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Review Article

"SAILOLITH" - A MEAL TIME SYNDROME? - A REVIEW

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A R T I C L E I N F O

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A B S T R A C T

Calcifications are of different kinds, when they are found in salivary gland its termed as sialolithiasis. They are found more in submandibular gland, more in males of adult age group. Clinically they are oval to round shaped swelling present associated with the gland intraorally. Salivary gland stones are quite often found during aradiographic examination. They are treated more in a conservative mode, rarely as a surgical approach wherein a glandular resection is done. Most modern treatment strategies are used in treating salivary gland stones.

INTRODUCTION

Sialolithiasis is caused by the obstruction of a salivary gland or duct by the formation of calcareous concretions or sialoliths.[1-12]The process is self-limited as in with viral parotitis or mumps, but in others it may be a relapsing and remitting illness, such as chronic sialadenitis. Sialolithiasis, or salivary gland calculus, is the terminology used to describe the formation of calculi, or sialoliths, within the excretory salivary ducts or the glandular parenchyma. These are more commonly found in major salivary glands, being associated to the submandibular gland in 80%, the parotid gland in 6-20% and the sublingual or minor salivary glands in only 2% of cases[13]. Sialolithiasis is the second most common disease of the salivary glands after mumps[14]Sialolithiasis is commonly occurs in adults, mounting to 30% of all salivary gland diseases. However it can also occur in children, but the frequency is rare when compared to adult population and accounting to 3% of the population.[15]Sialolithiasis is a common salivary gland disorder characterized by the obstruction of the salivary secretion, accounting for approximately one third of salivary gland disorders.[16-19]Exact etiology is still not known. There are many hypotheses put forth regarding this disorder[16]. Despite the large number of hypotheses, the mechanisms of formation and development of the sialoliths within the salivary gland ducts or/and parenchyma remain unexplained[20]. These hypotheses include the agglomeration of sialomicroliths, anatomical variations of the salivary ducts and an altered biochemical composition of saliva. It is considered that salivary stasis or decreased salivary flow contributes to the precipitation of calcium.[16]Sialoliths most commonly occur in the submandibular gland rarely occurring in the parotid glands and other salivary glands.[21] According to Levy, *et al*, the prevalence of submandibular gland sialolithiasis is 80% in submandibular, 19% in the parotid and 1% in the sublingual glands.[22] It's more common in males with a male to female ratio of 2:1 and the incidence is high in the third to sixth decade of life. Sialoliths causes obstruction of salivary flow and episodes of local pain and edema, especially during meals[23]. Although their pathogenesis remains unknown, sialoliths are constituted by the deposition of calcium-rich salts around a central nidus, which may consist of desquamated epithelial cells, foreign bodies, or bacteria and their decomposition products.[24]Salivary calculi are usually unilateral in occurrence and round to oblong, have an irregular surface in most of the cases, vary in size from a small grain to the size of a peach pit, and are usually yellow.[25]

Theories

Although the etiology is still unknown: higher mucus content, greater degree of alkalinity, concentration of calcium and phosphate salts, longer duct and saliva flows against gravity are considered as the etiological factors.[26] Other factors that predispose to stasis in the Wharton duct (eg , an uphill course, a dependent gland, a wider lumen, and a tighter orifice) may play a role as well.[27]Stones apparently develop as a result of an initial organic nidus followed by the deposition of inorganic material, both of which are derived from the salivary fluid[28].Sialolith formation is more likely to occur in the submandibular gland due to its anatomic position requiring the salivary flow against gravity, longer and more tortuous duct and production of alkaline saliva rich in mucin. Most submandibular calculi are detected as radiopaque formations in plain radiographs and as radiolucent filling defects in sialogrphy.[29]More than 80% of all sialoliths are localized within the duct system of the submandibular gland and only 20% within the parotid gland. Approximately 90% of

