

## Spatial orientation of the facial nerve in relation to parotid tumours

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### Abstract

**Objective:** The aim of this study was to identify the distribution of parotid tumours within the gland in relation to the facial nerve branches. Documentation revealing such a relationship has not been reported previously.

**Method:** A prospective study involving 111 patients was carried out over a period of 18 years in a specialist otolaryngology unit within a district general hospital. The relationship of the facial nerve to the tumour was graded into six types. The grading system was then employed to categorize each case.

**Results:** More than two-thirds of the tumours were pleomorphic adenomas. The majority of these were located in the body and not in the tail of the parotid gland. In 50 per cent of these cases, the tumour was in close association with the two major divisions of the facial nerve. In the case of Warthin's tumours, 47 per cent were located in the tail, below the lower division of the facial nerve.

**Key words:** Parotid Gland Neoplasms; Facial Nerve; Parotidectomy

### Introduction

The facial nerve emerges from the skull through the stylomastoid foramen. The nerve enters the postero-medial surface of the parotid gland before dividing into the upper temporo-zygomatic and lower cervico-facial divisions. Each division further subdivides within the parotid gland, forming a total of five major branches, namely, the temporal, zygomatic, buccal, mandibular and cervical branches. The pattern of branching within the parotid gland can vary. It is not currently possible to predict accurately the facial nerve branching pattern pre-operatively in any given individual. In addition, the presence of tumour may lead to distortion of the normal anatomical relationships. Anatomically, the main trunk of the facial nerve as it exits from the stylomastoid foramen is the most reliable site for initial identification during surgery.<sup>1</sup> It has been previously noted that the facial nerve trunk and its branches normally lie in the same plane.<sup>2</sup> The retromandibular vein has been noted to be on the medial aspect of the upper and lower trunks of the facial nerve in 90 per cent of cases; in the rest, this vein is lateral to the lower trunk and medial to the upper trunk.<sup>3</sup>

The shape of the parotid gland has been likened to an inverted pyramid. It has an upper and lower pole and three surfaces, i.e. antero-medial, postero-medial and superficial. The upper pole lies against the cartilage of the external auditory canal, while the lower

pole (tail) lies below and behind the angle of the mandible.

The parotid gland is often regarded as being divided into superficial and deep lobes by the facial nerve. It has been demonstrated that the relationship of the gland to the nerve is variable, with no true anatomical division into lobes. Salivary tissue almost always invaginates between nerve branches in a variable fashion, with no clearly dissectible surgical plane between the 'lobes'. Emerging from the stylomastoid foramen, the facial nerve enters high on the postero-medial surface of the parotid, passes forwards and divides into two main divisions behind the ramus of the mandible.

### Material and methods

The relationship of the facial nerve to parotid gland tumours was graded into six types, as shown in Figure 1: in type one, the tumour lies over the two major divisions of the facial nerve; in type two, the tumour is in contact with the lower division but clear of the upper division; in type three, the tumour is only in contact with the upper division; in type four, the tumour is positioned anterior to the major divisions of the facial nerve and is not in contact with any of them; in type five, the tumour lies superior to the upper division and is not in contact with any of them; while in type six, the

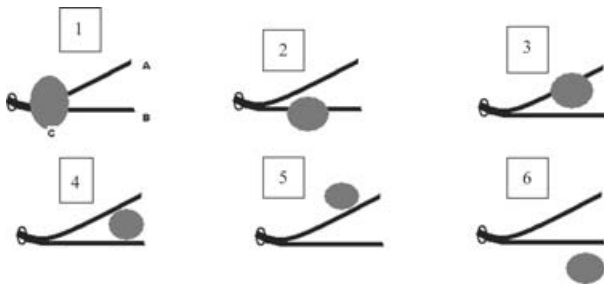


FIG. 1

The relationship of the facial nerve to the parotid tumour, graded as six types. A = Upper trunk of facial nerve; B = lower trunk of facial nerve; C = parotid tumour.

tumour lies inferior to the facial nerve branches and is not in contact with any of them.

