



## Research Article

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# Management Strategies of Benign Parotid Tumors

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## Abstract

**Background:** Parotid gland tumor is the most common salivary gland tumors. Benign tumors account for about 80% of parotid gland tumors. Surgical excision is the treatment of choice in most cases when treating benign parotid tumors. However, due to the special anatomical location of the parotid gland and the different pathology of the tumor, there are many complications after parotid gland tumor operation, which also seriously affects patients' quality of life.

**Methods:** We summarized and compared the traditional operation and the improved operation of parotid benign tumor, and compared the occurrence of various postoperative complications.

**Results:** We found that the incidence of postoperative complications of the modified operation was significantly low, and the quality of life of patients was good during postoperative follow-up.

**Results:** This study puts forward the prevention and treatment strategies for benign parotid tumors.

**Conclusion:** This is an effective technique for benign parotid tumors, yielding improved functional outcomes – including cosmetic aspects, sensation and surgical complications.

**Keywords:** Parotid gland tumor; Surgery; Complication; Incision.

## Introduction

Salivary gland tumors are one of the most common diseases in the maxillofacial region, parotid gland tumor account for about 80%. Fortunately, variations in certain proportions and relative incidences exist. Among parotid gland tumors, benign tumors account for about 80%, and malignant tumors account for 20% [1-3]. Surgical treatment is the first choice for benign parotid tumors. Although the parotid gland has a simple structure, its relationship

with peripheral blood vessels and nerves is quite complex. The special anatomy around the parotid gland and the pathological nature of the tumor makes the surgical complications of the parotid gland particularly high, such as gustatory sweating syndrome, facial paralysis, and facial depression deformity [4-6].

With the continuous improvement of parotid surgery, patients' quality of life has improved to a certain extent [7-9]. However, how to minimize the occurrence of complications on the basis

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of radical resection of tumors is still an urgent problem to be solved in the clinic. Based on the clinical experience of our team, we summarize the strategies that can effectively reduce surgical complications in benign parotid tumors in this article as follows:

- Retroauricular incision
- Anatomy of nerve under the retroauricular incision
- Preservation of the greater auricular nerve
- Preparation of parotid gland flap
- The use of ultrasonic scalpel combined with endoscopy

In clinical practice, this experience can significantly reduce postoperative complications.

### **Overview of parotid gland tumors**

Parotid gland tumors are the most common salivary gland tumors, and benign tumors account for the majority. The most common benign tumor of the parotid gland and the most common salivary gland tumor overall is the pleomorphic adenoma [10]. Hemangioma and lymphangioma are the most common non-epithelial tumors [11]. Most tumors are located in the parotid gland's anterior or posterior lobe. Benign parotid tumors grow slowly and often be found unconsciously. They have no activity, adhesion, or dysfunction, but some benign tumors with an infection also have pain symptoms. Parotid gland malignant tumors grow rapidly, adhere to the surrounding tissues, and grow infiltratively. In some cases, tumor growth invading the facial nerve will also cause facial nerve dysfunction. However, some low-grade malignant tumors can also show benign tumors in the early stage, which can easily be confused with benign tumors [12].

### **Surgical treatment strategy of parotid benign tumor**

#### **Development of parotid gland surgery**

Before the 1940s, due to the lack of understanding of the facial nerve and the pathological nature of parotid gland tumor, simple enucleation was mostly used in parotid gland tumor surgery [13]. During 1940s to 1970s, along with the improvement of surgeon understanding, the standard surgical methods of parotid gland tumors changed to superficial parotidectomy and total parotidectomy. This surgical method decreased the rate of recurrence in the long term, but the postoperative survival quality of patients was still poor. Since the 1970s, with the development of functional surgery, partial parotidectomy has been gradually recognized to ensure the safe boundary of tumor resection. This operation greatly improves the quality of life [7-9].

#### **Characteristics of parotid gland surgery in the new era**

The parotid gland has the largest volume in the salivary gland; it plays a very important role in daily salivary secretion. The parotid gland is divided into shallow and deep leaves, with the facial nerve as the boundary. In almost all cases, the anatomical relationship of the facial nerve in the gland requires careful identification and dissection of the nerve [14,15]. Therefore, the requirements for the chief surgeon are very high. With the increasing improvement of people's living standards, patients require not only complete tumor resection but also the best functional retention and cosmetic effect. This also makes many scholars have ex-

plored the functional and cosmetic surgery of the parotid gland. Parotid gland surgery in the new era has higher requirements for operators.

