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Comparison of surgical techniques for benign parotid tumours: a multicentre retrospective study

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Abstract. This study aimed to compare the outcomes of three surgical techniques for the treatment of patients with benign parotid tumours: superficial parotidectomy (SP; group 1), partial superficial parotidectomy (PSP; group 2), and ultrasonic scalpel-assisted minimal extracapsular dissection (US-MECD; group 3). Groups 1 and 2 received the conventional surgical technique, while group 3 underwent surgery with an ultrasonic scalpel. A total of 281 patients treated during 2012–2016 were included: 98 in group 1, 91 in group 2, and 92 in group 3. The mean surgical time and blood loss during surgery, as well as drainage time and amount, were significantly lower for US-MECD ($P < 0.01$). The great auricular nerve and parotid fascia were both preserved with US-MECD ($P < 0.01$), while the rate of capsule rupture with US-MECD was slightly higher than in the other groups ($P > 0.05$). There was less transient facial nerve paralysis and Frey syndrome with US-MECD ($P < 0.01$). No significant difference in wound infection, sialocele, or permanent facial nerve paralysis was observed among the three groups. Patients enrolled during 2012–2013 were selected to evaluate the recurrence rates, and no statistically significant differences were found among the groups. In conclusion, US-MECD showed similar effectiveness and fewer side effects than SP and PSP. The long-term effects of the new technique require further study.

Key words: benign parotid gland tumour; superficial parotidectomy; partial superficial parotidectomy; ultrasonic scalpel-assisted minimal extracapsular dissection.

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The parotid gland is the largest salivary gland and has the greatest incidence of benign tumours. More than 90% of benign parotid tumours are located in the superficial portion[1]. Surgical resection is the preferred treatment for parotid tumours, but the techniques for surgical removal have long been the subject of debate.

For many years, the superficial parotidectomy (SP) was recommended due to the low associated recurrence rate of 2–5%[2]. However, the frequencies of complications and side effects after this procedure are considerable. These risks prompted surgeons to adopt less invasive surgical techniques that had all of the benefits of SP while limiting the drawbacks.

The partial superficial parotidectomy (PSP) is a more functional approach for benign parotid tumours[3]. The advantages of PSP are the reduced amount of resected normal parotid tissue, reduction in dissected facial nerve branches, and the preservation of Stensen's duct (no ligation)[4], resulting in better functional outcomes and the same recurrence rate when compared to SP[5]. Experience gained in the use of PSP led to the recommendation of a more limited technique named extracapsular dissection (ECD). This procedure does not require the identification of the main trunk of the facial nerve, and a cuff of 2–3 mm of the normal parotid tissue is left around the tumour. Results of studies on the use of this technique showed that the recurrence rate following ECD was the same as those following SP and PSP, while the morbidity was considerably reduced[6,7].

With the development of surgical instruments, the application of an ultrasonic scalpel (Harmonic System; Ethicon Endo-Surgery, LLC, Guaynabo, Puerto Rico, USA) in head and neck oncological surgeries has been discussed by various authors[8–10]. The ultrasonic scalpel is a device that uses ultrasonic energy to cut and coagulate the soft tissues at the same time; therefore, no electrical energy is transferred to the patient[8]. Ultrasonic scalpel-assisted minimal extracapsular dissection (US-MECD) is a new surgical procedure for the treatment of benign parotid tumours. The use of MECD, which is approximately equivalent to meticulous nodulectomy, further reduces the size of the surgical defect and potential complications. Under the assistance of the ultrasonic scalpel, the surgical field remains bloodless, thus facilitating the surgery and reducing the surgical time by avoiding the need for ligatures or electric coagulation for haemostasis[11,12].

The purpose of this study was to investigate the surgical variables, postoperative complications, and recurrence rates of three different procedures for benign parotid tumours.

Methods

Patient selection and data collection

This retrospective study was conducted in three hospitals (First Affiliated Hospital of Huzhou University; Ninth People's Hospital of the College of Stomatology at Shanghai Jiao Tong University School of Medicine; Second People's Hospital of Changshu) and included patients treated during the years 2012–2016.

