

Parotid gland sialolithiasis: clinical treatment and morphological characterization

Sialolitíase da glândula parótida: *tratamento clínico e caracterização morfológica*

Sialolitiasis de la glândula parótida: *tratamiento clínico y caracterización morfológica*

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ABSTRACT: Parotid gland sialolithiasis is a rare clinical condition. The aim of this study is to report a case of this disorder, emphasizing the clinical, imaging, and ultrastructural aspects related to the diagnosis and treatment of the condition. To report a rare case of parotid gland sialolithiasis, emphasizing the clinical, imaging, and ultrastructural aspects related to the diagnosis and treatment of the condition. This is a case report conducted in a specialized head and neck surgery service involving a 40-year-old male patient presenting with edema and pain in the left parotid region, worsened during mastication and before meals. The diagnosis was established through clinical examination and computed tomography of the paranasal sinuses, which revealed a radiopaque image compatible with a sialolith in the parotid gland. After diagnostic confirmation, the patient underwent surgical removal of the salivary calculus,

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followed by morphological analysis using scanning electron microscopy (SEM) and chemical characterization through energy-dispersive X-ray spectroscopy (EDS). Complete resolution of symptoms was observed, with no postoperative complications. Ultrastructural analysis demonstrated a non-crystalline surface with smooth and nodular areas, while EDS revealed a predominance of carbon, nitrogen, and oxygen, in addition to the presence of calcium, phosphorus, sodium, sulfur, and chlorine. It is concluded that the association between clinical evaluation, imaging examinations, and ultrastructural analyses assists in the diagnosis, morphological characterization, and therapeutic management of parotid sialolithiasis.

Keywords: Sialolithiasis. Parotid gland. Scanning electron microscopy. Computed tomography. Surgical procedures operative.

RESUMO: A sialolitíase da glândula parótida é uma condição clínica rara. O objetivo deste trabalho é relatar um caso dessa afecção, enfatizando os aspectos clínicos, imaginológicos e ultraestruturais relacionados ao diagnóstico e tratamento da condição. Relatar um caso raro de sialolitíase da glândula parótida, enfatizando os aspectos clínicos, imaginológicos e ultraestruturais relacionados ao diagnóstico e tratamento da condição. Trata-se de um relato de caso realizado em serviço especializado de cirurgia de cabeça e pescoço, envolvendo paciente do sexo masculino, 40 anos, com edema e dor em região parotídea esquerda, agravados durante a mastigação e antes das refeições. O diagnóstico foi estabelecido por exame clínico e tomografia computadorizada dos seios da face, que evidenciou imagem radiopaca compatível com sialólito em glândula parótida. Após confirmação diagnóstica, o paciente foi submetido à remoção cirúrgica do cálculo salivar, seguida de análise morfológica por microscopia eletrônica de varredura (MEV) e caracterização química por espectroscopia de raios X por dispersão de energia (EDS). Houve resolução completa dos sintomas, sem complicações pós-operatórias. A análise ultraestrutural demonstrou superfície não cristalina com áreas lisas e nodulares, enquanto a EDS revelou predominância de carbono, nitrogênio e oxigênio, além da presença de cálcio, fósforo, sódio, enxofre e cloro. Conclui-se que a associação entre avaliação clínica, exames de imagem e análises ultraestruturais auxilia no diagnóstico, caracterização morfológica e definição terapêutica da sialolitíase parotídea.

Palavras-chave: Sialolitíase. Glândula parótida. Microscopia eletrônica de varredura. Tomografia computadorizada. Procedimentos cirúrgicos operatórios.

