Diagnostic and therapeutic sialendoscopy

An overview

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Introduction:

Common disorders of salivary glands involve obstruction involving their ductal system. Salivary gland calculi comprises the most common cause of enlargement of salivary glands. Obstructions could be caused by the presence of calculi, strictures of the duct etc. Sialoendoscopy is the most preferred mode of treating obstructions involving major salivary glands. Major advantage of this procedure is that it can be performed under local anesthesia as an office procedure.

History:

It was Konigsberger and his colleagues first used sialoendoscopy and lithotripsy to treat salivary gland calculi in 1990. During the year 1991 Gundlach and colleagues published their experience of doing sialoendoscopic procedures. Katz in 1991 used a 0.8 mm flexible endoscope to diagnose sialolithiasis and to remove them from major salivary glands. It was Kongisberger and colleagues who successfully used a flexible mini endoscope and intracorporeal lithotriptor to fragment major salivary gland calculi, thus opening up new vistas.
In 1994 Arzoz and his colleagues first introduced a 2.1 mm rigid endoscope which had a 1mm working channel as sialendoscope. This was indeed a mini urethroscope. They also used a Pneumoballistic lithotriptor along with this endoscope to hit the calculus and break it. This work was followed by Nahlieli who published his three years experience with rigid sialendoscope in the year 2000.

Instrumentation:

The diameter of the salivary duct sets the limit for the size of the instruments that can be used within them. The mini endoscopes that are used for cannulating the salivary gland duct can be divided into:

1. Flexible – The unique advantage of this endoscope is its flexibility making it easy to negotiate the kinks and bends present in the salivary gland duct. These flexible scopes cause lesser trauma to the duct. A major disadvantage is that it cannot be pushed through a stenotic segment of a duct. Its pushability is rather limited. Handling is also difficult. They are also very fragile and have a short life span when compared to the rigid and semirigid counterparts.
2. Rigid – These scopes have larger diameter and hence more stable. Its pushability is rather good. The image produced has excellent resolution. A

camera can be attached to the scope making recording process rather simple. One major advantage of these scopes is that they can be autoclaved.

3. Semirigid - This has been recently introduced. It has a small diameter, offers a clear view and because of its semirigid nature has good atraumatic pushability making it easy to introduce it into the ducts of major salivary glands. Semirigid scopes are of two types: Semirigid compact and Semirigid modular scopes.

Semirigid compact sialendoscope:

This system can be used for therapeutic purposes. The components of this system are:

1. Compact semi rigid endoscope
2. Fibreoptic light transmission system
3. Working channel
4. Irrigation channel
5. Fibreoptic image transmission system
6. The outer tube covers, stabilizes and protects all these components without adding on to the diameter of the whole system

Semirigid modular endoscopes:
In this type of endoscope the fibers used for transmitting light and images are combined to form a single proble like instrument. This probe can be used in combination with different sheaths. Using a small single sheath would create a diagnostic endoscope. The gap existing between the outer sheath and the optical system can be used as irrigation channel. If a single large lumen sheath / double lumen sheath is used then the whole system transforms into a potent surgical tool. The space inside the lumen can be used for introduction of various instruments. Major drawback of these modular systems is that sometimes air may get entrapped into the channel blurring the field of vision.

Advantages of modular endoscopes:

1. Economy – The optical system is the most expensive part of any endoscopic system. In this model the same system can be used for a variety of procedures. The same optical system can be combined with different sheaths there by creating a versatile tool.
2. Hygenic – Since the space between the sheath and the optical system is adeqate for cleaning the system the scope can be cleaned easily there by ensuring hygeine. In comparison the compact endoscopes have very thin irrigation channel making it difficult to clean. Plasma sterilization invariably is inadequate to sterilize these scopes.

The recent modular endoscopes are made of Nitinol steel which is more flexible than conventional steel. It is highly advantageous while maneuvering a tortuous salivary gland duct. It should always be borne in mind that a more rigid system is easier to steer.