Patients with a histologically confirmed benign tumour located in the superficial parotid gland, with a tumour size of less than 4 cm, were recruited. Patients with bilateral parotid gland tumours or a history of previous parotid surgery were excluded. Those who had other systemic diseases or for whom preoperative examinations were lacking were also excluded. After applying the eligibility criteria, a total of 281 patients who underwent SP, PSP, or US-MECD were included. These patients were divided into three groups for analysis. The study was approved by the ethics committees of all three hospitals, and written informed consent was obtained from all study patients.

All of the included patients were evaluated preoperatively with a clinical examination, ultrasonography of the bilateral parotid regions, and contrast-enhanced computed tomography (CT) or magnetic resonance imaging (MRI), as well as fine needle aspiration cytology (FNAC). The tumour size before surgery was measured by echography and CT imaging or MRI, and the largest transverse diameter according to the histopathology report was taken into consideration. FNAC results were a prerequisite for all of the enrolled patients, and these were confirmed by the final histological diagnosis.

The main variables measured during the surgeries were the surgical time (recorded as the interval between skin incision and closure) and the volume of blood lost during the surgeries. Postoperatively, the total drainage time and amount were measured. Imaging examinations were performed postoperatively according to a programmed schedule, with ultrasonography every 3 months for the first year, every 6 months for the second and third years, and every year for the fourth and fifth years. A CT scan or MRI was scheduled yearly. Surgical complications were assessed during the hospital stay and then at 1, 3, 6, and 12 months after surgery. Loss of sensation was assessed using a wisp of cotton and a pinprick on the ear. The House–Brackmann scale was used to grade facial nerve function, and permanent facial paralysis was defined as facial paralysis lasting longer than 1 year. Ten months after surgery, a subjective evaluation for Frey syndrome was performed for each patient, which included symptoms such as sweating while eating, warming, and flushing over the surgical field.

Surgical technique

The superficial parotidectomy (SP) technique begins with a pre-auricular and submandibular incision. The skin flap is lifted superficially to the parotid fascia. The great auricular nerve is sacrificed, and the facial nerve is dissected in a retrograde fashion with the parotid duct ligated. After resection of the tumour and superficial lobe of the parotid gland with the parotid fascia, the skin flap is sutured in place with layered stitching to directly cover the wound. The vacuum drainage is then maintained for 3 to 5 days after the surgery until the volume is less than 15 ml.

For the partial superficial parotidectomy (PSP), the incision is almost the same as that used in the conventional SP. The great auricular nerve is selectively preserved according to the position of the tumour. The main trunk of the facial nerve is identified, and branches close to the tumour are carefully dissected. About 2 cm of parotid gland tissue surrounding the tumour is completely removed, and the facial nerve branches outside of the tumour-bearing area are not extensively dissected. The drainage method used in PSP is the same as that used in SP[13].

Ultrasonic scalpel-assisted minimal extracapsular dissection (US-MECD) is a highly functional technique for the treatment of parotid gland tumours that uses an advanced surgical instrument. A smaller incision is used according to the position of the tumour and the surgeon's preference. The skin flap is elevated to the level of the parotid fascia up to 1 cm beyond the tumour. The edge of the tumour is marked and the parotid fascia is lifted away from the tumour in a retrograde manner. The tumour is then carefully mobilized with the ultrasonic scalpel exactly outside of the capsule, ensuring that any tissue that is cut does not have a facial nerve branch remaining within it. Meanwhile, the tumour capsule is never opened. If any difficulty is encountered when mobilizing the tumour, the dissection moves to a different location. When the facial nerve is encountered, a careful dissection is applied to identify and preserve it. During the procedure, it is important that the active vibrating terminal of the ultrasonic scalpel is always in contact with the tumour capsule, while the opposite terminal should always be in contact with the parotid gland tissue, making sure that damage to the facial nerve is avoided. The parotid fascia is sutured back after tumour resection, and vacuum drainage is also applied.

All three surgical techniques were performed at each of the hospitals that took part in this study. Conventional techniques, such as monopolar and bipolar electrocautery, were performed in the SP and PSP groups. The ultrasonic scalpel was only used in patients in the US-MECD

group. All surgeons were highly experienced and trained within the same system, thus the same standard of surgery was maintained.

