

# Primerjava rezultatov parcialne in superficijalne parotidektomije v zdravljenju pleomorfne adenoma parotidne žleze

## Partial vs. superficial parotidectomy for surgical treatment of pleomorphic adenoma of the parotid gland

Avtor / Author

Ustanova / Institute

Bogdan Čizmarevič<sup>1,2</sup>, Boštjan Lanišnik<sup>1,2</sup>, Dejan Dinevski<sup>1</sup>

<sup>1</sup>Univerza v Mariboru, Medicinska fakulteta, Maribor, Slovenija; <sup>2</sup>Univerzitetni klinični center Maribor, Oddelek za otolaringologijo, cervikalno in maksilofacialno kirurgijo, Maribor, Slovenija;

<sup>1</sup>University of Maribor, Faculty of Medicine, Maribor, Slovenia; <sup>2</sup>University Medical Centre, Department of Otorhinolaryngology, Cervical and Maxillofacial Surgery, Maribor, Slovenia;

### Ključne besede:

delna parotidektomija, superficijalna parotidektomija, pleomorfni adenom, Freyev sindrom, ponovitev bolezni, okvara obraznega živca

### Key words:

partial parotidectomy, superficial parotidectomy, pleomorphic adenoma, Frey syndrome, recurrence, facial nerve lesion

### Članek prispel / Received

17. 4. 2018

### Članek sprejet / Accepted

10. 12. 2018

### Naslov za dopisovanje /

#### Correspondence

Doc. dr. Bogdan Čizmarevič, dr. med.  
Univerzitetni klinični center Maribor,  
Oddelek za otolaringologijo, cervikalno  
in maksilofacialno kirurgijo, Ljubljanska  
5, 2000 Maribor, Slovenija  
Telefon: +386 41699567  
E-pošta: bogdan.cizmarevic@ukc-mb.si

### Izvleček

**Namen:** Superficialna parotidektomija predstavlja zlati standard kirurškega zdravljenja pleomorfnih adenomov obušesnih slinavk, v zadnjem času pa so vedno bolj popularni manj obsežni posegi, kot sta delna parotidektomija in ekstrakapsularna disekcija. Retrospektivno smo primerjali rezultate zdravljenja pri bolnikih s parcialno in superficijalno parotidektomijo. Primerjali smo število ponovitev in po-operativno morbidnost. **Metode:** V retrospektivno analizo smo vključili vse bolnike s pleomorfim adenomom obušesne slinavke, ki so bili operirani na Oddelku za otolaringologijo in maksilofacialno kirurgijo v UKC Maribor v obdobju od 1. 1. 2002 do 31. 12. 2016. Analizirali smo parezo ali paralizo obraznega živca, odstranitev tumorja v zdravo, pojav Freyvega sindroma, velikost tumorja, trajanje operativnega posega in ponovitve tumorja.

**Rezultati:** V obravnavanem obdobju

### Abstract

**Purpose:** Superficial parotidectomy is still the gold standard in surgical therapy for pleomorphic adenoma. Recently, less extensive procedures such as extracapsular dissection and before that partial parotidectomy were introduced. We analyzed the data of patients treated with either partial or superficial parotidectomy and compared recurrence rates and postoperative morbidity.

**Methods:** WA retrospective analysis of all the patients with pleomorphic adenomas who were treated at the Department of Otolaryngology from 2002 to 2016 was performed. The patients' data were analyzed for outcome measures: facial nerve deficit, margin status, Frey's syndrome, tumor size, duration of surgery and tumor recurrence. **Results:** During this period, 186 patients with pleomorphic adenomas of the parotid gland underwent surgery, 177 of these for the first time. Nine patients were referred to us with recurrence from an-

je bilo operiranih 186 bolnikov s pleomorfnim adenomom obušesne slinavke. 177 bolnikov je bilo operiranih prvič. Devet bolnikov je bilo predhodno operiranih v drugih ustanovah in so bili k nam napoteni zaradi ponovitve tumorja. Od prvič operiranih 177 bolnikov je bila pri 86 narejena parcialna in pri 75 superfacialna parotidektomija, pri 16 bolnikih je bila narejena totalna parotidektomija. Prehodna pareza in trajanje operativnega posega sta bili statistično pomembno večji pri superfacialni parotidektomiji. Freyev sindrom in število ponovitev nista bila odvisna od vrste posega.

