VOLUME - 10, ISSUE - 04, APRIL- 2021 • PRINT ISSN No. 2277 - 8160 • DOI : 10.36106/gjra

Original Research Paper

Oral Medicine

SALIVARY GLAND DIAGNOSTICS: A REVIEW

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ABSTRACT The inflammatory, obstructive, autoimmune and neoplastic disorders of the salivary gland include a salient group of head and neck pathologies and are caused by a variety of pathological conditions which affect the gland tissues. It is the chief responsibility of a dental surgeon to analyze and assign the relevant imaging method depending on the scenario with which the patient reports, to arrive at a proper diagnosis and for exact treatment planning. It is also necessary for the clinician to know about the imaging techniques, its need, interpretation and recent advances of the same.

KEYWORDS : Salivary glands, sialadenitis, sialolithiasis, magnetic resonance imaging (MRI), sialography, diagnostic imaging, radiography, flow cytometry, fine needle aspiration cytology (FNAC), computed tomography (CT), cone beam computed tomography (CBCT), neoplasm, positron emission tomography (PET), scintigraphy, ultrasound

INTRODUCTION

Salivary glands produce saliva which keeps the mouth and other parts of the digestive system moist, aids in the breakdown of carbohydrates and lubricates the passage of food down from the oropharynx to esophagus and stomach. These glands are classified as major which consists of the parotid, submandibular and sublingual glands and minor which consists of 800-1000 small mucus secreting glands located throughout the lining of oral cavity. Saliva is the most valuable oral extracellular complex fluid that contains secretions of both major and minor salivary glands, mucosal transudations, gingival crevicular fluid, serum and blood derivatives from oral wounds, desquamated epithelial cells, expectorated bronchial and nasal secretions, bacteria and its products, viruses, fungi, other cellular components and food debris. It helps to maintain the oral health and is also used as a non-invasive clinical tool for medical diagnosis and research. The constituents from the blood enter into the saliva by trans-cellular, passive intracellular diffusion and active transport or para cellular routes by extracellular ultrafiltration within the salivary glands or through the gingival crevice and therefore it shows a great sensitivity and co-relation with the levels in blood. It is also cost effective and easy to store and transport. Salivary diagnostics is a dynamic and effective modality that utilizes nanotechnology and molecular diagnostics for the diagnosis, prognosis and to monitor the post therapy status in oral and systemic diseases and using salivary biomarkers for disease detection.

CLASSIFICATION OF SALIVARY GLAND DISORDERS

DEVELOPMENTAL	FUNCTIONAL	OBSTRUCTIVE	INFECTIONS	OTHERS
ABERRANT/ECTOPIC GLAND	SIALORRHEA	SIALOLITHIASIS	VIRAL	FREY'S SYNDROME
APLASIA	XEROSTOMIA	MUCOUS PLUG	BACTERIAL	POST IRRADIATION
HYPOPLASIA		FOREIGN BODIES	MYCOTIC	- COMPLICATIONS
HYPERPLASIA		STRICTURE & STENOSIS		SALIVARY FISTULA
ATRESIA				
ACCESSORY DUCT				
DIVERTICULI				
CONGENITAL FISTULA				

CYSTS	ASYMPTOMATIC ENLARGEMENT	AUTOIMMUNE DISORDERS
MUCOCELE	SIALOSIS	SJOGREN'S SYNDROME
RANULA	ALLERGY	MIKULICZ'S DISEASE
BRANCHIAL CYST	ASSOCIATED WITH MALNUTRITION	RECURRENT NON-SPECIFIC PAROTITIS
LYMPHOEPITHELIAL CYST		

BENIGN NEOPLASM- SELDOM RECURRENT	BENIGN NEOPLASM- OFTEN RECURRENT	MALIGNANT NEOPLASM
WARTHI N'S TUMOUR	PLEOMORPHIC ADENOMA	CARCINOMA IN PLEOMORPHIC ADENOMA
ONCOCYTOMA	MUCOEPIDERMOID CARCINOMA	ADENOID CYSTC CARCINOMA
CYLINDROMA	ACINIC CELL TUMOUR	MUCOEPIDERMOID CARCINOMA
		SQUAMOUS CARCINOMA
		METASTATIC TUMOURS