Postoperative management

A pressure bandage was applied and changed daily over the first few days after the surgery. Antibiotic therapy was not routinely given. The patients were asked about any sensory disturbances each day, and were examined clinically and then sonographically if any abnormalities of the wound were detected, in order to identify or exclude seroma or haematoma. Antibiotic therapy was given if necessary. The patients were followed up via regular visits to the outpatient departments, at 3-month intervals, so even late complications could be detected.

Statistical analysis

The statistical analysis was conducted using GraphPad Prism 5.0 for Windows (GraphPad Software, Inc., La Jolla, CA, USA). Results were expressed as the incidence or mean and standard deviation. Analysis of variance (ANOVA) was used for multiple group comparisons. The χ^2 test was used for the analysis of categorical data. Logistic regression analysis was performed to identify the better surgery. $P < 0.05$ was considered to be statistically significant.

Results

The demographic characteristics of the study patients and tumour characteristics are described in Table 1. SP was performed in 98 patients (34.9%) and PSP was performed in 91 patients (32.4%), while US-MECD was performed in 92 patients (32.7%). The age and sex ratios were similar in the three groups, and the mean follow-up time was also the same in the three groups. Histological examination of the surgical specimen agreed with the FNAC result in all of the patients, confirming the diagnosis of the different types of benign parotid tumour. The location of the tumours was divided into three regions of the parotid gland: pre-auricular, tail, and retromandibular.

Table 2 illustrates the surgical data and variables, as well as the postoperative complications in the early and late stages.

The great auricular nerve was sacrificed in all patients in the SP group, while it was sacrificed in 31 patients in the PSP group, owing to large tumours or close resection margins. In contrast, the great auricular nerve was preserved in all patients treated with US-MECD ($P < 0.01$). The parotid fascia was totally or partially removed with the parotid parenchyma in the patients in the SP and PSP groups, but was preserved in all of the patients in the US-MECD group ($P < 0.01$). No intraoperative capsule ruptures occurred in the patients treated with SP, but rupture occurred in one of the patients treated with PSP and in two of the patients treated with US-MECD ($P = 0.3457$). The three patients with a ruptured tumour capsule all had it managed with thorough irrigation and a meticulous removal of any tumour particles. The facial nerve branch was unintentionally damaged in four patients in the SP group, two patients in the PSP group, and two patients in the US-MECD group due to the adhesion of the tumour and facial nerve ($P = 0.6605$).

The mean surgical time was significantly shorter in the patients treated with US-MECD compared with the patients treated with SP or PSP ($P < 0.01$). The mean blood loss during the surgery was less in the US-MECD group than in the other two groups, and this difference was statistically significant ($P < 0.01$). Likewise, a significant difference was observed in both the postoperative drainage time and volume between the US-MECD group and the SP and PSP groups ($P < 0.01$).

There was a significantly lower occurrence of decreased peri-auricular sensation in the early and late postoperative stages in the patients treated with US-MECD compared to those treated with SP or PSP ($P < 0.01$). Transient facial nerve paralysis was observed in five of the patients in the US-MECD group, and it was significantly more frequently observed in the patients in the other two groups (5.4% vs. 37.8% and 18.7%, $P < 0.01$). A full recovery of facial nerve function in these patients occurred between 1 and 6 months after the surgery, but two patients in the US-MECD group, as well as five patients in the SP group and two patients in the PSP group, still suffered permanent facial nerve paralysis (2.2% vs. 5.1% and 2.2%, $P = 0.4167$) after 1 year of follow-up. No significant differences in wound infection, salivary fistula (defined as salivary flow lasting more than 1 week), or local pain were observed among the three groups: 0% vs. 3.1% and 1.1% ($P = 0.1949$), 0% vs. 2% and 1.1% ($P = 0.3921$), and 0% vs. 6.1% and 3.3% ($P = 0.0567$), respectively.

