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Cone-beam Computed Tomography in Detection of Peripheral Cystic Lesions: A Technical Report

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ABSTRACT

This article introduces a technique to employ Cone-beam Computed Tomography (CBCT) as a beneficial modality in imaging peripheral cystic lesions. Increasing application of CBCT in maxillofacial field is a result of its performance and lower cost together with low radiation dose and its accessibility in dental clinics, however, CBCT scan is less useful in soft tissue lesions because of its limited contrast resolution. The aim of this report was to introduce a technique to employ CBCT in imaging peripheral cysts and investigating their internal structure. We present a 61-year-old woman with swelling in left upper lip associated with a nasolabial cyst. CBCT images did not provide required data on extension and periphery of the lesion. The patient was undergone aspiration of cystic contents and then injection of contrast media into the cystic cavity. Another CBCT scan was captured, and the invisible cystic shape of the lesion was visualized. CBCT cystography demonstrated the periphery, exact size and location of the nasolabial cyst. Using this technique imposed far less radiation dose and costs to patient than a usual CT scan. CBCT cystography is recommended for visualizing peripheral cysts and determining their exact size and location.

Key words: Cone-beam computed tomography, Cystography, Contrast media

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INTRODUCTION

Increasing application of cone-beam computed tomography (CBCT) in maxillofacial filed is a result of its performance and lower cost together with low radiation dose and its accessibility in dental clinics. The effective dose from a standard dental protocol scan with the multi-detector computed tomography (MDCT) is about 1.5 to 12.3 times greater than comparable dental CBCT scan [1].

However, the CBCT scan has some limitations. This imaging modality is less useful in soft tissue or peripheral lesions because of its low contrast resolution [2]. It is impossible to differentiate cystic lesions from solid tumors by using CBCT. Also, CBCT has limitations on demonstrating outline and internal structure of peripheral lesions and depicting changes in lining of the cysts which could be associated with possible neoplastic alterations. This shortcoming can be rectified using some media to improve the diagnostic range of this technique. Injection of contrast medium into a lesion (cystography) in order to demonstrate the interior cyst morphology and its extension has been described in the literature using Computed Tomography (CT), Magnetic Resonance Imaging (MRI) and conventional radiography [3-6]. However, to our knowledge there is no report of using cystography with CBCT.

In this study a technique to employ CBCT to investigate cystic lesions, by injecting contrast media in the lumen of the cyst, just before capturing CBCT scan has been developed. This procedure is performed after aspirating cystic contents. CBCT cystography can demonstrate exact size, location and periphery of peripheral cysts, and any changes in cystic wall; for instance irregularities, loss of integration and intra-luminal bulging which could be associated with possible neoplastic changes. This article describes the technique and presents a case of a nasolabial cyst and explains its radiographic findings using CBCT cystography.

CASE REPORT

A 61-year-old woman presented with chief complaint of painless swelling in left upper lip. The patient had noticed this swelling in this area for about 1 year. The patient's familial and medical history was unnoticeable. On extra-

oral examination there was a smooth swelling in the left nasolabial fold region which was soft in consistency on palpation. Intra-oral examination revealed fullness of the labial vestibule on left side of maxilla extending from midline to left canine. Anterior teeth had porcelain fused to metal crown.

In panoramic radiograph a well-defined radiolucent area in anterior left maxillary region was found extending from canine to midline. CBCT Scans of the interested region (Scanora3D, Sordex, Finland, FOV, 7.5*10 cm Voxel size, 200 µm, KVP 90, 6 mA) showed extensive erosion in anterior maxilla extending from canine to midline with posterior displacement of the nasal floor. Teeth number 11, 21, 22 and 23 had root canal fillings. The periapical bone was intact except for some PDL widening on the apexes of central incisors (Figure 1). These findings depicted the diagnosis of a chronic peripheral lesion most compatible with a nasolabial cyst.