The study was carried out prospectively. Surgery was performed in most instances via a standard 'lazy-S'-type incision, with employment of a bipolar 'neurosign' nerve stimulator/locator. At the time of operation, a diagram was drawn showing the relationship of the tumour to the branches of the facial nerve. Depending upon this relationship, each case was categorized based upon the grading system described above. All the operations were either carried out or supervised by the same surgeon.

## Results

A prospective study was carried out involving 111 patients who underwent partial parotidectomy over a period of 18 years. The mean age of the patients was 56.72 years (standard deviation (SD)  $\pm$  16.4 years), with a minimum age of 16 years and maximum of 98 years. There were 65 women and 46 men. Of the 111 patients, 75 (67.5 per cent) had pleomorphic adenoma, 19 (17.1 per cent) had Warthin's tumour, four (3.6 per cent) had acinic cell carcinoma and three (2.7 per cent) had muco-epidermoid carcinoma. There was one case each of adenoid cystic carcinoma, adenocarcinoma and Hodgkin's lymphoma. The mean age of patients undergoing surgery for pleomorphic adenoma was 56.76 years (SD  $\pm$  16.01 years) and that for Warthin's tumour was 67.47 years (SD  $\pm$  10.6 years). The male to female ratio for Warthin's tumour was 2:1; in contrast, the male to female ratio for pleomorphic adenoma was 1:2. The number of patients grouped into each type is shown in Figure 2.

Patients were followed up for a mean period of 6.82 years (SD  $\pm$  4.6 years), with a minimum period of one year and a maximum period of 18 years. None of our patients had post-operative permanent facial paralysis, but 14 (12.6 per cent) developed temporary weakness of facial function. Interestingly, 11 patients with temporary facial paralysis were classified within type one of our grading system.

## Discussion

Salivary gland tumours make up less than 3 per cent of all the head and neck neoplasms.<sup>4</sup> Among these,

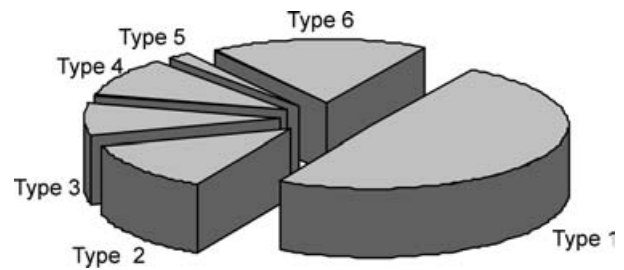


FIG. 2

Distribution of the different types of relationship between the facial nerve and the parotid tumour.

80 per cent occur within the parotid gland. The majority of parotid tumours are benign (80 per cent), with pleomorphic adenoma being the commonest. With the exception of Warthin's tumour, benign tumours of the parotid gland are more likely to occur in women than in men. The mean age of occurrence of these tumours is in the fifth decade. The major aim in the evaluation of a patient presenting with a parotid lump is to establish or exclude the diagnosis of malignancy. Irrespective of the nature of the tumour, parotidectomy with preservation of the facial nerve, unless involved, is the treatment of choice.

The tail of the parotid gland is traditionally described as the part of the gland that lies below the angle of the mandible, inferior to the ear lobe. Whilst it is possible that tumour may have distorted the normal anatomy, the aim of the present study was to delineate the specific relationship between the parotid tumour and the facial nerve. Documentation revealing such a relationship has never previously been reported. However, a radiological study has been carried out locating parotid gland tumours in relation to the facial nerve by magnetic resonance imaging and computed tomography scanning.<sup>5</sup> These authors assessed the course of the facial nerve in relation to two independent anatomical structures (a vertebra and the retromandibular vein). In another study, locating parotid lesions in relation to the facial nerve using anatomical landmarks, the authors noted the sensitivity and specificity of the retromandibular vein as 0.85 and 0.57, respectively, whereas those for the external carotid artery were 0.94 and 0.3, respectively.<sup>6</sup> In a third study, Conn's arc (a plane extending posteriorly from the outer surface of the mandibular ramus and soft tissue structures, including the posterior belly of the digastric muscle, the retromandibular vein and the lateral border of the masseter muscle) was used as a radiological landmark in predicting the position of the facial nerve pre-operatively.<sup>7</sup> These authors could predict the position of the facial nerve accurately in up to 69 per cent of cases.