A total of 149 patients who were treated from 2012 to 2013 were selected to compare the recurrence rate in each group from the long-term follow-up (Table 3). The ages, tumour sizes, and mean follow-up periods (nearly 3 years) of these patients were similar ($P = 0.988$, 0.824, and 0.762, respectively). Two patients suffered overall recurrence, one in the SP group and the other in the PSP group; none of the patients in the US-MECD group suffered overall recurrence. The tumour pathology for both patients with recurrence was pleomorphic adenoma. The difference in overall recurrence rates among these groups was not statistically significant ($P = 0.769$).

Table 1. Demographic and tumour characteristics for the patients enrolled in the study[a].

	Type of surgery			χ^2	*P*-value
	SP ($n = 98$)	PSP ($n = 91$)	US-MECD ($n = 92$)		
Age (years)[b]	48 ± 19	49 ± 16	49 ± 17	–	0.9461
Sex ratio (M:F)	53:45	49:42	49:43	–	0.9933
Mean follow-up (months)	27 ± 10	28 ± 11	28 ± 10	–	0.9649
Tumour size (cm)	2.7 ± 0.8	2.6 ± 0.7	2.6 ± 0.8	–	0.9205
Pathology				1.695	0.989
Pleomorphic adenoma (%)	58 (59.2)	59 (64.8)	60 (65.2)		
Warthin's tumour (%)	28 (28.6)	25 (27.5)	24 (26.1)		
Basal cell adenoma (%)	7 (7.1)	4 (4.4)	5 (5.4)		
Cystic lesions (%)	3 (3.1)	2 (2.2)	2 (2.2)		
Lymph node (%)	2 (2.0)	1 (1.1)	1 (1.1)		
Tumour location				0.2529	0.9926
Pre-auricular (%)	45 (45.9)	44 (48.3)	42 (45.7)		
Tail (%)	30 (30.6)	28 (30.8)	29 (31.5)		
Retromandibular (%)	23 (23.5)	19 (20.9)	21 (22.8)		

F, female; US-MECD, ultrasonic scalpel-assisted minimally extracapsular dissection; M, male; PSP, partial superficial parotidectomy; SP, superficial parotidectomy.

[a] Data are presented as the mean ± standard deviation, or as the number (%).

[b] Age at initial presentation.

Discussion

Surgery for benign parotid tumours is a widely used procedure, but the specific extent is still controversial. With the cur-

Table 2. Surgical variables and complications after surgery[a].

	Type of surgery			χ^2	*P*-value
	SP ($n = 98$)	PSP ($n = 91$)	US-MECD ($n = 92$)		
Preservation of GAN (%)	0 (0)	60 (65.9)	92 (100)	198.7	<0.01
Preservation of parotid fascia (%)	0 (0)	0 (0)	92 (100)	281	<0.01
Capsular rupture (%)	0 (0)	1 (1.1)	2 (2.2)	2.124	0.3457
Damage to facial nerve branch (%)	4 (4.1)	2 (2.2)	2 (2.2)	0.8294	0.6605
Surgical time (min)	71.8 ± 6.4	59.0 ± 5.7	52.9 ± 5.2[b,c]	–	<0.01
Surgical blood loss (ml)	63.2 ± 8.9	44.1 ± 4.1	21.3 ± 3.4[b,c]	–	<0.01
Drain time (h)	60.8 ± 7.0	57.8 ± 4.1	31.0 ± 3.9[b,c]	–	<0.01
Drainage amount (ml)	66.7 ± 9.4	47.7 ± 7.3	16.5 ± 2.8[b,c]	–	<0.01
Postoperative					
Decreased sensation (%)	98 (100)	70 (76.9)	27 (29.3)[c]	125.1	<0.01
Transient facial nerve paralysis (%)	37 (37.8)	17 (18.7)	5 (5.4)[b,c]	30.32	<0.01
Wound infection (%)	3 (3.1)	1 (1.1)	0 (0)	3.27	0.1949
Sialocele (%)	2 (2.0)	1 (1.1)	0 (0)	1.872	0.3921
1 year after surgery					
Decreased sensation (%)	23 (23.5)	11 (12.1)	3 (3.3)[b,c]	17.09	<0.01
Frey syndrome (%)	31 (31.6)	15 (16.5)	0 (0)	34.68	<0.01
Local pain (%)	6 (6.1)	3 (3.3)	0 (0)	5.741	0.0567
Permanent facial nerve paralysis (%)	5 (5.1)	2 (2.2)	2 (2.2)	1.751	0.4167

GAN, great auricular nerve; US-MECD, ultrasonic scalpel-assisted minimally extracapsular dissection; PSP, partial superficial parotidectomy; SP, superficial parotidectomy.

