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Advantages of Intraoral Removal Over Submandibular Gland Resection for Proximal Submandibular Stones: A Prospective Randomized Study

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Objectives/Hypothesis: To compare surgical outcomes after intraoral removal of proximal submandibular stones versus traditional submandibular gland (SMG) resection.

Study Design: A prospective randomized study.

Methods: Forty-four consecutive patients were diagnosed with proximal submandibular stones in the hilum of the submandibular gland by ultrasonography or computed tomography. All of the patients were randomized to undergo removal of the stones either by an intraoral approach (IORS group, 22 patients) or through SMG resection (SMGR group, 22 patients). We then compared the surgical outcomes between these two groups.

Results: Stones in the IORS group were significantly smaller than those in the SMGR group. There was no significant difference in the distance of the stones from the hilum between groups. The mean operation time in the IORS group was significantly shorter than that of the SMGR group. The mean hospital stay of the IORS group was also significantly shorter than that of the SMGR group, and IORS patients felt significantly less pain than did SMGR patients. No patient experienced any complication after surgery with the exception of a single patient who experienced transient and mild neck swelling.

Conclusions: Intraoral removal of proximal submandibular stones has several advantages over SMG resection. Based on our results, we suggest that our intraoral removal method be selected as the primary procedure for the removal of proximal submandibular stones rather than SMG resection.

Key Words: Submandibular gland, stone, intraoral removal.

Level of Evidence: 1b

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INTRODUCTION

Salivary stones are the most common cause of salivary ductal obstruction. Most salivary stones occur in the submandibular gland (SMG) and its ductal system. SMG stones are divided into proximal and distal stones depending on their relative position in Wharton's duct. About 40% of SMG stones are located distally in Wharton's duct and can be easily removed through an intraoral procedure.[1] However, proximal and intraglandular stones are difficult to remove transorally because of their positions deep in the mouth floor. Furthermore, it is widely believed that proximal stones cause permanent structural damage to the gland, thereby predisposing the gland to recurrent infection. Thus, proximal stones are generally removed from the submandibular gland using a transcervical approach. However, there is mounting clinical and experimental evidence that salivary glands can regain useful function after stone removal.[1,2] Therefore, several gland-preserving proximal stone removal techniques, including extracorporeal and intracorporeal lithotripsy, interventional sialography, and basket retrieval and sialoendoscopy, have been introduced for transoral proximal stone removal.[3,4] Hong et al. reported an intraoral removal technique for the submandibular gland with excellent outcomes.[5] We have also performed several intraoral submandibular gland resections and removed proximal Wharton's duct stones using the same approach.

In this study, we compared surgical outcomes after intraoral removal of proximal submandibular stones and traditional submandibular gland resection.

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MATERIALS AND METHODS

Patients and Study Design

Our study group comprised 44 consecutive patients who underwent removal of submandibular stones. All of the patients were diagnosed with proximal submandibular stones in the hilum of the submandibular gland by ultrasonography or computed tomography. We defined proximal submandibular stones as stones posterior to the first molar. All patients were randomized to undergo stone removal via an intraoral approach or SMG resection. A single surgeon (k.h.k.) performed all of the operations in this study. The method used to remove the stones was assigned from a randomized list constructed using a statistical random number table. The patients were assigned to either the intraoral removal (IORS) group or the conventional SMG resection (SMGR) group. None of the patients had a prior history of stone-removal surgery, and all patients had normal lingual nerve function prior to surgery. We compared the locations and sizes of stones, mean operation time, mean hospital stay, mean postoperative degree of pain based on a visual analog scale (0–10), and frequency of complications such as dry mouth, wound infection, sensory changes or loss at the operative site, altered lingual nerve function, history of meal-time syndrome, and any history of sialadenitis between the groups. This study was approved by our institutional review board.

Surgical Procedure

Intraoral stone removal was carried out using an approach similar to that reported by Hong et al.[5] After transnasal intubation and proper oral preparation with hydrogen dioxide and saline irrigation, an incision was made through the mucosa of the lateral floor of the mouth from the orifice of Wharton's duct to the lingual side of the retromolar region, leaving a cuff of normal lingual mucosa to facilitate wound closure. Careful dissection was performed between Wharton's duct and the sublingual gland, and the sublingual gland was removed with preservation of the lingual nerve. The duct was isolated along the lingual nerve to the hilum of the submandibular gland by applying external digital pressure to facilitate exposure. After localizing the stone with bimanual palpation, the duct was incised and the stone was removed (Fig. 1). The duct was then irrigated with normal saline to clean the region and to remove stone debris. The incised mucosa of the mouth floor was then sutured back without repairing the incision site of Wharton's duct. SMG resection was performed using the traditional method.

Statistical Analysis

Differences in locations and sizes of stones, mean operation time, mean hospital stay, mean postoperative degree of pain, and frequency of complications between the two groups were compared using the Mann-Whitney test. Statistical significance was accepted at $P < .05$. All statistical analyses were performed using SPSS for Windows version 15.0 (SPSS, Inc., Chicago, IL).

