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Clinical Case

Use of Cone-Beam CT for Surgical Planning and Execution of Avulsion of an Impacted Maxillary Canine: A Case Report

Utilisation de la Tomographie à Faisceau Conique pour la Planification Chirurgicale et le Traitement de l'Avulsion d'une Canine Maxillaire Incluse : À Propos d'un Cas

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ABSTRACT

Impacted maxillary canines present a real challenge for orthodontic and surgical treatment. Only a good diagnosis based on 3D imaging can allow optimal planning of the management of this clinical entity. We report a case of maxillary impacted canine avulsion in which Cone-Beam imaging was used to visualise the tooth and prepare for minimally invasive avulsion. This patient was admitted to the oral surgery clinic of the Institute of Odontology and Stomatology in Dakar for multiple tooth avulsion for prosthetic rehabilitation. An impacted maxillary canine was discovered by chance and Cone-beam CT imaging was indicated. The various axial, coronal and sagittal slices and three-dimensional reconstruction allowed better exploration of this tooth by defining its precise position and morphometry.

RÉSUMÉ

Les canines maxillaires incluses représentent un véritable défi pour le traitement orthodontique et chirurgical. Seul un bon diagnostic basé sur l'imagerie 3D peut permettre une planification optimale de la gestion de cette entité clinique. Nous rapportons un cas d'avulsion d'une canine maxillaire incluse dans lequel l'imagerie Cone-Beam CT a été utilisée pour visualiser la dent et préparer une avulsion mini-invasive. Ce patient a été admis à la clinique de chirurgie buccale de l'Institut d'odontologie et de stomatologie de Dakar pour l'avulsion de plusieurs dents en vue d'une réhabilitation prothétique. Une canine maxillaire incluse a été découverte par hasard et l'imagerie Cone-beam CT a été indiquée. Les différentes coupes axiales, coronales et sagittales ainsi que la reconstruction tridimensionnelle ont permis une meilleure exploration de cette dent en définissant sa position précise et sa morphométrie

INTRODUCTION

Maxillary canines are one of the most frequently impacted teeth, with a prevalence rate of 1% to 3%, just behind 3rd molars (1). Two-dimensional (2D) imaging, consisting mainly of dental panoramic radiography and periapical radiography, has often been used as a means of exploring and studying impacted maxillary canines (2). However, this radiology modality has a number of limitations, notably the 2D visualisation of structures, magnification errors, anatomical superimpositions and geometric distortions (3), which limit the estimation of the precise location of impacted canines. Cone-beam Computed Tomography (CT) images have a clear advantage over traditional imaging: they are 3D images. This makes it possible to navigate precise sub-millimetre slices in the axial, coronal and sagittal planes, which can improve the diagnosis and precise location of impacted maxillary canines (4). In addition, adjacent anatomical structures and their relationships can now be assessed in all three planes of space.

In addition, Cone-beam CT can improve the detection of dental anomalies and root resorption (3). It thus enables optimal exploration of the maxillary canine, and also helps to anticipate any difficulties that may arise during surgery. The aim of this case report is to present the interest of Cone-Beam CT in the diagnosis and preparation of the avulsion of an impacted maxillary canine through the report of a case received at the Dakar Institute of Dentistry and Stomatology.

CASE PRESENTATION

A 38-year-old female patient was referred to us by the Prosthetic Department of the Dakar Institute of Odontology and Stomatology for avulsion of teeth in a state of total coronal decay with a view to prosthetic rehabilitation. The patient reported no contributory history on examination. A panoramic dental examination was indicated to explore the various teeth to be extracted

and to obtain a general view of the maxillo-mandibular bone architecture. An impacted maxillary canine (23) was discovered by chance, which could be a negative factor in the fitting of a maxillary complete dental prosthesis (Figure 1).