### **Modified operation for parotid benign tumor**

#### **Superficial parotid approach**

The conventional surgical approach to parotid gland tumor is an «s» like incision; it starts from the earlobe, goes down vertically, bypasses the earlobe, turns forward in front of the mastoid tip, passes through the posterior edge of the mandibular ramus to the lower edge of the mandibular angle, and is parallel to the lower edge of the mandible for 1-2 cm [16-18]. This incision can fully expose the anatomical structure and make a clear visual field during the operation. However, the scar left after the operation is obvious, which is unacceptable to many patients with high appearance requirements.

Here, we have improved the incision. Use the incision of the medial edge of the tragus to integrate the posterior ear incision into the hairline. If the tumor is at the upper pole of the parotid gland, we can extend the incision upward to the temporal part during the operation. Conversely, when the tumor is in a lower position, the posterior incision should be extended backward. The whole incision is relatively hidden compared with the traditional incision. After the operation, through the investigation of patients' satisfaction with the obvious degree of scar, it is found that the satisfaction with the postoperative scar of retroauricular cosmetic incision is as high as 92.1%, which is significantly higher than that of the traditional group [19]. However, the retroauricular incision makes poor surgical vision compared with the traditional incision, which also increases the difficulty of operation to a certain extent, such as the anatomy of the facial nerve. Therefore, doctors need to have superb clinical skills. On the whole, the aesthetic effect of retroauricular incision is better, and it is the first choice for patients with high aesthetic requirements [19].

#### **Surgical approach to deep lobe of parotid gland in parapharyngeal tumor**

The Parapharyngeal Space (PPS) is one of several potential fascial planes of the head and neck which may become involved in various inflammatory and neoplastic processes [20]. The parotid gland extends forward to the ascending ramus of the mandible and the inner side of the medial pterygoid muscle to reach the parapharyngeal space. Although the incidence rate of tumors in this location is low, it is difficult to treat in the clinic because of their deep location and many important anatomical structures around them.

Most tumors in the parapharyngeal space can be cured by surgical treatment. There are many surgical approaches: cervical side, cervical jaw, cervical parotid, oropharyngeal, and so on [21]. After years of clinical research and postoperative follow-up, we found that the cervical approach to disconnect the mandible can be used as a conventional surgical approach. The cervical parotid gland, cervical jaw, and cervical should not be treated and used independently. The incision should be extended according to the size, location, and nature of the tumor based on the cervical approach so that the three incisions can be used together [22,23]. This surgical approach can complete the resection of most parapharyngeal tumors, reduce unnecessary trauma and improve the

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quality of life of patients after operation.

### **Anatomy of nerve under the retroauricular incision**

The core of parotid gland surgery is the dissection of the facial nerve. There are two methods to dissect the facial nerve: the anterograde method and the retrograde method [24]. The retrograde method is to find the trunk from the branch. The anatomical relationship between the mandibular marginal branch of the facial nerve and the posterior mandibular vein is relatively fixed. Looking for the mandibular marginal branch or descending branch of the facial nerve with the posterior mandibular vein as the sign is the most commonly used method. The posterior mandibular vein passes through the lower end of the parotid gland, and the mandibular edge or descending branch of the facial nerve is only on its superficial surface, but there are isolated cases where branches of the facial nerve pass through the deep surface of the posterior mandibular vein, so it should be carefully dissected [19].

The anterograde method is to find the branches of the facial nerve from the general trunk of the facial nerve. The procedure is to separate the posterior boundary of the parotid gland along the front edge of the sternocleidomastoid muscle to the tip of the mastoid process, fully expose the cartilage of the external auditory canal upward, routinely separate the parotid gland, determine the general trunk of the facial nerve, determine the cervical and temporal trunk according to the general trunk, and dissect the corresponding branches according to the location of the focus. When the retroauricular incision is applied, it is difficult to turn the flap forward during the operation. Although the incision can be extended to the temporal part and behind the ear according to the needs of the operation, it leads to increased trauma during the operation. According to statistics, when using a cosmetic incision for surgery, the probability of trauma caused by dissecting the facial nerve in the anterograde method is about 10%, while the probability of trauma caused by the retrograde method is about 30% [19]. Therefore, when applying the retroauricular cosmetic incision, it is more reasonable to dissect branches of facial nerve from the general trunk. However, the injury of the general trunk of the facial nerve is more serious, it requires the operator to master the method of facial nerve anatomy and dissect the facial nerve accurately [25].