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submandibular stones are situated in the distal portion of the Wharton duct or at the hilum.[30]Submandibular sialoliths are more common because the duct of this gland is longer, has antigravity flow, and less caliber compared with that of the parotid gland. The course of the duct is said to serpentanoius, which favor for the formation of stones .[31,32]This anatomic predisposition can be supported by the retrograde theory explained by Marchal *et al*, which says, retrograde migration of food particles, foreign bodies or pathogens ascending from the oral cavity into the salivary ductal system subsequently can act as a nidus[33,34]Generally the retention of saliva in the duct results in the formation of nidus for the formation of a stone .The muscular structure is so that in some areas it might help for the nidus formation , a study done by Yu *et al*, have reported this by doing sialednescopy on salivary duct .He found out a sphincter mechanism in the duct which act like a valve which prevent foreign body from entering in to the dome of the duct .so this anatomic variation can help in the formation of a nidus [35]. Intermittent stasis produces a change in the mucoid element of saliva, which forms a gel like matrix. This gel- matrix formed will act as a framework for the deposition of salts and organic substances, from the saliva, forming a nidus, which further forminga stone[36].

Harrison *et al.*'s theory says that it is subsequently seen after sialidenitis and also depends on the duration of the symptoms of sialidenitis. Chronic inflammation can result in stasis of the secretion in the duct which can result in formation of stone. The saliva flow in the submandibular gland is unlike the gravity of the earth and contains a large amount of mucin proteins. The calcium and phosphate content of the submandibular saliva is higher than other glands.[37] Gout is the only systemic illness known to predispose to salivary stone formation although in gout[36].

Formation theories

1. Formation occurs in two phases: a central core and a layered periphery. The central core is formed by the precipitation of salts, which are bound by certain organic substances. The second phase consists of the layered deposition of organic and nonorganic material.
2. Proposed that an unknown metabolic phenomenon can increase the saliva bicarbonate content, which alters calcium phosphate solubility and leads to the precipitation of calcium and phosphate ions.
3. Aliments, substances, or bacteria within the oral cavity might migrate into the salivary ducts and become the nidus for further calcification.
4. Parotid stones form after an inflammatory condition of salivary gland, whereas submandibular occurs around a nidus.

Submandibular gland calculi formation can be attributed to its because its viscous, mucous and more alkaline mode of saliva with a relatively high concentration of hydroxyapatites and phosphates which predisposes to the precipitation of salts. Moreover, the opening of Wharton's duct is narrower than the diameter of the whole ductand the duct ascends towards its opening, which is also favours for to saliva retention[38]
According to Hiraide, a foreign body or microorganism acts as a nucleus of initial stone formation. Takeda proposed a different mechanism with which the crystalloids present in the parotid gland may aggregate to form nuclei of calculi. Harrison explained that it might be as secondary to sialidenitis[39]. Recently the effect of tobacco on stone have been made as topic of interest. Tobacco in the form of smoking caused an increase in cytotoxic effect of saliva decreased polymorphonuclar cell activity or ability and a reduction in salivary amylase andsalivary proteins like peroxidase[40]. Association of serum electrolytes and the effect of smoking enhances for the formation of stone[41-46].

Biochemical composition

Insight to the biochemical composition of salivary stones might provide information to clarify the etiopathogenesis of salivary stones, to facilitate diagnosis, to prevent formation and to improve treatment. Salivary stones usually have a yellow or yellow-brown colour, and vary greatly in size and weight. The weight of the sialolith is significantly related to the age of the patient. This might relate to age-related changes in circulating serum levels of phosphate. This was shown in a study done by Saskia Kraaij *et al*. Several literatures are available which have reported that the serum phosphate levels are significantly lower in adults above the age of 50 years. Phosphate acts as crystallization inhibitor therefore, reduced circulating levels of phosphate could result in less inhibition of crystallization, resulting in larger sialoliths in older individuals. However an opposite phenomenon was noted in a study done by Saskia Kraaijetal, which h justified by giving time as a factor for the development of sialoliths[47]. The weight of salivary stones varies from 1 mg to almost 6 g, with an average weight of 300 mg, submandibular stones are slightly larger than parotid stones. When the diameter is 15 mm or more in any direction or when the weight is 1 g, termed as giant stones and are usually seen in glandular parenchyma, rather than in any ducts. The shape depends on from where they are originating, elongated in case of in ducts,as the ductal system are mostly elongated, whereas stones originating from the hilus or gland are round or oval[48]. Different studies show that there is a size variation from 0.1 to 30 mm. However, Drage *et al*. have reported a mean size of up to 3.4 mm (range from 1.5 to 9 mm) for the parotid and submandibular stones, and a mean number of 1.67 stones (range from 1 to 5) per patient[49].They rarely measure more than 1.5 cm. Mean size is reported as 6 to 9 mm, giant ones are rare and are put under the size of 3.5 cm or larger , the largest one reported in literature goes up to 70mm and has a "hen's egg" shape located in whartons duct. Here are also giant stone seen in thru hilum of submandibular gland, 40 mm,.[19-21]

