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REVIEW

Preoperative imaging procedures for lower wisdom teeth removal

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Abstract The aims of this paper were to critically review the role of radiographic imaging before lower third molar removal and to suggest a strategy for preoperative imaging based on available scientific evidence and clinical experience. Original articles and reviews including the MESH terms "third molar" and "radiography" were selected from the Medline database. Other sources were taken from references of selected papers. It was found that the scientific evidence on the usefulness of different preoperative imaging techniques of wisdom teeth is low. Therefore, information gathered from the literature was combined with the authors' clinical experience to suggest a strategy for preoperative imaging of lower third molars. Currently available radiological techniques used for preoperative imaging of lower third molars are also presented. It is suggested that panoramic and/or intraoral radiographs are sufficient as preoperative imaging in the vast majority of cases where there is no overlap between the mandibular canal and the wisdom tooth. Supplement with a posteroanterior open mouth projection will solve most of the remaining cases. In a restricted number of cases where there is an intimate relationship between the mandibular canal and the wisdom tooth, volume tomography such as cone beam computed tomography or low-dose computed tomography is indicated.

Keywords Third molar · Radiography · Nervous system trauma · Neurologic manifestations · X-ray computed tomography

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Introduction

The history of wisdom teeth problems is probably as old as the history of mankind. Notations of possible impaction of a lower third molar in an early hominid, *Australopithecus africanus*, have been reported [24]. Recently, new digital radiographs of the "Magdalenian Girl", a nearly complete 13,000- to 15,000-year-old skeleton excavated in France in 1911, were published by the field museum in Chicago. The radiographs show an unerupted lower wisdom tooth in a position prone to become impacted, and it has been claimed to be the oldest known recorded case of an impacted wisdom tooth [50] (Fig. 1).

The removal of impacted wisdom teeth is today a common procedure in dental practice. In the majority of cases, the surgical procedure is straightforward with little or no risk for damage to the surrounding structures. In many cases, however, there is an intimate relationship between the roots of the lower wisdom tooth and the mandibular canal or the lingual bone plate. In a considerable percentage of these patients, permanent or temporary damage to the lingual or inferior alveolar nerve may occur [8, 11, 29–31, 33, 55, 59]. In a recent retrospective study of patient complaints for neurosensory disturbances, it was found that impacted third molar is the main cause of permanent inferior alveolar nerve sensory deficiency outweighing both implant and orthognathic surgery as etiologic factor [36]. Another serious complication to third molar surgery is dislocation of the roots into the sublingual soft tissue where it may cause life-threatening infections (Fig. 2). Therefore, preoperative imaging of the lower wisdom teeth serves a place as an essential part of the preoperative evaluation. With the recent introduction and spread of modern low-dose three-dimensional radiographic imaging techniques such as cone beam computed tomography (CBCT),

Fig. 1 Digital radiograph of Magdalenian girl mandible demonstrating a third molar in a mesioangular position prone to become impacted. Photograph courtesy of Field Museum of Natural History, Chicago

preoperative radiographic mapping have become an important tool in the treatment of impacted lower wisdom teeth.

The aims of this paper were to critically review the role of radiographic imaging before lower third molar removal and to suggest a strategy for preoperative imaging of lower third molars based on available scientific evidence and clinical experience.

Demands on the radiological investigation

Ideally, the radiographic examination should give information not only about the lower third molar itself but also about the surrounding bone and the lower second molar. Regarding the lower third molar, there are a number of features that should be assessed such as angulation of the crown in the sagittal plane, the buccal or lingual inclination, the size and shape of the crown as well as the presence of pathology such as caries or resorption. The most important feature regarding the roots is their relation to the mandibular canal, but the number and shape of the roots as well as their stage of development and the depth of the root in the alveolar bone are also of interest. Features of the surrounding bone to be examined include the position of the ascending ramus, the density and structure of the bone and the presence of pathology such as cysts, tumours or evidence of previous pericoronal infections. One should not forget to assess the lower second molar as the prognosis of that tooth may influence the clinical treatment decision. Maybe it is better to remove a second molar with dubious prognosis and keep the third molar. If panoramic radiographs are available, the corresponding upper third molar should also be assessed as an elongated upper third molar interfering with the lower jaw may be the main cause of recurrent pericoronitis around the lower third molar.

When to use different radiological techniques

In this article, several different radiological techniques are described. Some techniques are simple while the others are more sophisticated resulting in detailed information. So, which technique should be used and when?

The first principle to adhere to when considering any radiologic investigation is that the benefit of the investigation should outweigh the risk associated with the investigation. Once the decision to perform a preoperative radiographic investigation is made, the next rule to adhere to is the ALARA principle. ALARA stands for As Low As Reasonably Achievable meaning that one should use the radiologic technique available that with the lowest radiation dose adequately supplies the information needed.

