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SURGICAL PROCEDURES INVOLVING SALIVARY GLANDS – A REVIEW

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ABSTRACT :

Surgical interventions for salivary gland pathologies are essential for effective management but can lead to complications, including speech and swallowing impairments. The major salivary glands—parotid, submandibular, and sublingual—play a crucial role in oral health, and surgical procedures are indicated for persistent symptoms, neoplasms, or failure of conservative treatments. Various techniques, such as sialolithotomy, sialadenectomy, and sialendoscopy, are employed to address underlying issues. Recent advancements, including minimally invasive options like transoral laser microsurgery and robotic-assisted surgeries, have improved patient outcomes. However, careful patient selection and comprehensive management strategies are crucial to minimizing complications. A multidisciplinary approach that integrates surgical techniques with chemoradiotherapy can enhance treatment efficacy and preserve organ function. This review intends to offer an in-depth exploration of the surgical techniques associated with salivary glands.

Keywords: Salivary Glands, Surgical Interventions, Sialolithiasis, Parotidectomy, Submandibular Gland Excision

INTRODUCTION :

Salivary glands play a vital role in oral health and overall well-being by producing saliva, which aids in digestion, facilitates taste, and helps maintain oral hygiene. The major salivary glands include the parotid, submandibular, and sublingual glands, while numerous minor glands are scattered throughout the oral cavity and oropharynx. Surgical procedures involving salivary glands are crucial for managing these disorders. Indications for surgery often include persistent symptoms, failure of conservative treatment, or the presence of neoplasms.[1] Various surgical techniques, including sialolithotomy, sialadenectomy, and sialendoscopy, offer different approaches to address the underlying issues affecting salivary glands. Surgical procedures targeting salivary glands are vital for addressing a range of pathologies, including both benign and malignant tumors.[2] Recent advancements in surgical techniques, particularly minimally invasive options, have significantly improved patient outcomes. For instance, approaches like transoral laser microsurgery (TLM) and transoral robotic surgery (TORS) are being increasingly adopted for malignant salivary gland tumors, as they demonstrate lower morbidity and better functional results compared to conventional methods.[3] The innovative "DROOL" procedure, which entails the excision of the submandibular gland and ligation of the parotid duct, has proven effective in reducing chronic sialorrhea in neurodevelopmentally impaired children, subsequently decreasing the incidence of respiratory-related hospitalizations.[4] Surgical management remains the primary approach for salivary gland tumors, with benign tumors, such as pleomorphic adenomas, accounting for a significant proportion of cases. Indications for surgical intervention span both neoplastic and non-neoplastic conditions, with benign tumors being the most prevalent. However, research indicates that surgical resection, especially in malignant cases, can lead to considerable complications, highlighting the necessity for careful patient selection and comprehensive management strategies.[5] This review aims to provide a comprehensive overview of the surgical procedures involving salivary glands.

SURGICAL TECHNIQUE FOR SUBMANDIBULAR DISORDER :

The surgical excision of the submandibular gland is typically performed under general anesthesia, with the patient positioned supine and the neck extended using a shoulder roll. The procedure involves careful incision planning to avoid injury to the marginal mandibular nerve and optimize cosmetic outcomes, with a 3-4 cm incision placed below the mandible's inferior border.[6] Various techniques exist for exposing the submandibular gland while preserving the marginal mandibular nerve, including raising a subplatysmal flap or utilizing a superiorly based deep cervical fascial flap to protect the nerve during dissection. Once the gland's surface is exposed and the nerve is safeguarded, blunt dissection is used to free the gland from surrounding structures, such as the digastric muscle and facial artery, while identifying the hypoglossal nerve beneath. The submandibular ganglion and duct are then ligated and divided, with careful attention to avoid retaining stones in the duct.[7] The proximal facial artery, which supplies the gland, is identified and ligated to free the specimen. Wound closure involves meticulous hemostasis, reapproximating the platysma with absorbable sutures, and achieving a cosmetically favorable skin closure. Postoperative management typically does not require drains or antibiotics unless indicated by the presence of infection or significant dissection. Overall, this meticulous approach aims to minimize complications while ensuring effective removal of the gland and maintaining functional integrity of surrounding structures.[8]

PAROTIDECTOMY :

