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Morphogenesis of Parotid Gland in Human Fetuses

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Abstract:
Background: *The present study attempted to find out the morphological changes of parotid gland in developing human fetuses.*
Materials and Methods*: Parotid glands from 60 fresh human fetuses of gestational age ranging from 12weeks to term, were studied in terms of their shape, position, location and relationship with the neighboring developing structures.*
Results: *The shape of the parotid gland is round upto 16 weeks of gestation. 17 weeks onwards the shape is oval with the long axis directed along a line joining the angle of the mouth and the tragus. In fetuses 34 weeks and onwards pyramidal shaped glands are seen though majority showed oval shape. In 12 to16 week fetuses glands are present at the angle of the mouth. From 17 weeks till 30 weeks the gland is at the middle of the line joining the angle of the mouth and the tragus. 32 weeks onwards glands are just away from the middle of the above line, towards the tragus although in some fetuses those are still in the middle of that line. None of the gland, even at term, showed preauricular location. None of the fetuses showed glandular agenesis, in all fetuses glands are present bilaterally.*
Conclusion: *When compared with various authors, some findings of the present study followed the foot-steps of previous workers whereas some were in contrary, the most important difference being the location of the gland.*
Keywords*: Parotid gland;Morphogenesis;Human fetuses;Stomodium;Location of the gland; Accessory parotid gland.*

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I. Introduction

The pair of parotid glands is the largest of the major salivary glands secreting the saliva into the oral cavity. The gland is located anterior to and below the lower part of the external acoustic meatus, extends subcutaneously backward over the anterior portion of the sternocleidomastoid muscle and mandible. It projects forwards on the surface of the masseter muscle. The gland is sub-divided into a larger superficial lobe and a smaller the deep lobe, deep to the ramus, the two being joined by an isthmus. Branches of the facial nerve emerge on the face from the anterior margin. In 20% of cases a small detached part, the pars accessoria, lies between the zygomatic arch above and the parotid duct below.[1] During the 6th and 7th week of embryonic period, the salivary glands begin to develop. The parotid glands are the first to appear (early in the 6th week). They begin as solid epithelial buds from the oral ectodermal lining (oropharyngeal epithelium) near angle of the stomodium. The club-shaped ends of these epithelial buds grow into the underlying mesenchyme. The tips of the outgrowth form branches and terminal acini. The connective tissue in the gland is derived from neural crest cells. All parenchymal (secretory) components develop by proliferation of the oral epithelium.[10]Parotid gland is round at birth and gradually grows over the surface of the parotid duct in early childhood. The gland does not arise in the position where the opening of the parotid duct is found in the adult.

A very few studies have been carried out to describe the morphogenesis of parotid gland in human fetuses. The present study was an attempt to evaluate the development of the parotid glands in the human fetuses at different periods of gestation in terms of its shape, position, location and its relationship with the neighboring developing structures. Analysis of the data and result of this study enabled to highlight some views in this regard besides the prevailing information as cited in the literature. This study might be of help in upcoming neonatology from the surgical and radiological point of view in localization of the gland and neighbouring structures.

II. Materials And Methods

Sixty aborted fresh human fetuses without any gross abnormality, ranging from 10th to 40th gestational weeks (GW) were collected from Department of Obstetrics &Gynaecology after obtaining permission from the concerned authority and the Institutional Ethics Committee of RIMS,Imphal. Informed consent from the respective parent was taken after fully explaining the purpose of the research work. Samples were collected

over a period of two years by systematic random sampling. Calculation of gestational ages of the fetuses was done from obstetrical history and the crown-rump length (CRL) expressed in centimetre and measured as the distance between vertex i.e. the highest point on the sagittal suture and the rump i.e. the mid-point between the apices of the buttocks. Co-relation of the crown-rump length and gestational ages was done.[2] Weight was taken before preservation of fetuses. Gender was not considered. Fetuses were randomly categorized into 3 groups for easier study and observation as Group I(12-20 GW),Group II(21-30 GW) and Group III(31-40 GW)[10].The fetuses were then preserved in freshly prepared 10% Formalin for 2 weeks. The parotid regions of the fetuses were dissected by making skin incision starting from the angle of the mouth to the lateral canthus of eye to upper level of the tragus. The incision was extended upto the level of angle of the mandible, along the base of the mandible to reach the angle of the mouth again. The parotid glands in the human fetuses at different periods of gestation in terms of its shape, position, location and its relationship with the neighboring developing structures were noted. Photographs were taken using digital camera. The parotid glands were removed *en bloc* along with parts of surrounding structures.

III. Results

Morphological observations of gradual developmental changes of the parotid gland in fetuses of different gestational ages are:

GROUP I (12 – 20 weeks)

Number of fetuses studied in this age group is sixteen. Shape is the gland is round.The gland is located at the angle of the mouth, bilaterally in the early ages, gradually shifted away from the angle of the mouth towards middle of the cheek. (Fig.1)Surface is smooth in the younger aged fetuses whereas some lobulations were seen in the later age.Thin layer of adipose tissue covered the gland. Accessory parotid gland was seen in 2 fetuses.

Fig. 1: Location and Shape of Gland in a 14 Weeks Fetus

GROUP II (21 – 30 weeks)

Twenty seven number of fetuses are studied In most of the fetuses the shape is oval with long axis directed obliquely except in one fetus where it is round shaped. (Fig.2). the gland is located midway between the angle of the mouth and anterior border of the tragus bilaterally. The surface showed fine lobulations. Thick layer of adipose tissue covered the glands. Accessory parotid gland is seen in one fetus. Parotid duct is seen to emerge from the anterior border of the gland. Thin nerves emerging from the anterior border are also seen in some fetuses.

