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The value of cone beam computed tomography in the detection of salivary stones prior to sialendoscopy

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Abstract. This study aimed to assess the value of cone beam computed tomography (CBCT) in the detection of salivary stones in patients with signs and symptoms of salivary gland obstruction. A total of 142 major salivary glands were analysed in a cohort of 127 patients with signs and symptoms of salivary gland obstruction. CBCT scans were performed in order to determine the presence of one or more salivary stones. All glands were also investigated by sialendoscopy. The sensitivity, specificity, positive predictive value, negative predictive value, and accuracy were calculated for the submandibular gland, the parotid gland, and the whole group, based on the observers' abilities to diagnose the presence or absence of calculi in the CBCT scan using the sialendoscopy data as the gold standard. Fifty salivary stones were detected in the CBCT scans of the 142 glands analysed: 34 in the submandibular gland and 16 in the parotid gland. The sensitivity (94%), specificity (90%), positive predictive value (84%), and negative predictive value (97%) for the whole group were good to excellent, with an overall accuracy of 92%. CBCT appears to be an ideal first-line imaging modality for patients with signs and symptoms of obstructed major salivary glands.

Key words: cone beam computed tomography; salivary glands; salivary stones.

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Sialolithiasis, the formation of calculi within the salivary ducts, represents the most common pathology of the salivary glands. The majority of stones are found in the submandibular gland (80%), with 20% occurring in the parotid gland[1]. Affected patients often present with recurrent, sometimes mealtime-related, painful glandular swelling, which can be complicated by bacterial superinfection.

The diagnosis and management of sialolithiasis was revolutionized by sialendoscopy about 15 years ago. This technique allows direct visualization and exploration of the salivary ductal system. In addition to diagnosis, this procedure enables the safe extraction of salivary ductal stones, obviating the need to excise the gland. As a result, the risks associated with traditional surgical procedures for the submandibular and parotid gland, such as injury to the marginal mandibular, lingual or facial nerves, or damage to the hypoglossal and local sensory nerves, are eliminated[2].

However, sialendoscopy is associated with certain limitations. Usually, submandibular gland stones smaller than 4 mm and parotid gland stones smaller than 3 mm can be retrieved with the wire basket[3]. The removal of larger stones requires prior fragmentation using alternative techniques such as laser or lithotripsy, transoral stone removal, or a combined approach incorporating endoscopy and an open surgical procedure.

Achieving high success rates for stone removal depends mainly on the selection of the most appropriate technique. Preoperative imaging is helpful in this clinical decision-making process. Several imaging modalities are useful for this purpose, including two-dimensional (2D) radiography, ultrasonography (US), magnetic resonance imaging (MRI), computed tomography (CT), and sialography. Each of these imaging modalities has its own advantages and disadvantages. Cone beam computed tomography (CBCT) is a modern imaging technique that has been used increasingly in the head and neck area since its introduction in 1998[4]. However, data regarding the value of CBCT in detecting salivary stones are scarce[5,6].

This prospective study assessed the value of CBCT in the detection of salivary stones in a cohort of more than 100 patients with signs and symptoms of salivary gland obstruction. All patients were planned for sialendoscopy procedures with prior CBCT scanning.