### **Preservation of greater auricular nerve**

Starting from the 2nd and 3rd cervical nerves, the great auricular nerve is the largest cutaneous branch of the cervical plexus. It not only has a corresponding sensory nerve function but also is an anatomical marker of important nerves and organs in the neck [26,27]. The great auricular nerve is mainly divided into the parotid branch, anterior auricular branch, earlobe branch, and posterior auricular branch. The parotid branch and anterior branch are mainly distributed in the parotid gland area and often pass through part of the parotid gland tissue, making them difficult to preserve during surgery in order to completely remove the tumor and reduce recurrence, while the earlobe branch and posterior auricular branch are mainly distributed in the earlobe and mastoid region. The traditional parotid surgery can better expose the operation field by cutting off the great auricular nerve and its branches, but most patients complain of the earlobe and peripheral numbness after the operation [28]. In our clinical research, we found that preservation of the trunk, earlobe branch, and pos-

terior branch of the great auricular nerve could well preserve the sensory function of the operation area. Through postoperative research, it was found that 85% of the patients who retained the greater auricular nerve felt normal in the operation area, while only 50% felt normal who did not retain the greater auricular nerve [29]. In general, preservation of the great auricular nerve can significantly improve the quality of life of the patients [30,31].

### **Prevention of facial depression**

Regarding benign parotid tumors, sometimes the tumors are too large and excessive tissues need to be removed during surgery, resulting in significant facial depression and deformity after surgery, which seriously affects patients' facial appearance and quality of life [31]. At present, grafts are often used to fill the operation cavity to reduce the occurrence of depression deformities, such as sternocleidomastoid muscle flap and parotid gland flap. Sternocleidomastoid muscle flap is to cut the upper third of sternocleidomastoid muscle laterally to the inner half, then sharply separate it upward along the longitudinal axis of the sternocleidomastoid muscle, and rotate and cover the muscle flap with distal cranial fracture as the pedicle to fill the defect in the operation area [32]. According to the research, the sternocleidomastoid muscle flap play a certain role in preventing facial depression. However, the sternocleidomastoid muscle flap also has some disadvantages, such as distal necrosis, difficulty to observe tumor recurrence, limited neck movement, more postoperative bleeding, and so on. The above-mentioned shortcomings also make the operator need to strictly grasp the indications when choosing the sternocleidomastoid muscle to prevent facial depression deformity [33].

Parotid gland flap refers to the partial removal of the parotid gland to preserve the function of the parotid gland. After the tumor is removed at the safe boundary, the remaining parotid gland is reset. Parotid gland flap does not cause additional surgical trauma, do not exhibit problems such as distal necrosis of muscle flap and excessive postoperative bleeding, and can prevent facial depression to a certain extent. However, when the resected parotid tumor is too large, the remaining tissue of the parotid gland is not sufficient to fill the tissue defect, and in this case, we have to choose or combine other repair methods [49].

### **Prevention of gustatory sweating syndrome**

Gustatory sweating syndrome (Frey syndrome) is one of the common complications after parotid surgery [4]. Its etiology is recognized as the healing of parasympathetic fibers and sympathetic fiber endings after parotid surgery. When eating parasympathetic fibers, causes vasodilation and sweat gland secretion in the parotid masseter muscle area dominated by sympathetic fibers, resulting in skin flushing and sweating [5,6]. Therefore, preventing nerve fiber regeneration is an important method to prevent the gustatory sweating syndrome.

Parotid masseter fascia is considered to be a natural barrier to preventing gustatory sweating syndrome [34]. The method of preserving the parotid masseter fascia is different from the conventional method. Before turning up the flap, the parotid masseter fascia should be cut, and the parotid masseter fascia should be included in the flap and turned up together to directly expose the parotid acini. When the flap is restored and the wound is closed,

the parotid masseter fascia is tightly sutured, and then the platysma, subcutaneous tissue, and skin are closed in layers. Without retaining the parotid masseter fascia, the probability of postoperative gustatory sweating syndrome is about 60%, and the surgical method of parotid masseter fascia is about 15% [50]. This shows that preservation of the parotid masseter fascia can prevent gustatory sweating syndrome to a certain extent [35,36].

As a common way to prevent gustatory sweating syndrome, the sternocleidomastoid muscle flap can take into account the dual functions of preventing gustatory sweating syndrome and repairing facial depression [31]. However, when the sternocleidomastoid muscle flap is prepared, the external neck will collapse slightly, and it is not easy to observe the postoperative recurrence after implantation of the muscle flap. The intraoperative accessory nerve injury will also lead to movement disorder of the neck and shoulder. Some studies have suggested that the accessory nerve injury can be avoided through the operator's fine operation [37].