Role of outer diameter of the endoscope:

This is the most important factor that determines whether the scope can negotiate the narrow channels of salivary gland ductal system. These scopes are usually 1.5 mm in circumference. It is this size that makes it easy for the scope to negotiate salivary gland ductal system. Some of the semi rigid scopes made by Karl Storz have a slight bend near its tip, this feature helps the scope in negotiating the branches of the ducts easier. This bend ofcourse has its drawbacks. It reduces the effective diameter of the sheath there by making it difficult for insertion of straight surgical instruments via the portal. The intraductal postion of these scopes can easily be ascertained by the transillumination effect created over the skin. The shaft of the endoscope is provided with markings which indicates the distance the scope has been introduced into the ductal system.

Diameter of working channel:

This aspect is important inorder to perform certain specialized therapeutic tasks using sialendoscope. The working diameter has a direct effect on the stability of the instrument used in sialendoscopic therapeutics. Working channel diameter of 0.8 mm is a must for using instruments such as forceps, balloons, or baskets. These instruments occupy about 0.4 mm of this working channel space. Studies have shown that the incidence of metal fatigue is directly correlated with this diameter. The smaller this diameter more the chance of metal fatigue.

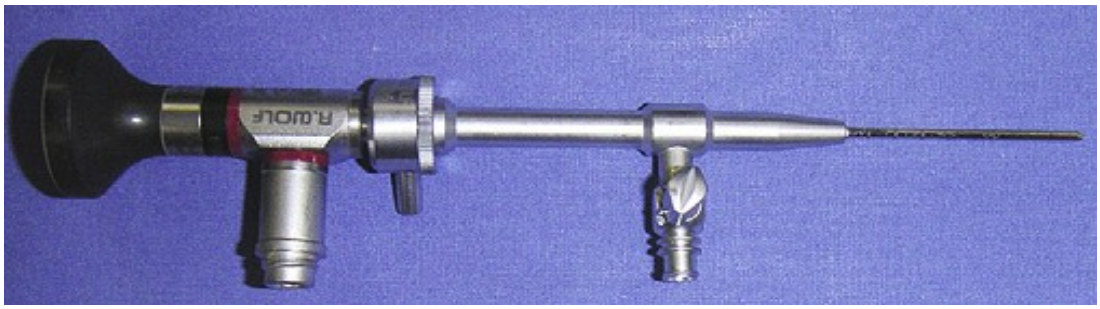
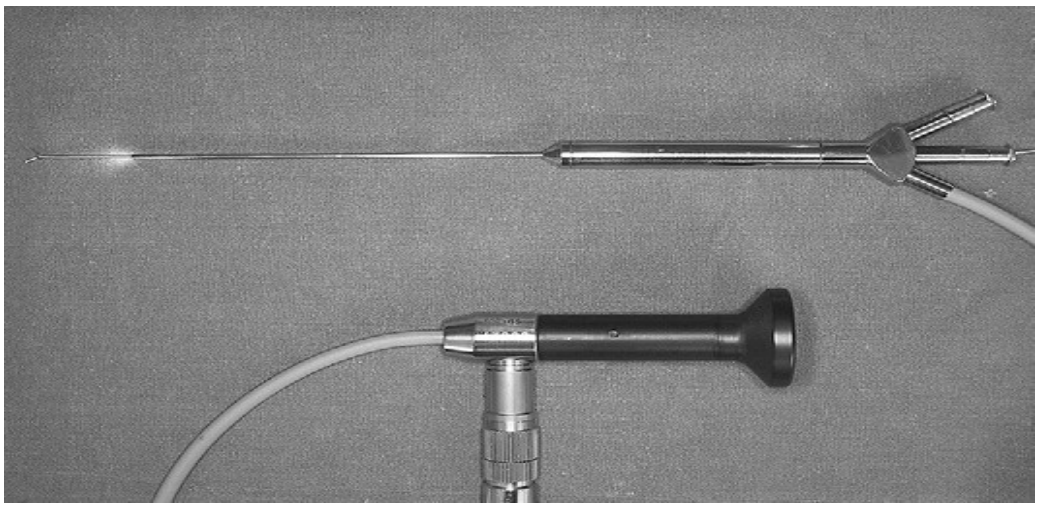


