The feasibility of cone beam computed tomographic sialography in the diagnosis of space-occupying lesions: report of 3 cases

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Cone beam computed tomography (CBCT) is being widely used in recent years and has modernized the practice of oral and maxillofacial radiology by its inherent advantages, such as short scanning time, high resolution, and low dose of radiation to the patient. Sialography can be considered as the second step of assessment of space-occupying masses after initial diagnosis with ultrasonography. Sialography is combined with plain radiographs in routine practice. It can also be combined with advanced modalities such as computed tomography (CT), magnetic resonance imaging (MRI), and CBCT. In this report, we describe 3 cases to confirm the feasibility and superiority of sialography using CBCT and 3-dimensional (3D) images in space-occupying lesions of major salivary glands when conventional sialography is not diagnostic or MRI and CT are not easily available or affordable. CBCT sialography and its 3D images can be helpful in the diagnosis of space-occupying lesions of major salivary glands. (Oral Surg Oral Med Oral Pathol Oral Radiol 2014;117:e452-e457)

Diagnostic imaging has a crucial role in the assessment and management of symptomatic major salivary gland diseases. Such imaging can help in finding the nature, extent, and (probably) the cause of these diseases and can reveal their possible effects on the adjacent anatomic structures.

Imaging of the major salivary glands is currently performed with one of the following imaging modalities: occlusal intraoral radiographs, conventional sialography, ultrasonography (US), computed tomography (CT) with or without contrast media, magnetic resonance imaging (MRI) with or without enhancements, magnetic resonance sialography, and nuclear salivary scintigraphy. Each technique has its own indication or shortcomings considering the primary assessment made and the availability of these devices.

Currently, US is the preferred imaging modality in the initial evaluation of salivary glands in many countries. It is widely available, low-cost, patient-friendly, and safe and is valuable for the assessment of superficial lesions of the parotid and submandibular glands. It has been reported to be 98% accurate in discriminating glandular lesions from extraglandular lesions. However, US is an operator-dependent technique and is limited in outlining deep parotid masses that are obscured by the mandible. Thus, clinicians should seek further imaging modalities to discover large tumor extension or to reach the definitive diagnosis in locally invasive lesions.

Initially performed in 1902, sialography illustrates the ductal structures of the salivary glands by introducing a contrast agent into the orifice of its duct. Traditionally, sialography is performed by using plain radiographs and injection of water-soluble contrast media into the major salivary gland ducts to outline the anatomy of the ducts, find strictures, and detect salivary stones (sialoliths).

Conventional sialography, CT, and MRI can be used to assess space-occupying lesions of salivary glands when US fails. The main shortcoming of conventional sialography is in the diagnosis of space-occupying lesions.

Space-occupying masses of the salivary glands can be subdivided into cystic conditions and neoplastic lesions. Salivary gland tumors are uncommon, and cysts are rare. Fewer than 5% of salivary gland masses are related to cysts, and salivary gland tumors represent fewer than 3% of all tumors in the head and neck region.

With combinations of imaging modalities, 3-dimensional (3D) images of ductal structure and gland anatomy can be obtained by combining sialography with CT or MRI. The high radiation dose of CT and the sophisticated methods of MRI are their primary well-recognized limitations.

Today, the rapid achievement of a 3D image volume using cone beam computed tomography (CBCT) has overcome the limitations of MRI images and spiral (medical) CT scans. CBCT is being widely used in recent years and has modernized the practice of oral and maxillofacial radiology by its inherent advantages, such as short scanning time, high resolution, and low dose of radiation to the patient. The CBCT equipment and procedures are primarily designed for proper imaging of bone and some soft tissue. Very fine images and 3D reconstructions can nevertheless be obtained by CBCT,
and it might be used for the differential diagnosis of suspicious radiolucent lesions of the mandible.\(^6\)

Sialography has been found to be the most successful technique to evaluate major salivary gland function and to obtain accurate assessment of the obstructive conditions of the salivary glands.\(^7\)\(^-\)\(^9\) This method can also be considered as the second step of assessment of space-occupying masses after initial diagnosis with US. Sialography is combined with conventional radiologic projections in routine practice.

The purpose of this report, which presents 3 clinical cases, is to verify the feasibility and superiority of CBCT sialography and its 3D images in the diagnosis of space-occupying lesions of major salivary glands.

**CASE REPORTS**

**Case 1**

A 55-year-old man with a history of 6 to 7 months of painless swelling of the right parotid gland was referred for sialography by his otolaryngologist. The clinical evaluation suggested a space-occupying lesion, and he was referred for conventional sialography. The sialography procedure was carried out by an experienced academic maxillofacial radiologist in a private dentomaxillofacial radiology center using the hand injection technique. The orifice of the primary duct of the salivary gland under examination was dilated with a series of gutta percha cones from No. 25 to No. 45. This was followed by cannulation of the main duct through the orifice using a customized catheter. The catheter was a scalp vein, gauge 19 for parotid glands with blunted needle. Subsequently, 4 to 5 mL of contrast material (Visipaque; ioxaglate, 270 mg per 20 mL, Nycomed Amersham, Ireland) was injected slowly into the duct of the gland. We presumed 1 mL for the ductal phase and 3 mL for the parenchymal phase (blushing stage).