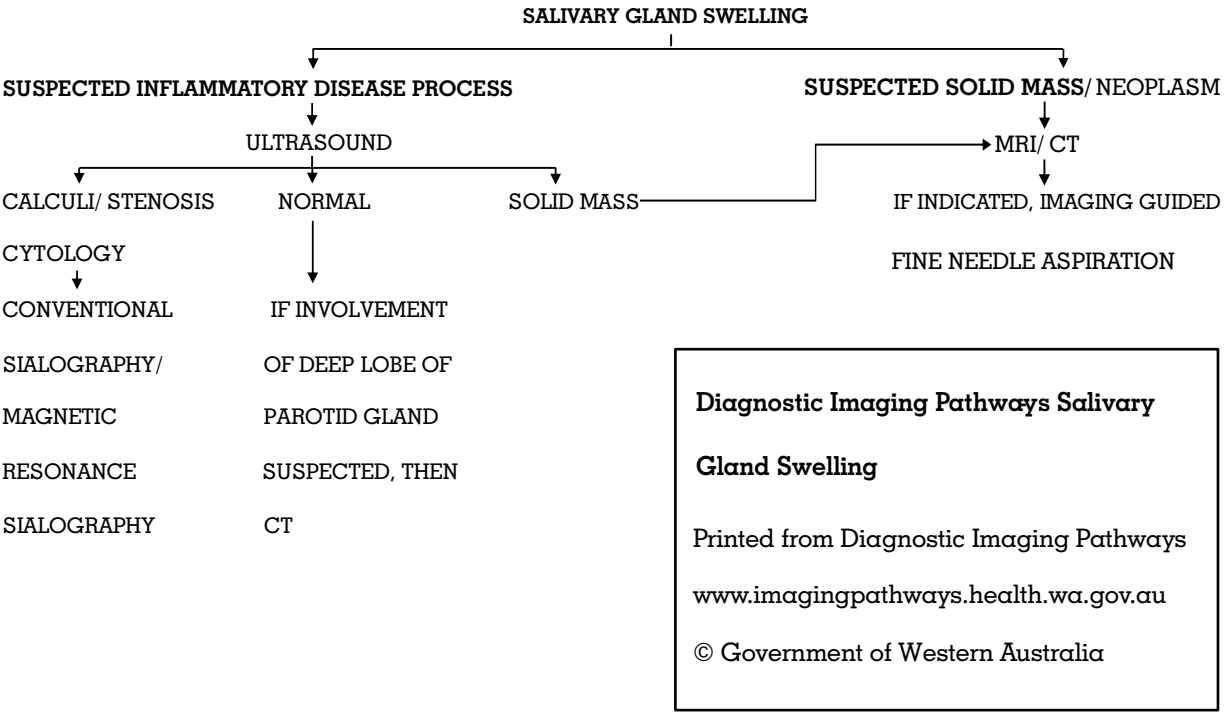
Grisius M.M., Fox P.C. Salivary Gland Diseases. In: Lynch MA, Brightman VJ, Greenberg MS, Glick M eds. Burket's Oral Medicine. 10th ed. Spain: BC Decker Inc; 2003. 563-577.

SALIVARY BIOMARKERS

Biomarkers are defined as cellular, biochemical and molecular characteristics by which normal/abnormal processes can be recognized and / or monitored. Salivary biomarkers help in non-invasive diagnosis of disease and monitoring of general health.

SALIVARY BIOMARKERS	USES
DNA	• STANDARD GENOTYPING • BACTERIAL INFECTIONS • DIAGNOSIS OF HEAD AND NECK CANCER • FORENSICS
RNA mRNA	• IDENTIFICATION OF BACTERIA/VIRUS • HEAD AND NECK CANCER • INFORMATION ON TRANSCRIPTION RATES
PROTEINS	• DIAGNOSIS OF PERIODONTITIS • DIAGNOSIS OF HEAD AND NECK CANCER • DIAGNOSIS OF DENTAL CARIES
MUCINS/GLYCOPROTEINS	• DIAGNOSIS OF HEAD AND NECK CANCER • DIAGNOSIS OF DENTAL CARIES
IMMUNOGLOBULINS	• DIAGNOSING VIRUSES (HIV, HEPATITIS B AND C)
METABOLITES	• DIAGNOSIS OF PERIODONTITIS
DRUGS AND THEIR METABOLITES	• DRUG ABUSE MONITORING • DETECTION OF THE DRUG PRESENT IN THE BODY
BACTERIA/VIRUSES	• REACTIVATION OF EPSTEIN-BARR VIRUS (MONONUCLEOSIS)
CELLULAR MATERIAL	• DIAGNOSIS OF HEAD AND NECK CANCER