Figure showing rigid sialendoscope

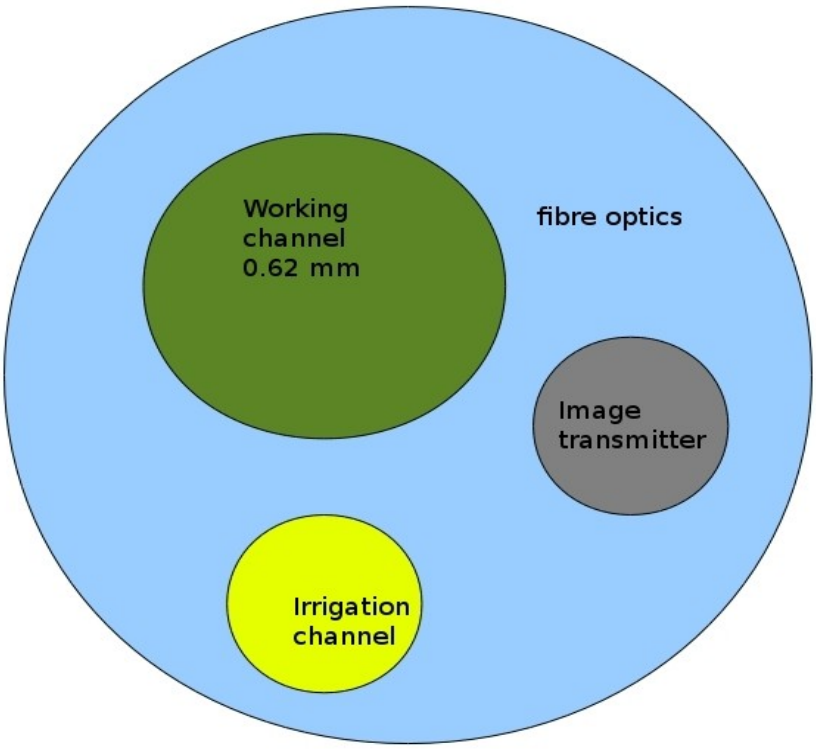
Semiflexible sialendoscope with a bent tip



Semirigid therapeutic sialendoscope

Sterilization procedures for sialendoscopes:

Sialendoscopes are highly fragile instuments. Since these instruments when used for diagnostic purposes come into contact with intact mucosa semicritical sterilization procedures like wiping the scope with savlon / spirit gauze would be sufficient. Scopes used for therapeutic purposes should be autoclaved. Since these instruments are highly fragile only limited number of autoclave cycles can be performed.



Diagramatic representation of the tip of therapeutic semirigid sialendoscope

Image resolution produced by sialendoscopy system:

Image resolution of sialendoscopy system is very good because of dense packing of optical fibers. Most modern sialdendoscopes have a resolution of 6000 pixels.

Instruments used in therapeutic sialendoscopy:

Forceps:

Two types of forceps are available:

1. Grasping forceps with serrated edges. These forceps are useful in dilating the ducts and grasping and removing small stone fragments after crushing the calculus.
2. Cup forceps with sharp edges. This forceps is useful in crushing calculus and taking biopsy of suspicious tissue.

These two forceps can easily be attached to an universal handle. Ideally the handle which allows rotation of the tip of the forceps is considered to be advantageous.

Figure showing toothed forceps

Figure showing universal handle

Image showing biopsy forceps with cutting edges

Baskets:

Baskets are very useful in removing salivary gland calculi. These baskets are classified according to:

1. Number and form of their wires
2. Type of tips
3. Presence or absence of outer sheath

These baskets can be attached to the universal handle provided. These handles need not provide rotatory movement of the tip of the basket compared to the ones used along with forceps.
Baskets with higher number of wires (more than 4) are very useful in removing small stones.
Baskets made of strong wires (made of nitinol steel) are very useful in dilating the salivary gland duct and in negotiating the stenotic segment.

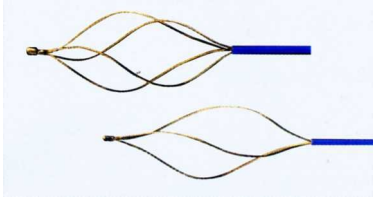


Image showing a typical basket forceps

Graspers:

This is a mixture of forceps and basket. But its use is highly limited.