The use of radiological investigations, as well as any other preoperative diagnostic test, should thus be based on a principal understanding of the usefulness of each test. However, to establish such principles, evidence-based information on each test's diagnostic properties as well as how the test outcome will affect the clinical outcome is needed. Regretfully, such information is sparse regarding preoperative radiologic evaluation of wisdom teeth. A

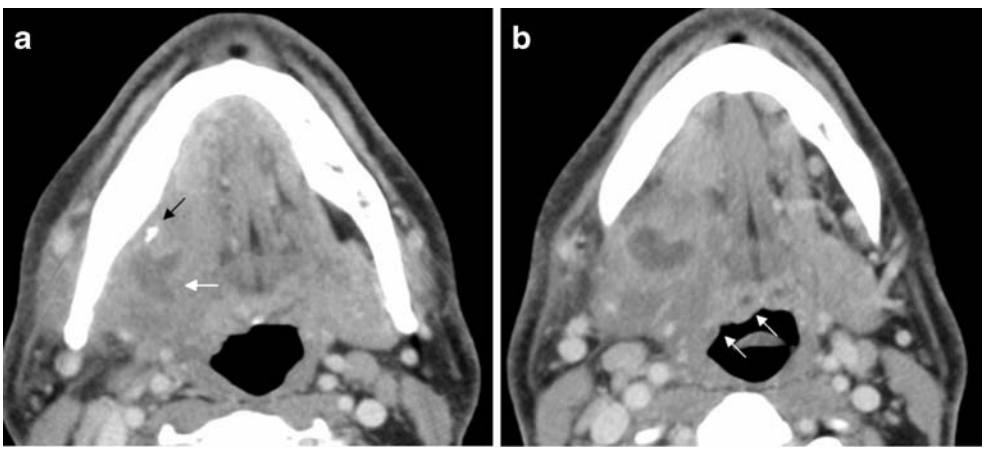

Fig. 2 **a** Contrast enhanced axial CT of sublingual abscess (*white arrow*) caused by root displaced during third molar removal (*black arrow*). **b** Same patient as (**a**). Note extensive cellulitis and bulging of soft tissues decreasing the airway space (*arrows*)

Medline search on the MESH terms "third molar" and "radiography" resulted in 332 articles, 89 of which had those MESH terms as major topics. Of these articles, 30 were deemed by the authors as relevant, concerning preoperative radiographic evaluation of wisdom teeth [1–4, 6, 7, 9, 10, 14, 20, 21, 25, 26, 28, 31, 32, 34, 39, 41, 43, 45, 49, 52, 61, 62, 64, 67, 71, 75, 76]. All these articles could be regarded as presenting only a low level of evidence according to the evidence criteria set by Limchaichana et al. [37]. As the scientific evidence on the usefulness of preoperative imaging of wisdom teeth is low, we still have to rely heavily on individual clinical decisions. However, a few general principles can be pointed out.

A preoperative radiologic test can be of good use when:

1. The result of the test influences the treatment decision.
2. The result of the test might change treatment outcome.
3. Documentation of preoperative lesions are to be compared with postoperative outcome.

Inadequate reasons for ordering preoperative radiologic tests are:

1. To satisfy our own curiosity
2. For medicolegal reasons
3. To ensure third party reimbursement

Available techniques

Plain radiography

Standard intraoral radiography

Intraoral radiography is the most common method to evaluate lower third molars as the technique should be available to all dentists. However, the scientific documentation on the use of intraoral radiography for preoperative radiographic examinations of third molars is very limited. As intraoral radiographs are two-dimensional images of three-dimensional structures, superimposition and thus obscuring of objects occur.

By using a parallax technique, also known as the tube shift technique, where at least two radiographs with a difference in vertical or horizontal angulations are exposed, the anatomical relationship between different structures can be determined. This technique was first described by Clarke and was further developed by Richards in the early 1950s and is especially useful in the preoperative evaluation of lower third molars as the tooth's relationship to the mandibular canal in most cases can be clarified [13, 56, 57]. Limiting factors in the use of intraoral radiographs, besides the superimposition of objects, are the demands on patient cooperation and difficulties in placing the film and in aiming the X-ray tube for imaging of posterior structures such as the third molar (Fig. 3).

Panoramic radiography

Panoramic radiography is a technique for producing a single image of both jaws. Its advantage is a low patient radiation dose and convenience of examination due to the extraoral technique. It also produces information on all wisdom teeth in a single image. The panoramic radiograph meets many of the demands on the radiological examination of lower third molars, but as a stand-alone technique there are definite shortcomings. Panoramic radiography only provides information on the position of the mandibular canal in the vertical plane but no information on the position of the canal in the horizontal direction. Furthermore, the assessment of the position of the canal in the vertical direction is uncertain due to difficulties inherited in the panoramic technique. A variable magnification and the fact that a lingually positioned structure will be projected upwards will reduce the accuracy of the assessment of the position of the mandibular canal. As the panoramic technique produces a sharp image layer of limited width, small errors in positioning of the patient can prevent visualisation of the mandibular canal and obscure the view of fine details such as root anatomy. Also root curvatures in the buccal or lingual direction can place the roots outside the sharp image layer.

Other extraoral techniques

The traditional way in plain radiology to explore anatomical relationships is with the aid of multiple projections either in different planes or different angulations using the parallax phenomenon. Many modern multifunctional panoramic units can utilise the parallax phenomenon producing extraoral scanograms. The scanogram consists of at least two projections with a difference in vertical and/or horizontal tube shift angle (Fig. 4a). This method renders a stereographic interpretation of the area possible. Interpretation with the parallax method as used with intraoral radiographs is possible as well. The extraoral approach has practical advantages compared to intraoral radiography. The wisdom tooth can be imaged regardless of its position in the jaw, and the demands on patient cooperation are low.

