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Title: **Single-Surgeon Parotidectomy Outcomes in a Series of 162 Parotidectomies (SSPO162P)**

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Preliminary Abstract

This study will be based on the personal clinical experience in the surgical management of both benign and malignant parotid gland tumours by Dr. Georgios Doundoulakis.

The scope of the work will include an analysis of the incidence of benign versus malignant neoplasms, as well as the frequency of transient facial nerve paralysis following surgery. As large single-surgeon series are scarce in the current literature, this thesis aims to review the experience of a single surgeon performing parotidectomies. The analysis will focus on pathology, surgical technique, and nervus facialis outcomes. Additionally, benchmark data will be provided regarding complication rates and operative times.

1. PREFACE

This master thesis was written by Tomas Fuchs Bøttern while attending the European University Cyprus, during the 11th and 12th Semester in Medicine.

This report uses the Harvard Referencing System (2008) when citing works. The parenthesis following a citation or written text i.e. (Authors Name, Year) refers to the source used for that chapter or as a direct citation.

The bibliography chart also follows the design and rules laid forth in the Harvard Referencing System, namely the layout referencing of published material in its print and non-print form. The following is an example of the layout of an article reference.

Reference in this master thesis:

(Clemmesen, et al., 2025)

In bibliography:

Clemmesen, T. B. R., Larsen, B. I. & Hvilsom, G. B., 2025. Benigne Spytkirteltumorer. *Ugeskrift for Læger / Journal of The Danish Medical Association,* DOI: 10.61409/V04250352(20), pp. 1886-1888.

In total there is circa 8600 words in the relevant chapters excluding references and tables.

No Generative AI was used in the writing or research for this master thesis; this includes AI summaries on search engines. Specifically, only the search engine DuckDuckGo was used when researching articles as AI summaries can be disabled and not shown at the top of search results, Figure 1:

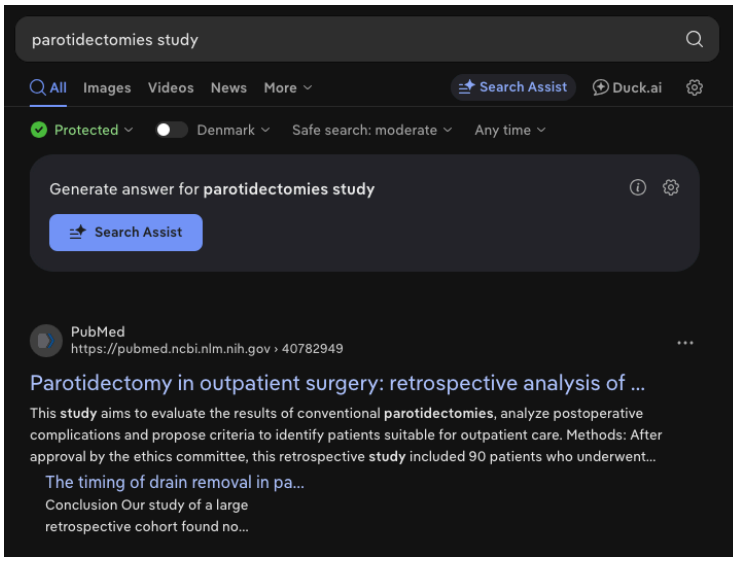

Figure 1 - No AI search, Source: Screenshot 2026 by author

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3. INTRODUCTION

The largest salivary gland, the Glandula Parotis, is found bilaterally on the lateral side of the human face. Nervus Facialis (CN7) courses through this gland, providing motor innervation to the muscles of facial expression. A multitude of both benign and malignant tumours exist and the resection of those, either palliative or intended curative, can have detrimental outcomes for the patient if CN7 is potentially damaged. This can lead to either transient or permanent paresis of the face. This master thesis seeks to investigate the different tumours, be those benign or malignant, the surgical treatment and procedures, either curative or palliative, and their outcome for the patients, with an emphasis on preserving CN7 functionality and the overall health outcome for the patient. The patient data that will be analysed and used in this thesis stems from 162 parotidectomies performed by Doctor Georgios Doundoulakis.

3.1. PURPOSE

The purpose of this thesis is to evaluate the types of surgical procedures used in parotidectomies on the outcome of health and function of the 7th cranial nerve.

3.2. INITIAL PROBLEM STATEMENT

The aim of this thesis is to establish which surgical intervention provides the best outcome for preserving CN7 functionality after parotidectomy (partial / superficial / total), therefore the following preliminary problem statement has been formulated:

"Which surgical procedure(s) provide the best outcome for the patient in terms of long / short term / no sequalae, measured by the functionality of CN7 before and after parotidectomy"

4. SAMPLE AND METHODOLOGY

This master thesis will be based on a retrospective case-study from 162 parotidectomies all performed in Cyprus. Each case will be anonymised to preserve patient privacy before being included in this thesis.

4.1. DATA GATHERING

This thesis will use a qualitative approach, based on data from 162 parotidectomies. Each data entry will be sorted into two categories based on type of tumour, be that benign or malignant on a per patient case basis. Each of those categories will be further sorted according to the type of surgical intervention used (total, partial). The functionality of CN7 for each patient, before, and after surgical intervention will be evaluated and the success of each parotidectomy is determined by the functionality of CN7 after surgery. If functionality of CN7 is unchanged (based on pre-op functionality), that is deemed a "*success*", if functionality of CN7 is worse after intervention, that will be deemed a "*failure*".

4.2. LIMITATIONS

This thesis only investigates the performance of parotidectomies, measured by CN7 functionality post-op, from a single surgeon. The results found in this thesis will therefore only be applicable to one surgeon and not the general surgical community at large. If the findings in this thesis points towards X type of intervention is better than Y type intervention, a further and larger study, encompassing multiple surgeons is recommended before generalised conclusions can be made and new recommendations in care can be pushed.

Criteria of success of a given surgical intervention is the preservation of CN7 functionality, which can be both subjective and objective in its measurement. Objective from the point of view of the physician in his or her physical examination, and subjective from the point of view of the patient. The patient might not display the physical manifestations of CN7 paresis but can report subjective problems post-op that cannot be confirmed through objective examination.

5. PRELIMINARY MESH KEYWORDS

Preliminary MeSH Keywords: D010306 1, D012469 2, D010305 3, D010307 4, D005154 5

6. ANALYSIS

The following section will cover the anatomy, physiology, and the tumours of the glandula parotis. Furthermore, in order to answer the problem statement, the surgical interventions and surgical techniques used in excising the tumours will be listed and examined, without critique. First when analysing the pt data and the outcome for each pt, can the techniques used and implemented be criticised and evaluated based on the outcome for each patient. This chapter will also cover the most common presenting symptoms the patient might have when being impacted by a tumour in the parotid gland.