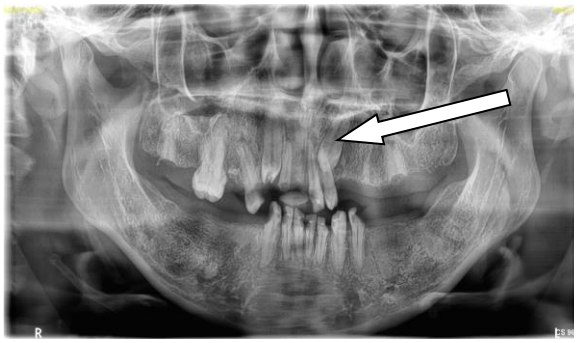

Figure 1: a panoramic radiograph showing an impacted canine

The dental panoramic radiograph did not allow us to locate this canine precisely in the different planes, and the geometric superimpositions did not allow us to define the palatal or vestibular position of this tooth. A 3D Cone-Beam radiograph was then indicated to determine the exact angle of inclusion of the tooth with a view to its avulsion, as it could not be repositioned on the dental arch due to the patient's extensive edentulism. The sagittal section shows that the canine is located in the vestibular plane 2.3 mm from the canine hump. In this sagittal section, we can see that the root of this tooth passes in front of and outside the anterior border of the right maxillary sinus (Figure 2).

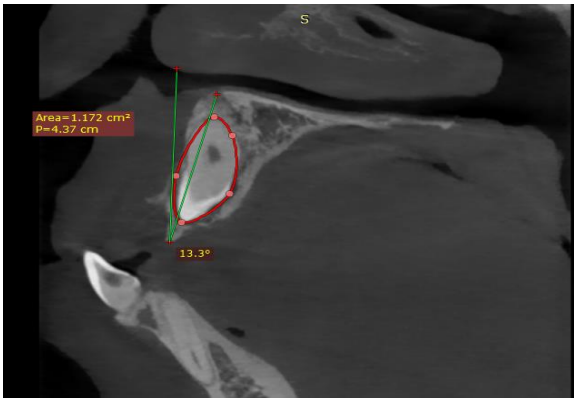

Figure 2: sagittal section showing the angle of impaction and the tooth surface

The coronal section also shows a crown located very close to the maxillary vestibule. The morphometry of the canine can be determined in order to assess the difficulties of avulsion. The length of the tooth was 14.3 mm, while the width of the crown was 7.2 mm (Figure 3). The coronal section shows a mesio-version tooth with the apex pointing from front to back; this makes it possible to predict the various mobilisation movements required to dislodge this impacted canine (Figure 3).

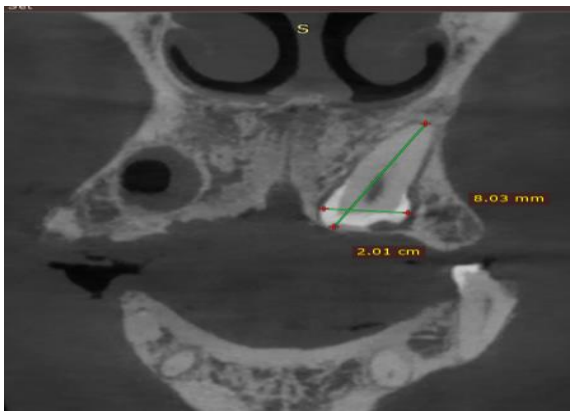

Figure 3: Coronal section showing the morphometry of the impacted canine

On the axial section, we can see that the tooth is impacted in a vestibular direction with a crown located on the outer third of the axial section line of the Cone-Beam CT, showing an impact severity of 3.8 mm; mild impact severity (Figure 4).

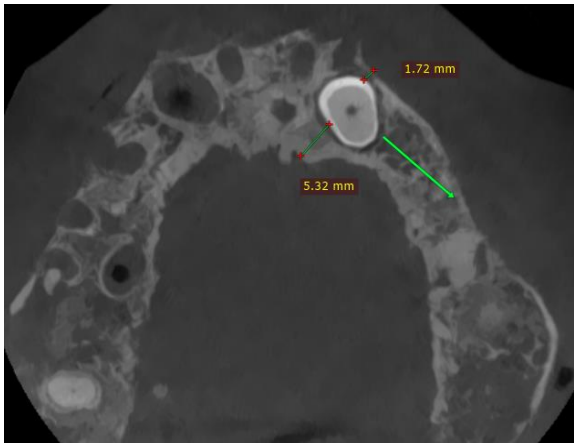

Figure 4: axial section showing the proximity of the tooth to the vestibule

The 3D Cone-Beam reconstruction provided an overall view of the bone elements covering the tooth. We were thus able to determine the surgical protocol for an avulsion that would be minimally invasive for the surrounding tissues and promote better prosthetic rehabilitation; the vestibular approach would then be preferred. On the basis of all these radiological arguments, after infiltrating a 2% lidocaine-based anaesthetic solution, we performed a mucoperiosteal detachment and then exposed the tooth. An osteotomy was performed to release the alveolar bone around the tooth using a burr mounted on a contra-angle handpiece (Figure 5).