The exact etiopathogenesis of salivary calculi is unknown but as a general rule all the sialoliths are composed of an organic and inorganic matrix part and present a highly mineralized cores surrounded by concentric alternating mineralized and organic layers. Various studies have put forth explaining about the microstructure of these sialoliths. Depending upon which gland had it originated the microstructure varies greatly. A study was done by Yeong-GwanImetal, using scanning electron microscopic (SEM) evaluation and energy-dispersive X-ray spectroscopy (EDX). The highly mineralized amorphous core surrounded by lamellar and concentric structures was revealed. Specific structures and patterns are also explained having numerous microstructures like nodular, laminar, reticular and micro granular .Indefinite patterns include partly and rudely hexagonal, needle-like and plate-shaped crystals and sizes arranged in haphazard fashions.

Some may even show no inner layer with concentric ring like formulations.[50]

Various authors had studied about the composition of composition of sialoliths of salivary glands. For instances, Taher etal studied salivary gland stones from 95 subjects and found the composition to be 89.8% phosphate salts (hydroxyapatite), 7.9% oxalates, and 2.3% urate salts. In contrast, Kasaboğlu *et al*. conducted studies on six subjects sialoliths in which all of them contained large amounts of calcium phosphate salts (mostly hydroxyapatite). Stelmach *et al*. did their study on sialoliths from upon 46 subjects and reported the presence of C, Ca, O, P, and S[51]. However the inorganic matrix part was still in ingenuity regarding its composition. A study conducted by Osuoji *et al*, found that only 5% of the organic phase was soluble in water after demineralization. Studies conducted using electron microscope have suggested development of a core formation from organic matter and microorganisms. However microorganisms have been found in the periphery and not in the nucleus part of the sialoliths .On the contrary various studies conducted in this regard could not route the sialoliths formation due to any microorganism or bacteria. Hence most studies conducted point to the fact that sialoliths are composed of mainly different salts of Ca and P. In a study using Fourier transform infrared, FT-Raman, and fluorescence spectroscopic techniques, the ratio of the major elements of a sialolith was calculated and it was 7:3 for Ca and P. In addition to this small amounts of Mg, Na, Cl, Si, Al, Fe, and K are also found [50].Submandibular and parotid sialoliths consist of an amorphous, mineralized cent core or nucleus, with concentric laminated layers or shells of organic and inorganic substances, of which the nucleus measures 0.5 to 1.5mm in size .The nucleus part is soft compared to other parts. The material present in the stone varies greatly, with respect to the contribution of the arterial. The organic shell matrix varies greatly in different parts of sialoliths from 23 to 100%. Mainly the inorganic matrix comprises of calcium phosphates, either as hydroxyapatite or carbonate apatite, so 20% of weight is contributed by tis organic part .whereas organic part consists of mainly, collagen, neutral and acid glycoproteins, other proteins, lipids and carbohydrates such as glucose and mannose. The weight of any stone is more defined by the inorganic part of the matrix. Submandibular stones contain between 70–80% and parotid stones around 50%. The mineral component is proportional to the size of the sialoliths, indicating that the process of mineralization is an ongoing process, as with the time passes. Hydroxyapatite ($Ca5(PO4)3OH$) is present in all submandibular stones, frequently together with whitlockite($Ca3(PO4)2$). Octacalciumphosphate($Ca8H2(PO4)6.5H2O$)and brushite ($CaHPO4.2H2O$) are less often identified. Whitlockite is especially found in sialoliths from Wharton's duct and often present in the nucleus. Even Parotid salivary stones show the presence of hydroxyapatite crystals in hem just like submandibular stones. The frequency of Whitlockite and octacalcium phosphate crystals presence is more in parotid when compared to submandibular stones. The inorganic components of minor quantity include, potassium, sodium, ferrum, silicon, brimstone and chloride. Lipids and proteins are other organic components present in stones. the proteins consists of 5% weight in submandibular stones , whereas the presence of lipids are not consistent with weight as compared to proteins . As with proteins, the submandibular matrix show much more compared to parotid stone matrix. This has been studied and showed by a technique called immunoblotting techniques, where the authors observed a large, unidentified glycoprotein in solubilized submandibular sialoliths .The presence of low molecular weight proteins are also studied and recorded .All these proteins are calcium loving proteins and are present in human submandibular saliva and are bound to calcium ions in sialoliths. Amino acids analysis of proteins in submandibar stones show, high amount of alanine, glutamine, and aspartic acid. Whereas Lysine, proline, methionine, cysteine, phenylalanine, tyrosine and threonine were present in lower amounts. Lipids are shown to be present in the organic matrix of both submandibular and parotid sialoliths. The lipid content is directly related to weight of the stones.[52]