SALIVARY GLAND DIAGNOSTIC IMAGING PATHWAY



Diagnostic Imaging Pathways Salivary Gland Swelling

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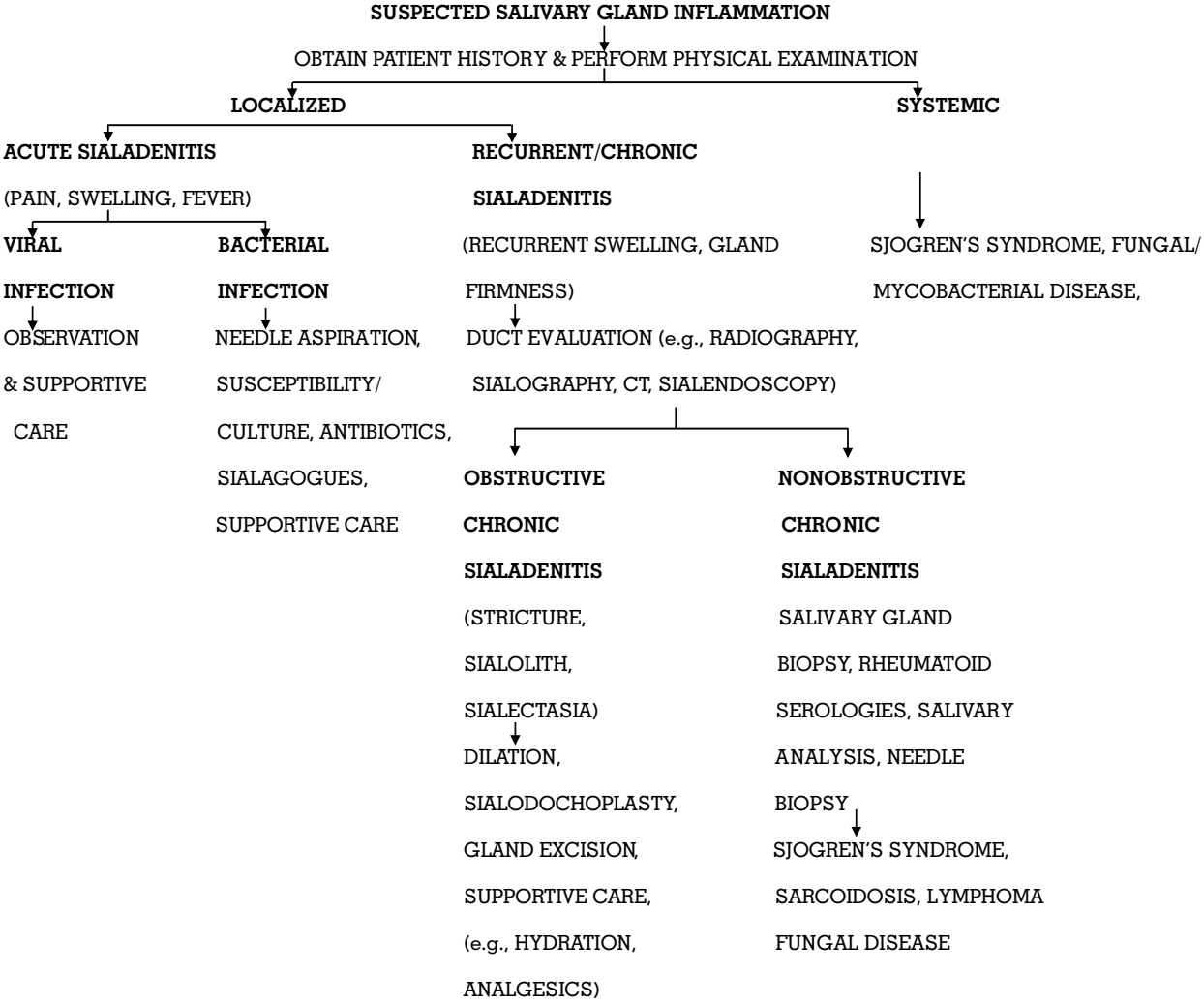
SALIVARY GLAND DIAGNOSIS AND MANAGEMENT TREE