Figure 5: Mucoperiosteal detachment with Molt's rugin

The tooth was luxated using a lift in accordance with radiological information and extracted using forceps (Figure 8). Post-operative management was straightforward.

DISCUSSION

It is important to consider the advantages of Cone-Beam CT in canine localisation and its impact on patient management. Therefore, the potential improvement in surgical management of patients through the use of Cone-Beam CT imaging merits investigation. This prospective study was conducted on patients who had 2D and 3D panoramic Cone-Beam CT images and focused on surgical treatment planning based on radiographic information and factors that may affect surgical decisions. Palatal positions of impacted canines are generally associated with absent or hypoplastic lateral incisors (5) or even supernumerary teeth (6). Buccally impacted canines are often associated with dento-dental or even dentomaxillary disharmony (7). Consequently, in the axial plane, greater emphasis was placed on impacts that deviated (palatal/ vestibular) from the medial-alveolar region. The canine in our study was slightly impacted in accordance with the severity of the inclusion reported in our patient's axial section. This result is similar to that found by Ross et al (7) who reported a predominance of impacted canine with a mild grade of severity. The vertical position of the canine would have an influence on the periodontal state after extrusion and on the choice of surgical exposure technique and even avulsion of this tooth (8).

In the coronal plane, the canine was located mesial to the midline of the lateral incisor as shown in Figure 2. In general, a more mesial location of an impacted canine relative to the distal margin of the lateral incisor has been associated with an increased frequency of impaction and a higher incidence of dento-osseous resorption (9). This may also compromise periodontal health and reduce the likelihood of spontaneous eruption of the canine into the dental arch (10).

In the sagittal plane, the angle of inclination of the canine studied was 32.4°, which is similar to the findings of the study by Ross et al (7) which showed 84% of impacted canine teeth with a sagittal angle of inclination of less than 45°. The severity of this angle indicates a more difficult eruption path and reflects the difficulty of moving the root buccally during orthodontic treatment or avulsion (11). It is important to note that to quantify canine inclination, we used the palatal plane as a reference, mainly because it is local and skeletally based (11). The occlusal plane is not a stable frame of reference because it is dental in origin and does not provide enough information for a successful operation (2).

CONCLUSION

Our study shows that cone-beam tomography is an essential tool for exploring and planning the avulsion of an impacted canine. Compared with 2D radiography, it provides more information about the precise position of the tooth and the tissues surrounding the impacted canine.

DECLARATIONS

Ethics approval and consent to participate

The research protocol was submitted to the Institutional Ethics and Research Committee of the Faculty of Medicine, pharmacy and odontology of Dakar-Senegal, which issued us an ethical clearance and a research authorization (permit number: 192/UCAD/FMPO/VDRC/DAASR/ CSD and approval date: April 24, 2023). Informed consent to participate was taken from the patient reported in this study. We respected the confidentiality and anonymity of the data collected.

Consent for publication

NA

Declaration of data availability and materials

The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare no conflict of interest.

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Institutional Review Board Statement

The study was conducted in accordance with the guidelines of the Declaration of Helsinki and approved by the Institutional Ethics and Research Committee of the Cheikh Anta Diop University of Dakar (permit number: 182/UCAD/FMPO/VDRC/DAASR/ CSD and approval date of April 24, 2023).

Authors' contributions

Diatta Mamadou : data analysis, writing and correction of manuscripts;

Kane Mouhammad, Ba Abdou: protocol drafting and management;

Messina Ebogo, Lamine Ndiaye: choice of subject and draft manuscripts;
Alpha Kounta, Catherine Gassama: drafting of the protocol and draft manuscripts
Tamba Babacar, Soukèye Tine: correction of the manuscripcand general supervision.
All authors have read and accepted the published version of the manuscript.

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