Neutrophil Extracellular Traps

The mechanism that leads to the formation of sialoliths has still been elusive. Various concepts have been discussed ranging from altered ion concentrations in saliva to the presence of bacteria or foreign bodies in the ducts to micro-calcifications of cell debris ejected from salivary gland cells. The variation in salivary content in different glands vary depending upon the physiology. Hence this is another causative factor for stone formation in glands. Saliva of parotid glands contains less calcium ions than those of submandibular glands, making the former less susceptible to the formation of concernments. Hence this can be said by the fact that Parotid sialoliths have an average size of 6.4 mm (range 1–31 mm) and contain more organic and less inorganic compounds than submandibular stones, which have an average size of 8.3 mm (range 1–35 mm).The nervous system also has some role to play as the secretion is completely dependent on autonomous system and has been demonstrated in studies conducted in study animals. In patients having recurrent parotid infection the stone formation is noted compare to others .All the above said factors contribute to the formation of stone formation however the growth of it is still in dispute: many theories have been put forth, one among them are the neutrophil extracellular trap formation is an essential step for formation .This trap formation is a type of inflammatory repose wherein when the neutrophils contact with crystals tries to form the nidus for the stone formation. Crystals and other danger signals (i.e., bacteria) are potent attractors for neutrophils, inducing their activation and NET formation. In the salivary glands, neutrophils enter theductal system, which are having some sort of bacteria, foreign bodies, and other chemo attractive factors as complement, which initiate the formation of a nidus. By externalization of their chromatin, neutrophils form neutrophil extracellular traps (NETs)[53]. Some other study using PCR method found the presence of bacterial DNA mainly oral commensals.[54]

Imaging modalities

The algorithm for imaging the salivary glands depends on the clinical scenario with which the patient presents. Imaging plays a very crucial role in the diagnosis of cause, extent and effects of obstruction related to any salivary gland disorders. Various imaging modalities are being adopted depending upon the clinical need and works on different principles. It's solely the clinician role to choose what modality suite his clinical case. Since sialolithiasis may have a variety of manifestations, CT should can be the mainstay of imaging [55-56]. Sialography an ancient methodology to view salivary gland and is associated structures is an excellentmodality for demonstrating ductal anatomy and the presence of stones and strictures. The addedadvantage of sialogrphy is that an assessment of the interventional sialogrphy procedures can be carried out using different dyes that can demonstrate any stones, or blockage or structures in the ductal system[57].

Various imaging modalities ainclude sialogrphy with iodinated contrast material, sonography, CT, MR sialography, cone-beam CT, and sialendoscopy. Intraoral radiographic methods are among others, which are common methods. Except for sonography and MR sialography, all methods are requirex-ray exposure. The USG is based on the principle of sound waves, hence it has its own limitations, on various parameters. However, it is an operator-dependent imaging and may be inaccurate in detecting stones smaller than 2 mm.[58] Sialoliths are an incidental findings on the radiographic image whether it may be intraoral or extraoral. Sometime patients come with signs and symptoms or else it may be incidental findings on the image. Sonograph can be recalled as common man way to find a stone at much cheaper cost when compared to other modalities. Since it does not use any ionizing radiation its use is most recommended. And also because of its availability, lack of invasiveness and low cost sonography is widely used by radiologists[59]. Both panoramic and occlusal radiographic techniques displayed satisfactory diagnostic performance and should be considered before using a CT/CBCT scan to detect submandibular sialoliths[60].