6.1. ANATOMY

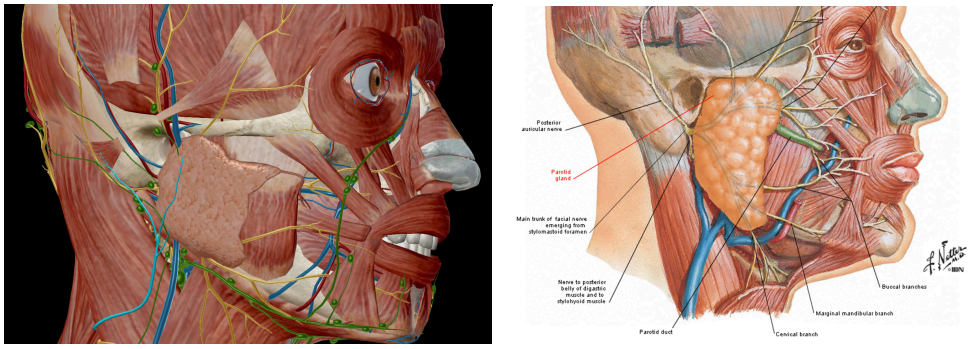

Figure 2 - Left: Human Anatomy Atlas 2008, Right: Interactive Atlas of Clinical Anatomy V1.1 - 1997

The parotid gland is bordered superiorly by the zygomatic arch, anterior by the mandible and masseter muscle, posterior by the external auricle tragus and the sternocleidomastoid muscle, and lastly the inferior part of the gland is between the ramus of the mandible and the sternocledіomastoid muscle overlying the digastric muscle (Witt, et al., 2021). It is diveded into a deep and a superficial lobe, separated by the nervus facialis (CN7 - providing innervation to the muscles of facial expression). The gland is perfused by the posterior and superficial arteries (from the external carotid artery), and it is drained by the retromandibular vein (from the superficial temporal and maxillary veins). It is innervated by the auriculotemporal nerves and the great auricular nerve providing sensory innervation. The act of salivation is parasympathetic, its control originates with the glossopharyngeal nerve.

Surgical landmarks for the identification of CN7: Antegrade: Tympano-mastoid sutures, direction landmark, showing the direction of the styolmastoid foramen, ca 2mm superior to CN7, whereas the depth is found from the digastric, 1 cm inferior to CN7. The tragal cartilage indicates the location of the exit of CN7, located 8mm cranial to the foramen (Witt, et al., 2021).

6.2. PHYSIOLOGY

When food is ingested and chewed, the process of mastication begins, where the food is mixed with saliva produced in the salivary glands. The parotid glands primarily produce the enzyme ptyalin (alpha-amylase), which hydrolyses carbohydrates. It is secreted through the parotid duct (Stensen duct) that opens into the oral cavity through the buccal mucosa near the second molar (topside). This process enables easy digestion and swallowing of the food consumed (Hall & Hall, 2021) & (Mescher, 2018) & (Bickley, et al., 2021).

6.3. TUMOURS

The most common type of tumour type found in the GP are of the benign kind (Clemmesen, et al., 2025) & (Pecorari , et al., 2023), accounting for up to ~70-80% of all tumours, whereas the malignant tumours only account for up to ~15-35% of all cases (Clemmesen, et al., 2025) & (Pecorari , et al., 2023). For benign tumours the pleomorphic adenoma is the most common, and for malignant tumours the mucoepidermoid carcinoma is the most commonly found, both of these tumours and the less common ones will be analysed in chapter 6.3.1 and 6.3.2. When a tumour is discovered, the earlier the better, as described by (Choi, et al., 2021), the larger tumour volume at discovery, the worse potential outcome for the functionality of CN7. Age also plays a significant role in functionality of CN7 post-op (Cirignaco, et al., 2025), they found that each increase in year of the patient increases the odds of post-op functionality issues with CN7. They attribute this to age-related changes in the patient, such as tissue elasticity, decreased vascular supply and overall less resilience the higher the age of the pt. Furthermore the location of the tumour, be that in the superior / middle / inferior parortid has a great impact on post-op CN7 functionality. Tumours located in the inferior lobe had a higher incidende of CN7 paralysis or palsy when compared to tumours located in the superficial lobe, they estimate this increase to be due to closer proximity to CN7. Tumours located in the upper and deep lobes, had a higher incidence of temporary and permanent CN7 injury as compared to the other lobes.

table 15-1 Salivary Gland Tumors: Location, Histology, and Characteristics

Type	Typical Location	Histology	Characteristics
Pleomorphic adenoma (benign mixed tumor)	Parotid gland; can occur in submandibular or minor salivary glands	Variable mix of epithelial and mesenchyme-like elements	Most common salivary gland tumor; benign; tends to recur after resection; malignant transformation occurs but is rare
Warthin tumor	Parotid gland	Cystic spaces lined by double-layered eosinophilic epithelium, all embedded in lymphoid stroma	Benign, bilateral, most common in smokers, "motor oil" cyst fluid
Oncocytoma	Parotid gland	Large, granular-appearing, eosinophilic-staining epithelial cells	Benign; peak occurrence in the elderly
Mucoepidermoid carcinoma	Parotid gland	Comprised of mucus-producing and epidermoid components and cells intermediate between the two	Behavior varies from indolent to highly aggressive; tumors with a greater number of epidermoid cells and nonparotid tumors tend to be more aggressive
Adenoid cystic carcinoma	Minor salivary glands	Variable; most characteristic appearance consists of cribriform pattern with masses of small, dark-staining cells arrayed around cystic spaces	Tends to infiltrate perineural spaces and cause pain; slow-growing malignancy with late metastasis
Acinic cell carcinoma	Parotid gland	Neoplastic cells resemble normal acinar cells	Uncommon malignant tumor seen most often in young men

Figure 3 - List of Salivary Gland tumours, Source: (Feather, et al., 2021)

6.3.1. Benign tumours

There are many types of benign tumours found in the GP (which is where the vast majority of tumours are found of the salivary glands (Clemmesen, et al., 2025), this section will focus on the three most commonly found benign tumours. Other benign tumours, such as Canalicular Adenoma, Cystadenoma, Oncocytoma, or Myoepithelioma have been excluded from this analysis as they are rare (<1-2% of all cases) and in order to limit the scope of this thesis. Therefore, the Pleomorphic Adenoma, the Warthin's Tumour and Basal Cell Adenoma will be included as those three types of benign tumours are the most common (Schneider, et al., u.d.).

The Pleomorphic Adenoma (PA) is the most common type of benign salivary gland tumour, circa 80% are found in the parotid and it is usually found unilateral (Schneider, et al., u.d.). The GP has a small chance of transformation potential into malignancy, around 1% risk pr. year, although a low risk for transformation, when PA is resected, if tissue is left behind, it often recurs. The PA can grow quite large therefore it is important for

surgical intervention as the larger its mass the higher the risk for potential CN7 inclusion, furthermore, the longer the PA is left in situ, the higher the risk for malignant transformation, thus underscoring swift surgical intervention after diagnosis (Clemmesen, et al., 2025) & (Cirignaco, et al., 2025).

