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High resolution computed tomography of the inferior alveolar and lingual nerves

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Abstract. Coronal and axial high resolution computed tomography of the mandible extends facilities in dentoalveolar surgery. Preoperatively the relationship between the mandibular canal and the roots of deeply displaced third molars can be determined precisely. After surgical removal of lower wisdom teeth iatrogenic defects of the lingual cortical bone can be detected. The additional information obtained when compared with conventional radiographs is demonstrated in case descriptions. Indications for this technique, radiation exposure and implications for surgery are discussed.

Key words: High resolution computed tomography – Surgical removal of the lower third molar – Iatrogenic lesions of the lingual nerve

Surgical removal of deeply displaced lower third molars carries the danger of damaging the inferior alveolar nerve, since there is a close relationship between the mandibular canal and the apices. Tetsch and Wagner [1] found that hypoaesthesiae and paraesthesiae occurred in 1.5 % of patients aged 12–14 years. In older patients this proportion rose to 12 %. The most frequent cause is partial or complete severance of the nerve during blind use of rotating or other instruments. However, there are other causes, including an inter- or intraradicular path of the nerve, angled roots and compression of the nerve by fragments of the roots or the roof of the mandibular canal if the extraction is done with a lever without sufficient care. Riediger et al. [2] examined patients after 142 microsurgical revisions of the inferior alveolar or lingual nerves. Only 79 % of the patients reported definite improvement, while in 21 % slight improvement or no change occurred.

Taking an orthopantomogram (OPT) and/or an intraoral dental film preoperatively is usually sufficient to avoid severing the inferior alveolar nerve. If the roots of deeply displaced wisdom teeth are projected over the mandibular canal on the orthopantomogram or dental film, we also use high resolution computed tomography (HRCT).

Tactile and taste deficits of the lingual nerve after surgical removal of lower third molars are usually due to partial or complete severance of the nerve, as a result of faulty positioning of the retromolar mucosal incision and/or penetration of the lingual cortical bone with rotating instruments. Such bone defects can be detected by HRCT.

Methods

CT was carried out in the coronal plane with the head hanging. With this technique the course of the mandibular canal with respect to the roots can be visualised precisely, particularly around the impacted tooth. Imaging of iatrogenic defects of the lingual cortical bone is also possible.

The examination plane must be perpendicular to the body of the mandible, this can be achieved by angulation of the gantry and/or positioning the patient. If hanging the head is not possible because of vertigo or nausea coronal scanning cannot be carried out. The axial plane parallel to the body of the mandible then has to be chosen, as when metal artefacts caused by crowns, bridges or other implants impair assessment of coronal images. For coronal or axial imaging a lateral scout view is obtained, which enables correct choice of the imaging plane (Fig. 1, 2).

The thickness of the contiguous sections is 2 mm. Factors are 120 kV, 160 mA and time of scanning 3 s. Reconstruction was done with a special high-resolution algorithm to visualise the trabeculae. For imaging a window 3000 Hounsfield units, level 400 units proved optimal. Imaging of a lower third molar necessitates 5–10 scans, whereas a defect of the lingual cortical bone can generally be detected with 3–8 scans.

Case reports

Four case reports demonstrate the information yielded by HRCT of the lower third molar, and the consequences for surgery. The fifth case shows iatrogenic perforation of the lingual cortical bone.

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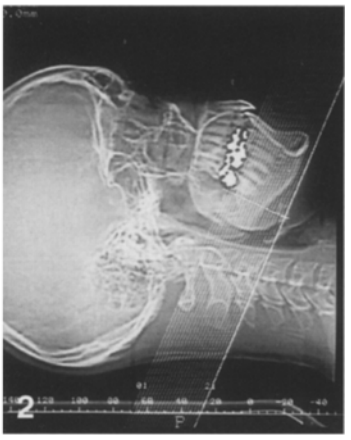

Fig. 1. Lateral scout view for planning the coronal imaging plane

Fig. 2. Lateral scout view for planning the axial imaging plane

Fig. 3a,b. Case 1. **a** Orthopantomograph (OPT), showing the mandibular canal obscured by the roots of the third molar. The course of the nerve between the root and the overlying cortex is shown on coronal CT (**b**)

Fig. 4a–f. Case 2. **a** The mandibular canal is again superimposed on the roots of the third molar. A series of coronal sections (**b–f**) clearly shows the relationship of the roots to the canal

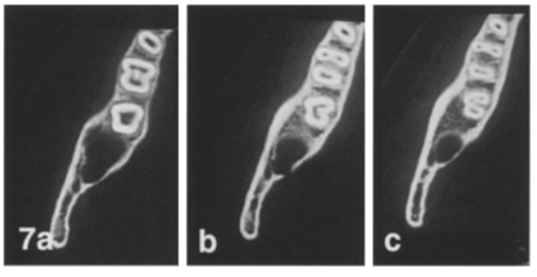

Fig. 5a–e. Case 3. **a** The OPT shows not only superimposition of the inferior dental canal and the third molar, but the close relationship of the mesial root of the lower 8 and the distal root of the lower 7. However, coronal and axial CT (**b–e**) shows that the canal runs medial to the lower 8 and caudal to the roots of the lower 7. The relative positions of the roots are also clarified

Fig. 6a,b. Case 4. On the OPT **a** the relationship of the inferior dental canal and the roots of the third molar is not clear, but coronal CT (**b**) shows a root hooking around its cranial and lateral aspects; the compact bone around the nerve is clearly visible

Fig. 7a–c. Case 5. Axial CT following extraction of all four wisdom teeth. A 2 mm defect is seen in the cortex on the lingual side of the mandible

Case 1

In this 42-year-old woman the inferior dental canal was projected over the coronal third of the roots of the third molar on the OPT (Fig. 3a). Coronal CT (Fig. 3b) demonstrated the course of the canal between the root and lingual cortical bone, thinned by the nerve. A buccal osteotomy was possible without risk, but to avoid squeezing the inferior alveolar nerve when extracting the tooth, the roots should not be removed before cutting off the crown.