[a] Data are presented as the mean ± standard deviation or number (%). Analysis performed using analysis of variance (ANOVA) and univariate logistic regression.

[b] $P < 0.05$ for comparison of SP vs. MECD subgroups.

[c] $P < 0.05$ for comparison of PSP vs. MECD subgroups.

Table 3. Recurrence rate for patients included from 2012 to 2013[a].

	Type of surgery			*P*-value
	SP ($n = 51$)	PSP ($n = 48$)	US-MECD ($n = 50$)	
Age (years)	47.2 ± 18.5	47.6 ± 16.1	47.4 ± 16.5	0.988
Tumour size (cm)	2.5 ± 0.8	2.5 ± 0.8	2.6 ± 0.8	0.824
Mean follow-up (months)	34.9 ± 7.9	36.1 ± 7.7	35.3 ± 7.4	0.762
Recurrence (%)	1 (2.0)	1 (2.1)	0 (0)	0.769

US-MECD, ultrasonic scalpel-assisted minimally extracapsular dissection; PSP, partial superficial parotidectomy; SP, superficial parotidectomy.

[a] Data are presented as the mean ± standard deviation or number (%).

rent assurance of a low recurrence rate, the focus of surgical techniques has shifted to the management of functional outcomes. Examples of these advances in surgical technique include PSP and ECD, which have been described in many articles in the literature as being able to reduce morbidity and the surgical time without compromising the recurrence rate[3,14–16]. However, the complications following parotid surgery assisted by an ultrasonic scalpel versus those following conventional procedures have rarely been discussed.

MECD further reduces the amount of resected normal tissue around the tumour compared to ECD. As reported in the literature, tumour recurrence can be reduced to less than 2% if the tumour is located within 1 mm of the margin. A thin connective tissue layer is sufficient to prevent recurrence[17]. Therefore, the ultrasonic scalpel was introduced into our approach to benign parotid tumours.

The main advantage of the ultrasonic scalpel is that the surgical field remains bloodless, allowing the tumour to be distinguished from the surrounding tissue. Bleeding in the surgical field, especially adjacent to the nerve, can make the procedure complicated and lead to a prolonged surgical time[18]. In addition, the width of the vibrating terminal is approximately 2 mm, which technically means that approximately 2 mm of tissue around the tumour will be resected. In other words, the real margin of the US-MECD procedure is at least 2 mm around the tumour capsule, which could explain the low rate of recurrence observed in the patients in this study[19].

Of the 50 patients in this study treated with US-MECD during the years 2012–2013 (with a follow-up period ranging from 24 to 48 months), none suffered from recurrence. This result indicates that US-MECD leads to a similar, or even better, recurrence rate when compared with SP (2.0%) and PSP (2.1%). However, a limitation of this study was its relatively short follow-up duration. Since recurrent pleomorphic adenoma can present between 7 and 10 years after treatment[20,21], the recurrence rate of all of the patients enrolled should be analysed for a longer period postoperatively for further assessment.

The potential complications resulting from parotid surgery are the main concerns of the patient and the most crucial one is facial nerve paralysis. Usually, a more complete parotidectomy results in a higher rate of transient facial nerve dysfunction[22]. According to a large cohort study, 1.9% of patients developed permanent facial nerve paralysis after ECD and 9.8% of patients after non-ECD procedures[23]. The present study results highlight the advantages of the ultrasonic scalpel over monopolar or bipolar electrocautery and the limited range of the surgical technique. Since the ultrasonic scalpel does not transmit electricity and the eschar and desiccation are minimal, it is unlikely to stimulate the nerves or muscles, resulting in a reduction in postoperative complications[19]. In this study, the patients with permanent facial nerve paralysis after US-MECD were carefully reviewed. The relatively large size of the tumour and rupture of the tumour capsule are likely to have been the causes of the iatrogenic nerve injury. Although the data obtained from the current study did not demonstrate a significant difference in postoperative facial nerve function among the three groups, a larger sample size is required to provide better evidence of a trend.

