RESEARCH PAPER

Comprehensive Review On Surgical Anatomy Of Parotid Duct

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Abstract

Background: Parotid duct also known as stenson's duct is known for its characteristic course and variability in number as well as branching pattern since its discovery with variation prevalence rate of 20-30%. It carries secretions of parotid gland into the oral cavity. Distinguishing patterns of the commencement, dimensions and branching of the duct are reported in the literature. The knowledge of the surgical anatomy of the duct is essential for parotid and maxillofacial surgery because of its close association with the facial nerve. Dimensions of the duct are clinically significant for all endoscopic interventions like transductal facial nerve stimulation, sialoscopy, lithotripsy and procedure for ductal stenosis. Present article is a comprehensive review of surgical anatomy of the parotid duct along with embryological basis of variations integrating with clinical relevance which makes its useful for diagnostic accuracy, interventional procedures and therapeutic outcomes.

Keywords: Parotid Duct, Parotid Gland, Accessory Parotid Gland, Facial Nerve, Buccal Branch, Parotid Duct Line, Sialoendoscopy, Ductal Stenosis.

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INTRODUCTION

Human body has three main salivary glands. Parotid is the largest salivary gland located below zygomatic arch and produce predominantly serous secretions which is drained by parotid duct (PD).[1] The parotid duct (PD) which is also termed as Stensen's duct after Danish anatomist emerges from the anterior border of the gland.[2] Accessory parotid gland is widely reported in the literature with incidence range between 21 to 71 % [2,3] Accessory parotid is also drained by separate duct which in due course may join the main parotid duct.[2,3]

The PD normally passes between two buccal branches of the fascial nerve after emerging from the anterior border of parotid gland. It then lies on masseter and pierces buccinator at right angle. It opens opposite to the crown of second upper molar tooth [2,4,5,6] Heidman described that PD is a single duct which has branching pattern. [1, 7,8] On review of literature, we found only one study by Yonsei, where Devis classification is described for the branching pattern of PD.[9]

Varied dimensions of the PD are reported in literature, length in the range between 24mm to 57mm.[1,10,11] Diameter of PD is not uniform and varies at different levels.[6,11] The dimensions of PD are important for all ductal procedures like lithotripsy, sialoendoscopy etc.[2,4,6, 10,11,12] That's why we have included review of PD dimensions in different studies in the present article. Duplication of PD is not uncommon.[4,8,10,13] In case of the presence of two PDs dimensions of both ducts are mentioned.

Present article is a comprehensive review of fundamental anatomy of the parotid duct like course, dimensions and the number of PD. We tried to correlate the variation of duplication with development of the PD. Clinical

significance added in the article makes it an integrated valuable source for academic study, research and clinical practice.

METHOD

total 20 articles reviewed. Studies of parotid duct describing anatomy, course, number, development and clinical significance are selected.

DISCUSSION

Course of the parotid duct –

The parotid duct (PD) which is also termed as Stensen's duct after Danish anatomist emerges from the anterior border of the gland.[2,12] As per author **Rajesh B. Astik** the PD is formed by the union of two or three ducts which either ascend or descend perpendicular to the main duct.[4] Avril Horsburgh said the tributary duct of PD meets it at an angle of 53 degrees.[6]

After emerging from anterior border of parotid gland, PD passes between upper and lower buccal branch. It then crosses the masseter and pierces buccinator muscle to open in the oral cavity opposite the crown of upper second molar tooth.[1,2,4,10,13,14] When the PD is superficially lying on masseter between upper and lower buccal branches it may receive accessory parotid duct if present.[1,4,8]

Surface Anatomy of Parotid duct - Farabeuf had described Parotid Duct Line (PDL) for guiding on location of PD in emergencies to reduce morbidities associated with PD injury. [15] It involves to major points. Tragal point and the lip point. As per this concept, commencement of PD is at a tragal point which is equidistance between tragus and antitragus while termination of PD is at lip point which is middle of upper half of lip.[15,16,17] It is a S-shaped curve and not a straight line.[15,16,17]

