Preservation of greater auricular nerve during parotidectomy: Sensation, quality of life, and morbidity issues. A systematic review

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ABSTRACT: *Background.* Our objectives were to assess the evidence of preservation of the greater auricular nerve in parotidectomy with regard to morbidity and quality of life.

Methods. This was a systematic review. Inclusion criteria were: English literature, prospective and retrospective studies. Exclusion criteria were: single case reports, ''teaching'' reviews. Outcome measures were: tactile sensation, pain, thermal sensitivity, and quality of life.

Results. Although quality of life does not seem to be adversely affected when the greater auricular nerve is sacrificed, preservation of the posterior branch was recommended in 8 studies. When preserving the nerve, the incremental operative time increase is no more than 10 to 5 minutes after a rapid learning curve.

Conclusions. There is level Ib evidence that preservation of the greater auricular nerve minimizes the postoperative sensory disturbance and should be considered whenever tumor clearance is not compromised. There is no evidence that overall quality of life is affected when the greater auricular nerve is sacrificed. © 2013 Wiley Periodicals, Inc. *Head Neck* **36:** 603–608, 2014

KEY WORDS: greater auricular nerve, morbidity, nerve sacrifice, nerve preservation, parotidectomy, paresthesia, quality of life

INTRODUCTION

Parotid surgery is commonly performed for benign and malignant neoplasms, and inflammatory and autoimmune conditions. The main concern for the surgeon is preservation of the facial nerve, but the most common patient-reported postoperative complaint is sensory disturbance around the postauricular, preauricular, and lobular areas.[1,2] Of all the long-term sequelae of parotidectomy for benign disease, Frey's syndrome appears to be another great concern to patients, even at more than 5 years postoperatively.[3]

Several studies in the literature have shown that sacrifice of the greater auricular nerve (GAN) during parotidectomy leads to sensory and functional deficits, increased risk of neuromas, and traumatic injury.[3,4]

The degree of short- and long-term morbidity has been studied before but the evidence for or against preservation of GAN remains a matter of debate in head neck surgery.[4–16]

The objective of this article was to assess the evidence regarding GAN preservation versus sacrifice in parotidectomy and the impact on sensation, quality of life, and overall morbidity.

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METHODS

A PubMed, Medline, Embase, Cinahl, and Cochrane search was performed using the terms: great auricular nerve, morbidity, nerve sacrifice, nerve preservation, parotidectomy, paresthesia, and quality of life. References from the relevant articles were also searched.

We included English literature, randomized and non-randomized trials, and prospective and retrospective case series. We excluded single case reports and ''teaching'' reviews. Articles not focusing on specific outcome measures, quality of life, and/or short- or long-term morbidity were also excluded from the review.

RESULTS

Selection bias in disease extent and length of follow-up, blinding of the results, lack of common outcome measures, and uncontrolled studies were some of the problems preventing a formal meta-analysis. The literature review identified 22 articles published in the English-language literature of which 13 only met our inclusion criteria. Table 1 summarizes the studies that dealt with preservation versus sacrifice of the GAN and the common outcome measures used.

We could identify 3 double-blind, randomized controlled trials (RCTs) in the literature. There were overall 11 prospective and 2 retrospective studies. In the double-blind RCTs, the only common outcome measure used was tactile sensation. Other common outcome measures were subjective sensation, mean operative time, 2-point discrimination, and pain.

TABLE 1. Studies focusing on preservation versus sacrifice of GAN in parotidectomy.