There is a growing consensus in the surgical literature about the importance of minimizing intraoperative blood loss. Furthermore, minimizing the surgical time and blood loss are important for reducing the occurrence of postoperative complications. The results of this study showed significant reductions in the surgical time, blood loss, and postoperative drain time and drainage amount in the patients in the US-MECD group compared to the patients in the conventional technique groups. These results could be explained by the fact that all of the parts of the surgical procedure were performed using the ultrasonic scalpel. Furthermore, the reduction

in postoperative drainage can be considered significant proof that coagulation is also efficient.

Frey syndrome (gustatory sweating) can occur after any parotid surgery, causing embarrassment and reduced quality of life[24]. One of the most recognized risk factors for this syndrome is the amount of parotid gland tissue removed with disruption of the parotid fascia[5,25]. A preventive technique involves the placement of a barrier between the bare postganglionic parasympathetic nerve fibres and the sweat glands of the skin flap. In the current study, US-MECD resulted in a minimal loss of parotid gland tissue around the tumour, and the parotid fascia was preserved and sutured back after the resection of the tumour. These procedures appeared to provide a highly effective barrier, without the need for additional surgery or an increased financial burden for the patient. Thus, it is not surprising that the incidence of Frey syndrome following US-MECD is much lower than the incidence following the conventional procedures. However, the low rate of Frey syndrome reported here is solely based on patient reporting – no objective testing was performed. Subjective reporting is known to significantly underestimate the rate of Frey syndrome, which has symptoms that may take up to a year or longer to develop.

This study had certain limitations. First and foremost, tumour recurrence is considered a devastating outcome of functional parotid gland surgery in consideration of facial nerve injury and the preservation of parotid gland tissue, and a longer follow-up period is required for future study. The functional changes of the parotid gland should be evaluated and compared before and after surgery. This could be done using salivary gland scintigraphy (SGS), a non-invasive approach that provides a quantitative evaluation[4]. Meanwhile, more objective measurements should also be conducted for the evaluation of Frey syndrome and peri-auricular sensation, such as the Minor starch–iodine test and the sensory index score[26].

In conclusion, this study found that US-MECD appeared to confer superior outcomes over SP and PSP for the management of benign tumours located in the superficial parotid gland with a diameter of less than 4 cm. Notably, this technique should be performed by experienced surgeons who are skilled in dissection of the facial nerve, while the incompletely defined long-term risks of recurrence should also be considered. Further validation in large-scale multicentre randomized controlled trials is warranted to determine the optimal treatment of benign parotid tumours.

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Competing interests. The authors declare that they have no conflict of interest.

Ethical approval. This study was approved by the ethics committees of the Ninth Peoples Hospital, College of Stomatology, Shanghai Jiao Tong University School of Medicine (No. 2018-42-T42), the First Affiliated Hospital of Huzhou University (No. 2017031), and the Second People's Hospital of Changshu (No. 20170603).