Rogers J, McCaffrey TV. **Inflammatory disorders of the salivary glands.** In: Flint PW, Haughey BH, Lund VJ, et al., eds. Cummings Otolaryngology Head and Neck Surgery. 5th ed. Philadelphia, Pa.: Mosby Elsevier; 2010: 1151–1161.

SALIVARY GLAND DIAGNOSTIC TESTS

1.PLAIN FILM RADIOGRAPHY:

A conventional radiographic imaging technique can be used for salivary gland since they are located superficially. Plain film imaging was done to determine salivary gland disorders before the development of more trailblazing imaging techniques. It is the simplest, least expensive, readily available and least sensitive of all imaging modalities. It has the potential to identify unrelated pathology in the areas of salivary glands that may be mistaken as salivary gland disease, such as resorptive or osteoblastic changes in adjacent bone. Plain film imaging is advisable in evaluating calculi, detecting calcification in hemangiomas and evaluation of lymph nodes. Dental panoramic tomography, lateral oblique, rotated anteroposterior projections are used to picture the parotid glands. The Stenson's duct is imaged with an occlusal film with extended chin, open mouth and cheeks blown out to portray any lesion near the gland orifice. Imaging of submandibular gland includes dental panoramic tomography, lateral oblique, lower oblique occlusal and lower 90° occlusal radiograph to show the gland and duct respectively with extended chin, open mouth and tongue depressed by patient's finger.

2.XERORADIOGRAPHY:

Xeroradiography employs a thin layer of photoconductive selenium alloy (amorphous selenium) as the detecting medium, partially dissipating the charge by exposure to x-ray to form a latent image, and making the latent image visible by a photoelectric process. It produces finer and clearer images due to the edge contrast enhancement and wide exposure latitude. The landmarks on the cephalogram such as Sella, ANS, Basion and the outline of condylar process and articular fossa, the trabecular pattern of mandible and interdental crestal bone edges were set clear and distinct. It was very useful in the detection of radiolucent sialoliths. The only disadvantage was larger skin radiation dose which was 2.4 to16.2 times higher than the conventional film techniques.

3.INTRAORAL RADIOGRAPHY:

Intraoral radiographic techniques are used in routine dental practice and is divided into 3 categories: Periapical projections, Bitewing projections, Occlusal projections. Sialoliths in the anterior 2/3rd of the submandibular duct are typically imaged with a cross-sectional mandibular occlusal projection. The posterior portion of the duct may be demonstrated with an over-the-shoulder occlusal projection view, where the directing cone is placed on the shoulder and central ray is directed in an anterior direction through the angle of the mandible, with the patient's head rotated back and tilted to unaffected side. Parotid sialoliths are more difficult to demonstrate than the submandibular variety owing to the tortuous course of Stenson's duct around the anterior border of the masseter and through the buccinator muscle. As a rule, only sialoliths anterior to the masseter muscle can be imaged on an intraoral image. To demonstrate sialoliths in the

anterior part of the duct, an intraoral image receptor is stabilized with a holder inside the cheek, as high as possible in the buccal sulcus and over the parotid papilla. The central ray is directed perpendicular to the center of the receptor.

4.EXTRAORAL RADIOGRAPHY:

A panoramic projection frequently demonstrates sialoliths in the posterior duct or reveals intraglandular sialoliths in the submandibular gland if they are within the image layer. The image of most parotid sialoliths is superimposed over the ramus and body of the mandible at the level of or just superior to the occlusal plane, making oblique lateral radiographs of the mandible of limited value. To demonstrate sialoliths in the submandibular gland, the lateral projection is modified by opening the mouth, extending the chin, and depressing the tongue with the index finger to improve the image of sialolith by moving it inferior to the mandibular border.