A complementary projection to standard panoramic or intraoral radiographs is a posteroanterior (PA) open mouth view. This view is usually valuable for determination of both the relationship between the teeth and the mandibular canal as well as the inclination of the wisdom tooth, in the bucco-lingual direction. In many cases where intraoral or stereographic radiographs fail to reveal the bucco-lingual

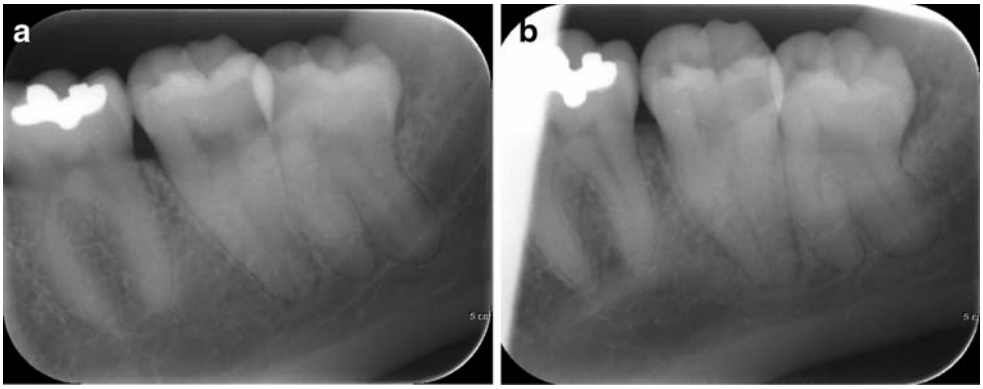

Fig. 3 Intraoral radiographs where the tube shift technique clearly depicts the course of the mandibular canal as buccal to the roots of 38. **a** Parallel projection. **b** Tube head shifted to a more inferior position than in (**a**)

position of the mandibular canal, the PA view is sufficient to reveal the canal/root relationship (Fig. 4b).

Conventional tomography

Conventional tomography comprises the use of complex multidirectional movements in order to achieve radiographic slices of the volume investigated. Hypocycloidal or spiral tomography can provide high-quality images of the teeth as well as the adjacent alveolar process. Due to limitations in the ability to visualise soft tissue and the inherent phantom images that tend to obscure small details, conventional tomography has for some years been superseded by computed tomography (CT) and in recent years by cone beam computed tomography.

Computed tomography

Regardless of the technique, plain radiography is unavoidably limited in the evaluation of three-dimensional relationships such as root anatomy or the mandibular canal pathway. For a detailed preoperative mapping or visualisation of subtle bone changes, computed tomography is needed.

The basic principle of CT is that a fan-shaped, thin X-ray beam passes through the body at many angles to allow for cross-sectional images. The corresponding X-ray transmission measurements are collected by a detector array. The transmission measurements recorded by the detector array are digitised into picture elements (pixels) with known dimensions. Gray-scale information contained in each individual pixel is reconstructed according to the attenuation of the X-ray beam along its path. Current conventional scanners employ continuous scanning (spiral or helical CT or multi-detector computed tomography (MDCT)), enabling volumetric imaging and multiple high-quality reconstructions in different planes.

Computed tomography was for a long time considered a high-dose technique, but with the development of MDCT and low-dose protocols tailored for the diagnostic task, this no longer holds true as doses below 0.15 mSv is achievable [48, 63, 69].

Cone beam computed tomography

The main difference between CT and CBCT is that the latter technique uses a flat panel detector instead of one or several rows of X-ray detectors. This allows for the collection of the information needed to reconstruct the investigated volume to be settled during a single rotation. In practice this results in images with a higher spatial resolution than in commercially available CT scanners and

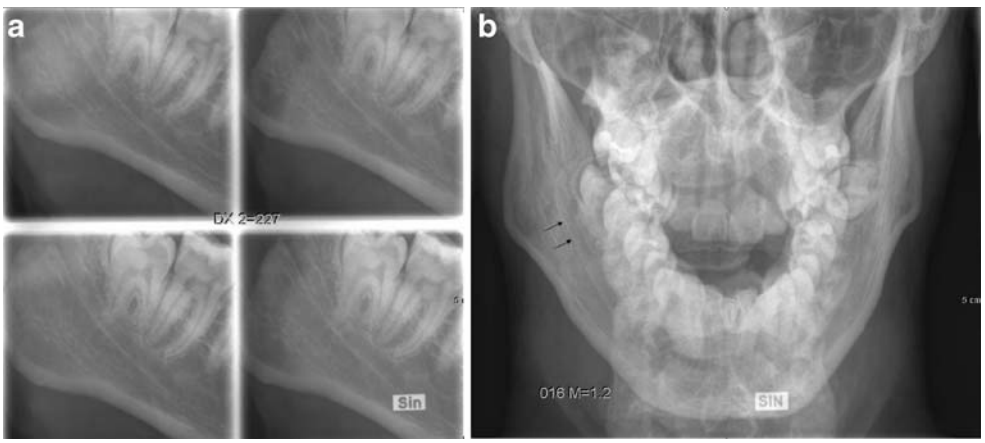

Fig. 4 **a** Stereographic radiographs from a Scanora unit. With the aid of stereoscopic binoculars, a three-dimensional image can be perceived. **b** Posteroanterior radiograph. The lateral relationship between the mandibular canal (*arrows*) and the roots of 48 can easily be judged on the posteroanterior (PA) view

usually, but not always, at a lower radiation dose. Doses between 0.05 and 0.6 mSv have been reported [38]. Several CBCT systems have been designed for imaging hard tissues of the dentomaxillofacial region, and the use of CBCT for dental procedures has recently increased. This technology allows for three-dimensional representation of the dento-maxillofacial skeleton with minimal distortion, but at lower equipment cost and simpler image acquisition as compared to traditional CT systems. Since CBCT produces images with isotropic sub-millimetre spatial resolution, it is well suited for dedicated dentoalveolar imaging (Fig. 5).

