Impact of stone characteristics and ductal anatomy on surgical treatment of submandibular sialolithiasis

Edward Tannenbaum BA[1], Claire Orth BS[1], Piper Wenzel BS[1], Benjamin Fick MD[2], Kailey Henkle MS[3], and Henry Hoffman MD MS[4]

1: University of Iowa, Carver College of Medicine; 2: University of Iowa Hospitals and Clinics, Department of Radiology; 3: University of Iowa College of Public Health, Department of Biostatistics; 4: University of Iowa Hospitals and Clinics, Department of Otolaryngology Head and Neck Surgery

IOWA Carver College of Medicine

Introduction

Salivary flow obstruction due to stones is termed obstructive sialolithiasis and is a common cause of gland swelling and pain.[1] It may be associated with xerostomia and can progress to infection with abscess formation.[1] Salivary stones occur at a frequency of approximately 10% of kidney stones and most commonly present in the submandibular gland.[1] Location, shape, mobility, and size of the calculi have been found to be factors in the management of salivary gland stones.[2]

- Density and composition of renal calculi, quantified by radiation attenuation measured in Hounsfield Units (HU) from CT analysis, have been reported as factors affecting the surgical outcomes of nephrolithiasis treatment.[3]
- There has been limited investigation evaluating the role of these factors in the management of salivary stones.
- Further research on the role of radiological parameters in the management of sialolithiasis could yield improved prognostication and patient outcomes.

Objective

Investigate the relationship between imaging characteristics of submandibular salivary ducts and stones with their surgical management.

Methods

Retrospective review of a consecutive series of patients who underwent surgical treatment for submandibular sialolithiasis between 2013 and 2018 at UIHC by a single surgeon.

- Focus on initial surgical treatment provided review of three categories: (a) 49 gland preserving procedures without the use of laser lithotripsy, (b) 7 gland preserving procedures with the use of laser lithotripsy, and (c) 26 gland resections.
- Data collected from electronic medical records included patient age, sex, density of stone in HU, stone volume, stone length (greatest linear dimension on CT imaging), number of stones, location of stones, procedure information, persistent symptoms, and subsequent treatment.
- Successful outcome was defined as relief of pain and swelling after the initial surgical treatment without need for subsequent treatment identified during the follow-up period defined.

Results

- Gland-preserving surgery was successful in 80% of cases (84% without laser vs. 57% with laser), while gland resection was successful in 100% of cases.
- No significant differences in stone density (p = 0.8) or volume (p = 0.5) were identified when comparing successful and unsuccessful outcomes.
- Shared decision making by the patient and surgeon leading to gland resection was associated with proximal stone location in 96% of patients and large stone length (>5 mm) in 73% of patients.
- Among the patients in the gland resection group with small to moderate length stones (≤ 5 mm), 86% were associated with ductal stricture or scarring.

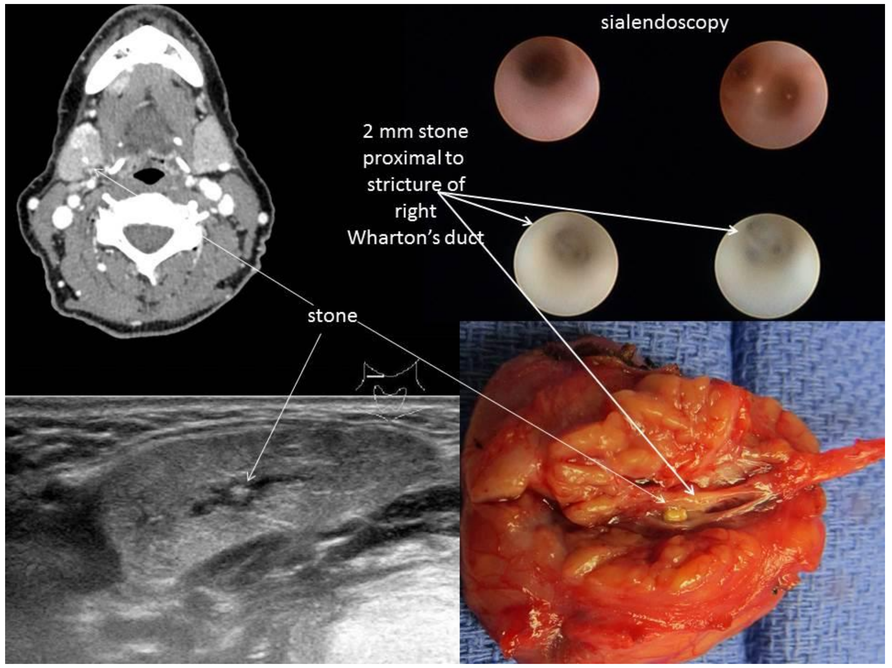


Figure 1. Small stone proximal to stricture in right Wharton's duct.[4]

Gland Preserving Without Laser			
Characteristic	Successful, N = 41[1]	Unsuccessful, N = 8[1]	p-value[2]
Number of stones			0.028
1	29	4	
2	6	1	
3+	1	3	
Location			
Intraparenchymal	2	2	0.12
Proximal	13	3	>0.9
Middle third	9	5	0.033
Distal	19	4	>0.9

[1] n;
[2] Fisher's exact test; Wilcoxon rank sum test; Wilcoxon rank sum exact

Discussion

- Proximal stone location and large stone length were identified as the primary indications for gland resection.
- The presence of multiple stones or stones located in the middle third of the submandibular duct may be associated with recurrent symptoms or the need for additional treatment following gland-preserving procedures performed without laser.
- Stone location, length, and ductal abnormalities were more important associations than stone density or volume in determining management options.
- Limitations of this study included selection bias, lack of long-term follow up, variations in HU measurements, exclusive review from a single surgeon at a Midwestern academic center, and relatively small number of patients who underwent procedures with laser.
- Future efforts may include multi-site, prospective studies with increased follow up duration and number of patients undergoing procedures with laser lithotripsy.

Conclusion

This series identified proximal location coupled with stone length and ductal abnormalities as factors influencing management toward sialoadenectomy. Stone density and volume may be less important factors in surgical planning.

Acknowledgments

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References

1. Badash I, Raskin J, Pei M, Soldatova L, Rassekh C. Contemporary Review of Submandibular Gland Sialolithiasis and Surgical Management Options. Cureus. 2022;14(8):e28147. Published 2022 Aug 18. doi:10.7759/cureus.28147
2. Koch M, Mantsopoulos K, Müller S, Sievert M, Iro H. Treatment of Sialolithiasis: What Has Changed? An Update of the Treatment Algorithms and a Review of the Literature. J Clin Med. 2021;11(1):231. Published 2021 Dec 31. doi:10.3390/jcm11010231
3. Molina WR, Marchini GS, Pompeo A, Sehrt D, Kim FJ, Monga M. Determinants of holmium:yttrium-aluminum-garnet laser time and energy during ureteroscopic laser lithotripsy. Urology. 2014;83(4):738-744. doi:10.1016/j.urology.2013.11.017
4. Salivary Stone Imaging Correlates. Iowa Head and Neck Protocols. May 20, 2017.Accessed July 12, 2026. https://iowaprotocols.medicine.uiowa.edu/protocols/salivary-stone-imaging-correlates