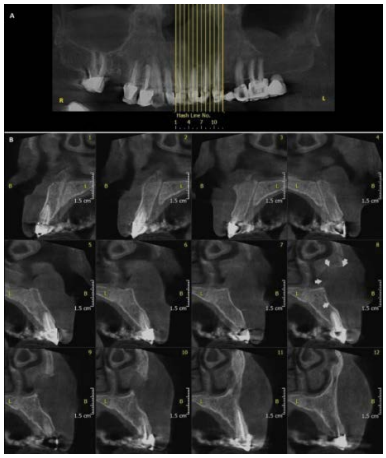

Figure 1: (A) Reformatted panoramic view and (B) Cross sectional cone beam computed tomography images show erosion in the buccal plate of anterior maxilla. Periapical alveolar bone is normal except for some PDL widening on the apex of central incisors (sections No. 1 and 5). The detectable periphery of the lesion is marked by arrows

Needle aspiration was performed at the most prominent and the softest area of vestibular expansion. The aspiration was positive and using 18 gauge needle, 1.8 ml of cystic fluid was aspirated, the syringe barrel was separated then, leaving the needle in adjacent soft tissue, and 1.8 ml of contrast medium (Meglumine compound 76%, Daroupakhsh, Tehran, Iran) was injected into the lesion through the same needle left on position. And another CBCT scan was captured.

Post-injection CBCT showed a homogeneous high attenuating cyst like lesion in anterior left maxillary region extending from midline to canine which has displaced the nasal floor posteriorly. Extensive erosion in anterior maxilla could be detected. The lesion size was 3*2*1.5 cm. The radiopaque area was surrounded by a thin uniform radiolucent rim between the underlying bone and cystic contents which indicates the cystic wall (Figure 2).

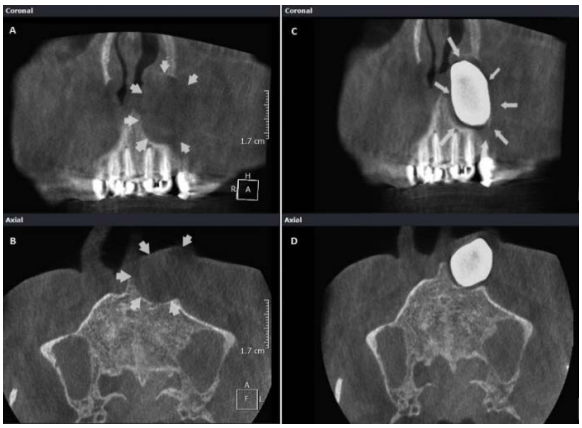

Figure 2: Cone Beam Computed Tomography images before and after injection of contrast media. (A) Coronal and (B) Axial pre-injection CBCT images. Erosion of anterior maxilla and displacement of anterior nasal floor can be detected. Arrows indicate detectable margins of the lesion. (C) Coronal and (D) Axial images showing high attenuation within the cyst located in the left nasolabial fold following injection with contrast media. The lining of the cyst is visualized between cystic contents and supporting bones

Based on clinical and radiographic findings a differential diagnosis of an extensive nasolabial cyst was made. An incision trough labial mucosa was given, and the cyst was surgically enucleated completely with the lining under conscious sedation. Histopathological examination confirmed the diagnosis of the nasolabial cyst.

DISCUSSION

Various lesions can occur in the maxillofacial region. Exact knowledge of the morphology and extension of lesions and their relationship with surrounding structures is essential before performing oral surgery. Preoperative radiographic examination can reduce surgical complications, post-surgical functional impairments and surgical stress. CBCT is a high accurate modality for preoperative assessment of the maxillofacial lesions [2]. However, CBCT has limited low-contrast resolution. It is likely that the lower radiation dose results in increased noise, which affects the low-contrast detection of soft tissue. CBCT cannot differentiate cystic lesions from soft tissue masses because of this limitation [7]. This shortcoming can be rectified with injection of a high attenuating material into the cystic cavity which increases the subject contrast and visualizes the internal structure of the cystic lesion and lining of the cyst. Cystography is a well-known technique in medical practices such as finding bladder tumors, bladder fistulas and investigating internal structure of long bone cysts [8,9]. There are also reports on cystography in the maxillofacial field in the literature using plain films, CT and MRI. The aim of such studies was to reveal the cystic shape and limitation of lesions, finding cyst wall leak and fistula tracks. Misra et al. conducted a study for diagnosis of a nasolabial cyst. The injection of iodinated contrast media into the soft tissue lesion was performed, and a maxillary cross-sectional occlusal radiograph