The Warthin's Tumour (WA) is the second most common benign salivary gland tumour, around 17% of all salivary gland tumours are WA, and are usually related to patients with a smoking history (Longo, et al., 2025). WA is commonly found caudally in the GP and is bilateral in up towards 10% of all cases. WA have a very rare malignancy transformation, <0.1% of WA cases transform into malignancy. Due to its preferred caudal location, there is an increased risk of CN7 involvement. Therefore, as with PA, early intervention is recommended (Cirignaco, et al., 2025) & (Clemmesen, et al., 2025).

The Basal cell adenoma (BCA) is the third most commonly found benign tumour of the GP, although it is very rare. The BCA is slow growing, but with a high recurrence rate even when resected with free boarders. It is usually found in the superficial lobe of the GP; with this location it has a lower chance of CN7 sequala compared to those located caudally (Yasunori, et al., 2026) & (Nnko, et al., 2024).

6.3.2. Malignant tumours

The Mucoepidermoid Carcinoma (MEC) is the most common malignant tumour of the GP, around 10-15% of all tumours. It is usually located below the auricle, presenting as a fixed mass, with this location it often involves the mandibular branch of CN7. Due to its aggressive nature and fast growth, it is common that the mandibular branch cannot be spared leaving the patient with motor deficits such as a hanging lower lip on the affected side (Almas, et al., 2020) & (Cirignaco, et al., 2025).

Basal Cell Adenocarcinoma is a rare malignant tumour of the salivary glands that is primarily found in the GP. As opposed to MEC it is a low-grade tumour with good prognostic outcome for the patients, although recent studies have shown the possibility of local recurrence in up towards 50% of cases. It is usually located distally of the GP overlying the masseter muscle (Vitorino, et al., 2022) & (Jung, et al., 2013) & (Hirsch, et al., 2007).

6.1. ASSESSING NERVUS FACIALIS FUNCTIONALITY

In order to evaluate which surgical technique provides the best post-op preservation of CN7 functionality, a way or process to accurately assess CN7 functionality has to be found. The most commonly used rating assessment is the House-Brackmann grading scale (HBGS) (Kang, et al., 2002). HBGS is used to evaluate the severity of CN5 paralysis based on the symptoms of the patient. The HGBS grades eye closure, forehead movement, mouth movement and synkinesis[1], and combines each finding into a grade from I-VI, where I is normal functionality, and VI total CN7 paralysis. For each 0.25cm upwards movement of either the eyebrow or outward movement of the patients mouth, 1 point is assigned up to a max of 8 points (i.e. full 1cm movement = 4points). Table 1 lists the grade and the evaluation for each attribute used in assigning a grade. The HGBS has been criticised as the evaluation is subjective in nature and it does not consider if one part of the face has minimal paralysis vs another part of the face having major paralysis (Kang, et al., 2002) which would result in a higher score instead of a lower score.

Grade	Description	Eye Closure	Forehead Movement	Mouth Movement	Synkinesis
I	Normal functionality	Complete	Normal	Symmetrical	None
II	Slight weakness, normal tone + symmetry at rest	Complete, slight effort	Normal	Slight asymmetry	Mild
III	Moderate dysfunction, no weakness at rest	Complete, with effort	Slightly reduced	Asymmetry present	Noticeable
IV	Severe dysfunction, facial weakness	Incomplete	No movement	Asymmetry with effort	Present
V	Severy dysfunction, minimal facial motion	Incomplete	No movement	Very asymmetrical	Present
VI	Total facial paralysis, no motion	None	No movement	No movement	None

Table 1 - House-Brackmann Grading System - Source: (Azizzadeh, u.d.)

As mentioned before, HGBS rating system has been criticised as being subjective in nature, furthermore it does not consider secondary defects defined as functional defects other than muscle weakness, such as: hyperacusis, crocodile tears, to name a few, which can result in decreased quality of life for the patient. Compared to HGBS the Sydney facial grading system, evaluates each branch of CN7 by movements of each muscle group innervated by each branch and assigns a score of 0-3 (Stodulski, et al., 2014). The Sunnybrook CN7 grading system assess resting symmetry, voluntary movements, and synkinesis. For resting symmetry, the affected side is compared to the non-affected side of the face and a score is assigned between 0-20, the higher score the more symmetry. Voluntary movement score assess the voluntary movement by the patient of the muscles innervated by CN7, assigning a score from 20-100, the higher the score, the better the ability of the patient to voluntarily move the muscles. Synkinesis assess the presence and severity of involuntary movements of the face, assigning a score from 0-15, the lower the score the less observed synkinesis. See Figure 4 for the Sunnybrook grading scale.

[1] involuntary muscle movements

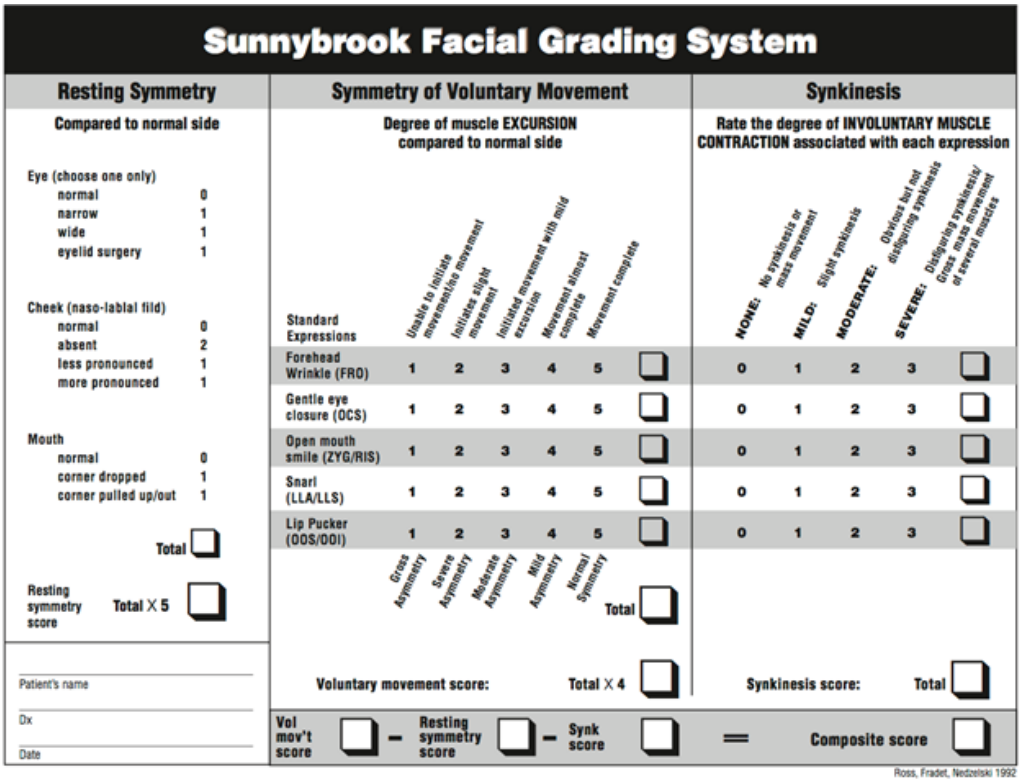

Figure 4 - Sunnybrook Facial Grading System - Source: (Azizzadeh, u.d.)