**Zaključek:** Prišli smo do zaključka, da delna parotidektomija pri kirurškem zdravljenju pleomorfnega adenoma v večini primerov zadošča za radikalno odstranitev tumorja, saj je število ponovitev enako pri obeh skupinah.

other institution. Among these 177 patients, 86 were treated by partial parotidectomy, 75 by superficial parotidectomy and 16 by total parotidectomy. Transient facial weakness and the duration of surgery differed significantly between the different types of operation. Frey's syndrome and recurrence rate were not significantly different between the groups.

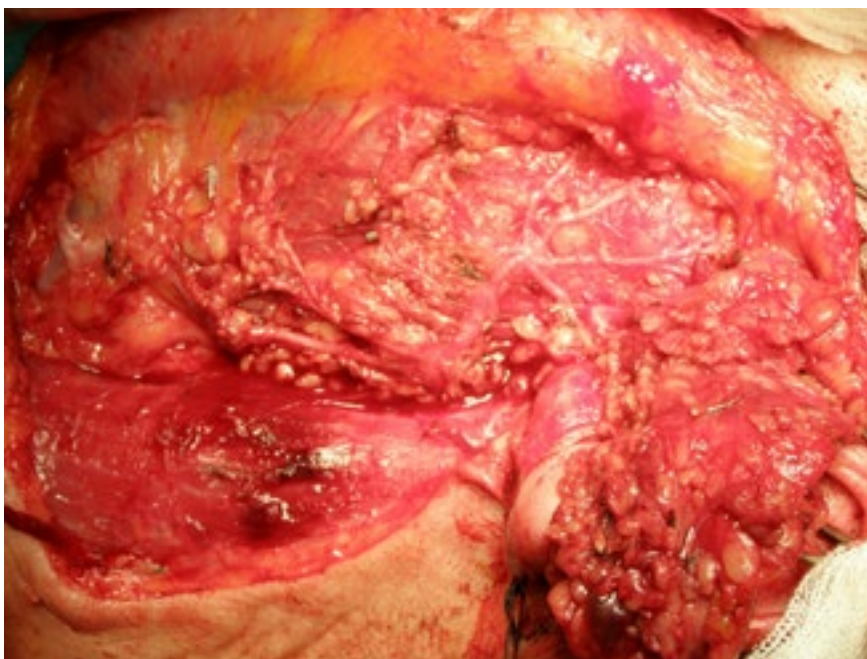
**Conclusions:** Radical surgery could be achieved with limited removal of the parotid while the recurrence rate was the same between the groups.

## INTRODUCTION

Pleomorphic adenoma is the most common benign tumor of the major salivary glands, representing 45 to 60% of all tumors (1, 2). Despite its benign histology, it recurs after incomplete surgical excision, and may malignantly transform. Most pleomorphic adenomas develop in the lower part of the superficial lobe of the parotid gland; only a small percentage of them develop in accessory salivary glands or in the deep lobe (3). The tumor grows slowly, and is mostly found in patients between 45 to 50 years of age (4, 5). It occurs more commonly in women (6).

For the past 50 years, the gold standard therapy for pleomorphic adenoma has been superficial parotidectomy with preservation of the facial nerve. In the past, some surgeons recommended tumor enucleation, a procedure with the lowest incidence of facial nerve injury. Some authors advocated the removal of the entire parotid gland, while still preserving the fa-

cial nerve (7, 8). Enucleation was abandoned by most authors due to its high incidence of tumor recurrence, since the rate of relapse after this procedure is very high, at between 21 and 70% (9, 10). Superficial pa-



**Figure 1.** Superficial parotidectomy; all main branches of the facial nerve are exposed and the entire superficial pole with the tumor is prepared for removal

rotidectomy (Fig. 1) is actually partial parotidectomy but the name derived from the surgical field defines a specific operation where the entire lateral part of

the parotid gland, superficial to the facial nerve, is removed, together with the tumor. In partial parotidectomy (Fig. 2) only the tumor and clinically-healthy



**Figure 2.** Partial parotidectomy; only limited branches of the facial nerve are exposed and tumor and surrounding (clinically healthy) tissue is prepared for removal

parotid tissue around the tumor is removed (11, 12). In recent years, surgical procedures where only the tumor with the cuff of uninvolved parotid tissue is removed have become increasingly popular (13, 14).

