Is that the facial nerve?

A review of the understanding of the anatomy of the facial nerve in first branchial arch anomalies, and an unusual case of anatomical duplication

R Roplekar Bance, P Coyle, A Dias

Department of ENT, Luton and Dunstable NHS Foundation Trust

Background

We present a case of a patient with a 1st branchial arch anomaly. **The anatomy of the facial nerve in relation to the duplicate ear canal was unexpected. A review of the literature was performed to further improve and consolidate knowledge and understanding of the anatomical findings of First Branchial Arch Anomalies**

Case Report

A six year old girl was admitted under paediatrics for an abscess. She was reviewed by ENT and an incision and drainage was performed for the fluctuant unresolving abscess in September 2016. Comment was made on a small pre-auricular 'pit.' She was admitted again for IV antibiotics in August-September 2017. Reportedly, several course of oral antibiotics had been prescribed in primary care for recurrent infective episodes. During this time, an aspiration under GA was attempted; when this did not yield any pus, a single stab incision was performed at the the most fluctuant palpable part of the abscess; a small amount of debris and pus was released. The patient went on to develop a small chronic fistula.

MRI was completed during a non-infected period. The patient underwent excision of cyst, the tract and a superficial parotidectomy in October 2017.**The facial nerve was extremely superficial, and there was concern that this was a second trunk. However, following the nerve back as part of the parotidectomy, it was confirmed this was a single main trunk, but had been significantly displaced by the branchial anomaly.** Histology described the lesion as “Sections showing normal epidermis with underlying cartilage”. This case was classified as Work Type I.

Figure 1 MRI scan showing anomaly tract

Figure 2 CN VII overlying duplicate canal

Figure 3 Excised accessory/duplicate canal

Literature Review

Method

Two literature searches were completed using Medline database search strategy. The search parameter keywords were:

- 1. 'facial nerve involvement' OR "cranial nerve VII" (and expansion thereof) AND 'first branchial.'
- 2. 'first branchial' AND 'duplicate ear canal' OR 'accessory ear canal' (and expansion thereof).

A total of 41 abstracts were found; two of the authors reviewed the abstracts, and papers that may fulfil the following criteria were identified:

- 1) Comment on CN VII in relation to First Branchial anomalies
- 2) Comment on duplication of CNVII or The External Auditory canal

Results

A total of 24 papers were requested as potentially fulfilling the criteria; 2 were unavailable in English, and so 22 papers were reviewed in full. Majority of papers were case series or case reports. Excluding D'Souza et al¹ who reviewed published cases from 1923 to 2003, in the papers generated from this search, a total of 134 cases featured. Of these 134, 38 were clearly defined as Work Type I, 34 as Work Type II. The remainder were unclassified.

YEARS	TOTAL NUMBER OF CASES	NUMBER CASES DEFINED AS WORK TYPE I	NUMBER CASES DEFINED AS WORK TYPE II
1964 - 2018	134	38	34

Figure 4 Summary of Literature Search

Discussion

Of the ectodermal clefts that separate the paired, mesodermal branchial arches, the first cleft is the only one that does not obliterate as the mesoderm of the branchial arches grow. This first ectodermal branchial cleft persists such that it's dorsal part becomes the External Auditory canal; the ventral part of the cleft should obliterate, but failure to do so allows the formation of anomalies of the first branchial cleft.

BRANCHIAL GROOVES		BRANCHIAL ARCH STRUCTURES				PHARYNGEAL POUCHES
Adult derivative	Arch no.	Cranial nerve	Branchiomeric muscles	Skeletal derivative	Aortic arch	Adult derivative
Ext. auditory meatus	I Mandibular	V Trigeminal	Muscles of mastication, anterior belly digastric, mylohyoid, tensor tympani, tensor palatini.	Malleus, incus, sphenomandibular ligament, sphenomalleolar ligament (Meckel's cartilage)	I	1 Middle ear Eustachian tube
	II Hyoid	VII Facial	Muscles of facial expression, stapedius, stylohyoid, posterior belly digastric	Stapes, styloid process, stylohyoid ligament, lesser cornu hyoid, upper part body hyoid	II	
Cervical fistula	III	IX Glossopharyngeal	Stylopharyngeus	Greater cornu hyoid, lower part body hyoid	III	2 Palatine tonsil
	IV	X Vagus	Laryngeal musculature, pharyngeal constrictors	Laryngeal cartilages	IV	3 Thymus, inferior parathyroid
	V	XI Spinal accessory	Sternocleidomastoid	Trapezius	VI	4 Superior parathyroid
						5 Ultimobranchial body

Figure 5 Diagrammatic Representation of Branchial Grooves/Clefts, Arches and Pouches ²

- **Work Type I** defects have only ectodermal derivatives, and usually close to the true canal
- **Work Type II** defects have remnants of mesodermal origin too, as the defect is 'pulled' medially and inferiorly away from the true canal as the mesoderm of the 1st and 2nd arches (either side of the first cleft) develop (eg mandible, hyoid)

Paper Author and Year	Comment on Anatomy of CNVII and Duplication
B. Crymble et al, 1967	2 cases. Main trunk of CN VII split and encircle the limb of the fistula tract, then joined up again in one case
F. Purcelli, 1967	3 cases. CN VII compromised in 3rd. recovered with time. 2 branches 'surrounded' in 2nd case, but main trunk not visualised/involved. Tract was medial to CNVII in case 1; once excised ,was removed by pulling 'under' the CNVII.
G. S. Gillman et al, 1999	1 case. CNVII can be displaced to a more superficial plane, putting nerve at risk even during skin flap elevation. Photo shows cartilaginous duplication of the EAC, which was medial to CN VII
M.Kumar et al, 2000	Based on development of BA, first arch and groove derivatives should be superficial to CN VII (as is second arch structure) but isn't always so. This is attributed to the CN VII migration with developing facial muscles. This case needed extended cortical Mastoidectomy to safely identify the nerve. Two divisions of the CN VII passed either side of the defect.
X. Guo et al, 2012	Classifies CNVII position into three types. States is difficult to predict the relation pre-operative, but in series of 41 found deep relation more common if R. sided in younger patient, low down, and Work Type II.
D. Hinson et al, 2014	Multiple variations of CNVII in relation to 1st BA Anomaly known (especially in Work Type II); this is only published case of duplicated CNVII.
Burak Ertas et al, 2015	Case report of 7 Work type II First BA anomalies. Neither examination nor imaging can clearly define CNVII in relation to defect, or the risk to the nerve or variability of position.
J. Rockey et al, 2003	Case report of duplication of canal in Work type II, with duplicate ossicles

Figure 6 Summary of the Literature Comments on CNVII and 1st Branchial Anomalies

Conclusions	
❖	Repeat I&D in First Branchial Anomaly defects should be avoided
❖	Early surgery, dependent on patient age, should be the aim to reduce inflammatory scarring and changes to tissue planes and anatomy of CN VII
❖	CN VII can have a very variable course in relation to all 1 st Branchial Arch Anomalies.
❖	Surgeons should be vigilant for unusual duplications

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