6.2. SURGICAL INTERVENTION AND OPERATIVE TECHNIQUES

In 2016, the European Salivary Gland Society (ESGS) now known as Multidisciplinary Salivary Gland Society (MSGS), published a draft attempting to classify the treatment of benign GP tumours (Clemmesen, et al., 2025), where the anatomical relationships and tumour mass influences the choice on surgical techniques used. The goal was to systematically evaluate the surgical treatment and bring on evidence-based research through the use of standardised nomenclature. The ESGS / MSGS created levels that divide the GP into five levels (I-V), each level refers to the surgical procedure and the anatomical levels that are being removed from the GP, see figure 5.

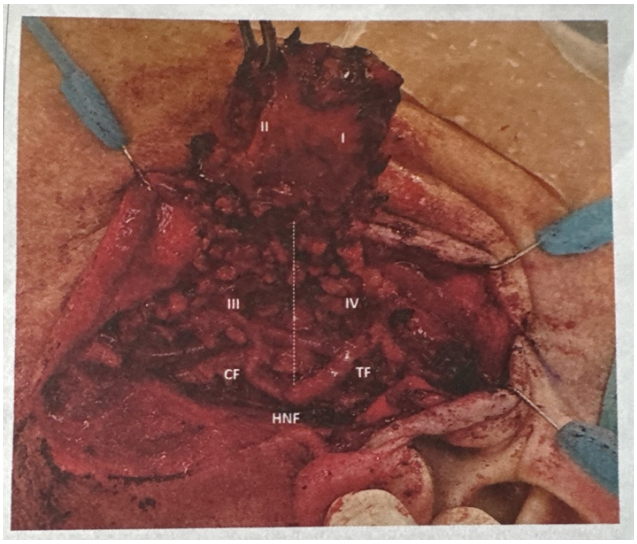

Figure 5 - ESGS / MSGS surgical levels and anatomy - Source: (Clemmesen, et al., 2025)

Figure 4: HNF - main stem of CN7, I - left sided parotidectomy, II - parotidectomy, TF - temperorofacial branch of CN7, CF - cervicofacial branch of CN7, ESGS levels of I, II, III, and V. Dotted line - line between main stems of CN7 and ductus stenosis dividing in superior and inferior.

The preferred surgical intervention for GP surgery are superficial parotidectomy (SP) and partial superficial parotidectomy (PSP) when the tumour is located in the superficial lap. Using SP, the entirety of the tumour along with the superficial lap is removed through the dissection of NF and its intraparotid branches (See Figure 5: Level I or Level II). Another technique used is extracapsular dissection (ECD) where the tumour is removed with 2-3mm free resection boarders from the tumour without dissecting into the main branch of CN7. ECD is used more frequently in certain operative centres versus SP or PSP for superficial tumours, but it is recommended that the surgeon is well trained in SP or PSP when using ECD as there is a high risk of needing to convert from ECD to SP or PSP.

Which surgical technique to use is debated, multiple studies, (Almas, et al., 2020) & (Ellingson, et al., 2003) to name a few, have tried to list advantages and disadvantages for each mentioned above. ECD has been highlighted as having a lower risk of causing temporary facialis paresis and Freys syndrome, but those studies have been criticised for selection bias as the tumours selected for ECD are smaller in mass than those selected for SP (Clemmesen, et al., 2025). Another study included 266 patients operated using either PSP or ECD found a significant lover damage potential for nervus auricularis magnus using ECD, which implemented using only ECD as the standard of treatment for the treatment of superficial Warthin tumours (Clemmesen, et al., 2025).

A retrospective study from 2024 (Almas, et al., 2020), looked at the outcome of CN7 paralysis after SP or Total Parotidectomy (TP) were performed on patients at Maroof International Hospital. The study included 78 patients with a mean age of 53 years old, ranging from 11 to 94 years. Using fine needle aspiration before each surgical intervention, circa 70% (55) had benign pathology, 23% (18) had malignant pathology and 6% (5) had inconclusive pathology. 12% (10) of patients was found to have tumour involvement into the main trunk of CN7 or its branches, discovered during surgery. Tumour size was also analysed, 15% (12) had a tumour below 2cm in diameter, 35% (28) had a tumour between 2 and 4cm, whereas 48% (38) had a tumour larger than 4 cm. After tumour removal, the tumours were analysed and 59 had benign pathology vs 55 from FNA and 15 vs 18 from FNA had malignant pathology. They found that 28 of the 59 patients with benign pathology had CN7 paralysis in the post-operative period, these were graded according to the House-Brackmann grading system (see chapter 6.1), 9 patients had grade II palsy where 8 fully recovered, 11 had grade III palsy, where 7 recovered facial motility, 7 patients with grade IV palsy, where only 2 recovered facial nerve functionality. Only one patient presented with grade V palsy who unfortunately did not recover CN7 functionality after the operation. For the patients with malignant pathology, 4 patients had grade II palsy where all recovered CN7 functionality, 3 patients had grade III palsy where only 1 did not recover, and 4 with grade IV palsy where also only one recovered. Mentioned earlier, the tumour size is the most important determinant on CN7 functionality post-operation. The study found that the patients with a tumour diameter below 2cm of which there were 5, 1 had grade II palsy, 1 with grade III palsy that did not recover function, and 3 with grade IV palsy where 2 recovered. Palsy was found in 12 patients with a tumour diameter between 2 and 4 cm, 4 patients with grade II palsy where 2 did not recover functionality, 5 patients with grade III where 2 also did not recover functionality, and lastly 3 patients with grade IV palsy, where 2 also did not recover functionality. There where 23 cases of palsy where the tumour exceeded 4cm in diameter, 9 patients had grade 2 palsy with only 1 not recovering functionality, 8 had grade III palsy with 2 patients not recovering functionality, 5 had grade V palsy with 4 patients not recovering functionality, and 1 with grade V palsy that did not recover functionality. This study found that the biggest determining factor for not regaining CN7 functionality was tumour diameter sizes above 4cm.