Reference	Design	Number	Study length	Outcome measures	Results	Author suggestions
4	DB RCT	93	1 y	Tactile sensation* *Mean % with normal sensation	Sacrificed 85.7% Posterior preserved 90.4% Lobular preserved 97.1%	Preservation of the posterior branch might not be necessary during parotidectomy.
				Pain* *Mean % with normal sensation	Sacrificed 72.1% Posterior preserved 81.5% Lobular preserved 86.4%	Authors recommend that the lobular branch of GAN should be preserved in parotidectomy, if the tumor does not involve the nerve.
				Mean operative time (min)	Sacrificed 115.3% Posterior preserved 122.5% Lobular preserved 123.6%	
5	PRO	19	5 y	Tactile sensation	Anesthesia 47% Paresthesia 58% Lobular preserved 97.1% Normal sensation 26%	The posterior branch of the GAN should be preserved if it does not compromise tumor resection.
				QOL	Interference in daily living: • 50% no interference • 70% sensory symptoms either completely abated or stabilized • 35% had a describable functional deficit	
6	PRO	46	1 y	Pain* (pin prick) *Measured via a sensory index	9.29 $\pm$ 4.68 vs 7.85 $\pm$ 5.61 ($p = .485$) (NS)	Preservation of the posterior branch of the GAN might not be necessary during parotidectomy.
				QOL	Interference in daily living: Majority of both groups stated ''almost no interference'' Reported abnormal sensation: 41% vs 40%	
7	DB PRO	21	1 y	Tactile sensation* *Minimum diameter that could be felt with an anesthesiometer	2.9860 mm vs 3.5400 ($p < .05$)	GAN preservation should be considered whenever tumor clearance is not compromised.
				2P discrimination	18.4 mm vs 16.9 mm ($p = .267$)	
				Pain* (pin prick) *% found to have abnormal pain	20% vs 27.3% ($p < .05$)	
				Perceived numbness	28% vs 67%	
				Mean operative time (min)	+16 for preservation (5–27)	
8	PRO	22	1 y	Tactile sensation	Anesthesia 50% Paresthesia 86% Lobular preserved 97.1%	GAN morbidity may be bothersome enough to warrant efforts to preserve the posterior branch of the GAN when possible and appropriate.
				QOL	Patient questionnaire scores out of 10: • Sensation: 7.1 • Paraesthesia: 3.1 • Satisfaction with sensory function: 7 • Pain score: 1.9 • Discomfort score: 2.6 • Bothersome morbidity score: 3.0	

(Continued)

TABLE 1. (*Continued*)

Reference	Design	Number	Study length	Outcome measures	Results	Author suggestions
9	PRO	40	6 mo	Tactile sensation* *Measured using VAS 0–100	66.9 vs 26.6 ($p = .001$)	Preservation of he posterior branch of the GAN during parotidectomy is valuable to reduce the postoperative sensory disturbance and further helps to improve the quality of life.
				QOL* *Measurement using VAS 0–100	71.9 vs 45.7 (S, $p = .001$)	
10	DB PRO	81	2 y	Tactile sensation*+ *Mean minimum pressure thresholds in g/mm^2	1 year: 1.35 vs 8.10 2 year: 1.25 vs 3.54	The authors recommended that the posterior branches of the GAN should always be preserved in parotidectomy, if tumor clearance is not affected.
				Perceived numbness* *Asked to evaluate their degree of numbness	None: 100% vs 24% Mild: 3% vs 32% Moderate: 0% vs 36% Severe: 0% vs 8%	
				Mean operative time (min)	179.5 vs 182.6 ($p = .62$)	
11	PRO	24	1 y* *1-y follow-up in GAN pre- served group. No specific follow-up time defined for the sacrificed group	Tactile sensation 2P discrimination Pain (sharp/blunt discrimination) Operative time (min)	Anesthesia 0% vs 70% Paresthesia 28.6% vs 30% Normal sensation 71.4% vs 0% Good perception 33.3% vs 0% Moderate perception 21.4% vs 30% Absent perception 45.2% vs 70% Good perception 64.3% vs 0% Moderate perception 33.3% vs 26.7% Absent perception 5% vs 73.3% +5–10 for preservation	From this study, it seems reasonable to spare the GAN during parotid surgery.
12	RP	53	3 to 69 mo (median 22 mo)	QOl	Abnormal symptoms • 57% reported at least 1 abnormal symptom Interference in daily activities: • None 77% • Almost none/little/somewhat 19% • A good amount/a lot/ a tremendous amount 1%	The overall QOL was not significantly affected after GAN sacrifice during parotidectomy.
13	RCT	30	1 y	Tactile sensitivity*+ *Mean score measured as 0–3 (0 = worst; 3 = best) Pain*+ (Sharp/blunt discrimination) *Mean score measured from 0 to 3 (0 = worst; 3 = best) 2P discrimination*+ *Mean score measured from 1 to 4 (4 = worst; 1 = best) Mean operative time (min)	3 vs 2.725 2.875 vs 2.425 2.8 vs 3.05 121 vs 118 ($p = .62$)	Preservation of the GAN decreases the early postoperative sensitivity deficit. Therefore, the routine sacrifice of the GAN during parotidectomy should be avoided, mainly in cases of benign
14	RP	95		Tactile sensation* *% with abnormal sensation Pain*	Ear: 40% vs 86% ($p < .0001$) Cheek: 48% vs 54% ($p > .05$) Ear: 39% vs 48% ($p < .0002$)	Supports preservation of the GAN.

