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ANATOMY OF SALIVARY GLANDS – GLANCE ON RARE VARIATIONS

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ABSTRACT

The paired parotid glands are the largest of the major salivary glands and produces mainly serous secretions. The secretion of this gland reaches the oral cavity through single parotid duct (Stenson's duct). The parotid duct begins at the anterior border of the gland, crosses the masseter muscle, and then pierces the buccinator muscle to reach the mucosa lining the mouth at the level of the cheek. The submandibular gland is one of the three major salivary glands, in which his excretory duct is called Wharton's duct, which empties into the caruncles, on the floor of the mouth. A sound knowledge of rare anatomical variations besides helping us in solving many clinical problems. The present review reports on various rare entities related to parotid and submandibular glands from numerous literatures.

Key words: Major Salivary glands, Stenson's duct, Wharton's duct, functions, rare entities.

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INTRODUCTION

The human salivary gland system can be divided into two distinct exocrine groups. The major salivary glands include the paired parotid, submandibular, and sublingual glands. Additionally, the mucosa of the upper aerodigestive tract is lined by hundreds of small, minor salivary glands. The major function of the salivary glands is to secrete saliva, which plays a significant role in lubrication, digestion, immunity, and the overall maintenance of homeostasis within the human body. [1]

The submandibular gland is a salivary major gland located in both sides of the face, in the pit of the sub perforation of the mucous on both sides [3,4]. Nevertheless, in some occasions they present a few slightly common variations in the evacuation channels of the glands; therefore, the present case describes an unusual variation of the path of Wharton's duct.

The parotid gland (PG), the largest salivary gland, is the located anteriorly and inferiorly in the external acoustic meatus, partially covering the ramus of the mandible and the masseter muscle [6]. The saliva produced by the parotid gland is mainly serous with a high content of amylase and immunoglobulin A.

The embryonic development of parotid gland is well established. The parotid gland is formed by the proliferating ectoderm of the primitive oral cavity, which invaginates into the adjacent mesenchyma during the sixth week of pre-natal development. Such invagination gives rise to several epithelial sprouts that proliferate and migrate posteriorly in a chain of cells that bend over in order to form ducts by the time the tenth week of gestation is reached. The posterior ends of each epithelial structure differentiate to form acini, which start their secretory

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function around the eighteenth gestational week. [7] The ducts directly linked to the secretory tissue have smaller diameter and are lined with a single layer of cubic epithelial cells. These ducts merge to form larger and larger ones until excretory ducts are formed having a stratified layer of cuboid epithelial cells, followed by larger ducts lined with layers of cylindrical epithelial cell, which finally merge to form a single main duct, the Stenson's duct. This is formed by smaller ducts lying near the posterior margin of the ramus of the mandible, and measures about 5 cm. [8,9] The Stenson's duct, then, crosses horizontally off the anterior margin of the ramus of the mandible, passes laterally to the masseter muscle, goes around its anterior margin and through the buccinator muscle to end up into the oral cavity. [10]. Normally the Stenson's duct exits from anterior border of the parotid gland and opens as a sole parotid duct in the oral cavity. It is lined by stratified cuboidal or stratified columnar epithelium [6].

DISCUSSION

Many researchers had found several variations in parotid ducts. They demonstrate evidence of anatomical variations of the parotid gland in the presence of double ducts, which may also be associated with the binding of a submandibular duct with the parotid duct in several cases.

Lewkowicz et al. had established that accessory parotid gland is the normal salivary tissue separated from the main parotid gland. It is located approximately 6 mm anterior to the parotid gland proper, between the skin and the masseter muscle, along an imaginary line that extends from the tragus to a point midway between the ala of the nose and the vermilion border of the lip [11].

Polayes et al. had found the accessory parotid gland, which is little known and seldom mentioned in the literature, exists in 21% of individuals [12]. There is no known histologic difference between the accessory tissue and the parotid gland proper [12].

Sun G et al. had seen masses arising in the accessory parotid tissue usually occur around the central third of a line drawn from the tragus to the bottom of the ala of the nose, parallel to the main parotid duct [13]. This line lies approximately 1 fingerbreadth below the malar arch and also along the course of the buccal branch of the facial nerve [13].