Dimensions of parotid duct –

When we see morphometry of PD, various length and diameters are mentioned in the literature as shown in Table 1. In the literature, as per review, PD has 50mm mean length and 3mm mean diameter.[2,4,6,18] As per author kaori Amano, PD can be 6 to 8 cm in length in adults.[14] Stringer had reported mean length of parotid duct as 42 ± 7.5 mm while mean diameter as 0.6 ± 0.2 mm.[3]

According to Avril Horsburgh diameter of PD is not same throughout.[6] It is more at the commencement around 1.8 mm, least in the middle of its course with the mean diameter of 1.1mm and near termination little less than the diameter at origin with the diameter of 1.6mm.[6] Author J zenk also mentioned characteristic narrowing in the middle and different diameters of PD at different locations with minimum diameter of 0.1 mm and maximum diameter of 2.3 mm.[11] Fernandes *et al.* reported two ducts of length 26.49 mm and 37.25 mm.[10] Author Aktan reported a duct of 55mm length.[19] Author Atson in his study found two ducts with the length of 26.49 mm and 37.25 mm from commencement till merging. Atson mentioned diameters of two ducts at the commencement around 3.05 mm and 3.31 mm while near termination as 2.84 mm and 2.68 mm respectively.[10] Author Heidmann gave range of 24mm-69mm with mean duct length on right side 45.9 mm and on left side 48.5mm.[1] As per the findings of Heidmann, mean duct length was more in females than in males. On the right side, the author mentioned mean duct length in male was 45mm while in female as 46.8mm. On left side, mean duct length in male was 46mm and female was 50.9mm. This also indicates PD length was slightly more on left side compared to right. When double ducts are present, average length for right sided superior duct on was 35.2mm and inferior duct was 45mm respectively. On left side average length for superior duct was 57mm and for inferior duct was 37.2mm.[1] Avishai G, mentioned the mean luminal diameter as 1.6 mm and the mean length of the duct was 50 ± 9.6 mm in his study. [8]

Figure 1

Table 1: Length of Parotid Duct in the various studies [arranged chronologically as per year of the study]

Title of Study	Author	Year	PD - Reported Duct Length(s)

Diameters of the Main Excretory Ducts of the Adult Human Submandibular and Parotid Glands	Johannes Zenk[11]	2000	Duct length Range ~ 40–50 mm
Parotid Gland with Double Duct: An Anatomic Variation Description	Atson Carlos de Souza Fernandes[10]	2009	Superior duct: 26.49 mm; Inferior duct: 37.25 mm (cadaveric case report)
Redefining the surface anatomy of the parotid duct: an in vivo ultrasound study	Stringer *et al.* [3]	2012	Duct length ~ 42 ± 7.5 mm
Anatomy of the parotid duct: Assessing variations of the parotid gland drainage pattern. Translational Research in Anatomy	Heidmann *et al.*[1]	2021	Right Duct length ~ 45.9 mm Left Duct length ~48.5mm Duct length Range ~ 24mm-69mm
Anatomical Features of the Parotid Duct in Sialography as an Aid to Endoscopy—A Retrospective Study	Gal Avishai[20]	2022	Duct length Range ~ 45–50 mm (sialography imaging)

Number of parotid duct – As per Author sumathi and Bailey incidence of double parotid duct is 7%.[13] Aktan, M Taheri, Fernandes, Amro, Ferreira reported unilateral double PD.[5,10,19] Stringer, Astik, Dave, Atson, reported bilateral double PD.[1,3,4,10]

Author Alan in their study mentioned unilateral single PD in 31% of cases. In the ducts with branching pattern bifurcated pattern was the most common found in 48.3% of cases. Trifurcated and multiple branches found in equal number of cases (7%).[8] Author Heidmann reported 94.12 % cases with single duct and 5.88% cases with double ducts.[1]

Development of parotid duct – PD development starts at six week of gestational age. It develops from the epithelial bud formed by epithelial-mesenchyme interaction in the oral cavity at stage 15.[4,5,13] Proximal part of the bud forms duct while distal part forms gland.[5,13] Initially furrow develops between mandibular and maxillary process towards the angle of mouth.[2,4] Proximal part of this furrow gets canalized and form tube. This tube persists and form duct. Distal secretory portion develops as a sprouting from the proximal duct portion in tenth gestational week.[2,4,5,21]