Parotid gland flap refers to the partial removal of the parotid gland during operation, retaining the function of the remaining parotid gland, and resetting the remaining parotid gland after full dissociation [51]. And the parotid masseter fascia is reset and reconstructed, to prevent the occurrence of taste sweating syndrome to a certain extent. And this repair method will not add new surgical wounds, greatly reduce the pain of patients without complications, and has good popularization value.

To further improve the prevention of gustatory sweating syndrome, some scholars have proposed the use of barrier fillers to block the regeneration of nerves [52]. The oral repair membrane is a xenogenic acellular dermal matrix obtained from bovine skin tissue after treatment. The main component is collagen egg, with the repair of parotid fascia, the biofilm is gradually and completely degraded without any residue, and the biofilm has good histocompatibility and less local rejection. The success rate of repairing the membrane to prevent taste sweating syndrome is about 90% [52].

#### **Combined use of the endoscope and ultrasonic scalpel through the retroauricular incision**

Minimally invasive surgery is the trend of development as time goes on. Endoscopic technology fully embodies the characteristics of minimally invasive that is, small incision and minimal damage to surrounding tissues. The successful application of endoscopic technology in head and neck surgery such as thyroid, submandibular gland, and branchial cleft cyst, coupled with the continuous development and improvement of surgical instruments, makes the endoscopic surgery of parotid gland possible [38,39].

Endoscopic surgery through a cosmetic incision refers to the design of retroauricular cosmetic incision, and the length of which is adjusted according to the size of the tumor, generally 3-6cm. The procedure is performed by conventionally cutting the skin and subcutaneous tissue, turning up the whole parotid masseter fascia, exposing the superficial lobe of the parotid gland to the upper-end sternocleidomastoid muscle, and then assisting in identifying the facial nerve and surrounding important anatomical structures through endoscopy. After complete resection of the tumor, close the operation area [40].

Compared with conventional open parotid surgery, endoscopic assisted parotid surgery has unique advantages. The length of the incision assisted by the endoscope is significantly shorter than that of traditional open surgery. The postoperative scar is smaller and more hidden, which can meet the aesthetic requirements of people. When undertaking endoscopic-assisted parotidectomy for benign parotid tumors, the intraoperative endoscope enters the operative area through a single incision, which provides a clearer surgical field of view due to its illumination and magnification, making the important surrounding anatomical structures clearer and allowing the operator to easily identify the facial nerve during the procedure, thus reducing the injury of the facial nerve [41-43].

Some researchers believe that the endoscopically assisted incision is small and excessive intraoperative bleeding will affect the surgical field and the surgical effect. The use of an ultrasonic scalpel makes up for this disadvantage. The high-frequency sound wave outside the ultrasonic scalpel causes the local temperature to rise, which promotes the coagulation of broken capillaries and achieves the hemostatic effect [44-46]. However, if the operation space is insufficient during the operation, the ultrasonic knife cannot be used indiscriminately, because the heat generated by the ultrasonic knife head will cause reversible damage to the nerve. Generally speaking, it is safer to be 5mm away from the nerve. Ultrasonic scalpel combined with endoscopic assisted surgery can reduce the amount of intraoperative bleeding and shorten the operation time. It can not only hide the operation area but also operate simply and efficiently. It is worthy to be popularized in the clinic [47,48].

#### **Discussion**

For the surgical approach to benign tumors in the superficial lobe of the parotid gland, the retro auricular incision proposed in this paper has the advantages of concealment and a good aesthetic effect. The retro auricular cosmetic incision can meet the surgical requirements of most superficial parotid gland tumors, completely expose the tumor and ensure the radical cure of the tumor. At the same time, the postoperative scar is not obvious, which meets people's pursuit of aesthetics. However, compared with the conventional incision, the postoperative visual field of the retro auricular cosmetic incision is smaller, the precision of the operation is higher, and the flap needs to be opened with greater force when turning over the flap, which is very demanding for the operator and assistant.

For benign tumors located in the deep lobe of the parotid gland, an approach to disconnect the mandible through the lateral cervical approach is proposed because the tumor protrudes from the deep surface of the parotid gland into the parapharyngeal space. During the operation, the incision can be extended according to the size and nature of the tumor, combined with the cervical jaw and cervical parotid approach to complete the radical cure of the tumor. The proposed surgical approach for parotid deep lobe tumors protruding to parapharynx overcomes the shortcomings of poor visual field and unfavorable hemostasis of the previous oropharyngeal approach, reduces the injury of the facial nerve and improves the quality of life of patients [19].