Tuned aperture computed tomography

Tuned aperture computed tomography (TACT) is a technique based on the theory of tomosynthesis first published by Ziedses Des Plantes in 1938 [79]. It was introduced by Webber and co-workers in 1996 [73]. There are basically two kinds of TACT described in the literature: intraoral [74] and extraoral [26]. The potential of TACT to evaluate the relationship between the mandibular canal and the roots of the third molar has been reported in two experimental studies [26, 44]. As no clinical studies or dose estimations have been published to the best of our knowledge, TACT can be considered a promising but still an experimental technique for the preoperative evaluation of lower third molars.

Magnetic resonance imaging

Magnetic resonance imaging (MRI) is an imaging method that uses a strong static magnetic field and radiofrequency pulses in order to emit signals from hydrogen nuclei within the volume investigated. This technique, which does not involve the use of X-rays, has a superior soft tissue resolution and a high sensitivity to pathologic changes as compared to earlier imaging modalities. With this imaging technique, hard tissues such as the cortical bone and teeth are void of signal due to the absence of hydrogen nuclei in these tissues. MRI is therefore not the best technique to visualise the mandibular canal, and its main use in the maxillofacial region has been imaging of soft tissue lesions. High resolution MRI has the potential to visualise the lingual and inferior alveolar nerves and may in the future prove useful also for evaluation of third molars [18, 42, 46]. As the demonstration of hard tissue anatomy is poor and the access to MR scanners still is limited, it is currently recommended only for the evaluation of gross pathological changes such as tumours and cysts when other less sophisticated techniques are inadequate.

Ultrasound imaging

Ultrasound imaging (sonography) uses high frequency sound waves to view soft tissues such as muscles and internal organs. In an ultrasound examination, a hand-held transducer is placed against the skin. The transducer sends out high frequency sound waves that reflect off body structures. The returning sound waves, or echoes, are displayed as an image on a monitor. Unlike with an X-ray, there is no ionising radiation exposure with this test.

In a recent experimental study on pig cadavers, it was shown that ultrasound has a good ability to visualise the position and status of the lingual nerve [51]. These findings implicate a possible future role for ultrasound imaging in the postoperative evaluation of nerve deficiencies following third molar surgery. As the currently marketed ultrasound equipment cannot penetrate the mandibular cortex, its role in preoperative imaging of lower third molars remains obscure.

Discussion and review of literature

Several authors report that in unselected material the buccal position of the MC is the most common [32, 39, 70]. Mahasantipiya et al. [40], on the other hand, found that inferior position of the MC was most common, and Ohman et al. [47] reported the lingual position to be the most

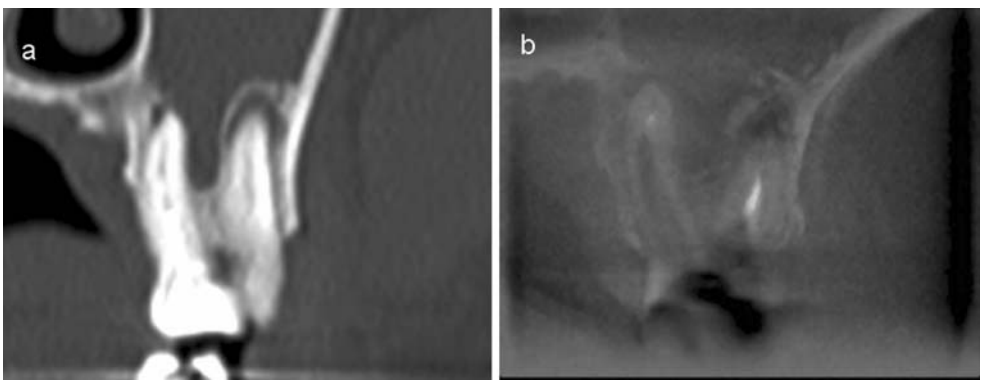

Fig. 5 Comparison between **a** CT and **b** CBCT of the same tooth demonstrating a higher contrast resolution with CT and a better spatial resolution with CBCT (images courtesy of Prof. Reinhilde Jacobs, Oral Imaging Center, Fac Medicine, KU Leuven)

common in patients with a close relationship between MC and the roots of the lower third molar. The wide discrepancy in the figures on MC position between the different studies is probably due to the different inclusion criteria.

Although the incidence of postoperative dysaesthesia of the inferior alveolar nerve is low in general, third molar surgery is still the main cause of neurosensory disturbances of this nerve. Temporary injuries in 0.4–5.5% and permanent nerve damage in 0.1–1.0% have been reported [11, 64, 68, 72]. However, several sources indicate that the incidence increases dramatically when there is a close relationship between the mandibular canal and the tooth. Nerve injury in as much as 23–60% of such cases has been reported [30, 31, 33, 59]. Therefore, numerous attempts have been made to use different radiological signs, mainly on panoramic radiographs, to determine if there is a correlation to the close relationship between tooth and mandibular canal or to neurosensory disturbances of the inferior alveolar nerve. The radiographic signs such as darkening of the roots, interruption of the white lines of the canal, diversion of the canal and to a lesser degree, narrowing of the canal, are associated with neurosensory disturbances and with close relationship between the lower third molar and the mandibular canal [9, 30, 33, 43, 58, 59, 62].