(Continued)

TABLE 1. (*Continued*)

Reference	Design	Number	Study length	Outcome measures	Results	Author suggestions
				(Pin prick)	Cheek: 48% vs 54% ($p > .05$)	
				*% with abnormal sensation		
				QOL	Subjective complaints 37% vs 64%	
					% of patients that felt symptoms were significant	
					Ear: 14 vs 53 ($p < .006$)	
					Cheek: 49 vs 47 ($p > .05$)	
				Mean operative time (min)	120 vs 118	
15	PRO	31	6–12 mo	Pain (Pin prick)	"For both anesthesia and hypo esthesia there is no significant difference between the 2 groups"	The added operative time taken to preserve the. posterior branches of the nerve cannot be justified on the basis of these data.
				Perceived numbness*	Ear: 55.6% vs 25% (NS)	
				*% with abnormal sensation	Face: 11.1% vs 25% (NS)	
16	RCT	12	1 y	Pain	No sensory loss 50% vs 0%	Supports preservation of the GAN where appropriate.
				(Pin prick)	Angle of mandible only 33% vs 0%	
					Ear lobe and angle of mandible 17% vs 100% ($p < .01$)	
				Operative time (min)	+10–15 minutes for preservation (NS)	

Abbreviations: RCT, randomized controlled trial; PRO, prospective study; QOL, quality of life; RP, retrospective study; DB, double blind; GAN, greater auricular nerve.
* Data extracted from graphs using plot digitizer software.

There was significant heterogeneity among studies with regard to patient selection, outcome measures, and study design, especially in the nonrandomized trials.

Impact on sensation

All 3 randomized controlled studies showed a significant degree of sensory loss after GAN sacrifice as compared with preservation. However, only Hu et al[4] do not support preservation of the posterior branch of the GAN based on their findings. The reason for this is more apparent when looking at the design of the study. This particular study differs because they distinguish between the posterior branch and a lobular branch and thus have 3 different groups within their trial. They conclude that it is preservation of the lobular branch that prevents significant sensory loss and that ''preservation of the posterior branch might not be necessary.'' The areas tested in this study were the superior helix, preauricular, posterior-auricular, lobular, and infra-auricular. The results in Table 1 are a mean of all these areas and appear to show little difference between the 3 groups. However, the results are more striking when the results are split into their component parts. When sensation is tested in the lobular region only, the sacrificed and posterior preservation groups have significantly lower sensory recovery (57.1% and 63% have normal sensation at 1 year, respectively), whereas nearly all of the lobular preservation group have normal sensation (96.4%). This is reflected in the slightly higher mean score attributed to this group. In all the other areas tested, all 3 groups show a similar sensory recovery profile. Therefore it is because of the results in the lobular area that the authors have derived their conclusions.

In the other 2 RCTs[13,16] there was a significant improvement in sensory morbidity in the GAN preserved groups and the authors support preservation of the GAN.

The majority of studies that measured tactile sensation chose to divide the sensory distribution of the GAN into different areas and test them separately. The only exceptions are Suen et al[7] where they tested the lobular region only and Yokoshima et al[9] where they tested the pinna only. Apart from these exceptions, all the studies found the most significant difference in sensation between GAN preserved and GAN sacrificed groups to be in the lobular region.

Tactile sensation was the most common outcome measure throughout the analysis. This sensory modality can also be defined as ''light touch'' and was measured in 9 of the 13 studies. It was measured through a variety of means, with the most common methods being application of cotton wool or an anesthesiometer. Where a ''pin prick'' was used to measure sensation this has been defined as pain sensation; the exception was the study by Biglioli et al,[11] where the authors specify that the pin was applied lightly, and so this has been defined as tactile sensation.

Most of the studies had a 1-year follow-up. The rate of improvement in sensory morbidity was most pronounced between week 1 or immediate postoperative time and 3 months follow-up. Only 2 studies extended their follow-up further than 1 year.[8,14] Both these studies found that sensory morbidity improved after 1 year, although at a significantly reduced rate.

In those 9 studies that measured tactile sensation 8 of them felt that preservation of the posterior branch of the GAN was necessary on the basis of improved postoperative sensation.

It is possible that the type of sensory modality or test used has an effect on the outcome. This is demonstrated by those studies that chose to measure pain as their primary outcome using a ''pin prick.'' In 2 of the 3 studies they concluded that posterior GAN preservation was unnecessary based on their findings; however, Brown et al[16] are the exception in this case.