In this retrospective analysis, we aimed to determine whether there is a difference in morbidity or the recurrence of the pleomorphic adenoma in patients who underwent superficial parotidectomy versus those who underwent only partial parotidectomy. We compared the incidence of tumor recurrence, facial nerve deficits, Frey's syndrome, and the duration of the surgical procedure.

## PATIENTS AND METHODS

In our retrospective analysis, we analyzed the medical records of all patients who were treated at the Department of Otolaryngology, Maribor University Medical Centre, Slovenia, from 1st January 2002 to 31st December 2016. In all patients that underwent superficial or partial parotidectomy, the tumor was removed together with the cuff of surrounding parotid tissue wherever possible, while at the plane of the facial nerve the nerve was dissected free from the tumor capsule without injuring the nerve.

In partial parotidectomy the tumor was removed together with the clinically-healthy surrounding parotid tissue, whereas in superficial parotidectomy the entire superficial pole of the salivary gland was removed together with the tumor. The type of operation was chosen according to the preference of the surgeon and tumor size. In cases where there was insufficient clinically-unaffected tissue surrounding the parotid, we performed superficial parotidectomy.

In superficial parotidectomy, the entire lateral part of the gland together with the tumor was removed and all facial nerve branches were identified and dissected. The facial nerve trunk was identified either via antero- or retrograde dissection. With the anterograde technique, the facial nerve was identified below the tragal pointer. In the retrograde method, the marginal branch was identified posterior to the facial vein on the masseteric fascia and/or the cervical branch was identified by following the retromandibular vein.

In partial parotidectomy, only a part of the gland was removed with the tumor. The most superior branch of the facial nerve was identified first and then the gland together with the tumor was dissected from the remaining facial nerve branches. We used either the retrograde or anterograde approach.

A small number of patients required total parotidectomy, where we removed the lateral part of the gland first and then the remaining deep lobe, which was removed in pieces. All the main branches of the facial nerve were identified in all types of operations and were preserved. In all parotidectomies, the radicality of the operation was estimated by the pathologist after examination of the removed tissue. We tried to remove approximately 1 cm of the unaffected tissue, but in most cases it was impossible if we wanted to preserve the facial nerve. Preservation of the facial nerve is a limitation in all types of parotidectomy.

In all patients the following outcome measures were analyzed: facial nerve deficit, margin status, incidence of Frey's syndrome, tumor size, duration of surgery and tumor recurrence.

Statistical analysis was performed using IBM SPSS Statistical Software. Statistical significance was calcu-

lated using the Chi square test and ANOVA.

## RESULTS

During this period, 186 patients with pleomorphic adenomas of the parotid gland underwent surgery and 177 (95%) of these patients were operated on for the first time. Nine patients were referred to us with recurrence of the pleomorphic adenoma. Those patients were excluded from further analysis since we lacked full information on the surgery performed and the histopathology of the tumor removed.

The data of the 177 patients included in the final analysis are presented in Table 1.

**Table 1:** The data of the patients surgically treated for pleomorphic adenoma of the parotid gland (n = 177)

		N (%)
Gender	Male	69 (39 %)
	Female	108 (61 %)
Tumor size	< 20 mm	96 (54 %)
	>20 mm	81 (46 %)
Parotidectomy	Partial	86 (49 %)
	Superficial	75 (42 %)
	Total	16 (9 %)

The mean age of the patients in the group was 49.1 years. There was a strong female predominance with a 1.6 to 1 female to male ratio. Superficial parotidectomy was performed in 75 patients, partial in 86 patients, and total parotidectomy in 16 patients.