Another study (Molinari, et al., 2024) looked at the efficacy of using neuromuscular retraining after patients, who underwent parotidectomies where the CN7 was spared, experienced varying degrees of facial palsy. This retrospective study included 46 patients, where the mean age at time of surgery was 54 years. Out of those 46 patients, 18 patients who experienced post-operative paralysis, ranging from IV (severe dysfunction and facial weakness) to VI (complete paralysis, no motion) assessed via the House-Brackmann grading system and Sunnybrook, where included. The facial palsy rehabilitation program used post-operatively instructed the patients in specific motor control exercises, first through a speech therapist then repeated exercises daily at home unsupervised. Their goal was to reduce synkinesis and the contraction of hypertonic facial muscles, with the ultimate goal of improving facial symmetry. Part of this process included mirror exercises, where the patients were instructed in using single mimic muscles, which through sensory input from reflection of the mirror allowed better central control of the mimic muscles. Furthermore, part of this rehabilitation program used facial massages, which they found effective in preventing post-op paresis of CN7, leading to better fine muscular coordination of the facial muscles - it reduced the use of hyperactive muscles in adjacent muscles impacted by the surgery. This visual feedback, with an emphasises on slow contraction of the facial muscles, provided the patients with instant visual cues on control of the muscles, avoiding over contraction on the non-affected side. Visualising the asymmetry of their faces, and the training of fine movements of muscles on the affected side, gave the patients, through the exercises, fine grained control leading to improvements over time on the affected side. In this cohort, two and six months after surgery, the average value of Sunnybrook increased from an original mean score of 54 to 76.5 for grade IV paralysis and to 95.4 for grade VI paralysis, meaning a significant increase in CN7 functionality compared to post-operative. This was followed up 12 months later where the operated patients no longer fit into either of the categories, meaning they had improved their use of CN7 that no IV or VI was present. Concluding the study after 2 years, only five patients out of the original 18 patients included, experienced grade II paralysis. They conclude that neuromuscular retraining has significant positive impact on regaining CN7 functionality. The greatest improvement was seen within the first 6 months post-op, but patients still showed improvement after 18 months highlighting the importance that long term rehabilitation is beneficial even for patients that do not show complete recovery after the first year's post-operative control.

The retrospective cohort study by (Ellingson, et al., 2003) examined the outcome after superficial parotidectomies (SP) on CN7 by comparing malignant versus benign tumours and their impact on CN7 functionality post-op. Their motivation for examining the outcome of benign versus malignant tumours is that malignant tumours can grow and involve the branches or even the trunk of CN7, and in cases as such, a portion or even all of CN7 in the parotid gland has to be removed. They also wanted to examine if there was a difference in long term CN7 paresis when the patient had either a benign or malignant tumour. The study included 67 patients with benign tumours and 52 patients with malignant tumours; the mean age was 56.5 years. For the benign group the mean age was 49.6 years and for malignant disease it was 65.4 years. They used the House-Brackmann grading system for assessing the functionality of CN7 in the post-operative period. When grouped together, malignant and benign tumours, circa 86% of their patients reported grade II (slight weakness, normal tone + symmetry at rest) or less at the first consultation after surgery. In total 94% of their patients with benign tumours of the GP had a grade II or below grade II at initial visit, compared to ca 77% of their patients with malignant tumours. When looking at grades III and above, they measured the time it took for recovery of CN7 functionality, for the benign cohort the mean time for recovery was 229.5 days and for the malignant cohort ca 138 days. They used Kaplan-Meier to compare the time to recovery for each group (benign and malignant), which found no significant difference. In conclusion, patients with benign disease have a greater chance of presenting with grade II or less after surgery, but whether the original disease is malignant or benign, the long-term implications on CN7 paresis is the same.

The following retrospective study done by (Nicoli, et al., 2017), looked at the use of microsurgical dissection of CN7 in parotidectomies and if there was any long-term benefit in preserving the functionality of CN7. This study is different from the others mentioned above as this tries to evaluate the benefits of a different surgical approach and technique used in parotidectomies. They included 109 patients, with a skew towards female 64 and male 45 with a mean age of ca 46 years, youngest 6 years, and oldest 74 years. They also implemented the use of the House-Brackmann grading system, evaluating each patient on the second day post-op, 1 week, and 3 months after successful treatment. The surgical technique used at the beginning did not differ from the standard surgical approach, the parotid was excised free superficially from the internal margin of the tragus, posteriorly to the mastoid, and to the inferior border of the mandible. This skin flap was then elevated to the superficial plane of the parotid fascia. They now employed a microscope to dissect further, until the mandibular branch of the facial nerve was located (crossing the facial artery and vein). Continuing the use of the microscope, each nerve branch of the facial nerve was identified and dissected free following the branches until they reached their origin on the main trunk of the facial nerve. They isolated the branches and main trunk of the facial nerve and could then remove the entire parotid gland if needed without disturbing the facial nerve and its branches. 109 patients in total had surgical procedures done, 78 patients had SP and 31 had conservative parotidectomy. For the patients undergoing SP the average operating time was 3 hours, the shortest taking 2hours and 15minutes, and the longest 4hours and 30minutes. For the patients undergoing total parotidectomies, the average operating time was 3 hours and 45 minutes, with the shortest taking 2hours and 45minutes, and the longest taking 7 hours and 45 minutes. The included patients were followed from 3 months to 16 years, with a median of 32 months for the entire cohort. For the patients that underwent superficial parotidectomies, 17 had complications after surgery, 7 patients had temporary facial nerve palsy, 5 had salivary fistula formation, and 5 patients developed Frey's syndrome (sweating on the cheek due to damage to the auriculotemporal nerve, is a rare syndrome, but often seen in patients that have underwent parotid surgery). The patients that underwent total parotidectomy, 16 had complications after surgery, 12 patients reported facial nerve palsy, 1 patient had salivary fistula formation, and 4 developed Frey's syndrome. The patients from both groups that reported facial nerve palsy after the surgical intervention, common for both was that none reported disfiguring difference between the operated side and the healthy side. There were no reports of severe synkinesis, involuntary contractures, nor facial spasm. These complications all had resolved in their 3-month post-operative follow-up. Therefore, the authors recommend the use of microsurgical techniques for all superficial parotidectomies along with conservative parotidectomies as all their patients reported no permanent injury to the facial nerve. The operating times were long for each patient on average, but they found the longer operating times outweigh the potential injuries that can be sustained to the facial nerve, more than make up for the longer operating times.

Having looked at different surgical techniques, the use of post-operative therapy for the regaining of CN7 functionality post-op, (ChiesaEstomba, et al., 2020) conducted a systematic review examining the use of intraoperative facial nerve monitoring during parotid gland surgery. As previously mentioned, facial nerve injury is the most severe complication of parotid gland surgery. They found that up to 65% (20-65%) of all patients experienced temporary facial nerve dysfunction following surgery, and 0-7% of those patients experienced permanent facial nerve dysfunction after surgery. They included patients having undergone superficial parotidectomies, total parotidectomies, and did not discriminate against pathology, benign, malignant, and inflammatory cause were included. As with other studies mentioned earlier, patient cases with pre-existing facial weakness were not included. They divided their results into patients operated using intraoperative facial nerve monitoring, and those without intraoperative facial nerve monitoring. In total they

found 1069 patients that fit their search parameters, 554 patients that underwent parotid surgery using intraoperative facial nerve monitoring and 515 patients in the control group, those that were operated on the parotid without intraoperative facial nerve monitoring. The two groups were comparable in terms of surgical procedures, 85% of patients in the group using intraoperative facial nerve monitoring had superficial parotidectomies, against 82.6% in the non-monitored group, and 15% in the intraoperative facial nerve monitoring group underwent total parotidectomies, against 17.4% in the non-monitored group. Pathology wise both groups were also similar with a predominance of benign pathology. They then looked at the incidence of post-operative facial nerve weakness and found that in the group that used intraoperative facial nerve monitoring was at 23.4% against 38.4% in the group not using intraoperative facial nerve monitoring, they found a 42.7% decrease in incidence of facial nerve weakness immediately after the surgery when using intraoperative facial nerve monitoring versus the control group not using intraoperative facial nerve monitoring. For permanent facial nerve weakness, in the group using intraoperative facial nerve monitoring, 5.7% of the patients reported permanent nerve weakness versus 13.6% in the group not using intraoperative facial nerve monitoring during surgery, this led to a total risk reduction of 7.82% when using intraoperative facial nerve monitoring during parotid gland surgery.