RESULTS

Twenty-two patients underwent intraoral stone removal, and 22 patients underwent traditional SMG resection. The proximal submandibular stones in the SMGR and IORS groups had mean diameters of 9.0 ± 4.5 mm (range, 3.6–16 mm) and 5.2 ± 2.7 mm (range, 2–10 mm), respectively; the stones in the IORS group were significantly smaller than those in the SMGR group ($P = .027$). Stones in the IORS group were located in the left (16 cases) or right submandibular gland (six cases). The mean distances from the hilum of the stones in the SMGR and IROS groups were 1.5 ± 1.3 mm (range, 0-5.6 mm) and 2.1 ± 1.4 mm (0–6.3 mm), respectively; these mean distances were not significantly different.

The mean operation time in the IORS group was significantly shorter than that in the SMGR group (51.1 ± 8.4 vs. 83.2 ± 20.2 minutes, $P < .01$). The mean hospital stay of the IORS group was also significantly shorter than that of the SMGR group (2.6 ± 0.5 vs. 5.3 ± 0.5 days, $P < .01$). We also evaluated postoperative pain using a visual analog scale (0–10); the mean postoperative pain ratings were 3.0 ± 2.5 in the IORS group and 4.3 ± 2.8 in the SMGR, indicating that IORS patients felt significantly less pain than did the SMGR patients ($P = .036$).

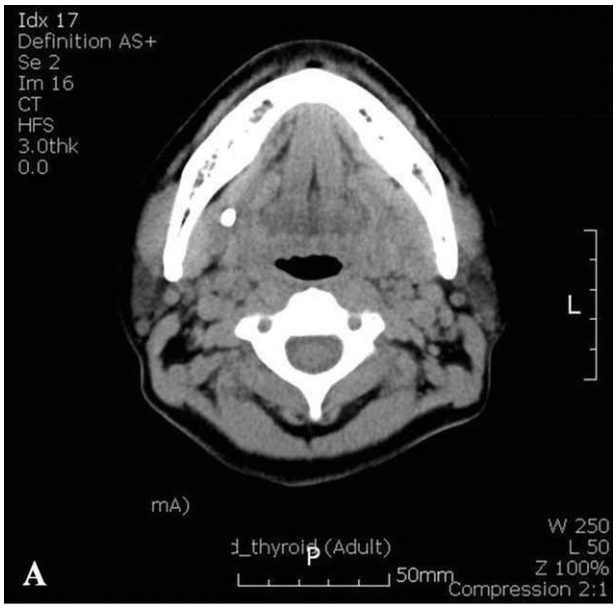
Stones were completely removed in all patients. The mean follow-up times were 18.8 ± 4.6 months (range, 12–24 months) in the SMGR group, and 18.0 ± 5.2 months (range, 12–24 months) in the IORS group. One SMGR patient experienced mild postoperative neck swelling, which spontaneously recovered within a few days, and another two patients experienced mild dry mouth after SMG resection, but this resolved within a few months.

The following factors were evaluated in both groups: altered lingual nerve function, history of meal-time syndrome, and history of sialadenitis. No patient experienced altered lingual sensory perceptions postoperatively, and no persistent lingual sensory deficits were reported. No other complications were encountered, and all patients were free of symptoms.

DISCUSSION

Traditional SMG resection procedures are based on the assumption that an obstructed and/or infected salivary gland is permanently damaged by the salivary obstruction or infection, and the structural damage incurred predisposes the gland to recurrent disease.[6] However, the incidence of iatrogenic injuries is relatively high considering that SMG resection is the standard operative procedure. Overall, temporary injury to the marginal mandibular branch of the facial nerve occurs in approximately 10% of cases, with permanent injuries in 3% of cases.[7] Injuries to the lingual and hypoglossal nerves are less common (<4%), but one half of these might be permanent.[7] Multiple nerve injury can also occur, and the risk increases significantly in an indurated and fibrosed glands because the lingual nerve can become welded to the gland by scar tissue.[7] Another frequent complaint of patients who have undergone SMG resection is an unsightly scar.[7]

Recently, several conservative and minimally invasive techniques have been developed for salivary gland surgery, including extracorporeal lithotripsy, interventional radiology, and operative sialoendoscopy.[8–12] These techniques are based on many reports showing that useful recovery can be achieved even in severely damaged glands.[1,2,13] These new techniques have improved the diagnoses of various salivary diseases, but their success