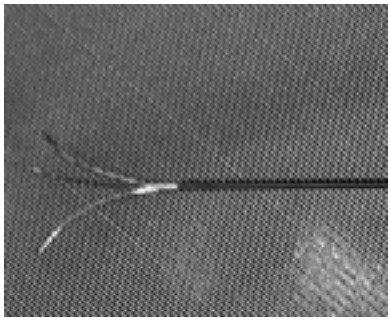


Image showing a grasper

This instrument is slowly finding its way out because of the propensity to traumatize the ductal mucosa. This invariably leads to ductal stenosis after the procedure which is a highly unwelcome complication.

Dilators:

These dilators are conical in shape and are used in the identification of the papillae and duct of major salivary glands. Two types of dilators are available:

1. Conical sharp dilator is useful in the initial identification and dilatation of the salivary duct papillae
2. Conical blunt dilator which can be introduced into the duct after the identification and dilatation of the papilla. Conical sharp dilators when used inside the ducts can cause trauma to the ductal mucosa and hence are best avoided in this scenario.

Solex soft lumen expanders:

The advantage of this instrument is that it is available in different sizes. It contains an outer sheath and an inner dilator. The advantage of this system is that after dilatation the inner probe can be removed leaving the outer sheath in the duct. Sialendoscope can easily be passed through this sheath, and calculi if any can be removed. Major advantage of leaving the outer sheath is that it prevents damage to the ductal mucosa while the calculus is being removed.

Image showing solex soft lumen expander

Drills and micromotor system:

Microdrills play a vital role in fragmenting the salivary gland calculi there by facilitating easy atraumatic removal. These microburrs have a diameter of 0.38 – 0.4 mm.

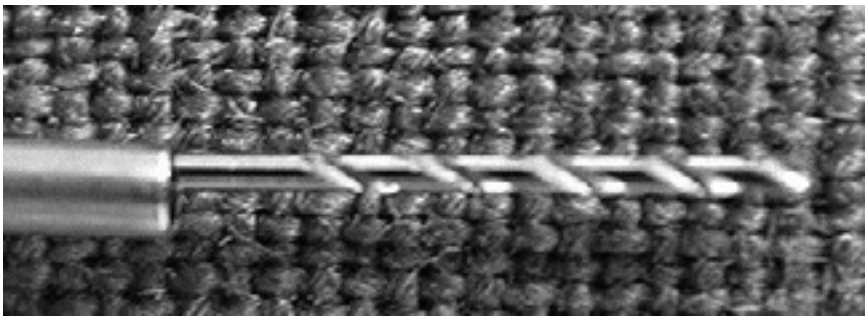


Figure showing microburr tip used to fragment salivary duct calculi

Balloons:

These are of two types:

1. Low pressure type – This balloon expands rapidly with minimal insufflation. These balloons are of limited use because of their propensity to rupture easily. They are useful in dilating thin membranous areas.
2. High pressure balloon – These are commonly used. They need a special syringe system for inflation. Major advantage of this high pressure balloon is

that they can easily be introduced via the sialendoscope port. Some of these high pressure balloons have sharp cutting margins and hence are very useful in fragmenting large salivary ductal calculi.

Cytology Brushes:

These brushes were originally designed to take biopsy from ducts of mammary glands. These brushes can be used to harvest cells from inaccesible areas of salivary glands there by facilitating tissue diagnosis. These brushes have been designed in such a way that they can easily pass through the portal of a sialendoscope. These brushes need to be handled with great care as they are very flimsy and can easily be damaged.