The study by (Liu, et al., 2023) conducted a meta-analysis comparing the outcome of facial nerve paralysis / weakness on whether the patients included underwent superficial parotidectomies or partial superficial parotidectomies. They included 23 publications containing 2844 patients in total. 1414 patients were treated with superficial parotidectomies and 1430 were treated with partial superficial parotidectomies. Of the included studies, twenty studies examined the outcome of transient facial palsy after parotid surgery. In total 1346 patients were treated with superficial parotidectomies, and 1292 patients were treated with partial superficial parotidectomies. They found that treatment with partial superficial parotidectomies reduced the risk of developing transient facial nerve palsy when compared to treatment with superficial parotidectomies. They also looked at permanent facial palsy after parotid gland surgery and as with transient facial palsy, found that using partial superficial parotidectomy reduced the occurrence of permanent facial palsy compared to superficial parotidectomies. Of the included studies, 10 reported on operating time and here they also found that partial superficial parotidectomies had a significant shorter operating time than superficial parotidectomies.

Another meta-analysis by (Al-dhohrah, et al., 2018) was conducted to evaluate, not the surgical techniques such as superficial parotidectomies nor partial superficial parotidectomies, but if there was any benefit between antegrade or retrograde facial nerve dissection in benign parotid surgery for the preservation and function of the facial nerve. The antegrade facial nerve dissection procedure identifies the trunk of the facial nerve when it exits the stylomastoid foramen (see Figure 2), it is then traced to where it bifurcates along with the peripheral facial nerve branches. The antegrade facial nerve dissection procedure is preferably used in non-obese patients or patients with smaller tumours. If the patient is obese or has a large tumour, the retrograde facial nerve dissection procedure is used. In the retrograde facial nerve dissection procedure, the mandibular or another branch of the facial nerve is identified, and from there the nerves are dissected back to the main trunk of the facial nerve. They identified a total of 481 patients, 243 had antegrade facial nerve dissection, and 238 patients had retrograde facial nerve dissection, and the age range of patients was from 12 to 79 years. The follow-up time post-op ranged from 2 weeks to 10years for all patients included. When comparing anterior facial nerve dissection to retrograde facial nerve dissection, 481 patients were evaluated, the incidence of transient facial nerve weakness was 16.4% and 16.04% for each group, meaning no statistically significant difference was found on whether anterior facial nerve dissection or retrograde facial nerve dissection approach was used during surgery. For permanent facial paralysis, the patients that underwent anterior facial nerve dissection reported a 2.41% incidence, and the patients that underwent retrograde facial nerve dissection reported a 0% incidence. Meaning no statistically significant difference was found between either approach on

the outcome of permanent facial paralysis. They also evaluated the risk of Frey's syndrome on either approach. In total 177 patients were evaluated for Frey's syndrome post-op, 76 patients underwent anterior facial nerve dissection, and 101 patients underwent retrograde facial nerve dissection. The incidence was 10.5% and 30.7% in the latter group, and again no statistical difference was found between either approach. Regarding surgery time, they found that retrograde facial nerve dissection shortened the operative time by 19.3 minutes compared to anterograde facial nerve dissection. In conclusion, neither approach provided a benefit over the other for the preservation of facial nerve functionality after surgery.

In lieu of the meta-analysis by (Al-dhohrah, et al., 2018) the retrospective review by (Prince, et al., 2026) also examined if there were any benefits to using anterior facial nerve dissection, or retrograde facial nerve dissection, or extracapsular parotidectomies for not only benign but also malignant tumours on the preservation of facial nerve functionality after surgery. In total they found 313 patients with benign tumours that had some type of facial weakness after surgery, where 55 patients had temporary and / or permanent weakness and only 4 patients had permanent weakness. 25% had a grade III weakness on the House-Brackmann rating scale. The most common encountered facial weakness was at the mandibular level reported by 65% of patients, 13% experienced it in the upper part, 10% in the lower division, 7% of all branches and 5% had a combination of lower and upper. They found in the benign group that the anterior facial nerve dissection increased the incidence of transient facial weakness post-surgery by 24% compared to only 14% using the retrograde facial nerve dissection and the lowest among those patients that underwent extracapsular surgery with 8%. They adjusted for confounding factors and found that the extracapsular dissection significantly reduced transient facial nerve weakness when compared to anterior facial nerve dissection. Likewise with retrograde facial nerve dissection, where it showed a decrease in temporary facial nerve paresis when compared to anterior facial nerve dissection. For the malignant tumours, 283 patients had facial nerve weakness, of those 119 had either permanent or transient weakness of the facial nerve following surgery. Of those 119 patients, 44 experienced permanent facial weakness with 25% affecting all branches of the facial nerve, 61% were located on the mandibular, 14% only the upper part. The patients experiencing temporary facial nerve paralysis, 72% were impacted on the mandibular, 11% only the upper parts, 8% included all branches, 4% only the lower division, and finally the last 5% covered both upper and lower branches. They found that transient facial nerve weakness happened more frequently in the anterior facial nerve dissection procedure - 34% of patients - when compared to the retrograde facial nerve dissection - 21% - of patients - and even less when the patients were treated with the extracapsular approach - 5% of patients. When they adjusted for malignant tumours, they found no statistic significant difference between the three approaches. In conclusion, for malignant tumours there was no difference in surgical approach on the outcome of either permanent or transient facial nerve weakness. For benign tumours, they found that extracapsular dissection significantly reduced temporary facial weakness and that retrograde facial nerve dissection also showed a reduction in temporary facial nerve weakness when compared to anterior facial nerve dissection.