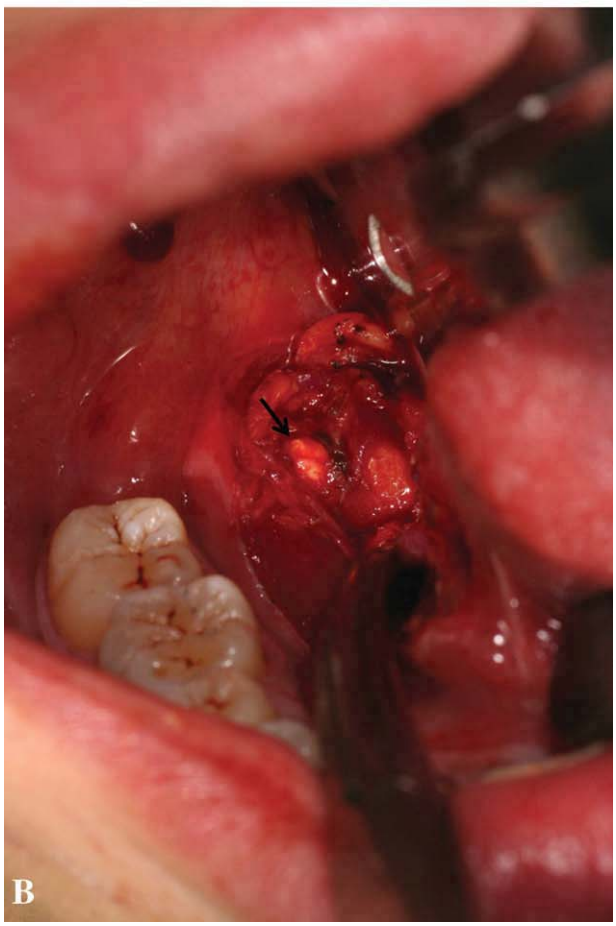


Fig. 1. Photographs showed computed tomography (CT) before surgery and operative procedure. (A) An axial CT demonstrated a stone in the hilum of right submandibular gland. (B) The stone (arrow) was exposed after incision of the Wharton's duct roof. [Color figure can be viewed in the online issue, which is available at wileyonlinelibrary.com.]

rates for stone removal are still variable and are worse for large stones than for smaller stones. Transoral removal of stones by incision of the duct over the stones has also been reported to be a successful treatment modality.[14] This surgical procedure is simple and has low morbidity; however, a small percentage of patients experience stone recurrence after removal.[15]

In our study, the mean stone sizes were 9.0 mm in the SMGR group and 5.2 mm in the IORS group, which is a significant difference. McGurk et al. stated that small stones that cannot be palpated are a contraindication for intraoral removal, but in our study, even though not all stones could be palpated, they were all successfully removed.[1] Removal of smaller proximal stones that cannot be easily palpated was facilitated by removal of the sublingual gland, which made it possible to directly palpate the proximal portion of Wharton's duct. We removed the ipsilateral sublingual gland during the procedure, although most other surgeons do not. We feel that removing the ipsilateral sublingual gland enhances identifications of Wharton's duct, the lingual nerve, and the locations of stones. Adverse effects caused by removal of the sublingual gland have not been reported.

Roh and Park reported that symptom recurrence and recovery of salivary function after stone removal were unaffected by the presence or absence of a neo-ostium.[16] In addition, they found that sialodochoplasty had no effect on postoperative outcome, suggesting that the presence of the neo-ostium might have a minimal effect in preventing symptom recurrence after complete stone removal. Furthermore, according to several reports, meticulous closure of the ductal incision might not be required to restore ductal patency or to prevent recurrence.[7,17] Although Capaccio et al. reported that they applied Surgicel Fibrillar to the incision site of the duct, we did not create a neo-ostium or repair the incision site of the duct.[17] No known complications occurred during the course of our study, and our results are consistent with those reported previously.

In our study, no patient complained of sensory changes around the tongue or floor of the mouth after surgery, in contrast to several other reports. This might be because we avoided manipulating the lingual nerve during the operation. By removing the sublingual gland, we also obtained sufficient operative fields so that traction of the lingual nerve was not necessary.

Intraoral stone removal resulted in significantly shorter hospital stays and operation times and less pain with no serious postoperative complications compared to those of traditional SMG resection. Our results demonstrate that intraoral removal of proximal submandibular stones with preservation of the gland and ductal system is safe and efficacious, and therefore is a valid alternative to traditional transcervical surgery.

This study had several limitations. The mean size between both groups was different. Although intraoral removal of smaller stones is more difficult than larger ones, the surgical outcomes can be different. We think that this is due to small sample size. In addition, there was not objective evaluation for the function of salivary gland

after surgery. However, we asked to patients about dry mouth and meal-time syndrome after surgery. These symptoms show the function of the salivary gland. No patient experienced dry mouth or meal-time syndrome, so we think that the salivary flow was intact after surgery.

CONCLUSION

Intraoral removal of proximal submandibular stones has several advantages over SMG resection in terms of hospital stay, mean operation time, and postoperative pain. We therefore recommend that our intraoral removal method replace SMG resection as the primary procedure for the removal of proximal submandibular stones.

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