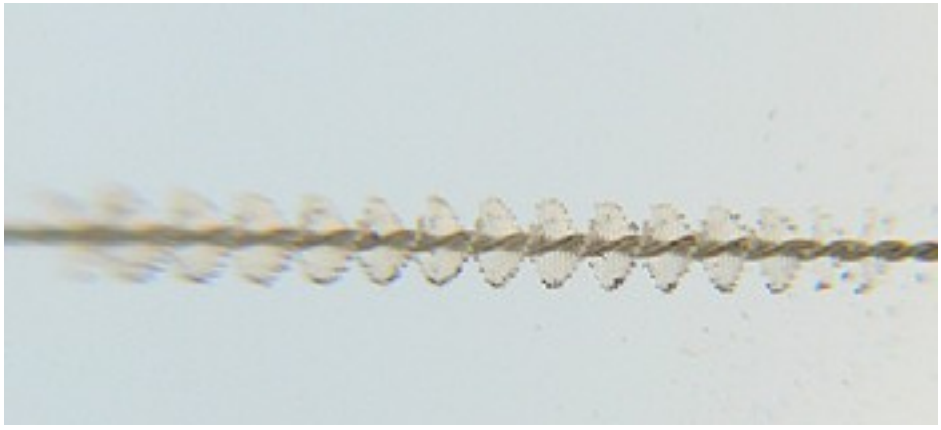


Image showing a cytology brush

Indications:

1. Diagnostic
2. Therapeutic

Diagnostic indications include any suspected obstructive salivary gland disease.

Therapeutic indications:

1. Treatment of salivary gland calculi which involves localization fragmentation and removal. It may also be used as a guide for external approach calculi removal.
2. Localization and dilatation of strictures.
3. In managing chronic sialadenitis by irrigation
4. In the management of recurrent juvenile sialdenitis

Diagnostic sialendoscopy:

Before embarking on this procedure a detailed patient history should be taken. Pointers in the history that could suggest obstructive salivary gland disease include:

1. History of glandular swelling associated with food intake.
2. Glandular swelling associated with pain

Ultrasonic examination is a must before diagnostic sialendoscopy. Before ultrasonic examination if a sialagogue is administered it would go a long way in assessing the cause and region of salivary gland obstructive pathology. Eventhough ultrasound examination would clinch the diagnosis in majority of cases it could create difficulties in the following scenario:

1. Ultrasonic examination fails to distinguish between non echogenic stone and stricture. In this scenario diagnostic sialendscopy helps in arriving at a diagnosis.
2. Ultrasonic examination fails in the quantitative assessment of salivary gland obstruction, because ultrasound doesnot precisely assess the three dimensional size of the salivary gland calculus. It also fails to assess the extent of stenotic segment or their number in cases of multiple stenosis.
3. If intraductal removal of calculi is planned then ultrasound exam is not suited because it cannot precisely assess the diameter of the duct.

Sialogram:

This investigation helps in the accurate assessment of the complete ductal system of the salivary gland. This is much better than sialendoscopy because it images the complete ductal system. Major disadvantages of sialography is that it can expose the patient to unnecessary radiation. It can also show false positives in the presence of air bubbles which may be mistaken for salivary gland calculus.

The advantage of sialendoscopy in these patients is that it can effortlessly be switched to the therapeutic mode in the same session.

Diagnostic sialendoscopy:

The advantage of this procedure is that it can be performed under local anesthesia. The mucosa of oral cavity can be anesthetized by topical use of 4% xylocaine. Additional infiltration anesthesia of the ductal area can be achieved by infiltration with 2% xylocaine with 1 in 10,00000 units adrenaline.

Step I:

Dilatation of the papilla of salivary gland duct. This can be achieved by insertion of a sharp conical dilator. Further dilatation is possible by the introduction of a blunt conical dilator. If the papilla is stenosed / narrowed due to persistent inflammation then papillotomy may have to be resorted to.

Step II:

Creation of artificial cavity. As performed in abdominal laparoscopic procedures an artificial cavity will have to be created to enable easy passage of sialendoscope. This cavity creation is achieved by irrigation of isotonic saline via the duct. The saline irrigated should be mixed with 4% xylocaine. The saline lubricates the duct of the gland facilitating easy passage of sialendoscope. The local anesthetic mixed with saline takes away the pain and discomfort of insertion.

Step III:
The outer sheath of sialendoscope is inserted via the major salivary gland duct. The endoscope follows later. The endoscope is attached to an endocamera which faithfully captures the image and projects it on a digital monitor. It should be borne in mind that a sphincter system is present near the papilla of Wharton's duct. Any damage to this system may lead to unnecessary salivary drooling. Papillotomy should be avoided in wharton's duct. The same sphincter system of Stenson's duct is located posteriorly hence papillotomy of stenson's duct will not cause sphincter problems. Before introduction of the endoscope the zero position of the scope should be ascertained by focussing on a letter. It is also prudent to orient onself to the direction of the instrument channel of the sialendoscope before the actual introduction.