RESUMEN: La sialolitiasis de la glándula parótida es una condición clínica rara. El objetivo de este trabajo es presentar un caso de esta afección, enfatizando los aspectos clínicos, imagenológicos y ultraestructurales relacionados con el diagnóstico y tratamiento de la condición. Relatar un caso raro de sialolitiasis de la glándula parótida, enfatizando los aspectos clínicos, imagenológicos y ultraestructurales relacionados con el diagnóstico y tratamiento de la condición. Se trata de un reporte de caso realizado en un servicio especializado de cirugía de cabeza y cuello, involucrando a un paciente masculino de 40 años, con edema y dolor en la región parotídea izquierda, agravados durante la masticación y antes de las comidas. El diagnóstico fue establecido mediante examen clínico y tomografía computarizada de los senos paranasales, que evidenció una imagen radiopaca compatible con sialólito en la glándula parótida. Tras la confirmación diagnóstica, el paciente fue sometido a la remoción quirúrgica del cálculo salivar, seguida de análisis morfológico mediante microscopía electrónica de barrido (MEB) y caracterización química por espectroscopía de rayos X por dispersión de

energía (EDS). Se observó resolución completa de los síntomas, sin complicaciones postoperatorias. El análisis ultraestructural demostró una superficie no cristalina con áreas lisas y nodulares, mientras que la EDS reveló predominio de carbono, nitrógeno y oxígeno, además de la presencia de calcio, fósforo, sodio, azufre y cloro. Se concluye que la asociación entre evaluación clínica, exámenes de imagen y análisis ultraestructurales contribuye al diagnóstico, caracterización morfológica y definición terapéutica de la sialolitiasis parotídea.

Palabras clave: Sialolitiasis. Glándula parotídea. Microscopía electrónica de barrido. Tomografía computarizada. Procedimientos quirúrgicos operativos.

INTRODUCTION

Sialolithiasis is a condition characterized by obstruction of the salivary gland due to calculi, known as sialoliths. It typically presents with edema and pain, and may progress to infection (Hammett; Walker, 2024; Musiał *et al.*, 2023). Small sialoliths are asymptomatic. It is a relatively rare disease in the parotid gland, with a frequency of 10% of cases, while in the submandibular gland it accounts for 87% of cases (Salzano *et al.*, 2025; Musiał *et al.*, 2023). Calculi are rarely observed in minor salivary glands, such as labial, palatine, and lingual glands (Wolf *et al.*, 2019; Hammett; Walker, 2024).

The majority of sialoliths are located in the distal third of the duct or the hilum of the gland (Reichel *et al.*, 2018). The annual incidence of larger salivary stones is estimated to be one per 10,000 to 30,000 individuals (Hammett; Walker, 2024; Musiał *et al.*, 2023). Studies indicate that sialolithiasis predominantly affects male patients aged 40 and above (Hammett; Walker, 2024; Salzano *et al.*; 2025). The etiopathogenesis of sialolith formation involves factors such as ductal obstruction, reduced salivary flow rate, dehydration, and changes in salivary pH, all of which can affect crystalloid solubility. Additionally, the formation of calculi is suggested by the retrograde migration of food particles, bacteria, or foreign bodies from the oral cavity into the salivary ducts (Reichel *et al.*, 2018; Musiał *et al.*, 2023; Sodnom-Ish *et al.*, 2023). Sialoliths are generally hard, pale-yellow concretions with a porous appearance and an oval or elongated shape (Hammett; Walker, 2024).

For sialoliths that do not respond to conservative therapy, parotidectomy may be necessary. This procedure has been refined with minimally invasive techniques for the extraction of large stones from salivary glands (Salzano *et al.*, 2026). Improvements in imaging diagnostics and the development of new endoscopes have led to a significant shift in therapy

in recent years, with conservative interventions now being more commonly performed in most cases (Wolf *et al.*, 2019; Salzano *et al.*, 2026).

Salivary sialoliths are predominantly composed of elements such as Ca, P, and small amounts of Mg, K, Na, Cl, Al, and Fe (Watanabe *et al.*, 2024). Studies on crystalloids in salivary duct cysts and in minor salivary glands have shown that sulfur compounds are one of the main components of the crystalloids (Sodnom-Ish *et al.*, 2023). In general, sialoliths consist of an organic and inorganic matrix, the presence of a central core, a peripheral laminar structure, and a main component of calcium phosphate (Watanabe *et al.*, 2024). There is still a lack of evidence regarding the specific cause of sialolith formation, indicating the need for more basic research on this topic.