5.ULTRASOUND:

Ultrasonography is a non-invasive procedure used for assessing submandibular and parotid gland. It is a quick procedure that is done with the help of a transducer with high linear frequency (7-10 MHz). It is used to distinguish solid and cystic lesions and acts as a guide for exact site of FNAC in salivary gland pathology. Ultrasonography along with color doppler imaging used to find the vascularity of the salivary gland lesion and also the nature of it. It is used to detect the various salivary gland pathologies like sialolithiasis, for distinguishing benign from malignant and intraglandular lesions from extra glandular lesions but cannot be used for deep parotid masses.

6.CONE BEAM COMPUTED TOMOGRAPHY:

It is used for detection of sialoliths with or without sialography. It is used to provide information on osseous tissue with reduced radiation exposure and is better than computed tomography.

7.COMPUTED TOMOGRAPHY AND MAGNETIC RESONANCE IMAGING:

Salivary gland pathologies and normal tissues adjacent to it are detected using CT and MRI. CT is preferred in acute sialadenitis. Coronal, axial and sagittal are the three planes in which the images of CT are produced by using computerized analysis of variance of absorption in all 3 planes. In pediatric patients, CT is contraindicated due to the radiation produced while exposed. MRI uses the differences in water content between body tissues and is based on the electromagnetic field absorbed and re-emitted to differentiate between lesions. It is mainly used for soft tissues by using the above parameters and computer software to reconstruct and provide the image. Larger stones and anatomy of the gland can be seen in MRI. CT and MRI measure the extent and depth of the tumors and also distinguish between 2 different lesions in close proximity. Gadolinium-enhanced MRI distinguish benign from malignant and T2 weighted MRI differentiates the Warthin's tumor from Pleomorphic adenoma.

8.SCINTIGRAPHY:

It uses radiopharmaceuticals uptake for the detection of salivary gland pathologies and when injection of i.v.99MTc-Pertechnate is given, the salivary gland takes it up and excretes it depending on increased or reduced uptake diagnoses the lesion. Many neoplastic lesions do not take up this and hence these are called as cold spots while Warthin's tumor is an exceptional and appears as hot spot.

9.SIALOGRAPHY:

In sialography, a contrast medium is injected into the salivary gland and radiographs are taken. It is used to image ductal systems and visualize whether the obstruction in the duct is a sialolith or a stricture. Sialography is not used in acute salivary infection and the ductal system imaging is done after giving contrast medium which takes places in three phases i.e., preliminary plain film, filling phase film and post evacuation film.

10.FINE NEEDLE ASPIRATION CYTOLOGY:

FNAC is a safe, economical and nontraumatic method with acceptable diagnostic accuracy. It allows exact differentiation between benign and malignant tumors of salivary glands and also helps in preoperative evaluation. Risk of open biopsy can be minimized in parotid tumors but the inflammatory masses of salivary glands may mimic epithelial neoplasm at cytology.

11.POSITRON EMISSION TOMOGRAPHY:

A PET scan uses radiotracers which decay with the emission of positrons which travel few millimeters converting mass into energy and releasing two high energy photons which are emitted approximately 180° to each other and combine the negatively charged electrons. The detection of these positrons by opposing detectors gives a 3-dimensional image of these events. Positron emission tomography uses a mild radioactive drug to show up areas of the gland where cells are more active than the normal and convey if the tissue is active cancer or not. If diagnosed as cancer, then a PET scan helps with the extent and the spread of the same. A PET-CT scan is a combination of both PET scan and a CT scan which help to add information about the extent, stage of cancer, whether a surgical excision has to be done, to decide the treatment, recurrence and to plan radiotherapy treatment.

12.SIALENDOSCOPY:

One of the latest salivary gland imaging method which uses fiberoptic endoscopic principles to diagnose the condition and intervene in form of irrigation, lithotripsy, helps in delivering the medication, and uses basket to remove small sialoliths with minimal invasion. A Sialendoscope is inserted in the major salivary gland duct opening under local or general anesthesia to visualize live glandular and ductal condition.