Parotidectomy is primarily performed to remove neoplasms, with 75% to 80% being benign tumors, predominantly pleomorphic adenomas and Warthin tumors. Malignant tumors, such as mucoepidermoid and adenoid cystic carcinomas, are less common, with metastasis from skin cancers being the most prevalent malignancy in the parotid gland.[9] Chronic parotitis and recurrent sialadenitis are also indications for surgery when other treatments fail. Preoperative evaluation is crucial, including history, physical examination, and facial nerve function assessment, along with imaging techniques like ultrasound-guided fine-needle aspiration cytology (FNAC) and MRI to accurately diagnose and plan treatment. FNAC has a 96% accuracy rate for distinguishing benign from malignant tumors, while core biopsy further enhances diagnostic reliability.[10] MRI techniques, including dynamic contrast-enhanced MRI, are particularly effective in differentiating tumor types and assessing malignant transformation risks. Neck dissection is indicated for clinically evident metastasis, with recommendations for selective dissection based on tumor grade and patient age. Adjuvant radiotherapy is suggested for advanced tumors or those with close margins, while conventional chemotherapy has limited effectiveness.[11] The TNM staging system is commonly used to assess salivary gland tumors, although its applicability can be debated due to the diverse behavior of different tumor histologies. The American Joint Committee on Cancer (AJCC) 8th edition remains the standard for staging these tumors.[12]

TYPE	FEATURES
Extracapsular Dissection:	This technique does not involve identifying the facial nerve. Instead, a facial nerve monitor is used to assist in resecting the tumor, typically for benign lesions other than pleomorphic adenomas.
Partial/Superficial Parotidectomy:	In this procedure, the tumor is removed along with a portion of the surrounding parotid tissue while ensuring the facial nerve is identified and preserved. This approach is commonly employed for benign tumors and cases of lymph node metastasis in the superficial lobe.
Total Parotidectomy:	This surgery entails the complete removal of the parotid gland, with efforts made to identify and preserve the facial nerve. It is indicated for aggressive malignant tumors, deep lobe tumors, sentinel lymph node excision located in the deep lobe, vascular malformations, or large tumors where distinguishing between the superficial and deep lobes is challenging.
Radical Parotidectomy:	This procedure involves the removal of the entire gland along with the facial nerve. It is typically performed when there is established preoperative facial paralysis or when a malignant tumor significantly involves the nerve. In such cases, simultaneous nerve grafting or facial reanimation techniques may be utilized.

SURGICAL TECHNIQUE FOR PAROTID SURGERY :

The parotidectomy procedure is conducted under general anesthesia, with special precautions to avoid muscle relaxants to facilitate monitoring of facial nerve function. The patient's neck is extended, and the head is turned away from the operative side. The facial area is scrubbed with antiseptic, ensuring the eye is protected. Drapes are arranged to expose the hemiface and neck.[13] If a nerve integrity monitor (NIM) is utilized, electrodes are placed near the branches of the facial nerve. Surgeons commonly employ a modified Blair incision, which begins in the preauricular skin crease and extends inferiorly, ensuring skin is preserved around the lobule to prevent deformities. An alternative incision is the modified facelift incision, which extends into the occipital hairline. After incising the dermis and platysma, an anterior skin flap is raised between the superficial musculoaponeurotic system (SMAS) and the parotid capsule. A thicker flap is preferred to reduce the risk of Frey syndrome and skin necrosis. Care is taken to avoid damaging facial nerve branches during dissection. While the greater auricular nerve is typically sacrificed, the posterior branch can be preserved by careful dissection.[14] If the entire nerve must be removed, it should be done distally to allow for potential reconstruction. The surgical assistant monitors facial muscle contractions during the procedure. The parotid tail is dissected from the sternocleidomastoid (SCM) muscle, and the external jugular vein may be ligated or preserved to minimize bleeding. The digastric muscle serves as a landmark for locating the facial nerve, and dissection must avoid the risk of injuring the nerve as it exits the stylomastoid foramen. Key landmarks such as the mastoid tip and tympanomastoid suture are used for identifying the main trunk of the facial nerve. Once the gland is mobilized, the surgeon identifies and preserves facial nerve branches, dissecting them carefully.[15] The tumor is excised with an appropriate margin of parotid tissue. For deeper lobe tumors, the superficial lobe may be fully removed or preserved for better exposure. During the procedure, benign tumors can usually be dissected away from the facial nerve without complications. In cases of malignant tumors, if preoperative paralysis exists, tumor removal may necessitate excising portions of the nerve. If no paralysis is present, shaving the tumor off the nerve is sometimes acceptable. In the case of tumor spillage, the area should be suctioned, and the capsule rupture site should be closed to avoid potential recurrence. Facial nerve integrity is checked before closure, and the wound is sutured in two layers. Postoperatively, facial nerve function is assessed, with some weakness expected, especially after total parotidectomy, although this usually resolves over time. A suction drain is placed until output decreases, and the duration of compressive dressing varies.[16]