Mentioned in the beginning of the analysis chapter, the research article by (Choi, et al., 2021) conducted a retrospective analysis of bulky malignant tumours of the parotid gland from patient cases stretching from 1995 to 2016. In total they found 60 patients out of 406 that fit their criteria as they excluded tumours <4cm in size, <18-year-old patients, and patients with a previous history of head and neck cancers. The primary purpose of the study was to examine the long-term survival of patients with large parotid gland tumours, and not as the previous studies that have been examined in this thesis, the functionality of the facial nerve post-surgery. Of the 60 patients included, 49 underwent surgery for curative intent, of those 49 patients, 31 patients had the facial nerve removed (22 patients had the main trunk removed and 9 patients had the peripheral branches of the facial nerve surgically removed). Over half of the patients included experienced facial weakness after surgery, leading to poor quality of life and poor prognosis due to tumour size and staging. Poor prognosis was attributed to large tumour size, and they found it a prognostic factor for long term survival - <50% of the patients included survived 5-years post-surgery. Therefore, they recommend self-examination (see Figure 6) of the parotid gland in all patients, not only those with suspected parotid cancers, but also those without any signs of disease for early detection of disease before the tumour potentially grows to a size that not only impacts long-term survival but also is detrimental to facial nerve functionality post-surgery. In their conclusion, parotid self-examination should be as standard as self-examination in breast cancer or colonoscopy for colorectal cancers.

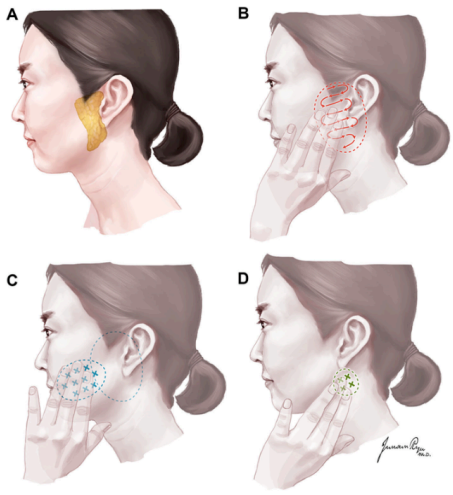

Figure 6 - Parotid self-examination, Source: (Choi, et al., 2021), reproduced without permission

Figure 6: Patients are taught where to find the parotid gland (a), patient palpates the parotid gland (b) to detect any lumps (superior to inferior), area from parotid gland to the corner of the oris, and finally the mandible and mastoid bone (d). Should any mass or palpable filling be found and the finding persist for more than two weeks, the patient should seek professional care for evaluation.

Another study briefly mentioned in the tumour analysis chapter, was the ten-year retrospective study conducted by (Cirignaco, et al., 2025) where they analysed the use of intraoperative nerve monitoring (with and without nerve monitoring) during parotid gland surgery for benign tumours and the outcome on the functionality of the facial nerve post-surgery. In total they examined the outcome of 329 patients operated for benign parotid gland tumours, of those 329 patients, intraoperative nerve monitoring was used in 135 surgeries, and 194 patients were operated without the use of intraoperative nerve monitoring. The study used a modified House-Brackmann grading scale, grouping scores III + IV into one group (moderate dysfunction), the same was done with scores of V and VI (severe dysfunction), in order to minimise bias through the subjective evaluation of the House-Brackmann scale. The functionality of the facial nerve was assessed the day before surgery, the first day after surgery, then after the first, third, and sixth month. Of the 135 patients operated

with intraoperative nerve monitoring, 7 experienced facial nerve dysfunction post-surgery, and 10 patients out of 194 patients experienced facial nerve dysfunction post-surgery in the group not using intraoperative nerve monitoring. In regard to the benefit of using intraoperative nerve monitoring, they found that it reduced the risk of injury versus not using intraoperative nerve monitoring and that the patients were less likely to develop facial paralysis / palsy after surgery. They found no association between the sex of the patient and the outcome of facial nerve functionality after surgery; the same results were found when examining the location of the tumour (sinistral or dextral) as it had no impact on facial nerve functionality. When examining the location of the tumour they found that patients with a tumour located in the inferior lobe had a higher incidence of facial nerve injury than those with a tumour located in the superficial lobe. When looking at the age of the patients and those that developed facial paralysis / palsy, as shown in other studies, they found that increased age of the patient is a significant factor for developing facial paralysis / palsy. In contrast to other studies that found tumour size to be a predictor for negative outcome of facial nerve functionality, this study found no significant difference in tumour size and patients with or without facial nerve paralysis / palsy. The same was found when looking at operating time (measured from knife start till last closing suture), longer surgeries did not pose an increased risk of facial nerve paralysis /palsy when compared to shorter surgeries.

For the analysis of the patient data, specifically the evaluation of the functionality of the facial nerve post-surgery (Lazim, et al., 2023) compared the three grading systems, House-Brackmann, Sunnybrook, and Sydney, and their ability to assess the functionality of the facial nerve when compared to assessment through nerve conduction studies. The nerve-conduction study is an objective measurement of facial nerve functionality whereas the three grading systems are subjective measurements. 22 patients with any peripheral facial palsy were recruited for the study and evaluated by a single researcher using the three subjective grading systems. For the nerve conduction studies, the patients were evaluated using electrode patches on the musculus orbicularis oris, the musculus nasalis, and the musculus orbicularis oris. They found that the three subjective grading systems did not differ in their assessment of the functionality of the facial nerve and all can be used equally and be interchanged according to physician preference, with the addition of facial nerve conduction studies to supplement the evaluation of facial nerve functionality.

7. ANALYSIS CONCLUSION

The following table summarises each article evaluated above and their recommendations in regard to the preservation of facial nerve functionality after surgery for tumours of the parotid gland.

Table 2 - Summary of analysis and recommendations

Article + Type of study	Number of patients	Evaluation	Recommendation
(Clemmesen, et al., 2025)	Review of literature	Surgical techniques such as Superficial Parotidectomies, Partial Superficial Parotidectomies, Extracapsular Dissection	Inconclusive, extracapsular dissection has shown benefit to the patient, recommendation is surgeons be trained on Superficial Parotidectomies and Partial Superficial Parotidectomies as extracapsular dissection can be forced to convert to either
(Almas, et al., 2020) Retrospective study	Benign: 55 Malignant: 18	Facial nerve functionality after either Superficial Parotidectomies or Total Parotidectomies	Largest impact on facial nerve functionality was tumour sizes > 4cm
(Molinari, et al., 2024) Retrospective study	Pathology not examined Patients: 46	Effect of neuromuscular retraining after parotidectomies on facial nerve functionality	Net positive effect when using neuromuscular retraining on facial nerve functionality post-operation. Greatest improvement seen within 6months, and long-term improvement seen after 18months
(Ellingson, et al., 2003) Retrospective study	Benign: 67 Malignant: 52	Superficial parotidectomies performed on benign and malignant tumours, which pathology impacts the functionality of the facial nerve the least	Long term implication on facial nerve after superficial parotidectomies is the same, pathology does not matter. Benign has a greater chance of only causing House-Brackmann grade II or lover vs. malignant pathology
Article + Type of study	Number of patients	Evaluation	Recommendation

