Facial Nerve Involvement During Temporal Bone Resection: Overall Survival And Locoregional Recurrence Outcomes.

Adrien Gendre (gendreadrien@gmail.com)
Department of Otolaryngology - Head & Neck surgery https://orcid.org/0000-0002-5562-8554
Holly Jones
Department of Otolaryngology - Head & Neck surgery
Alison McHugh
Department of Otolaryngology - Head & Neck surgery
Justin Hintze
Department of Otolaryngology - Head & Neck surgery
Fiachra Martin
Department of Plastic surgery – Beaumont Hospital
Barry O'Sullivan
Department of Plastic surgery – Beaumont Hospital
Rory McConn Walsh
Department of Otolaryngology - Head & Neck surgery
James Paul O'Neill
Department of Otolaryngology - Head & Neck surgery
Neville Shine
Department of Otolaryngology - Head & Neck surgery

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Abstract

Purpose: Facial nerve resection is often required in lateral temporal bone resection for tumors extending to the lateral skull base. Limited data exists to guide facial nerve reanimation strategies.

Methods: This is a retrospective cohort study. Patients undergoing lateral temporal bone resection in a national referral center were included and divided into two groups: facial nerve preservation or resection. Survival and locoregional recurrence outcomes were analyzed by Kaplan-Meier survival analysis. Prognostic factors were identified using univariate and multivariate analysis. Facial nerve reconstructive methods were collected.

Results: 39 patients were included with 20 having facial nerve resection at surgery. Squamous cell carcinoma (SCC) was the most common pathology. 48% of patients died during follow-up. Mean overall survival (OS) was 27 months and mean time to locoregional recurrence (LRR) 23 months in the facial nerve preservation group. Mean OS was 16 months and mean time to LRR was 13 months in the facial nerve resection groups (logrank OS p=0.330 and LRR p=0.445).

75% of patients in the facial nerve resection group had static facial nerve reanimation using tarsorrhaphy, gold-weight eyelid implant and fascia lata sling. Middle ear cavity extension was a negative predictor of OS and LRR.

Conclusion: Facial nerve resection during lateral temporal bone surgery is associated with poor overall survival and locoregional control outcomes. Multidisciplinary surgical management and static facial reanimation should be offered to maintain function and quality of life in this group of patients.

Introduction

Tumours of the lateral temporal bone are rare and account for 0.2% of Head and Neck cancers [1,2]. Primary tumors are uncommon and malignancy of the temporal bone more commonly arises due to spread from surrounding soft tissues [3]. Squamous cell carcinoma (SCC) is the most common tumour to involve the temporal bone [4]. Increasing rates of cutaneous SCC have been described in Europe and Australia [5]. It has been previously demonstrated that clear margins are associated with better outcomes in the management of these tumours and this would usually necessitate a resection of the lateral temporal bone [3,6].

Due to the extent of the surgery, it is our practice to involve multiple surgical subspecialties including head and neck surgeons, neuro-otologists, facial plastics reconstructive surgeons and sometimes neurosurgeons when deemed appropriate. Due to its anatomical course within the temporal bone, stylomastoid foramen and parotid, the facial nerve is at high risk of tumour invasion. In lateral temporal bone malignancy, the facial nerve is most commonly involved in its extratemporal portion, but perineural tumour extension can also occur along the nerve into the intratemporal portion [7].

In our practice, the facial nerve is usually sacrificed in cases of preoperative clinical or radiological involvement. At surgery, facial nerve branches or the trunk may be sacrificed due to its proximity to the tumour, in order to obtain clear margins. Reconstructive options for management of facial nerve paralysis in skull base tumors have been extensively described. They involve static and dynamic reconstructive techniques [8]. However there is limited published evidence to guide the type of reconstruction after facial nerve resection in temporal bone malignancy [9,10]

In this study, we evaluate facial nerve involvement in patients undergoing lateral temporal bone resection and its implications in terms of survival, locoregional recurrence [LRR] and reconstruction over a 20-year period in a large skull base unit receiving nationwide tertiary referrals.

Methods

We performed a single institution retrospective review of temporal bone malignancies managed surgically between 2000 and 2020. Patient chart's were reviewed for demographic data and tumour characteristics. Data collected included age, gender, smoking and alcohol status, American Society of Anesthesiologists (ASA) group, tumour histopathology and site. Additional physiological and operative variables were included for another pilot study conducted in our center, measuring preoperative POSSUM score [11].