Case 2

In a 31-year-old man the OPT (Fig. 4a) projected the mandibular canal over the coronal third of the roots of the displaced third molar. Coronal CT of the canal (Fig. 4b–f) showed the apices to be situated laterally and the roots cranially to the nerve. Buccal osteotomy and luxation of the roots after cutting off the crown were thus possible without any risk.

Case 3

In this 41-year-old woman's OPT (Fig. 5a) the apices of the third molar were projected over the mandibular canal. In addition, the mesial root of the lower 8 and the distal root of the lower 7 abut each other. Coronal and axial CT reveal the exact anatomy: the mandibular canal runs medial to the apices of the lower 8 and directly caudal to those of the lower 7 (Fig. 5b–e). The mesial root of the lower 8 is lateral to the distal root of the lower 7 (Fig. 5e). Surgical removal would have the same constraints as in case 1.

Case 4

In this 39-year-old man's OPT (Fig. 6a) the apices of the third molar overlie the inferior dental canal. Coronal CT (Fig. 6b) reveals a hooked root grasping the inferior dental nerve from the cranial and lateral aspects. Caudally and lingually the compact lamella limiting the nerve is clearly recognisable. To avoid damaging the nerve the roots have to be removed separately after the crown has been cut off, and the hooked root has to be rotated around the nerve.

Case 5

This 26-year-old woman lost touch and taste sensation after surgical removal of wisdom teeth, due to damage to the lingual nerve. On the axial CT a 2 mm defect in the lingual cortical bone is seen adjacent to the lower third molar, while 2 mm cranial and caudal the compact bone is intact.

Discussion

Damage to the inferior dental nerve is one of the most frequent complications of removal of displaced lower third molars. Nerve lesions can more easily be avoided if their topography is known. As compared to conventional radiographs HRCT offers:

- precise localisation of the mandibular canal in orovestibular and craniocaudal directions;
- detection of a inter- or intraradicular path of the nerve;
- precise determination of the distance between the inferior alveolar nerve and the third molar, and
- detection of orovestibular angulation of roots.

We believe HRCT is indicated if on an OPT or dental film the caudal border of the inferior dental canal lies cranial to one or more apices. If one adopts this criterion the question arises as to how often HRCT has to be performed in connection with surgical removal of lower third molars. A review of 200 OPTs taken by an oral and maxillofacial surgeon in private practice before this operation revealed that 15 patients (7.5 %) or 17 of 352 wisdom teeth (4.8 %) fell into this group. In ordinary dental practice this percentage is lower, as patients in whom removal of wisdom teeth is problematic are predominantly referred to oral and maxillofacial surgeons.

Knowing the topography, the surgeon can take preventive measures to avoid damage to the inferior alveolar nerve. If the nerve runs far cranial the crown of the tooth should be cut off and the roots severed, if necessary several times. The fragments are removed singly to avoid squeezing the nerve. The same procedure is followed if hooked roots grasp the nerve caudally; the root fragments can thus be rotated around the nerve. Axial extraction of the tooth in toto could result in partial or complete severance of the nerve. If the nerve has an inter- or intraradicular path the tooth has to be reduced up to the nerve by rotating instruments; the part of the root lying caudally then can be removed. This situation cannot be appreciated on conventional radiographs. Finally, severing of the nerve in extended osteotomies can be avoided if its path is known.

Experienced surgeons will be able to avoid nerve lesions in the situations mentioned even if CT is unavailable. In our opinion, however, surgery can be more purposeful, faster and with fewer complications if HRCT has been carried out preoperatively.

HRCT for detecting iatrogenic defects of the lingual cortical bone is indicated in only a few cases. If anaesthesia and loss of taste subserved by the lingual nerve occur after surgical removal of lower wisdom teeth, microsurgical revision has to be carried out as quickly as possible. If only partial touch or taste deficits are present, CT can help differentiate possible causes, if the surgeon is not sure of having penetrated the lingual cortical bone with rotating instruments. If this suspicion is confirmed, a mechanical lesion of the nerve must be assumed, and revision of the nerve should be carried out.

The lens of the eye is the critical organ of the skull because of its radiosensitivity. Merriam and Focht [3] indicated a minimal cataractogenic dose of 200 R when delivered in a single treatment. In our HRCT technique it can be assumed that the lens is not in the path of the rays. The dose to the lens amounts to 2–3 mGy depending on the distance of the imaging plane from the lens. These values are based on the data of Köster and Ewen [4] from HRCT of the petrous bone. The dose increases by a factor of 5–10, to about 10–20 mGy, if the lens is directly in the path of the rays. This latter dose corresponds to that of a one single conventional anteroposterior tomogram [5]. The lateral scout view delivers 0.15–0.62 mGy (mean: 0.39 Gy) to the lens [4]. Thus, the dose from our HRCT technique is about 1/400 th of the minimal cataractogenic dose to the lens if a lateral scout view, coronal and axial sections are obtained.

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