The mean tumor size was  $23 \pm 11.8$  mm [mean  $\pm$  standard deviation]; (range 6–90). In patients who underwent superficial parotidectomy the size was  $23.9 \pm 9.6$  mm (range 10–60) and in patients who underwent partial parotidectomy it was  $20.7 \pm 10.8$  mm (range 6–70). The patients who underwent total parotidectomy

**Table 2:** Outcome of the surgical treatment of the parotid pleomorphic adenoma in relations to the type of surgery. Total Parotidectomy data is not presented for comparison, but for information purpose only.

Outcome measure		Significance
<b>Surgical margins negative</b>	164/177 (93 %)	n. s.
Partial Parotidectomy	82/86 (95 %)	
Superficial Parotidectomy	68/75 (91 %)	
Total Parotidectomy	14/16 (87 %)	
<b>Transitory facial nerve weakness</b>	48/177 (27 %)	P < 0,05
Partial Parotidectomy	6/86 (7 %)	
Superficial Parotidectomy	30/75 (40 %)	
Total Parotidectomy	12/16 (75 %)	
<b>Frey Syndrome</b>	17/177 (10 %)	n. s.
Partial Parotidectomy	7/86 (8 %)	
Superficial Parotidectomy	9/75 (12 %)	
Total Parotidectomy	1/16 (6 %)	
<b>Tumor size</b>	23 mm	P < 0,05
Partial Parotidectomy	20,7 mm	
Superficial Parotidectomy	23,9 mm	
Total Parotidectomy	33,1 mm	
<b>Duration of Surgery</b>	117 min	P < 0,05
Partial Parotidectomy	95 min	
Superficial Parotidectomy	131 min	
Total Parotidectomy	175 min	
<b>Recurrence rate</b>	3/177 (1.6 %)	n. s.
Partial Parotidectomy	2/86 (2.3 %)	
Superficial Parotidectomy	1/75 (1.3%)	
Total Parotidectomy	0/16 (0 %)	

tomy had larger tumors that the average, measuring  $33.1 \pm 19.8$  mm (range 10–90).

The outcome margins of the surgical treatment are presented in Table 2. Microscopic margins of the removed tissue were negative in 164 patients (93%). In 13 patients (7%), the tumor was found at the margin of the dissection or the pathologist could not reliably confirm a layer of healthy tissue surrounding the removed tumor. Those margins were considered posi-

tive. In partial parotidectomy, the margin was positive in four out of 86 patients (5%) and in superficial parotidectomy in seven out of 75 patients (9%). In patients where total parotidectomy was performed the margin was microscopically positive in two out of 16 patients (13%). Those differences were not statistically significant.

Temporary facial nerve dysfunction after the procedure occurred in 48 out of 177 patients (27%). In patients who underwent superficial parotidectomy, the incidence of facial nerve dysfunction was significantly higher than after partial parotidectomy. In all patients after superficial or partial parotidectomy, the facial nerve dysfunction resolved within 3 to 4 weeks. In patients after total parotidectomy, the facial nerve was affected in 12 out of 16 patients. These also resolved after several weeks, but in one case, the facial nerve did not recover completely.

The average operating time was  $118 \pm 42$  minutes (range 30–265). In partial parotidectomy, it was  $95 \pm 31$  minutes (range 40–230), in superficial parotidectomy  $131 \pm 32$  (range 55–210) minutes, and in total  $173 \pm 54$  minutes (30–265). The operating time was significantly different between partial,

superficial and total parotidectomy ( $P < 0.05$ ). For total parotidectomy the operating time was significantly longer, because the small pieces of parotid tissue comprising the deeper part of the parotid gland have to be removed in order to preserve the main branch of the facial nerve.

Clinically evident Frey's syndrome was present in 17 out of 177 patients (10%). In patients after partial, superficial and total parotidectomy, Frey's syndrome was present in 8%, 12% and 6%, respectively ( $P <$

0.05).

All patients had the first control check-up 6 to 9 months after operation (for Frey's syndrome) and a second one 1 to 2 years after operation to check for recurrence. The patients were advised to come for a control check-up if they palpated any lump in the parotid region. The tumor recurred in three out of 177 patients (1.7%) three to seven years after surgery, specifically in two patients out of 86 (3.5%) after partial parotidectomy and in one out of 75 (1.3%) patients after superficial parotidectomy ( $P > 0.05$ ). One recurrence in a patient with partial parotidectomy was in a patient with positive microscopic margins after the first surgery. The other two recurrences were in patients where surgical margins were microscopically negative.