Impact on quality of life

Nine of the 13 studies assessed the impact of GAN preservation on quality of life (QOL). This was done through a variety of methods: questionnaires, visual analog scores, interviews regarding various aspects of daily living and certain abnormal symptoms. as well as perceived numbness as part of their overall QOL assessment (Table 1).

The most common outcome measures that were included in the QOL assessment were interference in daily activities, the presence of abnormal symptoms, and perceived numbness.

The effect on QOL appears to be inconclusive. Three studies suggest that preservation of the GAN does not significantly affect QOL.[6,12,15] In 2 of these studies[6,12] little difference was noted in the responses reported by both groups in their questionnaires. Porter et al[15] found that when participants were asked whether they had any sensory loss they found no significant difference between the 2 groups.

However, in 3 studies the authors felt that there was a significant difference between the ''GAN preserved'' and ''GAN sacrificed'' groups.[9,10,14] Participants in the study by Yokoshima et al[9] reported a lower QOL visual analog score in the preserved group. Hui et al[10] found that at 2 years all their participants reported no numbness in the preserved group as compared with 76% of the sacrificed group, with 8% of them reporting ''severe'' numbness. Chirstensen et al[14] found that participants were less likely to report adverse symptoms or effects on activities of daily living with GAN preserved.

In both studies by Ryan and colleagues[5,8] the same cohort of patients was used. The first study[8] followed them up for 1 year and the second for a further 4 to 5 years.[5] Functional deficit in participants was reported as 55% after 1 year and 45% after 5 years. They conclude that the effect on QOL is ''tolerable'' and maintain that preservation of the GAN is recommended. Similarly, Suen et al[7] also felt that GAN preservation is indicated in light of inconclusive findings on the effect of QOL. They state that their results suggest a trend in favor of preservation, although their results were not statistically significant.

DISCUSSION

The implications of GAN preservation remain controversial in the head neck community. Most studies demonstrate an improvement in sensory morbidity after GAN preservation, but this does not appear to correspond to a similar effect on quality of life. However, it is important to note that as well as a reduction in sensation and possible detrimental effects on quality of life, GAN sacrifice can also have more serious sequalae. These have been documented in various case reports and include traumatic neuroma, accidental burns, and self-inflicted skin injury.[2,17,18]

Brown and Ord[16] in the first RCT investigating the significance of GAN preservation on sensory morbidity found a statistically significant result in favor of GAN preservation; it could be argued that the cohort size of 12 was too small to be of any significance. They also limited their measured sensory modality to ''pin prick'' sensation. However, Vieira et al[13] later agreed with their results after conducting a larger RCT using pain, tactile sensation, and 2-point discrimination as their outcome measures.

Hu et al[4] introduced the concept of preservation of the lobular branch of the GAN, although this makes it difficult to make a direct comparison with the other studies. The anatomy of the GAN is usually described as bifurcating into an anterior and posterior branch, but there are several other studies which also make reference to more than 2 branches.[5,6,13] Hu and colleagues[4] suggest the reason for its omission is because it shares a common trunk with the posterior branch rather than trifurcating directly.

Vieira and colleagues[13] conducted their study with a secondary aim to study the anatomy of the GAN. They also conclude that the GAN has 3 main branches: an anterior branch, a superficial posterior, and a deep posterior branch. It is possible that the differences in the perceived anatomy of the GAN may account for some of the differences found in the various studies undertaken.

Preservation of the posterior branch of the GAN was feasible in the majority of cases and did not significantly increase operative time. Most studies give an additional time of between 5 and 15 minutes. Therefore GAN preservation should not be discouraged on the basis of operative time alone. The only exception was the study by Porter et al[15] who felt that this additional time of 20 to 25 minutes required for dissection and GAN preservation was not justified. Regardless of the potential benefits in postoperative sensory improvement, the GAN should not be preserved if oncologic clearance is thought to be compromised.

CONCLUSIONS

There is level Ib evidence that preservation of the posterior branch of the great auricular nerve minimizes the postoperative sensory disturbance and should be considered whenever tumor clearance is not compromised. Mean operative time when preserving the nerve should not be an issue because the incremental operative time increase is no more than 10 to 15 minutes after a rapid learning curve. There is no evidence that overall quality of life is affected when the greater auricular nerve is sacrificed.

More and well-designed multicenter trials and a formal meta-analysis of these studies are required to confidently address the issues of GAN preservation versus GAN sacrifice in parotid surgery.

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