The present work aims to report a clinical case and discuss the best treatment options within the clinical conditions of the diagnosis, based on the analysis of the chemical composition and micromorphology of the sialoliths using X-ray diffraction (EDX) and scanning electron microscopy (SEM). The SEM analysis was performed to determine, morphologically, whether there was a foreign body or organic materials causing the formation of a core in the center of the sialoliths.

This study was approved by the Research Ethics Committee of Hospital Municipal São José (HMSJ), Joinville, Santa Catarina, Brazil, under protocol number 6.173.762, and written informed consent was obtained from the patient for publication of the clinical data and images.

CASE REPORT

A 40-year-old male patient presented for a dental evaluation, reporting edema and pain on the left side of the face, specifically in the middle third of the mandibular branch, with increased intensity before meals and during mastication. However, the edema would subside upon massaging the area. The patient reported a progressive worsening of symptoms over the past 5 years.

In the medical history, the patient reported that massaging the area externally led to the expulsion of a large amount of salty salivary flow, and this salivary flow was intense when he felt hungry. The patient's medical history included treatment for renal and biliary calculi,

with no other significant comorbidities. He was not taking any ongoing medications and denied the use of tobacco and alcohol.

The intraoral physical examination revealed Fordyce spots on the buccal mucosa and lips. The patient had good oral hygiene, and there was a noticeable prominence of the parotid duct papilla.

During the extraoral physical examination, an enlargement in the middle third of the mandibular branch was noted. Palpation revealed a firm, stony, and non-fluctuant mass, suggestive of potential parotid duct obstruction. No edema was present at the time of examination (Figure 1). Gentle compression of the gland revealed reduced salivary flow compared to the contralateral side.

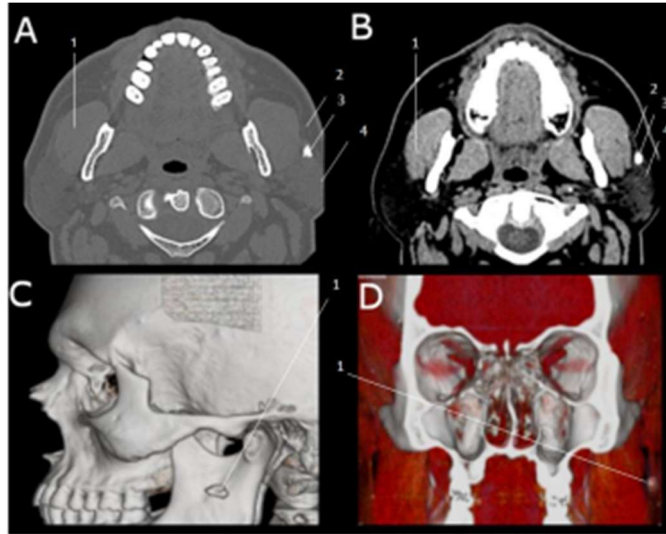
Following the evaluation, sialolithiasis of the parotid gland was considered the diagnostic hypothesis. A Computed Tomography (CT) scan of the facial sinuses was ordered to confirm the diagnosis. Upon review of the CT scan, the patient returned for further evaluation, which revealed a radiopaque image located in the middle third of the mandibular branch (Figure 2).

Figure 1 – Patient profile for external evaluation. Palpation revealed an enlarged mass, approximately 5 to 10 mm in diameter, with a firm, stony, non-fluctuant consistency.



Source: The author (2026).

Figure 2 – Computed Tomography (CT) scan of the Facial Sinuses.