SURGICAL MANAGEMENT OF SIALOLITHIASIS

For submandibular stones that are palpable in the floor of the mouth, a transoral duct slitting incision can be made under local anesthesia to excise the stone directly. Due to potential fibrosing in the duct from chronic infection and inflammation, it is crucial to perform sialendoscopy immediately after stone removal to assess duct patency and check for any remaining stones or fragments. For stones located more proximally and not accessible through direct vision, endoscopic techniques are utilized. Sialoliths smaller than 5 mm can often be removed intact using sialoendoscopy along with retrieval instruments like baskets or miniforceps.[17] The procedure begins with atraumatic dilation of the duct's orifice using lacrimal probes, gradually increasing the size of the probes to allow the endoscope to pass freely. In cases where dilation is difficult, a small papillotomy may be performed. Once dilation is successful, the endoscope is carefully inserted, ensuring not to perforate the duct walls. Saline irrigation helps further dilate the duct and clear debris. Instruments such as baskets and forceps can then be introduced through the endoscope to retrieve the sialolith. When retrieving the stone, caution is needed to avoid damaging the duct. If a sialolith cannot be removed intact, lithotripsy may be employed. This technique fragments the stone within the duct, either through intracorporeal or extracorporeal methods, followed by irrigation to clear the fragments from the ductal system.[18]

INTRACORPOREAL LITHOTRIPSY

Intracorporeal lithotripsy, or endoscopic lithotripsy, can be performed using mechanical fragmentation, lasers, or pneumatic devices. Mechanical Fragmentation involves using grasping forceps through the endoscope to crush the sialolith into smaller pieces, which can then be removed. Remaining small granules may become fibrosed in the duct or be self-expressed in saliva over the following weeks. Laser Lithotripsy employs lasers, such as holmium and erbium: YAG lasers, to fragment sialoliths. The laser fiber is placed in contact with the stone, generating high-pressure shock waves that break it apart. However, the effectiveness can vary based on the stone's composition, as only about 60% of the shock waves penetrate the stone. Risks include thermal damage to surrounding tissues, ductal perforation, and damage to the endoscope. Despite these challenges, some studies report extraction success rates over 80%. Pneumatic Lithotripsy utilizes a probe that transmits kinetic energy to fracture the sialolith. Microforceps and baskets are then used to remove smaller fragments. Limitations include the potential for fragments to embed in smaller ducts, which could cause complications such as sialadenitis. Some studies show a success rate of 98% for complete fragmentation.[19]

EXTRACORPOREAL LITHOTRIPSY (ESWL)

Extracorporeal lithotripsy employs high-intensity acoustic pulses directed at the sialolith, using electromagnetic or piezoelectric sources. This technique is effective for large sialoliths (15 mm or larger) and those 7 mm or smaller embedded in the duct wall. Success rates vary, with reports ranging from 26–69% for electromagnetic sources and 29–81% for piezoelectric sources. The parotid gland tends to have a higher success rate due to the less viscous saliva, which aids in clearing the duct.[20]

COMBINED APPROACHES TO SIALOLITHS

For larger stones (greater than 5 mm) or those not successfully extracted by endoscopic techniques, a combined sialolithectomy may be necessary. This involves using a sialoendoscope for visualization and making a floor-of-the-mouth incision to access the stone directly. Care must be taken to protect the lingual nerve during dissection. In cases of large parotid stones, a transfacial dissection may be required. The endoscope helps locate the stone, and direct visualization assists in its removal, minimizing the risk of facial nerve injury. If sialolith removal is successful, the duct is treated with steroids, and a drain is inserted to maintain patency and prevent stricture formation.[21]