A unilateral dental panoramic tomography (DPT) image was then acquired using the Planmeca system (Planmeca Oy, Helsinki, Finland) and a photostimulable phosphor sensor (Konica CR; Minolta, Japan) to confirm the best possible filling up of the ductal structures. All digitally acquired images were viewed under optimal conditions regarding the monitor and the room lights. In the conventional sialogram, no filling defects and no significant space-occupying lesions were detected, although the Stensen duct was deviated to the inferior. There were also no signs indicating chronic sialoadenitis. Conventional sialography showed no abnormality and was not responsive for explicit diagnosis in this case (Figure 1, A). Because the plain-film sialogram was not diagnostic, a sialo-CBCT was planned. The patient was then positioned in the CBCT unit (NewTom VGi; QR Srl, Verona, Italy) with a 1-mL boost of contrast media, and the scanning of the involved salivary gland was performed. The data were examined using the software supplied by the manufacturer. CBCT images were compared with the initial conventional sialography images.

CBCT in axial and cross sections clearly showed a space-occupying lesion in the superomedial aspect of the gland. This finding is compatible with the displacement of the duct inferiorly in conventional and CBCT sialography. There were no signs of filling defects (sialodochitis, sialectasia) or any sign of ductal deterioration and puddling of the injected contrast media. CBCT found a space-occupying lesion, which was concurrent with the patient’s condition and the anticipated diagnosis of the referring physician. Although the diagnosis of a space-occupying lesion without ductal disease was confirmed, the patient refused a fine-needle aspiration (FNA) examination (Figure 1, B).
Case 2

A 49-year-old man was referred to the dentomaxillofacial radiology clinic by his general dental practitioner to take a DPT image for routine dental examination. In the DPT image, multiple calcifications were detected, being superimposed on (and lateral to) the right ramus of the mandible. The patient did not present any history of previous diseases. The clinical examination found a slight asymmetry in the masseter muscles. Therefore, US examination was performed. The US examination reported a 22 × 26 × 15-mm, irregularly shaped, multilobulated, hypoechoic mass with posterior enhancement in the inferior margin of the right parotid gland in favor of a multilocular cyst. Multiple small echogenic foci were detected within the mass, with posterior attenuation in favor of foci of calcification. There was not any significant vascularity related to the mass. Based on these findings, the possibility of a multiloculated collection of lymph nodes or an enlarged lymph node with central necrosis and calcification should be considered. The possibility of a parotid gland tumor with necrosis and calcification could not be ruled out.

Therefore, the conventional sialography was performed using the same procedure described in the previous case. The sialogram showed ductal and parenchymal displacement in the inferomedial aspect of the parotid gland (Figure 2, A). However, the sialogram did not confirm the presence of a space-occupying lesion, which was revealed in US examination.

CBCT (NewTom VGi; QR Srl, Verona, Italy) was used to image the filling phase of the investigation, using 1 mL of Visipaque (270 mg per 20 mL) contrast media as the boost dose injected by hand. The CBCT system operated at 85 kilovolt peak and 3.5 mA with a 15 × 15-cm field of view and 10.8 seconds scanning time.

The CBCT sialography, in axial sections, showed a lobulated space-occupying lesion in the deep portion of the gland. Multiple calcifications were detected in the lesion. There was no evidence of ductal involvement, deterioration, or sialectasia. A few small round calcifications were detected outside the parotid gland (see Figure 2, B, C1, C2). The FNA examination under US showed some clusters of normal acini, very few ductal cells, and a few inflammatory cells in the

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Fig. 2. Case 2. A, Conventional sialography of the right parotid gland showing multiple calcifications in the periphery of the gland. The image shows no filling defect, space-occupying lesion, or any evidence of chronic sialoadenitis. The width of the major duct is consistent, although wider than normal. B, Three-dimensional image of the right parotid gland showing the evidence of the space-occupying lesion in the deep portion of the gland. C1, CBCT sialography, axial section. Arrows show the calcifications within the lesion. C2, CBCT sialography, axial section. The image confirms the evidence of space-occupying lesion in the deep portion of the gland. (CBCT, cone beam computed tomography.)
blood cell background. The FNA result was negative for malignancy.

Case 3
This 40-year-old man had a firm, movable swelling on the right side of the face, inferior to the ear. The conventional sialography showed decreased density of the parenchyma in the inferolateral aspect of the right parotid gland (Figure 3, A). The CBCT sialography showed a significant space-occupying lesion (see Figure 3, B-E).