However, even if there is an association, the occurrence or absence of radiological signs on panoramic radiographs can neither safely predict nor exclude a close relationship between the lower third molar and the mandibular canal. Even if there was a way to safely predict whether a close relationship existed or not with panoramic radiography, the information on the exact position of the mandibular canal would still be lacking. As knowledge of the course of the canal can influence the surgical approach substantially, this should be determined by the preoperative radiological examination. Recently, true sectional imaging with CT or CBCT has been recommended when radiological signs indicating close relationship are present on panoramic radiography [16, 43] or when the course of the canal could not be determined with conventional radiographic methods [47].

Although a number of studies have correlated different clinical and radiological variables to surgical difficulty [5, 22, 54, 60, 66, 78], proposed indices [35] are seldom used as they have been reported not to match actual surgical difficulty [78]. Gbotolorun et al. [23] in a recent study concluded that both clinical and radiological variables are important in predicting surgical difficulty in impacted third molar extractions.

Panoramic radiography is widely used for evaluation of third molars, and in a booklet on selection criteria for dental radiography by the Faculty of General Practitioners in the UK, panoramic radiography is said to be the most appropriate radiographic examination for deciding whether a third molar should be removed [19]. Chandler and Laskin, however, showed that the accuracy of panoramic radiography in classifying tooth impaction was lower than 50% [12]. Furthermore, when there is an inferior course of the canal in relation to the roots, a correct judgement often can be done, but when there is overlapping of the canal and tooth, a course buccal or lingual to the roots or a course between the roots cannot be determined. Different studies have also shown that panoramic radiography has limited accuracy regarding the number of roots and in the description of root morphology [1, 4]. In our opinion, a single panoramic image can be sufficient for the preoperative evaluation only if the root anatomy is uncomplicated and there is no overlap between the mandibular canal and the roots (Fig. 6). In all other cases, there is reason to expand the radiological examination.

Without doubt, the most frequent radiographic method for preoperative evaluation of third molars is intraoral radiographs. By using intraoral radiographs and the parallax method, the movement of the mandibular canal relative to the third molar on at least two differently angulated radiographs can be used to determine the bucco-lingual position of the mandibular canal. The parallax method can be used both in the vertical and the horizontal direction, but the orientation of the mandibular canal often makes the vertical parallax the more useful of the two. Intraoral

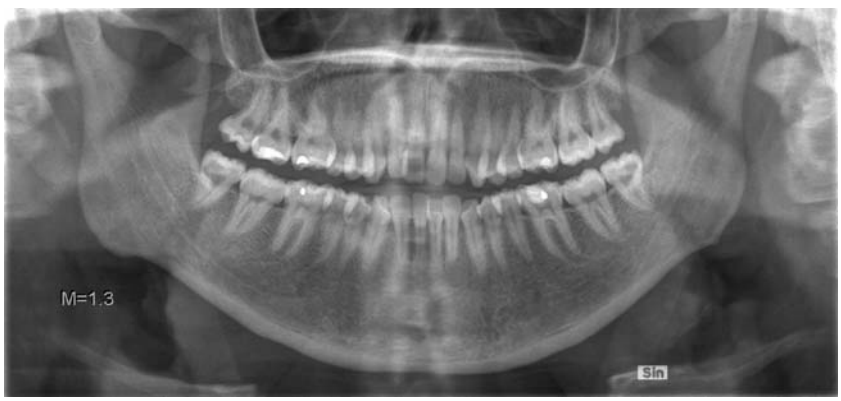

Fig. 6 In this case, where 38, 48 demonstrate uncomplicated root anatomy and the mandibular canal has an inferior position, a single panoramic radiograph suffices

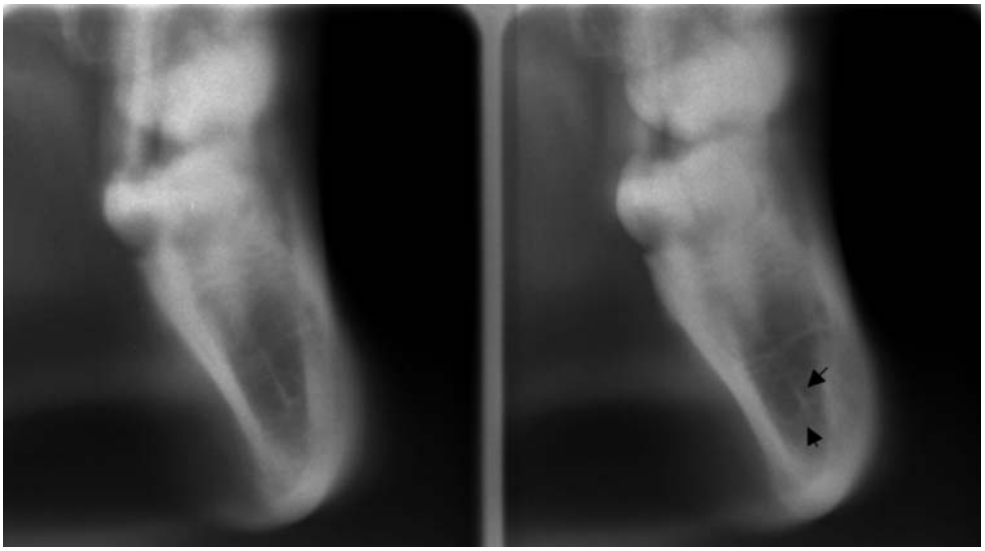

Fig. 7 Spiral tomographic cuts in the region of 38 on a dry skull. The mandibular canal which is situated at a distance from 38 is clearly seen on the right cut (*arrows*) where the canal has a horizontal path. On the left cut, which is more posterior, the canal is harder to identify as it has an oblique direction. Note considerable blurring of 38

