016/j.bjoms.2018.01.007

the midline up to the mandibular second premolar.[7] Altered sensation in this region may impede the ability to complete routine activities such as eating, speaking, kissing, shaving, applying make-up, and even brushing the teeth.[4] Adequate preoperative planning and a sound knowledge of the anatomy of this area is vital to avoid such devastating consequences.[8]

Reported data on the prevalence of the anterior loop and its length varies among different studies.[3,5,7,9,10] Methods to investigate it have consisted of panoramic radiography, dissection of cadavers, computed tomography (CT) and cone-beam CT. To avoid iatrogenic injury to the mental nerve, clinicians have advocated safety margins of 1–6 mm from the mental foramen.[5,11–14] Previous studies with different methods of assessing the anterior loop have shown that there is still no consensus regarding its dimensions.[3,10,11,15–17] The intention of this study, therefore, was to use the accuracy of multislice CT reformatted with specialised software, to improve the accuracy of assessing this important anatomical landmark. If reformatted CT could render similar results as cone-beam CT it could validate cone-beam CT in this setting.

The objectives of this study were to measure the prevalence and dimensions of the anterior loops of the IAN in a sample of South Africans by means of reformatted multislice CT and to make recommendations about dental implant surgery that involves the anterior mandible.

Material and methods

The protocol was approved (Ethics Reference No. 341/2013) by the Ethics Committee of the Faculty of Health Sciences, University of Pretoria. The sample consisted of 200 consecutive patients who had been sent for multislice CT examination for different reasons between 2008 and 2010 (before cone-beam CT became freely available in South Africa).

For a scan to be considered, the mandible had to be included in the volume with all teeth present up to the second premolar in the arch. Exclusion criteria included cases with radiographic signs of disease, injury, or operations on the mandible, a history of systemic disease, and absent teeth in the premolar area.

All CT scans were completed by the same radiologist using the same 64-slice machine (Brilliance CT, Philips). The protocol was identical for all patients, with the CT set to take slices 1 mm thickness with 0.5 mm overlap. The kV was standardised at 120, collimation 64 × 0.624, pitch 0.579, rotation time 0.5 s, filter set on “detail” and window set to C:200 and W:2000. The usual radiation dosage/scan was between 300 and 400 microSV.

Scans were reformatted by preparing industry-standard DICOM datasets on the scanner and importing it into Simplant Master Software (Dentsply Sirona). Surface rendering with realistic shading was applied to generate 3-dimensional views of the mandibular structures. In all cases we used bone reconstruction algorithms with slices 0.5 mm thick and increments of 0.5 mm or less, and all datasets were prepared by a reformatting centre. Although measurements on the 3-dimensional image are possible, all measurements were done using 2-dimensional images, as 3-dimensional ones are influenced by various software settings, such as triangle reduction and smoothing factors.

All measurements were initially made by one observer, the senior resident at the Department of Periodontics and Oral Medicine. To ensure reproducibility, an independent examiner (the first author) re-examined 20 randomly selected scans, without having access to any of the previous markings or measurements.

Measurements

Using the software the Alpha-plane was placed to align with the most anterior aspect of the mental foramen. This was first identified using the 3-dimensional window in full-screen mode for increased accuracy. Once the plane had been drawn, it was verified on the axial view for correctness (Fig. 1a).

The Beta-plane was drawn parallel to the Alpha-plane and touched the most anterior aspect of the loop of the IAN. To verify where the most anterior aspect of the anterior loop was, all the available views were scrolled through using the reconstructions. Once satisfied that it had been identified, we confirmed the Beta-plane. The distance between the Alpha- and Beta-planes constituted the length of the loop (Fig. 1b). If it was anterior to the Alpha-plane, the patient was considered to have no loop.

Statistical analysis

The statistical analysis was made with the help of IBM SPSS for Windows (version 24.0, IBM Corp, Armonk, NY, USA).

Interexaminer agreement

The level of interobserver agreement was calculated with the interclass correlation (ICC) test, using a two-way random absolute agreement model.

Prevalence of the IAN loop

The prevalence of loops was calculated/patient for the total sample, as well as for men and women, using the following criteria: the loop of the IAN had to present in either quadrant three (Q3) or quadrant four (Q4) of the mouth; it had to present bilaterally (in both Q3 and Q4) or; it had to present unilaterally in Q3 and Q4, respectively. The chi square test was used to examine the difference in the prevalence of the loops between men and women.

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