Tumours were staged based on the American Joint Committee on Cancer (AJCC) and the modified University of Pittsburgh staging systems [12–14]. Surgery involved at least a lateral temporal bone resection (LTBR), in some cases extended to a subtotal (STBR) or total temporal bone (TTBR) resection depending on tumor extension. Pre and post-operative facial function was graded with the House-Brackmann grading system [15]. Other data collected included types of reconstruction, adjuvant treatment and facial nerve reanimation techniques. Patients were divided into two groups: facial nerve preservation or facial nerve resection. Statistical analysis was performed using Stata/SE 16.0 software (StataCorp, TX, USA). A *p*-value of <0.05 was considered statistically significant for all analyses. A survival analysis using the Kaplan-Meier's method was used. Overall survival was measured in months from the date of surgery to date of death by any cause. Patients alive at the latest follow-up were censored. Locoregional recurrence-free survival was measured in months from the date of the surgery to the date of diagnosis of locoregional recurrence. Patients with no locoregional recurrence at the date of latest follow-up were censored.

A logrank test was performed to analyse the relationship between predictor variables and the risk of event (death or locoregional recurrence). Cox's hazards model was used for multivariate analysis of significant prognosticator variables.

The study was approved by the local audit and ethics committee.

Results

39 patients were included in the study between 2000 and 2020 (19 in the facial nerve preservation group, 20 in the facial nerve resection group). The mean age at diagnosis was 70 (range 33 – 90). Clinical and pathological features are shown in table 1. There was a predominance of male patients in both groups (79% and 75% in the facial nerve preservation and resection group, respectively). SCC was the predominant malignancy (95% and 75% respectively). Other malignancies included angiosarcoma (2 cases), basal cell carcinoma, non-small cell carcinoma, Merkel cell carcinoma and adenocarcinoma. The proportion of tumor involving the middle ear cavity was significantly more important in the facial nerve resection group (81% vs 32% in the preservation group, p=0.003).

About half of the patients in both groups were referred after previous surgery in a setting of recurrent or residual disease. Up to 20% of patients had previous external beam radiation therapy before referral to our unit. There was no significant difference in smoking or alcohol status between the 2 groups.

Preoperative hemoglobin was significantly lower in the facial nerve resection group (123 g/L) than in the facial nerve preservation group (135 g/L). There was no difference in terms of BMI and ASA status in the population with most patients graded ASA 2 or 3. All patients in the facial nerve preservation group had normal facial nerve function (grade 1 House-Brackmann).

35% of patients in the facial nerve resection group had a preoperative facial palsy (grade ³ 2 House-Brackmann). Facial nerve sacrifice for the other patients in this group was decided per operatively based on macroscopic findings.

There were significantly more AJCC T4 tumors in the facial nerve resection group (52%). T3 tumors accounted for 42% in the facial nerve preservation group. Of patients who had a facial nerve resection 22% had an AJCC N3b staging. In these cases the tumour was usually considered to be a metastatic lymph node from primary skin SCC. Although it was not statistically significant, the proportion of Pittsburgh stage 4 tumors was higher in the facial nerve resection group (this was inherent to the modified Pittsburgh staging system where facial nerve palsy upstaged the patient to stage 4).

Operative and postoperative features are shown in table 2. Most patients underwent a lateral temporal bone resection (LTBR) (90% and 84% in the facial nerve resection and preservation groups, respectively). A neck dissection (65% and 72% respectively) and parotidectomy (80% and 63% respectively) were performed to obtain en-bloc resection of the soft tissue tumor. Reconstruction using free flaps occured in 65% and 47% of patients in each groups respectively.

There was a significantly higher proportion of perineural invasion (PNI) in the facial nerve resection group (68%, p=0.023). Five patients in the facial nerve resection group had a dynamic facial nerve reanimation using sural nerve graft. In this group 75% of patients underwent static reanimation including one or more of the following technique: tarsorrhaphy (75%), superior eyelid goldweight implant (56%), fascia lata sling (50%).

More than 75% of patients had adjuvant external beam radiation therapy.

Overall, 48.7 % of patients died during follow-up. The mean OS time was 27 months +- 10 (IC95% 5 – 49) in the facial nerve preservation group. Mean OS time was 16 months +- 3 (IC95% 8 – 24) in the facial nerve resection group. Overall survival is represented with a Kaplan-Meier survival curve in figure 1. No statistical difference was found between the two groups using the logrank test (p=0.330). In univariate analysis in each of the 2 groups for overall survival, only middle ear cavity involvement was a significant prognostic factor (p=0.001).

Seven patients (37%) and 8 patients (40%) developed locoregional recurrence during follow up in the facial nerve preservation and resection group respectively. The mean time to LRR was 23 months +- 10 (range 0.4 – 46) in the facial nerve preservation group. Mean time to LRR was 13 months +- 3 (range 6 – 20) in the facial nerve resection group. Locoregional recurrence-free survival is represented with a Kaplan-Meier survival curve in figure 2. No statistical difference was found between the two groups using the logrank test (p=0.445).