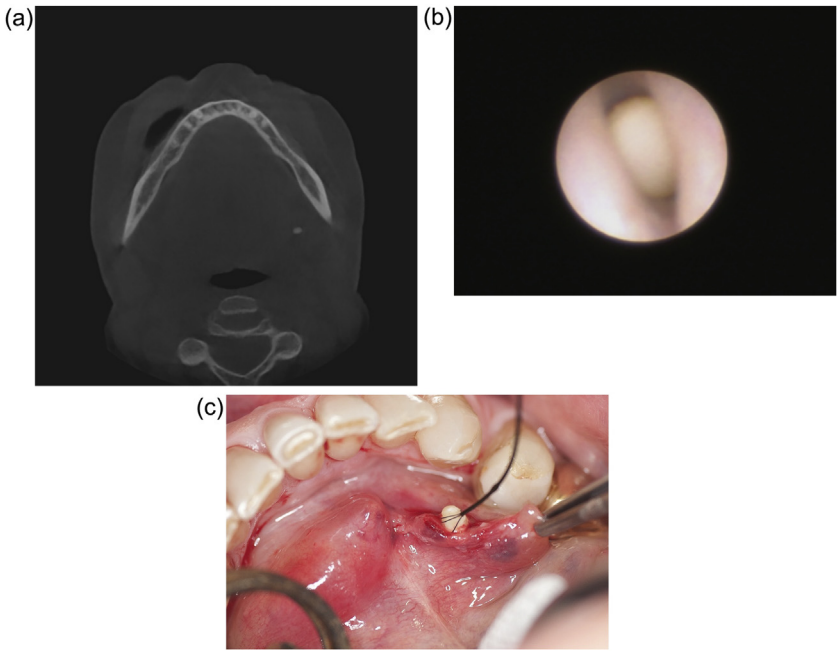

Fig. 1. (A) CBCT scan (axial view) showing a small opacity near the hilum of the left submandibular gland, probably a salivary stone. (B) During sialendoscopy, the stone was found to be proximal to Wharton's duct. (C) Sialendoscopic wire basket retrieval of the stone: after a limited papillotomy, the stone was removed easily.

Patients and methods

A total 306 patients who had been referred to the Department of Oral and Maxillofacial Surgery of the Medical Centre Leeuwarden, the Netherlands, for the diagnosis and management of a salivary gland obstruction of the submandibular or the parotid gland during the period January 2012 to August 2016 were initially included in this prospective study. A CBCT scan was performed at the first visit in order to determine the presence of one or more salivary stones. When a salivary stone was detected in the CBCT images ($n = 90$), the patient was planned for transoral stone removal ($n = 30$), sialendoscopic wire basket retrieval ($n = 47$) (Fig. 1), or a sialendoscopy-assisted surgical procedure, the so-called 'combined approach' ($n = 13$) (Fig. 2). The technique selected depended on the size and location of the stone. When there were no signs of calcification in the CBCT images ($n = 216$), only patients with persistent complaints of obstruction for more than 3 months were scheduled for sialendoscopy ($n = 75$). All CBCT images were acquired with a PaX-Zenith 3D scanner (Vatech, Hwaseong, Republic of Korea). The CBCT images were analysed by two experienced oral and maxillofacial surgeons using a workstation, which was technically approved for radiological diagnostics, consisting of a 17-inch LCD monitor and a computer.

As sialendoscopy is the only technique that allows direct visualization of the salivary ductal system, it was selected as the gold standard for the detection of salivary stones. Therefore, only patients who underwent sialendoscopy were included in this study. In this study group of 135 patients, the ductal system of a total of 152 glands was investigated by sialendoscopy. Two patients with multiple calcifications in both parotid glands were excluded because of the possible presence of polycystic (dysgenetic) disease of the parotid glands[7]. Two patients (one parotid gland and one submandibular gland) were excluded as it was not possible to enter the duct allowing the sialendoscopic procedure. Another four patients (three parotid glands and one submandibular gland) were excluded because of spontaneous loss of stones after the CBCT scan and before the sialendoscopy. Thus the final study group consisted of 127 patients (75 female and 52 male), in whom 142 glands (73 parotid and 69 submandibular) were investigated.

The patients ranged in age from 11.6 to 89.3 years, with a mean age of 52.4 years. The majority of sialendoscopy procedures

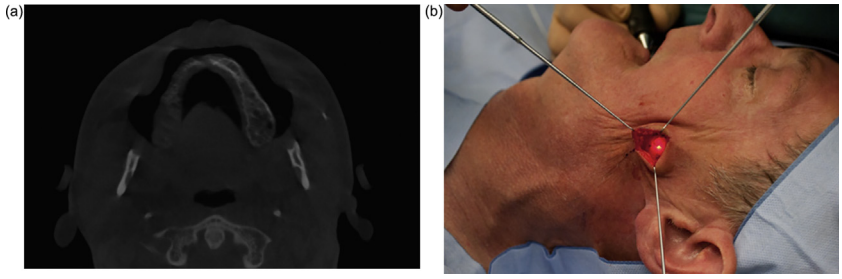

Fig. 2. (A) CBCT scan (axial view) showing a parotid gland stone in the middle third of Stensen's duct. (B) The stone was visualized on the monitor with the sialendoscope. The skin was opened at the point where the light from the endoscope was seen. After blunt preparation towards the light, the duct was opened and the stone removed (the so-called 'combined approach').