Conventional radiographs have been used for detecting sialoliths however, but since these may be poorly calcified then it may be not picked up by these techniques. Superimposition of these images over the mandible may be another problem and also the soft tissue contrast cannot be made out. A standard or crossectional occlusal technique can be used for its visualization if it is located in the glandular parenchyma; otherwise, other imaging examinations allow a better visualization. So it can be said that a 20% of cases can be visualized using these 2D methods .Volume acquisition is a significant stage which helps to plan the strategically approach to treatment planning so this involves a 3D reconstruction. Current works have provided a growing concern in using the 3D reconstruction adding detailed spatial/structural information for the presurgical planning in different case like odontogenic carcinoma, renal tumors, and other lesions. Even more precise modalities were employed for the image production and reconstruction so came the high contrast technology, where all the sections can be created in one sitting but this paused a problem of high exposure to radiation in ore areas than needed[61]. CBCT has been recently become widespread in maxillofacial radiology due to its high resolution and low radiation dose. The CBCT scanner uses acone-shaped X-ray beam with two-dimensional detectors and collects data by means of a single rotation around the patient taking 9-40 seconds. The reconstruction is then processed and the resultant image matrix is isotropic. The software of the system provides various processed images such as multiplanar reconstruction, volume rendering MIP, cross sectional, and partial panoramic images. Due to the isotropic voxels the images of the anatomic structures can be reconstructed clearly and accurately in any plane.[62]When soft tissue visualization matters the MRI system stands out to be the most suitable modality. The sensitivity and specificity for CBCT are superior and are comparable to the most favorable results for 3D imaging modalities such as medical CT and MRI sialography[63]. The lack of soft tissue landmarks makes it much challenging to mark the exact position of these sialoliths when compared to a CT image. CBCT images do no show whether the calcification is inside a soft tissue lesion, such as a malignant neoplasm, which is one of the differential diagnoses. Many literatures have reported this factor as shortcoming of this modality.[64] However compared with conventional techniques, CBCT was highly sensitive in showing the location and size of sialoliths. Due to inherent factors, panoramic images could be both distorted and magnified, which means that unreliable results could be produced when measuring distance on panoramic x-rays, even when the magnification factor is known. Whereas the advantage of CBCT is that it creates images that are not only dimensionally stable, and also anatomically accurate[65]This could be the factor adopted for its various the uses in diagnostic purposes in dentistry. This maybe also attributed to factor that cross-sectional imaging advantage of CBCT so it become the first choice for accurate diagnosis [66]CBCT allows acquisition of high-quality images using lower doses of radiation along with multi-planar reformations rendering precise diagnosis for an effective treatment planning .[67.] CT and CBCT system have shown to be of limited value in visualizing the ductal system. This may be due to poor soft tissue contrast. By applying high-resolution imaging protocols, 3D medical CT can successfully display even the smallest or semicalcified calculi[68] .

Superior image quality, high sensitivity and specificity leading to improved diagnostic ability, reduced radiation dose which ensures patient and operator safety, ability to capture the desired specific maxillofacial field of interest, thus providing a quick scan process, makes CBCT the preferred imaging modality and a preferred diagnostic tool in early detection of various oral and maxillofacial pathologies[69] . Using much higher modalities like medical CT with contrast can ensure much more clarity regarding the sialoliths as reported in various literatures. CT values and the salivary gland excretion fraction measured using scintigraphy in the submandibular glands seemed to be useful tools evaluating submandibular sialolithiasis [70].

Image volume analysis is a fundamental need in many conditions which can aid a lot in treatment planning stragies. Tomographic images can be processed into 3D images with the help of latest advanced medical technologies , contributing in to knowledge of the area and leading to an effect similar to anatomical structures and the own operative condition to be considered.3D reconstruction for surgical approach is another modality adopted in higher centers. 3D reconstruction is convenient as an assisting tool in the preoperative planning, thus optimizing the surgical access and facilitating the recognition of the lesion's shape for volumetric analysis[71].

The management of salivary stones is focused on removing the salivary stones and preservation of salivary gland function which depends on the size and location of the stone. Conservative management of salivary stones consists of salivary gland massage and the use of sialogogues[72].