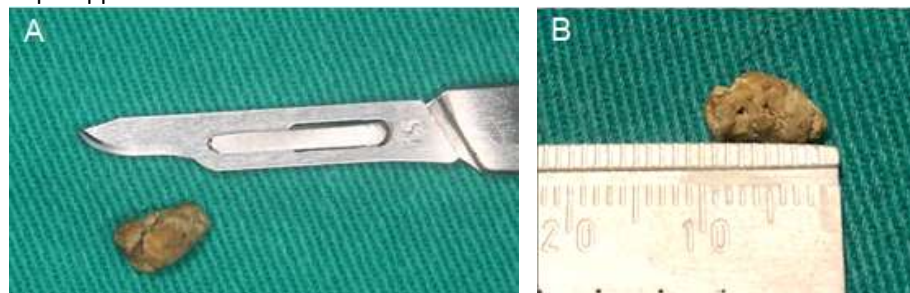


Nota: Image A1 and B1, Right Parotid Gland; image a2 and B2, Left Parotid Duct; image A3 and B3, radiopacity suggestive of a calculus (sialolith); image A4 and B4, Left Parotid Gland; image C1, well-circumscribed and solid image of a possible sialolith, located in the mandibular branch; image D1, coronal view showing a radiopaque image characterizing a possible sialolith.

Source: The author (2026).

The patient was referred to the otolaryngology and head and neck surgery department, where the sialolith was surgically removed (Figure 3). The patient remained asymptomatic throughout the follow-up period.

Figure 3 – Macroscopic appearance of the removed sialolith.

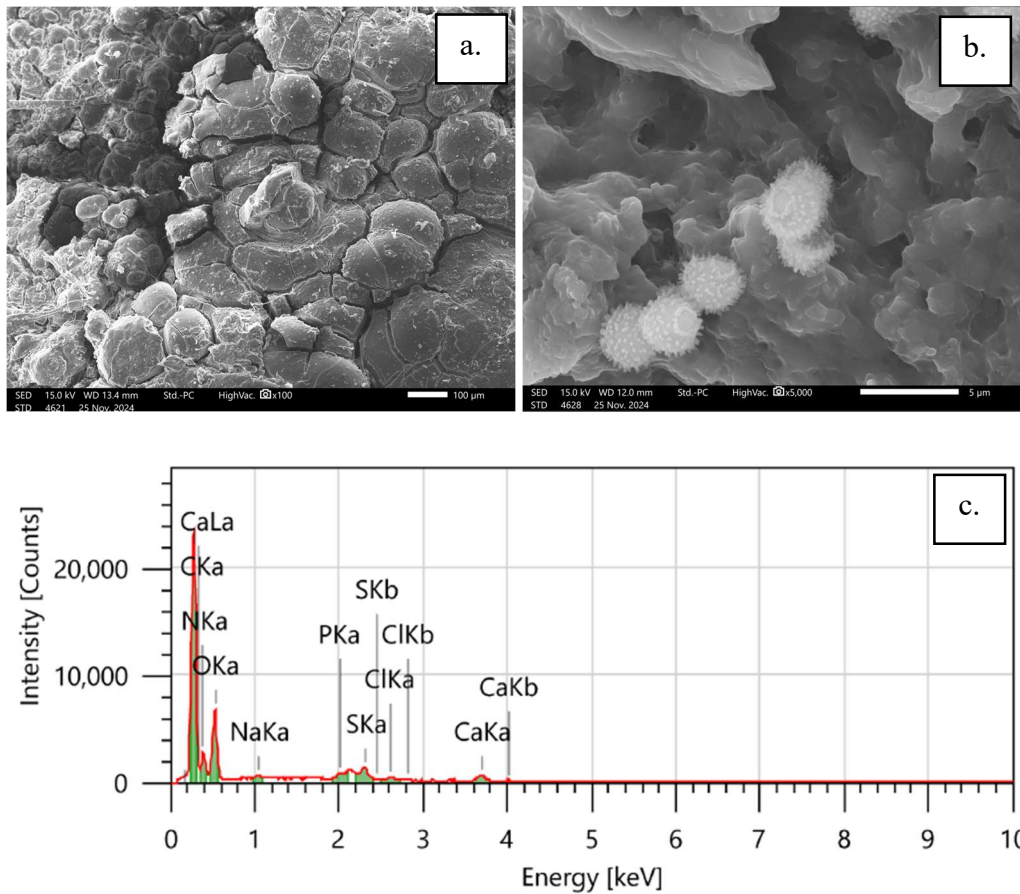


Nota: A and B: Removed sialolith.

Source: The author (2026).