revealed a well-defined ovoid uniformly radiopaque cyst superimposing on the roots and crowns of maxillary premolars with mild erosion of the nasal floor [6]. In another study performed by Zeltser et al. cystography using plain film in posteroanterior projection was used to demonstrate a "figure of eight" shape of a dermoid cyst [5]. CT cystography and MRI cystography were described in other studies, as diagnostic techniques for visualizing cyst wall leaks [3,4].

There is no evidence of previous study in the literature on the application of CBCT as an imaging modality for cystography. Therefore, the main purpose of this paper was to assess the benefits and limitations of this technique in examination of peripheral cystic lesions.

Nasolabial cyst is an extra-osseous lesion; hence, plain radiographs do not present any findings, except for cases with severe erosion of underlying bone surface or displacement of nasal fossa shown in intra-oral radiographs. Computed Tomography and Magnetic Resonance Imaging can reveal extension and size of the lesion and its relation to surrounding structures [10]. In the case of nasolabial cysts, CT scan is preferred to MR Imaging because of its lower cost and accessibility. In some cases of nasolabial cyst ultrasonography was performed as a useful and more cost-effective approach in the diagnosis but it cannot depict underlying bone changes [11].

Regardless of its limited contrast resolution, CBCT can be recommended as a dose-sparing technique compared with alternative standard medical CT scans. It is more accessible and has lower cost. CBCT cystography will somewhat mitigate the limitations of CBCT in imaging soft tissue cystic lesions.

In our case, CBCT cystography demonstrates exact three dimensional sizes, location and limitation of the nasolabial cyst and its relation to surrounding structures. The lining of the cyst was visualized indirectly between underlying bones and enhanced cystic contents. Such information cannot be achieved from a soft tissue lesion by application of the common CBCT scan. Knowing exact size and location of the lesion made the surgical approach more feasible and limited.

Neoplastic changes in cystic wall may appear as a bud-like growth toward the lumen of the cyst and irregularity in cystic lining. Although CBCT is frequently used in the maxillofacial region, it cannot depict these changes in the cystic wall, if it is used without complementary interventions. Some odontogenic cysts like odontogenic keratocyst have aggressive behavior which cause bone perforation and soft tissue extension [12]. CBCT with intraluminal injection of contrast media also can demonstrate the bone perforation and soft tissue extension of such an aggressive lesion. The benefits of using contrast media are listed in Table 1.

Table 1: Benefits of CBCT with intraluminal injection of contrast media

Benefits of using contrast media
Rectifying the important limitation of CBCT in imaging soft tissue cysts
Demonstrating the exact size of the peripheral cyst
Determining the exact location of the lesion for surgical planning; specially in cases with required safe margin
Assessing the extension and relation of the lesion to the surrounding structures
Displaying changes in thickness and integrity of the cystic wall which could be associated with neoplastic changes
Depicting the perforation areas with permeating the contrast media
Demonstrating the internal structure of cystic lesions

Despite all these advantages, cystography can be invasive and should be performed by a professional. Also, cystography is contraindicated in patients with previous history of hypersensitivity to iodine contrast media. In some systemic disorders intravenous use of contrast media should be used by caution, such as renal disease and underlying cardiac disease; however there is no data on the contraindication for extra-venous injection of contrast media in such systemic diseases [13]. This technique is only applicable in cysts with appropriate access. Lesions which are located deep in bone are difficult cases for cystography. CBCT cystography added information on the exact size, location and internal structure of the peripheral cyst to the previous CBCT findings. More case studies are needed to evaluate the ability of CBCT cystography in imaging internal structure and changes in cystic walls which could be associated with possible neoplastic alterations.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this article.

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