Fig. 2: Location and Shape of Gland in a 24 Weeks Fetus

GROUP III (31 – 40 weeks)

Of the seventeen fetuses studied in the age group, most of the fetuses showed oval shaped gland (Fig.3), some showed pyramidal shape with upper and lower poles, anterior and posterior borders. Location is midway between angle of the mouth and tragus,some are more towards the tragus. Surface showed course lobulations.Thick layer of tightly adherent pad of fat covered the gland. Accessory parotid gland was seen in three fetuses. (Fig.4) Parotid ducts were seen.

Fig. 3: Location and Shape of Gland in a 38 Weeks Fetus

Fig. 4: Accessory Parotid Gland (arrow head)

After the parotid glands are removed en-bloc with surrounding and underlying structures, gland tissue similar in colour and consistency is also seen on the inner surface. On longitudinal section, one gland is found to be divided into two parts by some horizontally running skeletal muscle fibres. (Fig 5)

Fig. 5: Gland Divided by Skelatal muscle (longitudinal section)

IV. Discussion

Development of the human parotid gland at various gestational ages of fetuses, ranging from 12 weeks to term, has been observed in the present study. There are literatures describing the morphological changes in developing parotid glands. The findings of the present study are correlated and compared with those mentioned in various available literatures by different authors.

Standring S[1] stated that 50% of the parotid glands were triangular on lateral view whereas in 30% cases glands showed rounded upper and lower borders. Mustapha et al[3] found it to be oval shaped. Odiinyk DI and Lavriv LP[4]had come across a variety of shapes of fetal parotids ranging from oval, leaf-like, horseshoe-shaped, triangular, irregular and quadrangular. According to Fouzia N et al[5] in 9-13 week fetuses the gland was rod like.In the present study, all the fetuses in 12-20 week age group showed round shaped parotid gland. From 21 weeks onwards till term all the fetuses showed oval shaped gland with long axis directed along a line joining the angle of the mouth and tragus except 3 fetuses which had rounded glands and in 2 fetuses the glands were pyramidal in shape.

Guizetti B and Radlanski RJ[6]concluded that the parotid gland analogue was found at the most lateral and cranial point of sulcus buccalis. Similarly, in the early aged fetuses of the present series the glands were located at the angle of the mouth.

Holsinger FC and Bui DT[7], so also Amano O et al[8] who found the gland to be located at preauricular region at term fetuses and adults. Fouzia N et al[5] found the gland in the preauricular region at 14-19 week and extending over the lower part of face in 20-40 week fetuses. In contradiction, the present study found that from 21 weeks onwards, glands were located midway between angle of the mouth and tragus, some near- term fetuses had glands just away from the middle, towards the tragus but none of the fetuses, even at term, had gland located at the preauricular region.

Holsinger FC and Bui DT[7], McWhorter GL[9] and McKean ME et al[10] found that the human parotid glands, both late fetal and adult, consisted of a large superficial lobe and a smaller deep lobe divided by facial nerve. But Guizetti B and Radlanski RJ[6] and Epsin-Ferra J et al[11] did not find any such division into lobes.In the present study, no evidence of such division of fetal parotid into superficial and deep lobe was found.

Guizetti B and Radlanski RJ[6] commented that surface of the parotid gland showed impressions of the surrounding structures. Surface of the glands in the present study showed fine lobulations and were covered by a layer of adipose tissue which was thin in early fetuses and became thicker and adherent with increasing fetal age.

The occurrence of accessory parotid gland was reported by Holsinger FC and Bui DT[7] and Samanta PP et al[12]. Accessory parotid gland was found to be present in 21% of cases in a study by Frommer J[13]and Toh H et al[14] reported it in 56% of cases. Present study found it to be present in 6 out of 60 fetuses i.e. in 10% of fetuses.

Smith WP[15] noted the occurrence of double parotid duct in about 7% of the cases. Cases of unilateral as well as bilateral double parotid ducts were reported by many workers such as Astik RB and Dave UH[16],

Fernandez ACS et al[17] and Aktan ZA[18]. Itoo SM et al[19] observed a 'Y' shaped parotid duct. No such variation of the parotid duct had been noted in the present study.

McKean ME et al[10] reported presence of many lymph nodes in and around the parotid gland. Lymph nodes were not found on gross observation of the fetal parotid glands of the present series

V. Conclusion

From the detailed gross examination of parotid glands in human fetuses from 12 weeks to term, it is concluded that shape of the parotid gland was rounded upto 16 weeks of gestation. 17 weeks onwards it became oval with the long axis directed along a line joining the angle of the mouth and the tragus. In fetuses 34 weeks and onwards pyramidal shaped glands were also seen though majority showed oval shape.In 12 to16 week fetuses glands were present at the angle of the mouth. From 17 weeks till 30 weeks the gland was at the middle of the line joining the angle of the mouth and the tragus. 32 weeks onwards glands were just away from the middle of the above line, towards the tragus although in some fetuses those were still in the middle of that line. None of the gland, even at term, showed preauricular location.None of the fetuses showed glandular agenesis, in all fetuses glands were present bilaterally. No evidence of division into superficial and deep lobe was seen. There were fine lobulations seen on the surface of the gland. No lymph nodes were seen around the gland on naked-eye observation.Very thin but distinct single parotid duct emerged from the anterior border of the gland from 21 weeks onwards. No variation in number or shape of the duct was encountered.A clearly detached accessory parotid gland lying above the parotid duct was present in 10% of the cases. Thin layer of subcutaneous adipose tissue overlied the gland till 16 weeks. The layer gradually became thicker 17 weeks onwards whereas at 32 weeks and onwards, it was thick as well as adherent.

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