## DISCUSSION

The distribution of our patients by both gender and age was the same as described in the literature (4, 5, 6). In most patients, we removed only a part of the parotid gland and in a minority of patients the entire gland was removed. The facial nerve was spared in all cases. The extent of the surgery was guided by the size of the tumor. Partial parotidectomy was selected for smaller tumors, while superficial parotidectomy was performed in patients with larger tumors. The size of the tumor definitely played a role in selection of the surgical procedure since the average size of the tumor was significantly different (Table 2). Among the most serious complications of surgical treatment of parotid tumors is facial nerve injury. In our cohort there was only one permanent noticeable facial nerve injury involving the lower branches. This was associated with a case of total parotidectomy (one out of 16 patients, 6%). According to the literature, a permanent facial injury occurs in 0 to 19% of cases treated by superficial parotidectomy and it is even more common in total parotidectomy (15, 16, 17, 18). Transient facial nerve dysfunction is far more common in superficial parotidectomy than in partial resection (9% vs. 40% respectively). According to data from the literature, transient facial nerve palsy occurs in 25% after su-

perfacial parotidectomies but in only about 6% after partial parotidectomies (17,19). It is perfectly understandable, therefore, that the largest group of patients with transient facial nerve paresis, were those who underwent total parotidectomy (12/16 or 74.4%).

Transient facial nerve weakening presents a serious burden for the patient, particularly if it affects eye closure. Facial nerve paresis significantly affects the patient, both functionally and aesthetically. It is therefore important to avoid it, especially in resection of benign tumors, but not at the expense of insufficient tumor resection. In our series, we managed to achieve negative margins in 93% of the patients. There was no difference between surgical procedures in terms of achieving surgical negative margins, but the size of the tumor must also be taken into account, as this guided the extent of the surgery. The explanation of the positive margin is multifactorial, ranging from specimen damage during manipulation to sub/extracapsular dissection of the tumor from the facial nerve branches. Irrespective of the extent of surgery, in most of the tumors the facial nerve is in contact with the tumor capsule. In this location, it is impossible to leave a cuff of parotid tissue around the tumor, and the facial nerve must be carefully dissected from the tumor capsule (reducing the procedure to extracapsular dissection). Extracapsular dissection has also been gaining popularity in recent years, especially with Iro et al. (20), who did not observe any recurrence in a series of 219 pleomorphic adenomas treated with conventional superficial parotidectomy and 76 patients treated with extracapsular dissection (20). Other authors also reported similar rates of recurrence after extracapsular resection and superficial parotidectomy (3.4% vs. 1.8%, respectively) (21).

The main problem in evaluating the recurrence rate is that recurrences occur relatively late, after several years. During this period, 12 patients with a recurrent pleomorphic adenoma underwent surgery. Nine of these patients were referred to us from other institutions. On the basis of ultrasound examination, our conclusion is that in all these patients, enucleation was most likely performed during the first surgery. Although the data on the number of enucleations performed in the meantime was lacking, the number of recurrences itself confirms that enucleation is a

procedure that should be abolished. We believe that in limited procedures the use of magnifying loupes greatly facilitates the removal as well as extracapsular dissection without breaching the pseudo capsule of the pleomorphic adenoma.

The radical removal of a tumor with the surrounding clinically-healthy parotid tissue was achieved in 68/75 of our patients treated by superficial parotidectomy, in 82/86 patients treated by partial removal of the salivary gland, and in 14/16 patients who underwent complete removal of the parotid gland. The difference was not statistically significant. Even though the margins were histologically positive in some cases, to date there have been no recurrences of the pleomorphic adenoma in the patients where the pathologist described positive margins. On the other hand, there was only one recurrence after superficial parotidectomy, where the pathologist described a complete tumor removal with a wide healthy margin, and one recurrence after partial removal of the parotid with a tumor, where the pathologist also described a safe margin. In one recurrence, the tumor envelope ruptured during the removal of the tumor near the nerve.