Specific growth factors produced by extracellular molecular proteins and collagen (Type I and IV) affect the development of branching in the parotid gland.[22,23] Collagen maintains the stability of branching points.[4] Author Atson says in relation to the secretory cells initially smaller single layered ducts develop. Such many ducts join and form larger multilayered ducts which on union forms final excretory duct.[21]

Embryological basis of duplication of PD -

As per author Sumathi, when there is early division of parotid duct and the acini sprouting from these ducts intermingle with each other double parotid duct will form.[13] As per another theory by Hulya and Atson, the bifurcated epithelial sprout when get invaginated by mesenchyme separately forms two separate ducts.[2,6,10]

As per author Rajesh Astik growth factors and cell matrix interactions for developmental signals by extracellular matrix contribute for morphogenesis and cell differentiation are responsible for variations in the number of parotid ducts.[4] As per the Heidmann, branching pattern of PD relies on the tributaries present inside the parotid gland which unite and form main PD.[1]

Duct pattern of parotid duct –

Author Devis *et al.* classified the duct pattern of the parotid duct depending upon how the tributary ducts from the superficial and deep lobes are joined to form the main PD as shown in Table 2. Superficial and deep lobe further divided into upper, middle and lower part as shown in Fig 1.[9] The author reported highest cases (42.2% cases) with

type a followed by 26.7 % cases with type b and 22.3% cases with type e. Type c and d cases were less and equal (4.4%).[9]

Table 2: Devis classification for Parotid duct pattern

TYPE	DESCRIPTION
Type a	Ducts from upper and middle superficial lobes join to form main parotid duct
Type b	Ducts from upper and middle deep lobes join to form main parotid duct
Type c	Ducts from upper and lower part of superficial lobe join with the duct from the middle part of deep lobe to form the main parotid duct
Type d	Ducts from upper, middle and inferior parts of superficial lobe join and form the main parotid duct
Type e	Ducts from upper part of superficial lobe and middle part of deep lobe join to form the main parotid duct

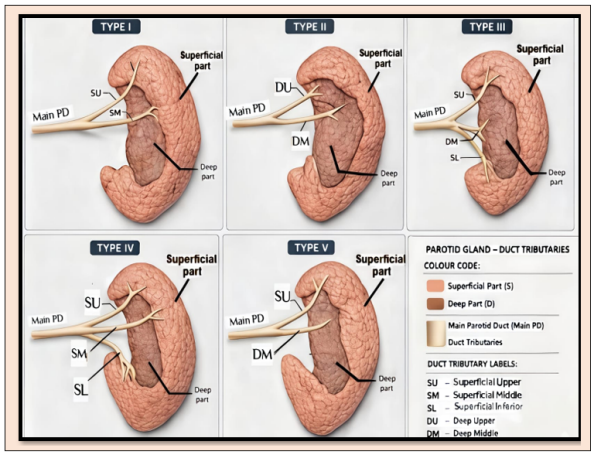

Figure 2: Diagrammatic Presentation of parotid duct pattern by Devis [self drawn diagram by author]

Clinical Significance

Dimensions of PD are significant for luminal diagnostic and therapeutic procedures.[1,2,10,12] Author Hulya said the number of PD is also important. Presence of two ducts can be mistaken for congenital fistula from accessory parotid gland in imaging procedures like CT guided sialography and fistulography [2,10,21,24,25]

The knowledge of dimensions of PD and its variations is essential for sialography, lithotripsy, siloendoscopy and trans-ductal facial nerve stimulation.[pd 3,4,6,18,19,20] Though parotid duct had physiological property of widening to its capacity still ducts with caliber of 1.2mm and more are suitable for ductal procedures as per author.[11]