When performing sialendoscopy of submandibular salivary gland the sublingual salivary gland duct could be seen opening in to the anterior part of wharton's duct. This opening usually lies 5 mm posterior to the papilla. This is one of the reasons for avoiding papillotomy in wharton's duct.

While performing sialendoscopy the lining mucosa of the ductal system should be carefully examined. In a healthy gland the ductal mucosa appears shiny and the underlying blood vessels can be clearly seen. In salivary glands affected by chronic sialadenitis the mucosal lining of the duct shows matted appearance with submucosal ecchymosis.

The presence of intraductal calculi if any should be documented. In wharton's duct the calculi are usually seen at its bifurcation. This bifurcation is present because of the presence of two portions (superficial and deep lobes of the submandibular gland). In parotid duct calculi usually lie posterior to its curvature.

Ductal polypi:

Ductal polypi when present will be seen as filling defects in a sialogram. They can be clearly seen in sialendoscopy and if necessary biopsy can also be performed.

Intraparenchymal sialoliths:

Presence of sialoliths in the parenchyma of salivary glands can also be observed if present close / adjacent to the ductal system.

Occult radiolucent calculi:
It should be borne in mind that nearly 70% of parotid gland calculi are radiolucent and quarter of submandibular calculi are radiolucent. Diagnosis of radiolucent calculi can be made only by observing filling defects in a sialogram or by direct visualization through sialendoscope.

Kink's and strictures:

Kink's and stricutres present in the salivary gland ductal system can be observed best in a sialogram. The same may be confirmed by performing sialendoscopy.

Presence of pelvis like ductal formation of wharton's duct:

This is one of the rare congenital anamolies that can be picked up while performing sialendoscopy. Instead of the routinely seen bifurcation / trifurcation the main duct assumes a pelvis like formation thus leading to obstruction in the drainage of saliva.

Presence of intraductal foreign bodies like hair, tea leaves can also be identified and if possible can also be removed.

Therapeutic sialendoscopy:

Eventhough sialendoscopy has been used for therapeutic purposes it should at best be considered to be an adjunt visual control of therapeutic procedures.

Sialendoscopy can be effectively used in dilatation of salivary duct strictures. Dilators rigid / balloon types can be used for the same.

Role of sialendoscopy in the management of salivary gland calculi:

The aim in the management of sialolithiasis is to remove the calculus completely. Sialendoscopy should be considered as one of the many management modalities available. Calculi of submandibular gland measuring less than 4 mm can be removed under sialendoscopic vision using basket. Similarly calculi measuring 3 mm and below can be removed using the same technique from parotid duct. Any calculi measuring more than the above mentioned size needs to be broken down into small manageable bits using either crushing forceps or extracorporeal / laser lithotripsy. When the calculi has been shattered to smaller manageable bits they can be removed transluminally under endoscopic visualization. Normal submandibular and parotid ducts measure 1.5 mm with the narrowest portion being 0.5 mm at the level of papilla. Hence the stone's diameter which can be handled by sialendoscopy should not be larger than 150% of the diameter of the anterior ducts.

Before attempting to remove salivary gland calculi conservatively patients should be encouraged to take sialogogues like bubble gum and the enlarged gland can be massaged in an attempt to flush out the calculi from the duct. Only when this conservative approach fails other invasive modalities of treatment should be considered.

Management of chronic sialadenitis:

Sialendoscopes can be used to clear mucous plugs which are a common feature of chronic sialadenitis. The duct also can be dilated by irrigation of normal saline through the ductal system.

Difficult scenario:

Therapeutic endoscopes may be large and would have difficulty in negotiating the major salivary gland ductal system. In these cases a modified Seldinger technique can be attempted. The papilla of the duct is dilated and then the outer sheath of the scope is passed through it.
The instrument used for calculi removal (guide wire, basket) etc is passed through it while the endoscope follows the same.

Side effects of therapeutic endoscopy:

1. Temporary swelling due to irrigation of the duct
2. Perforation of ductal wall
3. Wire basket blocks
4. Lingual nerve paraesthesia
5. Ranula
6. Ductal strictures
7. Post op infections