Two methods are commonly involved in management of a stones: noninvasive and invasive method. Medical management consists of gland message and antibiotics in case of infection. Invasive approach mainly consist of surgical approach with or without the use of visualaids[73] .Nearly all intraductal submandibular and parotid stones can be removed by a relatively simple intraoral approach under local anesthesia. Various modalities are used like lithotripsy, sialendoscopy or surgical removal[74]

The aim of the treatment is for mending the normal flow of salivary secretion. Large stones can impede the salivary flow for long time inducing irreversible damage to the gland parenchyma. However, as the stones are removed the gland can revert back. Sialodochotomy is a procedure done intraorally for the elimination of ductal sialolith, including the giant sialoliths. Potential issues comprise stenosis of the duct and damage to the lingual nerve. Submandibular gland excision is advocated in substantial intra-glandular sialolith, which cannot be approached through a transoral approach. Though advanced treatment modalities are available today for the management of giant sialolith, by transoral sialolithotomy with sialodochoplasty or sialoadenectomy still continue to be the cornerstone of treatment[75].

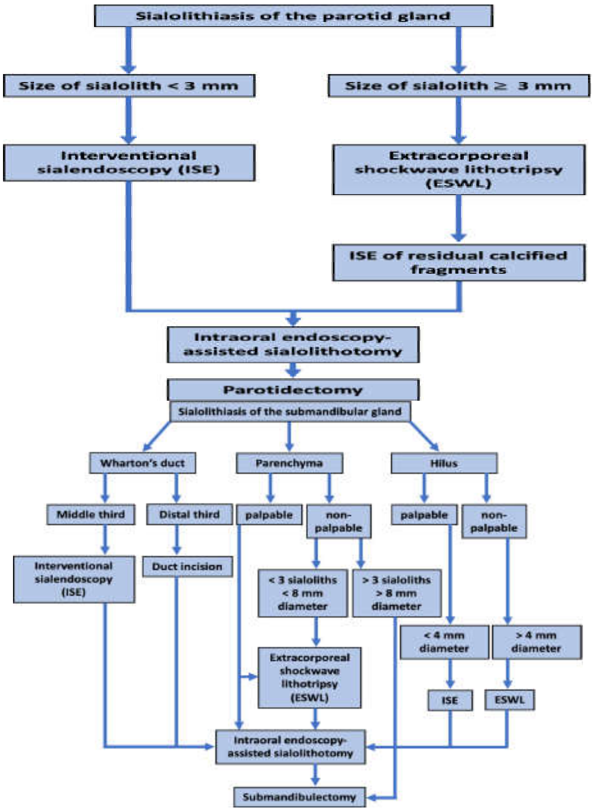
However, it is possible to diagnose this conditionusing a number of imaging modalities, as described above, but the most cost effective mode is sonography, detecting up to 90% of salivary duct stones. Sonography has been used along with a number of other imaging modalities to diagnose this condition. The use of real-time sonographic imaging allows for identification and confirmation of the presence of stones within the salivary gland. This modality is noninvasive, fast, and widely available, making it a first choice when assessing for sialolithiasis[76]. This also can be used as a gold standard investigation of choice for pre-procedural assessment of patients with submandibular cases. Ultrasound is widely used as a first-line examination due its availability, noninvasiveness and it does not use radiation making a safe diagnostic tool for an initialdiagnosis. However, reported data concerning its sensitivity, specificity, accuracy, positive and negative predictive values based on comparison with a standard of reference are very scarce[77,78].