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References

1. Norman JE. Recurrent mixed tumours of the major and minor salivary glands. In: Norman JE, McGurk M, editors. *Salivary glands*. St. Louis: Mosby Press; 1995. p. 229–42.
2. 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.
3. Witt RL. Minimally invasive surgery for parotid pleomorphic adenoma. *Ear Nose Throat J* 2005;**84**(308):310–1.
4. Liu H, Pei J, He Y, Lan X, Sun R, Deng T, Xu Y, Zhu G, Wang W, Duan Y, Ma H, Wang S, Fan J, Li C. Comparison of functional change in parotid gland after surgical excision of pleomorphic adenoma by two different types of parotidectomy. *Oral Surg Oral Med Oral Pathol Oral Radiol* 2016;**122**:385–91.
5. George KS, McGurk M. Extracapsular dissection—minimal resection for benign parotid tumours. *Br J Oral Maxillofac Surg* 2011;**49**:451–4.
6. Gleave EN, Whittaker JS, Nicholson A. Salivary tumours—experience over thirty years. *Clin Otolaryngol* 1979;**4**:247–57.
7. Hancock BD. Clinically benign parotid tumours: local dissection as an alternative to superficial parotidectomy in selected cases. *Ann R Coll Surg Engl* 1999;**81**:299–301.
8. Jackson LL, Gourin CG, Thomas DS, Porubsky ES, Klippert FN, Terris DJ. Use of the Harmonic scalpel in superficial and total parotidectomy for benign and malignant disease. *Laryngoscope* 2005;**115**:1070–3.
9. Salami A, Dellepiane M, Bavazzano M, Crippa B, Mora F, Mora R. New trends in head and neck surgery: a prospective evaluation of the Harmonic scalpel. *Med Sci Monit* 2008;**14**:1–5.
10. Salami A, Bavazzano M, Mora R, Dellepiane M. Harmonic scalpel in pharyngolaryngectomy with radical neck dissection. *J Otolaryngol Head Neck Surg* 2008;**37**:633–7.
11. Dean A, Alamillos F, Centella I, García-Álvarez S. Neck dissection with the Harmonic scalpel in patients with squamous cell carcinoma of the oral cavity. *J Craniomaxillofac Surg* 2014;**42**:84–7.
12. Muhanna N, Peleg U, Schwartz Y, Shaul H, Perez R, Sichel JY. Harmonic scalpel assisted superficial parotidectomy. *Ann Otol Rhinol Laryngol* 2014;**123**:636–40.
13. Witt RL. Facial nerve function after partial superficial parotidectomy: an 11-year review (1987–1997). *Otolaryngol Head Neck Surg* 1999;**121**:210–3.
14. O'Brien CJ. Current management of benign parotid tumors—the role of limited superficial parotidectomy. *Head Neck* 2003;**25**:946–52.
15. Roh JL, Kim HS, Park CI. Randomized clinical trial comparing partial parotidectomy versus superficial or total parotidectomy. *Br J Surg* 2007;**94**:1081–7.
16. Smith SL, Komisar A. Limited parotidectomy: the role of extracapsular dissection in parotid gland neoplasms. *Laryngoscope* 2007;**117**:1163–7.
17. Ghosh S, Panarese A, Bull PD, Lee JA. Marginally excised parotid pleomorphic salivary adenomas: risk factors for recurrence and management. A 12.5-year mean follow-up study of histologically marginal excisions. *Clin Otolaryngol Allied Sci* 2003;**28**:262–6.
18. 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**:e342–4.
19. Diamantis T, Kontos M, Arvelakis A, Syroukis S, Koronarchis D, Papalois A, Agapitos E, Bastounis E, Lazaris AC. Comparison of monopolar electrocoagulation, bipolar electrocoagulation, ultracision, and ligature. *Surg Today* 2006;**36**:908–13.

20. Patel N, Poole A. Recurrent benign parotid tumours: the lesson not learnt yet? *Aust N Z J Surg* 1998;**68**:562–4.
21. Carew JF, Spiro RH, Singh B, Shah JP. Treatment of recurrent pleomorphic adenomas of the parotid gland. *Otolaryngol Head Neck Surg* 1999;**121**:539–42.
22. Witt R. The significance of margin in surgery for parotid pleomorphic adenoma. *Laryngoscope* 2002;**112**:2141–54.
23. Mantsopoulos K, Koch M, Klintworth N, Zenk J, Iro H. Evolution and changing trends in surgery for benign parotid tumors. *Laryngoscope* 2015;**125**:122–7.
24. Ciuman RR, Oels W, Jaussi R, Dost P. Outcome, general, and symptom-specific quality of life after various types of parotid resection. *Laryngoscope* 2012;**122**:1254–61.
25. Koch M, Zenk J, Iro H. Long-term results of morbidity after parotid gland surgery in benign disease. *Laryngoscope* 2010;**120**:724–30.
26. Hegazy MA, El Nahas W, Roshdy S. Surgical outcome of modified versus conventional parotidectomy in treatment of benign parotid tumors. *J Surg Oncol* 2011;**103**:163–8.

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