Ear lobe numbness after parotid gland surgery is a common symptom due to the amputation of the great auricular nerve

[26,27]. To free the posterior inferior pole of the parotid gland, conventional parotid surgery usually needs to cut off the great auricular nerve. We found that preserving the branch of the great auricular nerve into the earlobe does not affect the dissociation of the lower pole of the parotid gland, which can ensure the radical cure of the tumor. At the same time, the preservation of the great auricular nerve will reduce the postoperative earlobe numbness of patients. Even if some patients have postoperative earlobe numbness, 85% can be recovered as long as the great auricular nerve is not broken during the operation [28].

Both methods of facial nerve anatomy are possible under the classical incision, but under the retro auricular cosmetic incision, because the surgical field is small, the method of retrograde method is relatively difficult, and the branch is thinner than the trunk, which is difficult to distinguish and easy to be damaged during the operation. Although the position of the main trunk is relatively fixed relative to the branch, there are some variations in its position. Sometimes the operator is not familiar with the anatomy of the facial nerve, which is easy to cause damage to the trunk, and the consequences are more serious. Therefore, the operator is required to have skilled facial nerve anatomy skills [25]. Under the retroauricular cosmetic incision, we compared the probability of postoperative facial paralysis caused by two different anatomical methods, and found that the anterograde method has a low probability of facial paralysis and is more suitable for facial nerve anatomy under the retroauricular cosmetic incision.

Conventional parotidectomy will lead to facial depression and sweating syndrome [4,31], which seriously affects the social and quality of life of patients. After years of clinical research, it is found that the operation method of preserving parotid masseter fascia can prevent 85% of taste sweating syndrome [28], which also puts forward higher requirements for the operator, requiring the operator to preserve the integrity of parotid masseter fascia during operation. Sternocleidomastoid muscle flap is a common repair method, but the preparation of sternocleidomastoid muscle flap sometimes leads to the injury of the accessory nerve, which also limits the movement of patients' neck after operation. At the same time, the sternocleidomastoid muscle flap also has the disadvantages of muscle end necrosis and incomplete hemostasis, so it needs to be careful when selecting the sternocleidomastoid muscle flap [33].

The repair film can prevent taste sweating syndrome and has good biocompatibility, it has a poor effect on preventing facial depression deformity, and the repair film will incur additional costs, which is a burden for patients with poor economic condition. Parotid gland flap refers to the partial removal of parotid gland tissue to retain the function of the remaining parotid gland tissue. At the same time, the remaining parotid gland is fully free, and then the remaining parotid gland is sutured and reset to achieve the function of filling the defect area. The preparation of the parotid gland flap does not cause additional surgical trauma and has fewer postoperative complications, which can meet the prevention of depression deformity after the operation of most parotid gland tumors. At the same time, we were surprised to find that a parotid gland flap can also prevent the occurrence of taste sweating syndrome. Keeping the integrity of parotid masseter fascia during operation and combining parotid gland flap, the probability of postoperative gustatory sweating syndrome is very low.

However, sometimes when the tumor is large and the remaining parotid tissue is small, it is difficult to prepare a parotid gland flap, which needs to be combined with other repair methods. In general, the parotid gland flap has good clinical application value.

The combined use of an endoscope and ultrasonic scalpel under cosmetic incision is in line with the concept of minimally invasive [42,48]. The incision of this technique is smaller than that of conventional surgery, and the scar is more hidden. However, there is still a lot of controversy about the indications for the use of endoscopy. Some people believe that endoscopy is suitable for tumors with a diameter of less than 4cm. If the tumor is too large to be completely exposed and cannot be completely removed during the operation, it will lead to tumor replantation and recurrence. About this, I have not done a systematic research, which needs to be improved in the later stage. The use of endoscope assisted combined with an ultrasonic scalpel under the retroauricular cosmetic incision requires the operator to have a more solid basic skill of surgical operation, which also puts forward higher requirements for the operator. In general, compared with traditional open surgery, this surgery is more reasonable in terms of beauty, minimally invasive, and curative effect. It is an easy to promote, less traumatic, and practical surgical method [41].

## Conclusion

Parotid tumor surgery has experienced a long development process. The ultimate goal of surgery is to maximize the quality of life of patients based on the eradication of tumors. In this paper, we summarize the experience of applying post auricular cosmetic incision, anterograde solution of profile nerve, preserving of greater auricular nerve, preparing of parotid gland flap, and using ultrasonic scalpel combined with an endoscope. The above methods result in fewer complications and are also effective for simultaneously ensuring parotid function and aesthetics, which are worthy to be promoted in clinical practice.