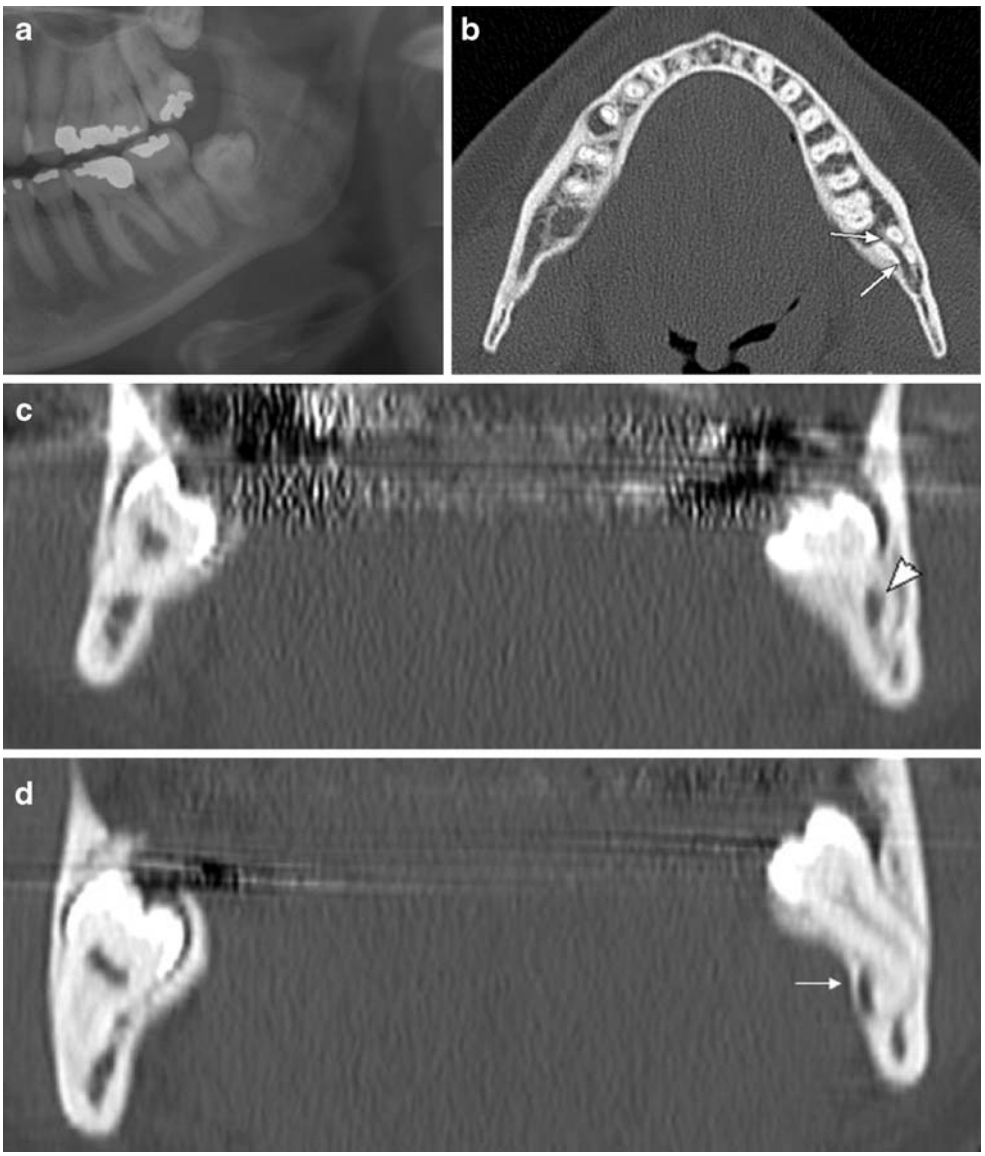

Fig. 8 **a** Cropped panoramic view demonstrating the mandibular canal overlapping the roots of 38. **b** CT image in transverse plane reveals an interradicular course of the canal (*white arrow*). **c** CT image in frontal plane shows grooving of the root (*arrowhead*). **d** Frontal CT image of another case. Root of 38 hooking around the mandibular canal which runs lingual to the root. Note compression of the mandibular canal and grooving of the lingual cortex (*arrow*)

radiographs are an excellent method in the majority of cases. However, in cases where there is a close relationship between tooth and canal, it is hard to safely predict the position of the canal. This fact and the demands on patient cooperation and difficulties in placing the film properly are limiting factors of intraoral radiography.

Wenzel et al. used a Scanora unit for obtaining scanograms to evaluate third molars [75, 76]. The accuracy compared to panoramic and intraoral images was significantly superior regarding the position and number of roots and was equally good for the relationship of the mandibular canal and the roots when validated against findings at surgery. Tammisalo et al. in an often cited article claimed to be able to identify the bucco-lingual position of the canal with the aid of scanograms in 97% of the cases [70]. These figures are remarkably high and misleading as only 23 out of 173 teeth were validated against surgical findings of a visible canal. In four of these 23 teeth with a close relationship to the canal (17.4%), disagreement was found between radiological and clinical findings.