Superficial course of PD on masseter makes it vulnerable for iatrogenic injuries in [pd1] facial rejuvenation surgeries like injection of botulinum or other facial and parotid surgeries and facial truma with lacerations in massetric and buccal regions [2,3,4] Surgeries like rhytidectomies which requires fascial separation have higher chances of injury to parotid gland as well as duct.[1,27] Mandel and silver reported that injury to PD can cause either compression of duct or obstruction of the duct which may lead to stagnation of secretions. [26]

As PD passes between branches of facial nerve, in PD injuries can have associated complications of facial palsy and parotid fistula.[1] Facial nerve injury occurs in more than 50% of patients with PD injury. Buccal branch of facial nerve will get injured more compared to other branches as its course is parallel to the PD.[15] Author Xinran reported the presence of ectopic parotid duct which led to buccal fistula was treated by the parotid duct disposition surgery.[27,28,29]

REFERENCES

1. E. Heidmann *et al.* Anatomy of the parotid duct: Assessing variations of the parotid gland drainage pattern.Translational Research in Anatomy.2021.Volume 25:100152
2. Ucerler, Hulya *et al.* Bilateral double parotid ducts: a case report. Anatomy. 2016. 10. 239-241. 10.2399/ana.16.042.
3. Stringer MD, Mirjalili SA,*et al.* Redefining the surface anatomy of the parotid duct: an in vivo ultrasound study. Plast Reconstr Surg. 2012 Nov;130(5):1032-1037. doi: 10.1097/PRS.0b013e318267d610. PMID: 23096603.
4. Rajesh Astik, Dave *et al.* Embryological basis of bilateral double parotid ducts: a rare anatomical variation. International Journal of Anatomical Variations.2011:Vol(4):141-143

5. Hassanzadeh Taheri MM, *et al.* Unilateral duplication of the parotid duct, its embryological basis and clinical significance: a rare cadaveric case report. Anat Sci Int. 2015 Jun;90(3):197-200. doi: 10.1007/s12565-014-0243-0. Epub 2014 Jun 22. PMID: 24952513.
6. Horsburgh A, Massoud TF. The salivary ducts of Wharton and Stenson: analysis of normal variant sialographic morphometry and a historical review. Ann Anat. 2013 May;195(3):238-42. doi: 10.1016/j.aanat.2012.11.003. Epub 2012 Dec 7. PMID: 23279725.
7. Som, Peter & Brandwein-Gensler, Margaret. (2011). Anatomy and Pathology of the Salivary Glands. 10.1016/B978-0-323-05355-6.00040-9.
8. Richards AT, Digges N,*et al.* Surgical anatomy of the parotid duct with emphasis on the major tributaries forming the duct and the relationship of the facial nerve to the duct. Clin Anat. 2004 Sep;17(6):463-7. doi: 10.1002/ca.20011. PMID: 15300865.
9. In young Park *et al.* A morphological study of the parotid gland and the peripheral branches of facial nerve in Koreans. Yonsei Medical Journal. 1977:Vol 18(1):45-51
10. Fernandes, Atson & Lima, Rafael & Rossi, Marcelle & Aguiar, Marcio. (2009). Parotid Gland with Double Duct: An Anatomic Variation Description. International Journal of Morphology. 27. 10.4067/S0717-95022009000100023.
11. Johannes Zenk *et al.* Diameters of the main excretory ducts of the adult human submandibular and parotid gland: A histologic study.Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology. Volume 85(5):1998.576-580.
12. Kulkarni CD, Mittal SK, Katiyar V, Pathak O, Sood S. Accessory parotid gland with ectopic fistulous duct--diagnosis by ultrasonography, digital fistulography, digital sialography and CT fistulography. A case report and review of current literature. J Radiol Case Rep. 2011;5(7):7-14. doi: 10.3941/jrcr.v5i7.680. Epub 2011 Jul 1. PMID: 22470802; PMCID: PMC3303448.
13. Shanmugam, Sumathi *et al.* Unilateral duplication of parotid duct – a rare cadaveric case report. IJAE.2016.18493.
14. Amano K, Moriyama H, Shimada K, Matsumura G. Morphological study of the parotid duct in human fetuses with special emphasis on the relationship between the buccinator muscle and the parotid duct. J Med Invest. 2009;56 Suppl:255-7. doi: 10.2152/jmi.56.255. PMID: 20224193
15. Lazaridou M, Iliopoulos C, Antoniades K, Tilaveridis I, Dimitrakopoulos I, Lazaridis N. Salivary gland trauma: a review of diagnosis and treatment. Craniomaxillofac Trauma Reconstr. 2012 Dec;5(4):189-96. doi: 10.1055/s-0032-1313356. Epub 2012 Jul 6. PMID: 24294401; PMCID: PMC3577598.
16. Robardey G, Le Roux MK, Foletti JM, Graillon N, Gormezano M, Varoquaux A, Lan R, Chossegros C. The Stensen's duct line: A landmark in parotid duct and gland injury and surgery. A prospective anatomical, clinical and radiological study. J Stomatol Oral Maxillofac Surg. 2019 Sep;120(4):337-340. doi: 10.1016/j.jormas.2019.04.006. Epub 2019 Apr 11. PMID: 30981905.
17. Toure G, Foy JP, Vacher C. Surface anatomy of the parotid duct and its clinical relevance. Clin Anat. 2015 May;28(4):455-9. doi: 10.1002/ca.22510. Epub 2015 Feb 12. PMID: 25683303.
18. Standring S (editor). Gray's anatomy: the anatomical basis of clinical practice. 29th ed. Edinburgh (Scotland): Elsevier ChurchillLivingstone; 2005. p. 515–7 *(PDF) Bilateral double parotid ducts: a case report*. Available from: https://www.researchgate.net/publication/314168550_Bilateral_double_parotid_ducts_a_case_report [accessed Mar 24 2026].
19. Aktan ZA, Bilge O, Pinar YA, Ikiz AO. Duplication of the parotidduct: a previously unreported anomaly. Surg Radiol Anat 2001;23:353–4.
20. Avishai G, Younes M, *et al.* Anatomical Features of the Parotid Duct in Sialography as an Aid to Endoscopy-A Retrospective Study. Diagnostics (Basel). 2022 Aug 2;12(8):1868.