## Declarations

**Author contributions:** RUI SHI and WHR gathered the related literature and drafted the first manuscript. SML created the figures. LG contributed to conception and design, acquisition and interpretation of data, and critically revised manuscript. KQZ designed this review and contributed to the critical revision of the manuscript. All authors contributed to the article and approved the submitted version.

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**Conflict of interest:** The authors declare that the research was conducted in absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## References

- Zhan KY, Khaja SF, Flack AB, Day TA. Benign Parotid Tumors. *Otolaryngol Clin. North Am.* 2016; 49: 327-342.
- Tian Z, Li L, Wang L, Hu Y, Li J. Salivary gland neoplasms in oral and maxillofacial regions: a 23-year retrospective study of 6982 cases in an eastern Chinese population. *Int J Oral Maxillofac Surg.* 2010; 39: 235-242.
- Bisdas S, Baghi M, Wagenblast J, Knecht R, Thng CH, et al. Differentiation of benign and malignant parotid tumors using deconvolution-based perfusion CT imaging: feasibility of the method and initial results. *Eur J Radiol.* 2007; 64: 258-265.
- Klintworth N, Zenk J, Koch M, Iro H. Postoperative complications after extracapsular dissection of benign parotid lesions with particular reference to facial nerve function. *Laryngoscope.* 2010; 120: 484-490.
- Maahs GS, de P, Oppermann O, Maahs LGP, Machado Filho G, Ronchi AD. Parotid gland tumors: a retrospective study of 154 patients. *Braz J Otorhinolaryngol.* 2015; 81: 301-306.
- Taylor SM, Yoo J, Matthews TW, Lampe HB, Trites JR. Frey's syndrome and parotidectomy flaps: A retrospective cohort study. *Otolaryngol Neck Surg Off. J Am Acad Otolaryngol Neck Surg.* 2000; 122: 201-203.
- Johnson JT, Ferlito A, Fagan JJ, Bradley PJ, Rinaldo A. Role of limited parotidectomy in management of pleomorphic adenoma. *J Laryngol Otol.* 2007; 121: 1126-1128.
- Larian B. Parotidectomy for Benign Parotid Tumors. *Otolaryngol Clin North Am.* 2016; 49: 395-413.
- Roh JL, Kim HS, Park CI. Randomized clinical trial comparing partial parotidectomy versus superficial or total parotidectomy. *Br J Surg.* 2007; 94: 1081-1087.
- Fusco N, Guerini-Rocco E, Schultheis AM, Badve SS, Reis-Filho JS, et al. The birth of an adenoid cystic carcinoma. *Int J Surg Pathol.* 2015; 23: 26-27.
- Maier H, Frühwald S, Tisch M, Danz B, Lorenz KJ. Epidemiology, diagnosis, and treatment of giant pleomorphic adenomas of the parotid gland]. *HNO.* 2007; 55: 812-818.
- Inaka Y, Kawata R, Haginomori SI, Terada T, Higashino M, et al. Symptoms and signs of parotid tumors and their value for diagnosis and prognosis: a 20-year review at a single institution. *Int J Clin Oncol.* 2021; 26: 1170-1178.
- Moore MG, Yueh B, Lin DT, Bradford CR, Smith RV, et al. Controversies in the Workup and Surgical Management of Parotid Neoplasms., *Otolaryngol. Neck Surg. Off. J. Am. Acad. Otolaryngol. Neck Surg.* 2021; 164: 27-36.
- Park W, Park J, Park SI, Kim H, Bae H, et al. Clinical outcomes and management of facial nerve in patients with parotid gland cancer and pretreatment facial weakness. *Oral Oncol.* 2019; 89:144-149.
- Guntinas-Lichius O, Silver CE, Thielker J, Bernal-Sprekelsen M, Bradford CR, et al. Management of the facial nerve in parotid cancer: preservation or resection and reconstruction. *Eur Arch Oto-Rhino-Laryngology Off J Eur Fed Oto-Rhino-Laryngological Soc Affil with Ger Soc Oto-Rhino-Laryngology - Head Neck Surg.* 2018; 275: 2615-2626.