The ability of the conventional tomography to identify the MC has been reported to be more than 97% [15, 32, 41]. The limitation of conventional tomography is, in our experience, its restricted ability to accurately demonstrate the precise anatomy in cases with an intimate nerve/root relationship or complicated root anatomy due to the inherent blurring effects (Fig. 7). Radiation doses of conventional tomography in the mandibular molar region have been reported to be between 0.033 and 0.059 mSv [17, 48].

The ability of CT to visualise the mandibular canal is outstanding [77], and CT is often used as gold standard to evaluate other radiographic techniques.

In a recent study [65], CBCT was shown to be as accurate as MDCT for linear measurements in the mandible. This makes it fair to assume that CBCT has as high validity as CT to correctly localise the mandibular canal. Hashimoto and co-workers from an experimental study claimed that CBCT has higher image validity than MDCT for small anatomical details in the maxillofacial region [27], and their claims are partly corroborated by studies of the temporal bone [53]. The major advantage of CT and CBCT with respect to third molar imaging is their ability to provide precise anatomical information.

Our experience

At our department we have, since year 2000, performed preoperative CT as a standard on lower wisdom teeth referred from the oral surgery department at the hospital and where the tooth/nerve relationship cannot be clearly elucidated with plain X-ray including panoramic, stereographic and PA projections. We have thus performed CT scanning on 40–50 patients annually out of a total of approximately 250 third molars surgically removed each year. Note that these 250 patients have been referred from general dentists and represent a selection of impacted third molars judged to be difficult to surgically remove. We often encounter findings of close relationship between roots and the mandibular canal, grooving of roots by the canal, thinning or perforation of the lingual bone plate by the canal or the third molar and circumscription of the canal by the roots [47]. Such findings will have an effect on the surgical approach and cannot be properly depicted by other radiographic techniques than CT or CBCT (Figs. 8, 9, 10, 11).

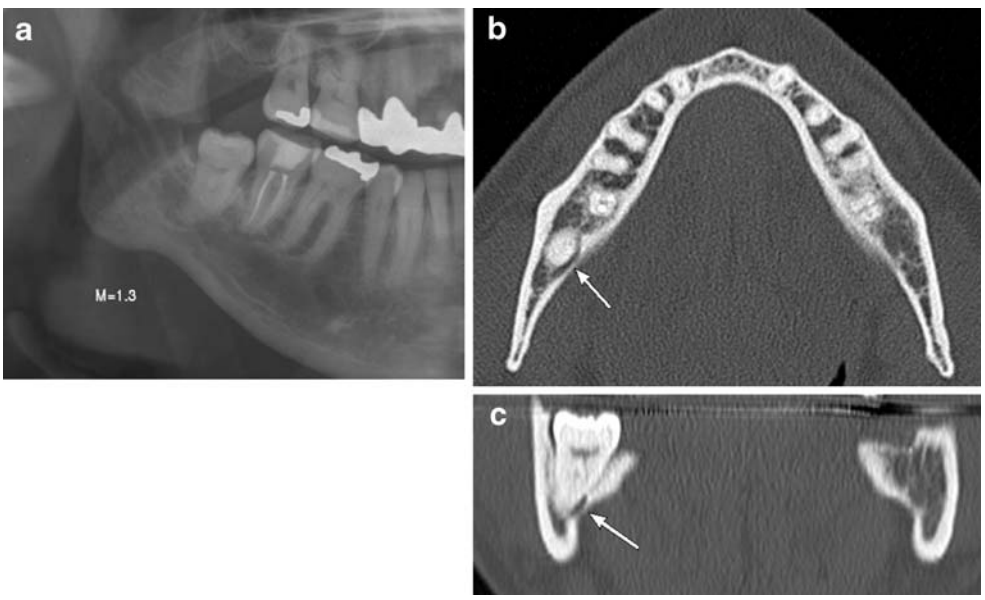

Fig. 9 **a** Cropped panoramic view demonstrating the mandibular canal overlapping the roots of 48. **b** Transverse CT image and **c** frontal CT image clearly show thinning of the lingual bone plate by the mandibular canal (*arrow*). In a case such as this when the surgeon can be sure of the position of the mandibular canal, the buccal bone can be freely removed thus minimising the risk for complications such as nerve damage, fracture of the lingual bone plate or dislocation of roots to the floor of the mouth

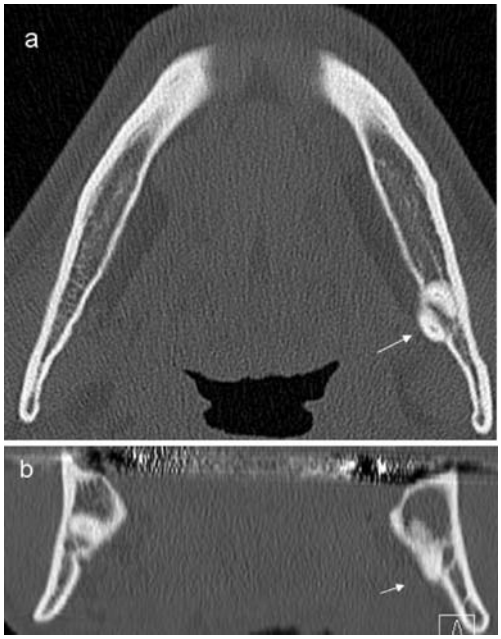

Fig. 10 **a** Transverse CT image and **b** frontal view demonstrating penetration of the lingual bone plate by the distal root of 38

Since our introduction of preoperative CT evaluation in selected cases in 2000, there has been no case of persistent nerve damage associated with third molar surgery at our hospital. We believe that volume tomography such as CT or CBCT, in selected cases where plain X-ray cannot clearly determine the tooth/nerve relationship, will give a better basis both for preoperative risk evaluation and the decision whether to operate or follow-up. As the decision to operate should be based on informed consent by the patient, this basic information is of crucial importance. Furthermore, the surgeons at our hospital also claim that the surgical procedure is considerably facilitated by the knowledge of the exact anatomical relationships, thus minimising intra-operative complications.