The third important complication that significantly affects the quality of life in the postoperative period is Frey's syndrome. Frey's syndrome usually develops 6 to 8 months after surgery. During meals, the patient sweats in the operated parotid area. The syndrome is often not clinically bothersome for the patient, but it can be diagnosed by the starch-iodine test in all patients operated on for a benign parotid tumor (22). According to the literature, clinically bothersome Frey's syndrome develops in approximately 40% of patients who undergo superficial parotidectomy (23). In our patients, clinically-manifested Frey's syndrome developed in 7/86 (7.7%) of the patients who underwent partial parotidectomy, 9/75 (11.7%) of the patients who underwent superficial parotidectomy, and 1/16 (6.2%) of the patients who underwent total parotidectomy. The syndrome was not manifested strongly enough as to require additional treatment in any of the patients. The differences in the incidence of Frey's syndrome were not statistically significant.

However, there was a major difference in the average duration of surgery. The average surgery time was 95.3 minutes for partial parotidectomy, 131.6 minutes for

superficial parotidectomy, and 173.8 minutes for total parotidectomy. The differences were statistically significant. The surgery time is important because the procedure is performed under general anesthesia. A shorter surgery time is important both for the operated patient as well as for the rest of the surgery program at the department (11).

Similar findings regarding recurrence, transient facial nerve dysfunction and Frey's syndrome were also found in a meta-analysis performed by Xie et al. (24). Sensory deficit in the parotid and external ear regions should be considered a very burdensome consequence of the surgery. Unfortunately, we do not have data on this outcome and can only assess it based on the literature and the scale of the intervention itself. Namely, in partial parotidectomy, the great auricular nerve and its main branches are mostly preserved, so the sensory deficit is significantly reduced (25).

Data from the literature suggest that partial parotidectomy is a safe operation and can be performed in selected cases with appropriately experienced surgeons and without compromising procedures (26, 27).

## CONCLUSION

This study was retrospective. As such, it was affected by some limitations and incomplete data. However, despite these constraints, it was possible to draw certain conclusions to be confirmed in the future by a prospective study on an appropriate number of patients. The study showed that radical surgery could be achieved with limited removal of the parotid and that the number of recurrences did not depend on the type of surgery. The primary advantage of limited intervention was the procedure's duration, which was significantly shorter than with superficial parotidectomy. Likewise, there were significantly fewer instances of transient facial nerve dysfunction. Thus, in small tumors, partial parotidectomy is preferable to superficial parotidectomy.

Conflict of Interest statement: The authors declare that they have no conflict of interest.

Compliance with Ethical Standards: Informed con-

sent was obtained from all individual participants included in the study.

Ethical approval: All procedures were performed in accordance with the ethical standards of the institutional research committee and the 1964 Helsinki declaration and its later amendments