Usually the Wharton duct empties into the floor of the mouth, but rarely joins the duct of the parotid gland, called Stenson duct, which ends leading to a single hole in the oral cavity, adjacent the second upper molar at the level of the Stenson's papilla [2]. But, Manzur et. al. had observed a variation in the travel of the right portion of the Wharton's duct, which doesn't end in the caruncles because the duct joins and anastomoses with the excretory duct of parotid gland. Unfortunately, there are no reported cases concerning the union of the submandibular gland duct with duct of the parotid gland unilaterally, as it was found in by Manzur et al.[14]

Koybasioglu et al. had found an accessory duct of the Submandibular gland and also established that this can produce several alterations such as an obstruction in the Wharton's duct. [15]

Gupta et al. had established that several things may be inside the duct and could cause new problems such as a tooth in submandibular gland duct or can produce most commonly sialolithiasis, in which the clinical symptoms are swelling of the salivary gland, and pain [16]

Peterson et al. suggested that secretion of saliva from PG that performed by Stenson's duct may be helped by possibly existing accessory PDs [17].

Slater et. al. had observed that the accessory parotid tissue consists of a 0.5 to 2.5 cm lobule of serous salivary gland tissue located anterior to the main body of the gland and is attached to a short aberrant branch of the parotid gland [18].

Avery et al. described development of the parotid gland in six stages: induction of bud formation from the oral epithelium by the underlying mesenchyme; formation and growth of epithelial cord; initiation of branching in terminal parts of the cord; lobule formation through repetitive branching of the epithelial cord; canalization of the cords to form ducts; and cytodifferentiation. The growth, cytodifferentiation and morphogenesis of the parotid gland depend on both intrinsic and extrinsic factors. The programmed pattern of cell specific gene expression is the genetic script established early in development, while extrinsic factors include cell-cell and cell-matrix interactions and growth factors. An intact basal lamina and the presence of mesenchyme are required for normal branching [19]. The synthesis and deposition of both types I and III collagen appear to be required for parotid gland branching morphogenesis [20].Type IV collagen and, to a limited extent, laminin have been shown to play a role in the regulation of the differentiation of parotid gland secretory cells and to some extent ductal cells. Collagen synthesis stabilizes and maintains the branch points. Specific growth factors presented by extracellular molecular proteins appear to regulate events such as branching and lobule elongation [19]. The cell-matrix interactions and growth factors are increasingly important to the understanding of how the developmental signals are transmitted or mediated by extracellular matrix molecules of the basement membrane and associated mesenchyme regulate specific gene expression and cellular function leading to morphogenesis and cytodifferentiation of parotid gland and development of such variant.

The presence of double parotid ducts can be explained on the basis of developmental morphology of the parotid gland. Aktan et al had reported a case of double parotid glands in the right side of the face of a 63-year-old male cadaver that merged with each other at a distance of 7 mm before perforating the buccinator muscle. They confirmed that these ducts were intra- parotid ascending and descending ducts, which did not merge inside the parotid gland as it occurs normally. Both ducts were fused with each other before reaching the buccinator muscle [21]. Comparable variation was also found by Fernandes et al. He reported the case of a parotid gland with the presence of two ducts located on the right side unilaterally ending a single orifice leading to the Stenson's papilla on the right side of the parotid gland of a 46 year old male cadaver, but origins of both ducts have not been traced in gland. He established that double parotid ducts measuring 26.49 mm and 37.25 mm in length and merging 3.35 mm proximal to the piercing of buccinator were present on the right side evidence that the two ducts belongs to the parotid gland [22].

Astik & Dave et al. in 2011 had measured length and diameter of bilateral parotid gland ducts and states that that the presence of these can be explained by morphological development. He found the double parotid ducts bilaterally in a 50 year old male cadaver. He measured the diameters of superior and inferior ducts on the left side was 2.4 mm and 2.6 mm, respectively; and on the right side 2.5 mm and 2.2 mm, respectively. Whereas normally the average dimensions of the parotid duct are 50 mm long and 3 mm wide [6] He also observed the unilateral double parotid duct with the superior duct measuring 28 mm and the inferior duct measuring 37 mm merged to form the main parotid duct within an accessory parotid gland and then emerged to run forward to pierce the buccinator; the length of the main parotid duct was 25 mm. The length of the ducts on the right side was 29 mm and 36 mm and that of the ducts on the left side was 28 mm and 34 mm. The ducts merged with each other at the level of the anterior border of masseter on both sides [23].