DISCUSSION

CBCT sialography was described initially by Drage and Brown in 2009, in a case report of 2 patients with salivary gland obstruction. In the first case, a single sialolith was identified in the right submandibular gland. In the second case, a sialolith and a stricture in the right parotid gland were identified and managed with interventional radiography. The authors could easily identify the salivary major duct, ductal branches, and obstructions in both cases. Unfortunately, that study did not indicate whether the technique was useful for space-occupying lesions.

Drage and Brown believed that CBCT sialography was indicated and justified when conventional sialography was assumed to be insufficient, or has been established to be insufficient, in complex cases of salivary duct obstruction. They also stated that selection criteria for CBCT were requisite and that the CBCT sialography would expose patients to higher x-ray radiation and accordingly must be reserved for more complicated cases.

They estimated the radiation doses that were delivered to the patients with CBCT sialography and construed that the radiation dose exposure in CBCT (96-134 mSv) was comparable with that of conventional fluoroscopic procedures (34-113 mSv). However, Jadu et al. estimated that the CBCT sialography procedure would deliver an effective radiation dose that ranged between 76 μSv (parotid gland) and 170 μSv (submandibular gland). They also estimated that effective radiation doses were similar to effective doses in conventional sialography (parotid, 65 μSv; submandibular, 156 μSv).

Drage and Brown concluded that a lower concentration of iodine (180 or 240 mg I/mL) might have been better. Jadu et al. believed that the lowest concentration of iodine available on the market (140 mg I/mL) would possibly be acceptable for CBCT sialography.
Adding to other researchers’ studies, in 2011 Li et al.\(^6\) reported a case of atypical Stafne bone cavity in which CBCT sialography showed detailed information of the content of the cavity and could help in its definitive diagnosis. They also stated the sialographic technique could be enhanced by the combination of sialography with CBCT, particularly with 3D image configurations.\(^6\)

In 2011, Varoquaux et al.\(^12\) reported (in French) a paraclinical examination aiming to find the cause of the nonlithiasic salivary gland obstructions. They studied the practicability and efficacy of sialography combined with CBCT with flat panel (CPCT). They concluded that by using 3D CPCT sialography, gland ducts even to their fifth or sixth branches were detectable, and also signal- and contrast-to-noise ratio was improved.

Jadu et al.,\(^8,11,13,14\) conducted a series of studies that led to the development of a new technique for imaging the parotid and submandibular salivary glands using sialography combined with CBCT. In their research in 2013,\(^13\) they reported the delicate secondary branches of the ducts and the parenchyma of the salivary glands were more detectable on CBCT images than plain film sialography. They also concluded that regarding the image interpretation, CBCT sialography could be better than conventional sialography in detecting the delicate structures of the parotid and submandibular salivary glands, finding sialoliths and single ductal strictures, as well as discriminating the normal salivary glands from glands involved with changes secondary to inflammation. They believe this achievement was because of the advantages of CBCT images over 2-dimensional plain radiographs, such as multiplanar viewing of CBCT images, elimination of overlapping structures, and the 3-dimensional nature of images.\(^13\) However, CBCT sialography images of our cases showed that 3D images obtained from the CBCT sialography images could not reveal the space-occupying lesion. This was different from what is usually seen in filling defects (i.e., sialodochitis and sialectasia, where 3D images are very efficient in diagnosis).

Jadu et al., in their statistically supported study,\(^14\) stated that if an abnormal finding was detected on CBCT images, the presence of the disease would be persuasively indicated. On the other hand, if a stricture was identified on CBCT images, then an obstruction should be considered assertively. They explained that this finding would probably be due to the fact that ductal obstructions can have secondary causes like space-occupying masses that may impinge and occlude the ductal structures.\(^13\) The detection of strictures on plain radiographs may have the possibility of overestimation and can be bewildered with areas of duct branching or bending.\(^13\) Ductal obstruction either is caused by calculi, strictures, or fibromucinous plugs or is secondary to mass lesions that might affect the ductal structures and induce their occlusion. They reported that the most common cause of obstruction observed on both CBCT images (46.8%) and plain radiographs (31.9%) was sialoliths.\(^13\)

In their studies,\(^13\) 2 cases were interpreted as space-occupying tumors. However, this study also did not point to the practicability of CBCT sialography as a useful technique in the diagnosis of space-occupying lesions.

Current diagnostic imaging provides a relevant diagnosis and also contributes to the overall management of patients. Future studies should grant the accurate assessment of the contribution of this diagnostic imaging to the patient management course. Evidence-based studies are required to find out whether the information obtained from this technique will change the clinician’s diagnostic thinking and whether this technique has any effect on the patient management and treatment plan. Moreover, the costs and benefits of this diagnostic imaging technology should be evaluated.\(^14,15\)

This study, presenting 3 clinical cases, confirmed the feasibility and superiority of CBCT sialography and its 3D images in the diagnosis of space-occupying lesions of major salivary glands.

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### REFERENCES


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