Clinical Features and Management

On general examination patient is normal for the height and weight for the age. Initial signs and symptoms offer the best guide to next steps in assessment, testing, and treatment, plus any needed referral or multidisciplinary care. Characteristic history, thorough clinical examination with the aid of imaging modality, we can give a provisional diagnosis of a sialolith[79]. Sialoliths are usually small and are round or ovoid, rough or smooth and yellowish in colour. The clinical symptoms are characteristic and aid in early diagnosis, however pain is only one of the feature and it does not occur however, Pain and swelling may be the cardinal signs and symptoms which are aggravated on anticipation of food due to the obstruction of salivary flow. Bimanual palpation of the floor of the mouth, in a posterior to anterior direction, detectes a palpable stone in a large number of cases of submandibular calculi formation[80,81]. Very rarely the stones breach or open to the floor of mouth, but literatures are available detailing about suchcases. Usuallythese are pertaining to submandibular stones. Such cases give history of developed swelling under the chin, and the swelling increased in size in the last couple of days. On clinical examination white colored stone found in the right Wharton's duct. So commonly swelling and related difficulties are common to salivary stone formation. Patients may complain of discomfort or mild pain during meals, accompanied by a sudden and recurring increase in size of the gland involved, followed by a gradual decrease[82,83]When the salivary calculi become large enough, dysphagia, dysphonia, and lymphadenopathy of involved area are presented[84.] However, lesions are usually asymptomatic, patients with sialolithiasis typically may experience postprandial salivary pain and swelling caused by obstruction of the physiological salivary flow[85-87]. Also reported are dryness of mouth which is transient, palpable lymph node in case of any infected stones, pus discharge from the duct, pain and swelling in the affected region, fever, malaise. Palpable swelling with or without local raise in temperature, milking of gland might show discharge of pus but rare clinical findings. However Initial signs and symptoms offer the best guide to next steps in assessment, testing, and treatment, plus any needed referral or multidisciplinary care[88-90].

In the occasional cases extra oral findings are relevant, wherein it can be more severe, stasis of the duct lading to reverse infection and lymphadenopathy. Pus discharge may also be noted[91].Intermittent episodes of moderate to severe pain and swelling in the concerned region for a week. The intensity of the pain increased during mealtimes. The swelling was described as minimal in the morning on awaking but varied in size throughout the day. The patient had no positive medical history however literature is available describing this condition coexisting with other carcinomatous swelling .[92-94] However in pediatric cases, the case may be slightly different as painful right cheek swelling, which was gradually increasing in size followed by fever, cough and runny nose for 1 day. The swelling was not related with eating and oral intake was not affected. This was the first episode of such swelling. There was no history ear discharge, trauma or toothache prior to the swelling. Intraorally no positive sign can be noted [95,96].The mode of therapy depends on the size of the stone, the location, and number of stones and whether the stone is impacted or mobile. Various treatment option are now available, ranging from conservative to surgical procedures[97]. Discussing all options will go beyond the scope of this work. The use of endoscopic and minimally invasive techniques allows for the greater preservation of the major salivary glands in cases of sialolithiasis.[98]A conservative track, including oral analgesia, hydration, local heat therapy and sialagogues to promote ductal secretions are proposed.[99,100] Surgical removals commonly applied mode of operation, since most of the stones are of small in size. A less invasive procedure is of utmost importance in order to preserve the gland's function[101- 106] Various newer developments in surgical approaches for various obstructive salivary gland diseases (OSGD)are being discussed in various literatures. These are commonly employed in different obstructive diseases. Surgical management of OSGD has undergone a marked shift over the past two decades. The morbidity associated with sialoadenectomy and open surgery led to the progressive development of minimally invasive, endoscopic methods of treatment. Intracorporeal lithotripsy, Extracorporeal lithotripsy, endoscopic sialolith removal, surgical removal of mucosal plugs etc are few methods described in various aspects with respect to the salivary glandstone management[107]
An update of the treatment algorithm are being discussed in various article which also suggest the advanced mode of sialolith management[108-110] Minimally invasive Er:YAG laser-assisted surgical treatment offers a good alternative to conventional surgical salivary stone removal. The diode

laser is applied for the surgical removal of giant sialolith with minimal or no postoperative complications were encountered. Sothis is an excellent tool for soft tissuesurgery in the oral mucosa. As per the existing evidences it can be stated that LAS as a conservative, efficient, safe, and gland-preserving alternative technique, in experienced hands, for management of mid-size sialolith removal from major salivary glands, when the indication is appropriate.[111-114]



The above is the revisedalgorithm as seen in different literatures .[115]

CONCLUSION

The sialolith may vary from one millimeter to several centimeters in size and occur in meal time due to elevated intraglandular pressure resulting from an increased salivary secretion in the obstructed gland or duct. As the exact cause of salivary stones is not known, there is no clear way to prevent them. This review enriches the general dentist and specialist practitioners encountering soft tissue calcification in the oral and maxillofacial imaging. Conservative management by using a minimally- invasive algorithm is a promising, well-established method in salivay gland stone treatment.

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