Many researchers had estimated tumors in parotid gland as well as accessory ducts. Batsakis G. et al. had analyzed that 50% of accessory parotid gland tumors are malignant, which is more than the 25% malignancy rate reported for tumors of the parotid gland proper [24,25]. Whereas, Choi et al. had found that tumors of the accessory lobe of the parotid gland are rare and are often approached by direct incision over the mass, inadequately [26]. Lin DT et al. had observed the behavior of these tumors which is comparable to that of tumors arising from the main parotid gland. Both benign and malignant processes may arise in this area from skin, lymphatic, adnexal, neurologic, and salivary structures [27]. Yoshihara et al. had established that accessory parotid gland neoplasms should be suspected in any patient presenting with a mid-cheek mass [28].He had demonstrated that these glands typically lie between the buccal and zygomatic branches of the facial nerve and may have multiple connections by way of 1 or more small tributaries to the Stenson duct [28].

The proper and precise knowledge of the normal topographic anatomy, dimensions of the excretory ducts and its variations are very important to those involved in their diagnosis and treatment. This variation also has clinical importance for parotid gland surgery and facial cosmetic surgeries. Clinicians for clinical procedures carrying out on this organ such as; reporting radiographic images (sialograms) and CT-scan (computerized tomographic scans), used in sialography and also for endoscopy of parotid duct, lithotripsy, and trans-ductal facial nerve stimulation in early stage of facial paralysis. Hence it is interesting for radiologists due to analysis of radiographic images, and surgeons for performing surgical procedures on this region [29].

The knowledge of presence of double parotid ducts is vital in diagnosis of congenital fistula from accessory parotid gland by CT sialography and CT fistulography [6], and avoiding iatrogenic injury to buccal branch of facial nerve in parotid gland surgery, parotid duct surgery and some facial cosmetic surgery [30]. Double parotid ducts may be a confused with congenital fistula from accessory parotid gland. Additionally, the duct may be severed by a facial laceration and is at risk of iatrogenic injury during facial surgery and injection of botulinum toxin into masseter muscle, because of its superficial location. To keep in mind the double parotid duct variation will reduce iatrogenic injury risks and improve diagnosis of parotid duct injury [31].

Sternocleidomastoid can be used in several ways by the surgeons who harvest these muscle flaps for reconstructions such as during parotid surgery (parotidectomy), where the Sternocleidomastoid muscle could serve as an excellent candidate for myocutaneous flap, may cover the surgical defects and possibly preventing Frey's syndrome [32,33]

Most benign neoplasms are found within the superficial lobe of Parotid gland and can be removed by a superficial parotidectomy. Tumors arising in the deep lobe of the parotid gland can grow and extend laterally, displacing the overlying superficial lobe without direct involvement. These parapharyngeal tumors can grow into "dumbbell-shaped" tumors, because their growth is directed through the stylomandibular tunnel [34].

The evaluation of a mid cheek mass can be extremely challenging, and lesions from this area may arise from normal anatomic anterior facial structures or from variations of the normal accessory parotid gland tissue [13].

The differential diagnoses include benign and malignant tumors of the accessory parotid gland, parotid gland cysts, adnexal tumors, neural tumors, metastatic disease, Kimura disease, and vascular lesions such as hemangioma and vascular malformations [26,18,35,36].

CONCLUSION

Therefore, it is vital to know the different anatomical variations that can be present in the excretory ducts of the salivary glands, because not only these variations can confuse the real diagnosis suffered by a patient if he is not aware of the existence of these, but is also of special attention for surgeons when operating to avoid any complications or laceration of the duct. Additionally, it is important that radiologists are enlightened about it to facilitate and assist in the diagnosis of these ducts by radiographic studies.

Nowadays, as researchers keep developing new organs or tissues it is possible that one of them produces an anatomical variation, either concerned to the form, the place where it is located or where it ends. It is very vital to report these finding so further studies can be initiated regarding to alterations that may cause such variations, such as an anomaly or condition either by the submandibular gland because of a decrease in salivary flow, or in the parotid gland by an excess of salivary flow.

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