- Carlson ER, Webb DE. The diagnosis and management of parotid disease. *Oral Maxillofac Surg Clin North Am.* 2013; 25: 31-48.
- Borumandi F, George KS, Cascarini L, Parotid surgery for benign tumours. *Oral Maxillofac Surg.* 2012; 16: 285-290.
- Franzen AM, Kaup Franzen C, Guenzel T, Lieder A. Increased incidence of Warthin tumours of the parotid gland: a 42-year evaluation. *Eur Arch Oto-Rhino-Laryngology Off J Eur Fed Oto-Rhino-Laryngological Soc. Affil with Ger Soc Oto-Rhino-Laryngology - Head Neck Surg.* 2018; 275: 2593-2598.
- Gao L, Ren W, Li S, Yan X, Li F, et al. Comparing Modified with Conventional Parotidectomy for Benign Parotid Tumors. *ORL J Otorhinolaryngol Relat Spec.* 2017; 79: 264-273.
- Bulut OC, Giger R, Alwagdani A, Aldabal N, Stenzinger A, et al. Primary neoplasms of the parapharyngeal space: diagnostic and therapeutic pearls and pitfalls. *Eur Arch Oto-Rhino-Laryngology Off J Eur Fed Oto-Rhino-Laryngological Soc Affil with Ger Soc Oto-Rhino-Laryngology Head Neck Surg.* 2021; 278: 4933-4941.
- Eisele DW, Richmon JD. Contemporary evaluation and management of parapharyngeal space neoplasms. *J Laryngol Otol.* 2013; 127: 550-555.
- Aasen MH, Hutz MJ, Yuhan BT, Britt CJ. Deep Lobe Parotid Tumors: A Systematic Review and Meta-analysis. *Otolaryngol Neck Surg Off J Am Acad Otolaryngol Neck Surg.* 2022; 166: 60-67.
- Zhi K, Ren W, Zhou H, Wen Y, Zhang Y. Management of parapharyngeal-space tumors. *J Oral Maxillofac Surg Off J Am Assoc Oral Maxillofac Surg.* 2009; 67 : 1239-1244.
- Gataa IS, Faris BJM. Patterns and surgical significance of facial nerve branching within the parotid gland in 43 cases. *Oral Maxillofac Surg.* 2016; 20: 161-165.
- Gandolfi MM, Slattery W. Parotid Gland Tumors and the Facial Nerve. *Otolaryngol Clin North Am.* 2016; 49: 425-434.
- Leoncini E, Ricciardi W, Cadoni G, Arzani D, Petrelli L, et al. Adult height and head and neck cancer: a pooled analysis within the IN-HANCE Consortium. *Eur J Epidemiol.* 2014; 29: 35-48.
- Zumeng Y, Zhi G, Gang Z, Jianhua W, Yinghui T. Modified superficial parotidectomy: preserving both the great auricular nerve and the parotid gland fascia., *Otolaryngol. Neck Surg Off J Am Acad Otolaryngol Neck Surg.* 2006; 135: 458-462.
- Hu J, Ye W, Zheng J, Zhu H, Zhang Z. The feasibility and significance of preservation of the lobular branch of the great auricular nerve in parotidectomy., *Int. J Oral Maxillofac Surg.* 2010; 39: 684-689.
- Colella G, Rauso R, Tartaro G, Biondi P. Skin injury and great auricular nerve sacrifice after parotidectomy. *J Craniofac Surg.* 2009; 20: 1078-1081.
- Yan F, Desiato VM, Nguyen SA, Lentsch EJ. Impact of greater auricular nerve sacrifice during parotidectomy on quality of life. *Head Neck.* 2021; 43: 70-78.
- Manola M, Moscillo L, Simeon V, De Luca E, Mastella A. The Effectiveness of Sternocleidomastoid Flap Versus Superficial Musculoaponeurotic System Flap for the Prevention of Frey Syndrome and Facial Depressed Deformity in Parotid Surgery for Pleomorphic Adenoma. *Ann Plast Surg.* 2018; 80: 125-129.
- Dell'aversana Orabona G, Salzano G, Petrocelli M, Iaconetta G, Califano L. Reconstructive techniques of the parotid region. *J Craniofac Surg.* 2014; 25: 998-1002.