It is believed that pleomorphic adenoma may arise anywhere in the parotid gland, with the most common location being the tail.<sup>8</sup> However, this is in contrast to our observations in this series, in which the majority of pleomorphic adenomas were graded

TABLE I  
INCIDENCE OF DIFFERENT TYPES OF FACIAL NERVE-PAROTID TUMOUR ARRANGEMENT, BY HISTOPATHOLOGICAL DIAGNOSIS

Facial n-tumour arrangement	Tumour histopathology (n)					
	Total	Pleomorphic adenoma	Adenolymphoma	Acinic cell tumours	Muco-epidermoid	Adenoid-cystic
Type 1	55	43	10	2	1	0
Type 2	14	9	3	0	0	0
Type 3	9	4	0	0	1	1
Type 4	11	5	0	0	1	0
Type 5	2	2	0	0	0	0
Type 6	20	12	6	2	0	0

n = nerve

as type one, i.e. the tumour was located in close relationship to the two major divisions of the nerve (Table I). In other words, most pleomorphic adenomas in our series were located in the body of the parotid gland rather than in the tail. Only in twenty of our patients presenting with a pleomorphic adenoma (26 per cent) was the tumour in the tail of the gland (i.e types two or six). Forty-seven per cent of Warthin’s tumours were located in the tail. The remaining tumours were located relatively inferior in the body of the parotid. As might be expected, none of the tumours were in a type three or five arrangement.

Although none of the patients in this series developed permanent facial nerve paralysis, 14 of them (12.6 per cent) suffered temporary facial weakness. In type one patients, a higher percentage (20 per cent) of temporary facial nerve paralysis was documented. In this group, the nerve was located in an anatomically disadvantageous position in relation to the tumour, which may explain the increased incidence of post-operative facial nerve weakness. More manipulation and electrical stimulation of the main facial nerve trunk and major divisions is likely to have occurred during dissection. The reported incidence of temporary facial nerve dysfunction varies and can be up to 47 per cent.<sup>9</sup> Facial nerve paresis after parotidectomy is associated with the length of the facial nerve dissected during the procedure.<sup>10</sup> The greater the length of facial nerve dissected, the higher the chance of temporary facial nerve paresis.

None of our patients suffered recurrence after primary surgery (coupled, where relevant, with radiotherapy). Radiotherapy was restricted to cases in which the tumour was of a more aggressive nature or when cellular spillage had occurred. The duration of mean follow up was 6.7 years (SD ± 4.5 years).

**Conclusion**

This prospective study assessed the spatial orientation of parotid tumours in relation to the major branches of the facial nerve. Such a relationship has not been documented before. The majority of pleomorphic adenomas were located in the body of the parotid gland, in close association with the two major divisions of the facial nerve. Only 20 per cent

of pleomorphic adenomas were located in the tail of the parotid.

- **The aim of this study was to identify the distribution of parotid tumours within the gland in relation to facial nerve branches, while investigating 111 patients undergoing parotidectomy over a period of 18 years in a specialist otolaryngology unit within a district general hospital**
- **More than two-thirds of the tumours were pleomorphic adenomas. The majority of these were located in the body and not in the tail of the parotid gland**
- **Forty-seven per cent of Warthin’s tumours were located in the parotid tail, below the lower division of the facial nerve**

**Acknowledgement**

We gratefully acknowledge the careful and successful work of the many surgical registrars in training who were involved in this project.

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Mr M Kumar takes responsibility for the integrity of the content of the paper.  
Competing interests: None declared

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