(Nicoli, et al., 2017) Retrospective Study	Pathology not examined Total patients: 109	Microsurgical dissection during Superficial Parotidectomies, Conservative Parotidectomies, and Total Parotidectomies	Use of microsurgical dissection provided a net benefit to the patients as no patient experienced permanent facial nerve paralysis
(ChiesaEstomba, et al., 2020) Systematic Review + Meta-Analysis	Pathology not examined Total patients: 1069	Intraoperative facial nerve monitoring vs without intraoperative facial nerve monitoring	Decreased incidence of Post-operative facial weakness when using intraoperative facial nerve monitoring by 42.7% Decreased risk of Post-operative permanent facial weakness when using intraoperative facial nerve monitoring
(Liu, et al., 2023) Meta-Analysis	Pathology not examined Total patients: 2844	Superficial parotidectomies vs Partial Superficial Parotidectomies	Partial Superficial Parotidectomies reduced incidence of partial + permanent facial nerve palsy vs Superficial Parotidectomies
(Al-dhohrah, et al., 2018) Meta-Analysis	Benign: 481 patients Malignant: 0 patients	Antegrade vs retrograde facial nerve dissection	No significant difference between the two approaches in preserving facial nerve functionality post-surgery
(Prince, et al., 2026) Retrospective review	Benign: 313 patients Malignant: 283 patients	3 different surgical techniques: Extracapsular, Anterior facial nerve dissection, Retrograde facial nerve dissection	Benign: Extracapsular -> Retrograde -> Anterior Malignant: No difference

(Choi, et al., 2021) Retrospective study	Malignant: 60 patients	Tumour size (bulky, >4cm) on long-term patient survival	Self-examination of the parotid gland to discover tumours in the parotid gland before they become bulky, threatening not only long-term survival but also facial nerve functionality
Article + Type of study	Number of patients	Evaluation	Recommendation
(Cirignaco, et al., 2025) Retrospective study	Benign: 329 patients	Use of intraoperative nerve monitoring for reducing facial nerve injury during surgery for benign tumours of the parotid gland	Intraoperative nerve monitoring can minimise injury to the facial nerve especially during complex tumours Tumour location in the deep + inferior lobes increased risk of injuries to the facial nerve post-surgery
(Lazim, et al., 2023) Comparison study	Pathology not examined Total patients: 22	Assessment of the three grading systems along with nerve conduction studies	Any of the three grading systems can be used interchangeable depending on physician preference, nerve conduction studies can be used to supplement the three grading systems

8. PATIENT DATA AND ANALYSIS

Awaiting transfer of patient data to author (see Appendix)

8.1. PT DATA

Awaiting transfer of patient data to author (see Appendix)

8.2. ANALYSIS

Awaiting transfer of patient data to author (see Appendix)

9. DISCUSSION

From the articles included in this thesis, the following recommendations having been created. They have been divided into surgical techniques, the impact of pathology, pre - peri - and post-operative findings and recommendations.

Surgical Technique findings and recommendations

- Use of microsurgical dissection of the facial nerve during parotid gland surgery is beneficial and should be implemented were applicable as no patients were left with permanent facial nerve paralysis (Nicoli, et al., 2017).
- (Al-dhohrah, et al., 2018) found no significant difference in using either antegrade or retrograde facial nerve dissection in preserving facial nerve functionality in benign tumour (in contrast to the study by (Nicoli, et al., 2017), whereas (Prince, et al., 2026) showed a benefit for preserving facial nerve functionality after benign parotid surgery with the greatest benefit from highest to lowest extracapsular approach, retrograde, and anterior. In malignant tumours, there was no benefit over either approach (Prince, et al., 2026).
- Partial superficial parotidectomies reduced incidence of transient and permanent facial nerve palsy when compared to using total parotidectomies (Liu, et al., 2023).
- Tumour sizes above four cm had the largest impact on facial nerve functionality after surgery independent of the surgical approach used (Superficial parotidectomies and Total parotidectomies) (Almas, et al., 2020), although the study by (Cirignaco, et al., 2025) did not find that the size of the tumour had a significant impact of the functionality of the facial nerve post-operation.

Pathology (malignant / benign) findings and recommendations

- Pathology in the form of malignant or benign tumours has no long term implications from superficial parotidectomies on the functionality of the facial nerve, but benign pathology has a greater chance of only causing House-Brackmann grade II palsy when compared to malignant pathology (Ellingson, et al., 2003)

Pre-Operative findings and recommendations

- Implementation of self-examination of the parotid gland in non-symptomatic patients should be as ubiquitous as breast-self-examination or the screening of colorectal cancer (Choi, et al., 2021). The earlier a potential tumour is discovered the better the outcome for the patient, especially with larger sizes of tumours (>4cm) (Almas, et al., 2020) having greater effect on the functionality of the facial nerve.

Peri-Operative findings and recommendations

- Intraoperative facial nerve monitoring should be used were applicable for all parotid surgeries as the nerve monitoring has shown decreased incidence for both transient and permanent facial weakness (ChiesaEstomba, et al., 2020).

Post-Operative findings and recommendations:

- Implementation of neuromuscular retraining for all patients having undergone parotid surgery exhibiting signs of facial nerve palsy / paralysis as it improves outcome of facial nerve functionality (Molinari, et al., 2024).

Evaluation of facial nerve functionality findings and recommendations

- According to (Lazim, et al., 2023), all three grading systems perform equally in assessing the functionality of the facial nerve. Therefore, this master thesis will use the House-Brackmann grading scale to assess the functionality of the facial nerve of the patients included in this study. The House-Brackmann is picked due to the authors preference and not based on the findings by (Lazim, et al., 2023), they only used 1 technician to evaluate all patients and only included 22 patients. To accurately assess each grading system a larger study would have to conducted that includes more patients and different assessors.

10. CONCLUSION

From the articles analysed in this thesis, there is no clear consensus on the best surgical approach to tumours of the parotid gland and the preservation of facial nerve functionality. The use of microsurgery to dissect the facial nerve before tumour removal though, shows the most promise in preserving facial nerve functionality. What appears to be the determining factor of preserving facial nerve functionality disregarding surgical approach, is the size of the tumour and its location in the parotid gland. The pathology of the tumour also has no effect on the functionality of the facial nerve after surgery. Since no clear recommendation can be made on surgical approach, what can assist in preserving facial nerve functionality is the self-assessment recommendation by (Choi, et al., 2021), if the tumour can be discovered before reaching sizes that are detrimental to the function of the facial nerve, less patients would experience lower quality of life from facialis paresis. If surgery is needed, using neuromuscular retraining shows promise in retaining function of the facial nerve post-surgery.

11. FUTURE PERSPECTIVES

Awaiting transfer of patient data to author (see Appendix)

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13. TABLE OF FIGURES

14. LIST OF TABLES

15. APPENDIX

Regarding patient data, as of 30.04.26 no patient data has been received. It is the hope of the author that the patient data is provided before the thesis presentation on 07.05.26 so it can be included and evaluated against the analysis. As it currently stands, what was supposed to be a retrospective study turned into a review of current literature instead with an analysis that is sound but lacks the patient data to truly shine.

16. AI USAGE STATEMENT

AI Usage Statement

I, Tomas Fuchs Bøttern, do not acknowledge the use of generative AI tools in the preparation of this assignment. Below, I provide details regarding the tools used (did not use any), their purpose, and the steps taken to ensure academic integrity, accuracy, and originality.

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