CONCLUSION:

The use of saliva as a diagnostic fluid is an easy, inexpensive, non-invasive, painless and stress- free approach in identifying hereditary, autoimmune, malignant, endocrinal disorders and also helps in assessing the level of drug usage. The quantitative changes in biomarkers in saliva can help identify the disease and its site. Hence it is necessary for a dental surgeon to know the normal salivary flow, its composition and function because saliva contributes more information than the one provided by serum.

REFERENCES:

1. Taneja A, Sachdev IS, Sethi S, Garga UC. **Salivary gland imaging: A pictorial essay.** Int J Med and Dent Sci 2015;4(1): 692-700.
2. Rastogi R, Bhargava S, Mallarajapatna GJ, Singh SK. **Pictorial essay: Salivary gland imaging.** Indian J Radiol Imaging 2012; 22:325-33.
3. Bhaumik J. **Imaging the Major Salivary Glands: A Review.** Adv Dent & Oral Health. 2018; 8(4): 555745. DOI: 10.19080/ADOH.2018.08.555745.
4. Mukesh Dhameja, Vikas Singla, Komal Dhameja, Neha Singla. **Diagnostic imaging of the salivary glands- a review.** International Journal of Contemporary Medicine Surgery and Radiology.2016;1(1):12-15.
5. Journal of Academy of Dental Education, 29–31, DOI: 10.18311/jade/2015-2016/15955.
6. ACTA OTORHINOLARYNGOLOGICA ITALICA 2017; 37:83-93; Doi: 10.14639/0392-100X-1597.
7. KEVIN F. WILSON, MD; JEREMY D. MEIER, MD; and P. DANIEL WARD, MD, MS, University of Utah School of Medicine, Salt Lake City, Utah. Am Fam Physician. 2014 Jun 1;89(11):882-888.
8. Grisius M.M., Fox P.C. **Salivary Gland Diseases.** In: Lynch MA, Brightman VJ, Greenberg MS, Glick M eds. Burket's Oral Medicine. 10th ed. Spain: BC Decker Inc; 2003. 563-577.
9. Rogers J, McCaffrey TV. **Inflammatory disorders of the salivary glands.** In: Flint PW, Haughey BH, Lund VJ, et al., eds. Cummings Otolaryngology Head and Neck Surgery. 5th ed. Philadelphia, Pa.: Mosby Elsevier; 2010: 1151–1161.
10. Pink, Richard & Simek, Jiri & Vondrakova, Jana & Faber, Edgar & Michl, Petr & Pazdera, Jindrich & Indrák, Karel. (2009). **Saliva as a diagnostic medium**. Biomedical Papers. 153. 103-110. 10.5507/bp.2009.017.
11. Yousem DM, Kraut MA, Chalian AA. **Major salivary gland imaging.** Radiology. 2000;216:19-29.
12. Lee YY, Wong KT, King AD, Ahuja AT. **Imaging of salivary gland tumours.** Eur J Radiol. 2008;66(3):419-36
13. Greenberg MS, Glick M. Burket's Oral Medicine -Diagnosis and Treatment. 10th ed. Ontario (NY): BC Decker Inc; 2003. p. 235-70.

14. Yuasa K, Nakhyama E, Ban S, Kawazu T, Chikui T, Shimizu M et al. **Submandibular gland duct endoscopy - Diagnostic value for salivary duct disorders in comparison to conventional radiography, sialography, and ultrasonography.** Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 1997; 84:578-81.
15. Liyanage SH, Spencer SP, Hogarth KM, Makdissi J (2007) **Imaging of salivary glands.** Imaging 19: 14-27.
16. Drage NA, Brown JE (2009) **Cone beam computed sialography of sialoliths.** Dentomaxillofacial Radiology 38(5): 301-305.
17. Nahlieli O, Baruchin AM (1977) **Sialendoscopy: three years' experience as a diagnostic and treatment modality.** J Oral Maxillofac Surg 55(9): 912-918.
18. Cawson RA, Gleeson MJ, Eveson JW. **The pathology and surgery of salivary glands.** ISIS Medical Media Ltd, 58 St Aldates, Oxford OX1 1st, UK, 1997. p. 10–21.2.
19. Wilson KF, Meier JD, Ward PD. **Salivary gland disorders.** Am Fam Physician 2014;89:882-8.
20. Diagnostic Imaging Pathways - Salivary Gland Swelling