## REFERENCES

1. Spiro RH. Salivary neoplasms: overview of a 35-year experience with 2 807 patients. *Head Neck Surg* 1986;8:177-84.
2. Cheuk W, Chan JK. Salivary gland tumor s. In: Fletcher CDM ed. *Diagnostic histopathology of tumor s*, 3rd ed. Philadelphia: Churchill Livingstone Elsevier; 2007:239-325.
3. Batsakis JG. Deep-lobe parotid gland tumor s. *Ann Otol Rhinol Laryngol* 1984;93:415-6.
4. Renehan A, Gleave EN, McGurk M. An analysis of the treatment of 114 patients with recurrent pleomorphic adenomas of the parotid gland. *Am J Surg* 1996;172:710-4.
5. McGregor AD, Burgoyne M, Tan KC. Recurrent pleomorphic salivary adenoma-the relevance of age at first presentation. *Br J Plast Surg* 1988;41:177-81.
6. Eveson JW, Cawson RA. Salivary gland tumor s. A review of 2410 cases with particular reference to histological types, site, age and sex distribution. *J Pathol* 1985;146:51-8.
7. McEvedy BV, Ross WM. The treatment of mixed parotid tumors by enucleation and radiotherapy. *Br J Surg* 1976;63:341-2.
8. Klopp CT, Winship T. Treatment of mixed tumor s of the parotid gland by subtotal parotidectomy. *Arch Surg* 1950;61:477-86.
9. Donovan DT, Conley JJ. Capsular significance in parotid tumor surgery: reality and myths of lateral lobectomy. *Laryngoscope*. 1984 Mar;94(3):324-9.
10. Maynard JD., Management of pleomorphic adenoma of the parotid., *Br J Surg*. 1988 Apr;75(4):305-8.
11. Stennert E, Guntinas-Lichius O, Klussmann JP, Arnold G, . Histopathology of pleomorphic adenoma in the parotid gland: a prospective unselected series of 100 cases. *Laryngoscope* 2001;111:2195-200.
12. Guntinas-Lichius O, Kick C, Klussmann JP, Jungehuelsing M, Stennert E., Pleomorphic adenoma of the parotid gland: a 13-year experience of consequent management by lateral or total parotidectomy. *Eur Arch Otorhinolaryngol* 2004;261:143-6.
13. O'Brien CJ. Current management of benign parotid tumors - the role of limited superficial parotidectomy. *Head Neck* 2003;25:946-52.
14. Rea JL. Partial parotidectomies: morbidity and benign tumor recurrence rates in a series of 94 cases. *Laryngoscope* 2000;110:924-7.
15. Laccourreye H, Laccourreye O, Cauchois R, Jouffre V, Ménard M, Brasnu D., Total conservative parotidectomy for primary benign pleomorphic adenoma of the parotid gland: a 25-year experience with 229 patients. *Laryngoscope*. 1994 Dec;104(12):1487-94.
16. Helmus C. Subtotal parotidectomy: a 10-year review (1985 to 1984). *Laryngoscope* 1997;107:1024-7.
17. Koch M, Zenk J, Iro H. Long-term results of morbidity after parotid gland surgery in benign disease. *Laryngoscope* 2010;120:724-30.
18. Dulugero P, Marchal F, Lehmann. Postparotidectomy facial nerve palsy: possible etiologic factors and results with routine facial nerve monitoring. *Laryngoscope* 1999;109:754-62.
19. Zbären P, Vander Poorten V, Witt RL, Woolgar JA, Shaha AR, Triantafyllou A et al. Pleomorphic



- adenoma of the parotid: formal parotidectomy or limited surgery. *J Am Surg* 2013;205:109-18.
20. Iro H, Zenk J, Koch M, Klintworth N. Follow-up of parotid pleomorphic adenoma treated by extracapsular dissection. *Head Neck*. 2013 Jun;35(6):788-93.
  21. Dell'Aversana Orabona G, Bonavolont P, Iaconetta G, Forte R, Califano L. Surgical management of benign tumors of the parotid gland: extracapsular dissection versus superficial parotidectomy—our experience in 232 cases. *J Oral Maxillofac Surg*. 2013 Feb;71(2):410-3
  22. Linder TE, Huber A, Schmid S. Frey's syndrome after parotidectomy: a retrospective and prospective analysis. *Laryngoscope* 1997;107:1496-501.
  23. De Bree R, Van der Waal I, Leemans CR. Management of Frey syndrome. *Head Neck* 2007;29:733-8.
  24. Xie S, Wang K, Xu H, Hua RX, Li TZ, Shan XF, Cai ZG. PRISMA-Extracapsular dissection versus superficial parotidectomy in treatment of benign parotid tumors: Evidence From 3194 Patients. *Medicine (Baltimore)*. 2015 Aug;94(34):e1237.
  25. Patel N, Har-El G, Rosenfeld R. Quality of life after great auricular nerve sacrifice during parotidectomy. *Arch Otolaryngol Head Neck Surg* 2001;127:884-8.
  26. Guerra G, Testa D, Montagnani S, Tafuri D, Salzano FA, Rocca A, Amato B et al., Surgical management of pleomorphic adenoma of parotid gland in elderly patients: role of morphological features. *Int J Surg*. 2014;12 Suppl 2:S12-S16.
  27. Colella G, Cannavale R, Chiodini P, Meta-analysis of surgical approaches to the treatment of parotid pleomorphic adenomas and recurrence rates., *J Craniomaxillofac Surg*. 2015 Jul;43(6):738-45