A suitable CT protocol for preoperative investigation of lower wisdom teeth involves the use of a spiral CT or a MDCT and millimeter-thick contiguous slices in the axial (transversal) plane. From these axial slices, reformatted sections in any plane can be made (Figs. 8, 9, 10). We prefer transversal and coronal 1–1.5-mm thick slices sometimes supplemented by corrected sagittal projections. A low-dose setting (in general <50 mA s at 120 kV regardless of the scanner) is sufficient. A bone algorithm (medium-sharp) should be used for reconstruction, and the images should be displayed in a bone window setting (wide window). Direct coronal slices as well as tube-settings above 75 mAs at 120 kV should generally be avoided as they will lead to an unnecessarily high radiation dose. The findings of Libersa et al. [36] that third molar removal is the main aetiology behind neurosensory disturbances to the inferior alveolar nerve and the high incidence of neurosensory disturbances, both of the lingual and inferior alveolar nerve branches, associated with third moral surgery, are worrying and indicate the need for a change in the paradigm of preoperative evaluation of third molars. Our review of the literature gives the impression that the aim of the radiographic investigation is merely to detect if there is a close relationship between the mandibular canal and the roots indicating the need for caution during the surgical removal of the wisdom tooth. In our opinion, this is an unsatisfactory strategy. Exact knowledge of the individual anatomical relations is a prerequisite for a tailored, optimised and effective surgical procedure. If for instance the mandibular canal is situated lingual to the root, general caution during surgery is not optimal, whereas swift and ample removal of buccal bone is the most adequate surgical approach (Figs. 8d, 9 and 11).

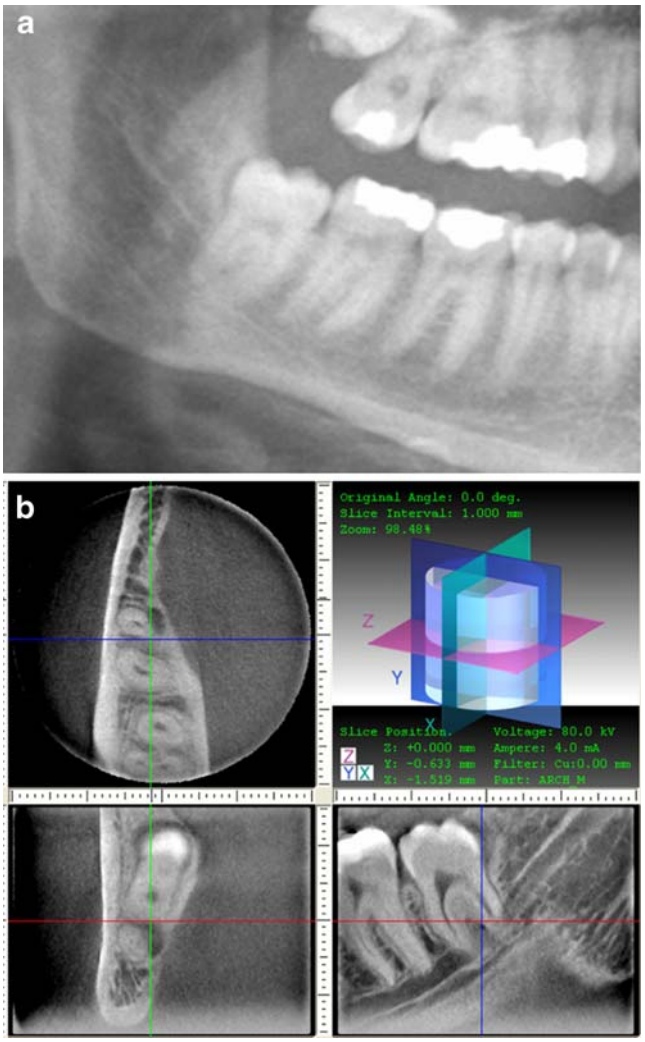

Fig. 11 **a** Panoramic radiograph showing mandibular canal overlapping the roots of 48. **b** CBCT images in three planes demonstrating the exact course of the mandibular canal lingual to and in contact with the roots of 48. Note the higher spatial resolution as compared to CT (Figs. 8, 9 and 10; images courtesy of Reinhilde Jacobs and Jeroen Vanhevele, Oral Imaging Center, Fac Medicine, KU Leuven)

Conclusion

In summary, a strategy for preoperative radiological investigation before surgical removal of third molars is suggested as follows:

1. Panoramic and/or intraoral radiographs are sufficient in the majority of cases, especially if there is no overlap between the roots and mandibular canal.
2. If the nerve/root relationship cannot be readily interpreted from panoramic and/or intraoral images alone, supplement with a PA open mouth projection will suffice in most cases.
3. When the examinations above cannot readily depict the nerve/root relationship, true sectional imaging with the aid of CBCT or low-dose CT is indicated.

If strict adherence to such a strategy for preoperative radiographic investigation of lower third molars is maintained and combined with a cautious surgical technique adjusted according to the radiologic findings, then it is our belief and experience that permanent nerve injuries following third molar removal will be an almost totally avoidable complication.

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