SURGICAL MANAGEMENT OF STENOSIS AND STRICTURES IN SALIVARY GLAND DISORDERS

The surgical management of stenosis and strictures in oral salivary gland ductal disorders (OSGD) involves a careful assessment of various factors such as the location, number, length, and tissue characteristics of the affected areas, with sialendoscopy being a crucial tool for direct visualization of ductal walls to differentiate between inflammatory and fibrous stenoses. Inflammatory ductal stenosis is treated through endoscopic irrigation and intraductal steroid administration, while fibrous stenoses require sequential dilatation and/or balloon dilatation; however, there is a risk of duct perforation during these procedures, indicated by sudden bleeding or swelling in the floor of the mouth, which may necessitate halting the procedure or navigating past the perforation if the operator is skilled. Following successful dilation, a balloon is inflated within the stenotic area, with careful monitoring to avoid over-dilation and duct rupture, and a drain is placed at the conclusion to maintain duct patency during the healing phase. Endoscopic interventions have demonstrated impressive success rates, with 85–95% of patients not needing further treatment; nonetheless, if these methods fail, more invasive procedures like transoral duct slitting may be considered. Overall, the approach to managing OSGD has shifted towards minimally invasive, gland-sparing techniques rather than traditional sialoadenectomy, which carries higher morbidity risks, positioning sialendoscopy as a key diagnostic and therapeutic modality that effectively addresses various causes of salivary gland obstruction while minimizing complications and preserving gland function.[22,23]

SURGICAL EXCISION OF RANULA

A ranula is a type of mucocele that forms in the floor of the mouth, typically originating from the sublingual gland (SLG) due to mucus extravasation caused by salivary duct obstruction or trauma leading to acinar damage. Patients usually present with unilateral or occasionally bilateral fluctuant swelling in the floor of the mouth, which can cause discomfort and speech difficulties. Plunging ranulas represent a more advanced stage, where the lesion extends beyond the mylohyoid muscle into the neck. Treatment options for ranulas include both medical and surgical approaches, with ranula excision combined with SLG removal demonstrating the highest success rate in preventing recurrence. The procedure is often performed transorally, even for plunging ranulas, but it presents challenges in identifying and preserving Wharton's duct, the lingual nerve, and the complete excision of the SLG. The dynamic nature of the floor of the mouth, which serves as a diaphragm separating the oral cavity from the neck, complicates surgical manipulation and requires significant experience and assistance. To address these challenges, the da Vinci robotic system has been utilized for anterior floor of the mouth surgery, offering enhanced visualization and allowing for a more standardized approach where the entire surgical team can engage effectively. During the procedure, robotic arms are positioned in the patient's mouth, and the surgeon operates from a console, utilizing specialized instruments for dissection. The SLG is carefully separated from critical structures such as the lingual nerve and Wharton's duct before excision of the ranula and gland. Complications associated with SLG excision via TORS mirror those of traditional methods, including potential injury to the submandibular duct or lingual nerve; however, enhanced visualization provided by the robotic system may reduce the likelihood of such complications. If the submandibular duct is injured, it can be repositioned and stented temporarily, allowing for recovery of salivary function post-removal. Overall, TORS facilitates a more predictable surgical environment with improved exposure and dexterity while preserving essential structures, although further research is needed to evaluate long-term outcomes and cost-effectiveness compared to conventional surgical techniques.[24,25]

CONCLUSION :

In conclusion, while surgical interventions are crucial for effectively managing salivary gland pathologies, it is important to recognize that these procedures can lead to various complications, particularly speech and swallowing impairments. The intricacies of the anatomical structures in the head and neck region mean that surgical resection can inadvertently affect surrounding tissues and nerves, potentially resulting in long-term functional deficits that impact a patient's quality of life. As a response to these challenges, adopting a multidisciplinary approach becomes essential. By integrating surgical techniques with chemoradiotherapy for select patients, healthcare providers can develop comprehensive treatment plans that not only target the malignancy but also prioritize the preservation of organ function. This approach allows for a more tailored treatment strategy, considering each patient's unique tumor characteristics, overall health, and personal preferences. Collaboration among surgeons, oncologists, radiologists, speech therapists, and other healthcare professionals can lead to more effective management of salivary gland tumors, enabling patients to achieve better functional outcomes while minimizing the risk of complications. Ultimately, a well-coordinated multidisciplinary strategy can enhance treatment efficacy and improve the overall well-being of individuals affected by salivary gland disorders.