The morphological characteristics of the calculi were examined with SEM, while the elemental distribution and the mean atomic weights were measured by EDS. The SEM analysis of the external surface revealed a calculus with a non-crystalline surface, featuring knobs and smooth areas (Figure 4a and 4b), while the EDS analysis of the external surface detected carbon (C), nitrogen (N), oxygen (O), sodium (Na), phosphorus (P), sulfur (S), chlorine (Cl), and calcium (Ca) (Figure 4c).

Figure 4 – Scanning electron microscopy of the sialolith (A and B) and Energy dispersive X-ray analysis: carbon peaks (C)



Source: The author (2026).

DISCUSSION

The removal of a sialolith from the parotid gland is typically performed after confirming the diagnosis, which involves not only a thorough patient history but also intraoral and extraoral clinical examinations, as well as imaging studies such as a CT scan of the facial sinuses and, when available, sialography.

Goncalves *et al.* (2021) suggest ultrasonography as a valuable imaging modality for cases with suspected ductal inflammation or stenosis, assisting in both diagnosis and treatment planning. In this case report, the patient showed no signs of inflammation or associated pathology in the parotid gland, so the imaging studies performed were adequate for diagnosis.

Sialendoscopy and sialolithotripsy are considered preferred conservative treatments due to their minimal complications. However, each case should be carefully evaluated to

determine the most appropriate treatment approach, considering factors such as the size, mobility, consistency, and location of the sialolith (Galdermans; Gemels, 2020).

Most sialoliths present a diameter between 2.1 and 10 mm, with only a small proportion (7.6%) exceeding 15 mm (Hammett; Walker, 2024). For calculi located in the parotid gland measuring less than 7 mm, extracorporeal shock wave lithotripsy (ESWL) is considered a highly effective second-line intervention when isolated sialoendoscopy fails, allowing fragmentation of the calculus for subsequent removal using endoscopic baskets or forceps (Hammett; Walker, 2024; Salzano *et al.*, 2026).

The submandibular gland is the most affected by sialolithiasis (85% of cases) due to its more viscous, alkaline saliva and higher concentration of calcium and phosphate salts, factors that favor mineral precipitation (Hammett; Walker, 2024). Although hydroxyapatite represents the main inorganic component of sialoliths, energy-dispersive spectroscopy (EDS) analyses have demonstrated that the central core (nidus) and peripheral layers may present high concentrations of carbon, nitrogen, and oxygen (Sodnom-Ish *et al.*, 2023). These elements reflect the presence of an organic matrix composed of inflammatory exosomes, bacterial biofilms, and cellular debris, which act as the initial substrate for progressive calcification (Sodnom-Ish *et al.*, 2023; Musiał *et al.*, 2023). Increased levels of proteins and nitrogenous compounds in saliva also appear to play an important role in the formation of these organic structures capable of trapping mineral crystals (Musiał *et al.*, 2023).

Initial treatment of sialolithiasis should be conservative, including the use of sialogogues, local massage, and nonsteroidal anti-inflammatory drugs (NSAIDs) to stimulate salivary flow and reduce glandular edema (Hammett; Walker, 2024). Pain and glandular swelling generally present a cyclical pattern, worsening during food stimulation and regressing after ductal obstruction is relieved. However, prolonged salivary stasis may favor secondary bacterial infections (Hammett; Walker, 2024).

Most sialoliths range from 2.1 to 10 mm in diameter, with only a small proportion exceeding 15 mm (Hammett; Walker, 2024). In calculi located in the parotid gland measuring less than 7 mm, extracorporeal shock wave lithotripsy (ESWL) represents an effective minimally invasive alternative, especially when isolated sialoendoscopy is unsuccessful. In such cases, fragmentation of the calculus enables subsequent removal using endoscopic baskets or forceps (Hammett; Walker, 2024; Salzano *et al.*, 2026).

Surgical removal becomes the treatment of choice when the sialolith exceeds 7 to 10 mm or is impacted, since calculi of this size rarely respond to conservative therapy or shock wave fragmentation alone (Hammett; Walker, 2024). Endoscopy-assisted techniques have demonstrated success rates of up to 93% in the removal of complex calculi larger than 6 mm while preserving glandular function and minimizing risks to the facial and lingual nerves (Salzano *et al.*, 2026). In the present case, the sialolith measured more than 7 mm, which is why surgical removal was considered the most appropriate therapeutic approach, resulting in complete resolution of symptoms and absence of postoperative complications during follow-up.