doi: 10.3390/diagnostics12081868. PMID: 36010218; PMCID: PMC9406592.

21. Moore, K. L. & Persaud, T. V. N. The Developing Human: Clinically Oriented Embryology. 7th Philadelphia, Saunders.2002.
22. Avery JK, Steele PF, Avery N. Oral Development and Histology. 3rd Ed., New York, Thieme. 2002: 293–296.
23. Spooner BS, Faubion JM. Collagen involvement in branching morphogenesis of embryonic lung and salivary gland. Dev Biol. 1980; 77: 84–102.
24. Samanta *et al.* An unusually located human accessory parotid glanda. A case report.Braz.J.morphol.Sci.24(1):53-4,2007
25. Bahadir, O.; Caylan, R.; Bektas, D. & Korkmaz, O. Sialolithiasis of an accessory parotid gland. Ann. Otol. Rhinol. Laryngol., 113(1):52-4, 2004
26. Zhao X, Yang S, Liu M, Cai M. Ectopic Parotid Main Duct on Buccal Mucosa: A Case Report and Literature Review. J Oral Maxillofac Surg. 2020 Aug;78(8):1349-1354. doi: 10.1016/j.joms.2020.02.015. Epub 2020 Feb 21. PMID: 32184087.
27. L.Mandel *et al.* Bilateral parotid duct obstruction after rhytidectomies:case report. J. OralMaxillofac.Surg.70(2):2012::449-452
28. Kessler AT, Bhatt AA. Review of the Major and Minor Salivary Glands, Part 1: Anatomy, Infectious, and Inflammatory Processes. J Clin Imaging Sci. 2018 Nov 15;8:47. doi: 10.4103/jcis.JCIS_45_18. PMID: 30546931; PMCID: PMC6251248.
29. Thibault *et al.* Internal architecture of the parotid gland at MR imaging facial nerve or ductal system? Radiology,188(3):701-5,1993