33. Zhi K, Ren W, Gao L, Zhao L, Huang S, et al. Face-lift incision combined with sternomastoid muscular flap in parotidectomy. *Aesthetic Plast Surg.* 2011; 35: 558-562.
34. Ogino A, Onishi K, Nakamichi M, Okaneya T. Use of Parotid Gland Fascia in the Prevention of Frey Syndrome After Parotidectomy. *J Craniofac Surg.* 2019; 30: 1009-1011.
35. Fiacchini G, Cerchiai N, Tricò D, Sellari-Franceschini S, Pietro Casani A, et al. Frey Syndrome, First Bite Syndrome, great auricular nerve morbidity, and quality of life following parotidectomy. *Eur Arch Oto-Rhino-Laryngology Off J Eur Fed Oto-Rhino-Laryngological Soc Affil with Ger Soc Oto-Rhino-Laryngology - Head Neck Surg.* 2018; 275: 1893-1902.
36. Mashrah MA, Aldhohrah T, Abdelrehem A, Koraitim M, Wang L. What is the best method for prevention of postparotidectomy Frey syndrome? Network meta-analysis. *Head Neck.* 2021; 43 (2021) 1345–1358.
37. Nofal AAF, Mohamed M. Sternocleidomastoid Muscle Flap after Parotidectomy. *Int Arch Otorhinolaryngol.* 2015; 19: 319-324.
38. Zou HW, Gao J, Liu JX, Qu ZL, Du ZS, et al. Chen, Feasibility and advantages of endoscope-assisted parotidectomy: a systematic review and meta-analysis. *Br J Oral Maxillofac Surg.* 2021; 59: 503-510.
39. Woo SH. Endoscope-assisted transoral accessory parotid mass excision. *Head Neck.* 2016; 38: E7-12.
40. Huang X, Zheng Y, Liu X, Sun W, Zeng L, et al. A comparison between endoscope-assisted partial parotidectomy and conventional partial parotidectomy. *Otolaryngol Neck Surg Off J Am Acad Otolaryngol Neck Surg.* 2009; 140: 70-75.
41. Gao L, Liang QL, Ren WH, Li SM, Xue LF, et al. Comparison of endoscope-assisted versus conventional resection of parotid tumors. *Br J Oral Maxillofac Surg.* 2019; 57: 1003-1008.
42. Chen J, Chen W, Zhang J, He F, Zhu Z, et al. Modified endoscope-assisted partial-superficial parotidectomy through a retroauricular incision. *ORL J Otorhinolaryngol Relat Spec.* 2014; 76: 121-126.
43. Huang X, Sun W, Liu X, Liu W, Guan Z, et al. Endoscope-assisted partial-superficial parotidectomy through a concealed postauricular skin incision. *Surg Endosc.* 2009; 23: 1614-1619.
44. Yang X, Yu Y, Li D, Dong L. Comparison of Complications in Parotid Surgery With Harmonic Scalpel Versus Cold Instruments. *J Craniofac Surg.* 2017; 28 : e342–e344.
45. Blankenship DR, Gourin CG, Porubsky EA, Porubsky ES, Klippert FN, et al. Harmonic Scalpel versus cold knife dissection in superficial parotidectomy. *Otolaryngol Neck Surg Off J Am Acad Otolaryngol Neck Surg.* 2004; 131: 397-400.
46. Markkanen-Leppänen M, Pitkäranta A. Parotidectomy using the Harmonic scalpel. *Laryngoscope.* 2004; 114: 381-382.
47. Gunduz C, Basoglu OK, Kvamme JA, Verbraecken J, Anttalainen U, et al. Long-term positive airway pressure therapy is associated with reduced total cholesterol levels in patients with obstructive sleep apnea: data from the European Sleep Apnea Database (ESA-DA). *Sleep Med.* 2020; 75: 201-209.
48. Xu SQ, Ma Y, Su HW, Cheng JF, Zhou YX. Comparison of the Effects of Focus Harmonic Scalpel and Conventional Haemostasis on Parathyroid Function in Thyroid Surgery. *J Ayub Med Coll Abbottabad.* 2019; 31: 481-484.
49. Manola M, Moscillo L, Simeon V, De Luca E, Mastella A. The Effectiveness of Sternocleidomastoid Flap Versus Superficial Musculoaponeurotic System Flap for the Prevention of Frey Syndrome and Facial Depressed Deformity in Parotid Surgery for Pleomorphic Adenoma. *Annals of plastic surgery.* 2018; 80: 125-129.
50. Ogino A, Onishi K, Nakamichi M, Okaneya T. Use of Parotid Gland Fascia in the Prevention of Frey Syndrome After Parotidectomy. *The Journal of craniofacial surgery.* 2019; 30: 1009-1011.
51. Aydin S, Erbay MF, Kizilay A. The effects of residual parotid volume on symptom-specific quality of life and complications in patients undergoing parotid surgery. *European archives of oto-rhino-laryngology: official journal of the European Federation of Oto-Rhino-Laryngological Societies (EUFOS): affiliated with the German Society for Oto-Rhino-Laryngology - Head and Neck Surgery.* 2021; 278: 5003-5011.
52. Mao Y, Chang YJ, Zhang XL, Xu FF, Yu SQ, et al. Lin chuang er bi yan hou tou jing wai ke za zhi = Journal of clinical otorhinolaryngology, head, and neck surgery. 2018; 32: 1810-1812.