The mechanisms of sialolith formation are still not well defined in the literature, but microscopy results suggest that the increased content of proteins and urea in saliva may be important in the context of sialolith formation. Therefore, despite the lack of high calcium and phosphorus levels in this study, the predominant composition of C, N, and O can be explained by the presence of urea and proteins, which are organic components that play a relevant role in the formation and composition of saliva and, possibly, the stones.

CONCLUSION

Sialolithiasis of the parotid gland is relatively rare. Accurate diagnosis is crucial for determining appropriate treatment and prognosis, which includes patient history, intraoral and extraoral clinical examinations, imaging studies, and precise analysis of reports. Determining the most appropriate treatment is essential, and when necessary, patients should be referred to specialized services for optimal care.

AUTHOR CONTRIBUTIONS

Conceptualization: Pedack, F. R.; Rosa, M. E. **Methodology:** Pedack, F. R.; Pickler, J. G. **Investigation:** Pedack, F. R.; Gonçalves, J. M. **Data curation:** Pickler, J. G. **Formal analysis:** Rosa, M. E. **Visualization:** França, P. H. C. **Writing – original draft:** Pedack, F. R.; Silva, B. L. **Writing – review & editing:** Silva, B. L.; Pedack, F. R.; Rosa, M. E.; Coelho, K. M. P. A. **Supervision:** Coelho, K. M. P. A.; França, P. H. C.

COMPETING INTERESTS

The authors declare that there is no conflict of interest.

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DECLARATION OF GENERATIVE AI IN SCIENTIFIC WRITING

The authors declare that they did not use generative artificial intelligence tools in the writing, analysis, or revision of this manuscript.

REFERENCES

GALDERMANS, Maarten; GEMELS, Bert. Success rate and complications of sialendoscopy and sialolithotripsy in patients with parotid sialolithiasis: a systematic review. **Oral and Maxillofacial Surgery**, v. 24, p. 145-150, 2020.

GONÇALVES, Miguel *et al.* Ultrasound in the diagnosis of parotid duct obstruction not caused by sialolithiasis: diagnostic value in reference to direct visualization with sialendoscopy. **Dentomaxillofacial Radiology**, v. 50, n. 3, p. 20200261, 2021.

HAMMETT, Jonathan T.; WALKER, Christopher. Sialolithiasis. In: **Statpearls** [Internet]. Treasure Island (FL): StatPearls Publishing, 2024.

MUSIAŁ, Natalia *et al.* Proteomic analysis of sialoliths from calcified, lipid and mixed groups as a source of potential biomarkers of deposit formation in the salivary glands. **Clinical Proteomics**, [s. l.], v. 20, n. 11, 2023.

REICHEL, C. A. *et al.* Ultrasound elastography in diagnosis and follow-up for patients with sialolithiasis. **Dentomaxillofacial Radiology**, v. 47, n. 7, p. 20170424, 2018.

SALZANO, Giovanni *et al.* Parotid gland sialolithiasis: a comprehensive systematic review and meta-analysis. **European Archives of Oto-Rhino-Laryngology**, [s. l.], v. 283, p. 1337–1352, 2026.

SODNOM-ISH, Buyanbileg *et al.* Identification of biological components for sialolith formation organized in circular multi-layers. **Scientific Reports**, [s. l.], v. 13, n. 12226, 2023.

WATANABE, T. *et al.* Sialolithiasis of minor salivary glands in multiple areas of the lips: scanning electron microscopy and energy dispersive X-ray spectroscopy analysis. **Journal of Oral and Maxillofacial Surgery, Medicine, and Pathology**, 2024.

WOLF, Gregor; LANGER, Christine; WITTEKINDT, Claus. Sialolithiasis: aktuelle Diagnostik und Therapie. **Laryngo-Rhino-Otologie**, v. 98, n. 11, p. 815-823, 2019.