In univariate analysis in each of the 2 groups for locoregional recurrence-free survival, the following were associate with a higher risk of locoregional recurrence: female gender (p=0.002), increased age (p=0.013), middle ear cavity involvement (p=0.001), no prior surgery [p=0.003). None of these factors remained significant in the Cox proportional model multivariate analysis.

Discussion

SCC of cutaneous origins was the predominant pathology (85% of the overall population). This was mainly in the form of advanced auricular or periauricular skin cancer or intraparotid metastasis of a cutaneous primary. This is consistent with similar studies from the USA and Australia [6,7]. This result is unsurprising and recent publications have described the increasing prevalence of cutaneous SCC [5]. Periauricular location is known to be a high-risk feature of this disease and up to 53% of our patients had previous surgery before referral. This highlights the need for a radical therapeutic approach from the outset.

Management of the facial nerve for parotid surgery has been discussed extensively [8,16–18]. A multidisciplinary approach is the gold standard which is in place at our center.

It is our practice in cases of preoperative normal facial function (House Brackmann I) to try to preserve the nerve where possible.

In cases of preoperative facial nerve palsy, 21% in our series, the main trunk of the facial nerve is sacrificed and the nerve is followed through the mastoid to be transected at the level of the second genu. The intratemporal portion is sent for frozen section analysis. In case of middle ear cavity involvement (54%), the facial nerve is transected at the level of the first genu.

In cases where the nerve is surrounded by tumor or directly invaded, it is sacrificed. Given the poor prognosis of this disease and the need to obtain clear margins to improve outcomes, this approach is advocated for in most skull base center [19].

The mean overall survival was higher in the facial nerve preservation group at 27 months compared to 16 months in the facial nerve resection group. This result is similar to other studies [20–22]. The difference between the two groups was not statistically significant, this may be due to the relatively small cohort size. The short overall survival in the facial nerve resection group has repercussions in terms of facial nerve reanimation.

Five patients underwent dynamic reanimation with sural nerve interposition graft. This method may give good results with most patients obtaining grade III House-Brackmann facial function [9]. However, improvement in facial function only starts at around 10 months postoperatively to plateau at 24 months [23]. Based on our results, a static reanimation using a combination of tarsorrhaphy, gold weight eyelid implant and fascia lata sling may be a better reconstructive option for these patients with a poor prognosis. 75% of our patients after facial nerve resection had one or a combination of these technique. This approach allows patients to maintain good quality of life with optimal oncological outcomes. It also maintains facial symmetry, allowing eye closure and oral competence [24–26]. Another factor influencing the type of facial nerve reanimation is the postoperative radiation therapy (PORT). Overall 84% of patients in our series were referred for PORT. Patients were discussed at the multidisciplinary meeting postoperatively and those with grade T3/T4 disease, ^{3}N2b, perineural or lymphovascular invasion were referred for PORT. Previously it was thought that PORT may impair the success rate of dynamic facial nerve reanimation but several studies have shown no difference in functional outcomes between radiated and unirradiated graft patients [9,27,28].

With regards to overall survival, the only significant prognostic factor was middle ear involvement. This has been discussed in previous studies and is consistent with the initial Pittsburgh staging [3,13,22]. Of the patients in this series, 55% had middle ear extension which is relatively higher compared to similar single-center series [6]. This result may be due to recruitment bias as our center is the national referral center for lateral skull base and neurosurgery.

It is worthwhile noting that a high proportion of our patients had positive deep margins (74% overall], which is similar to other available data [3,29]. This deep margin corresponds to where the tumor abuts the temporal bone. All patients had at least a lateral temporal bone resection ensuring clear margins. This is obtained by drilling and thus tissue is not available for histopathological examination. A more traditional en-bloc resection of the temporal bone has not been shown to have added benefit in terms of locoregional control or overall survival [2,20]. A similar result is found in our study where positivity of the deep margins is not statistically correlated to locoregional control or survival rate.

Up to 40% of patients presented locoregional recurrence with a mean time to recurrence of 23 months in the facial nerve preservation group and 13 months in the facial nerve resection group. This is in keeping with similar series [30]. In univariate analysis, patients who had not had previous surgery were found to be at higher risk of locoregional recurrence (p=0.003). In those cases of salvage surgery, a less conservative surgical resection was often advocated as these cases would be initially considered at higher risk. There might also be more difficult facial nerve preservation given previous dissection or radiation.

Similar to the OS, the high rate of locoregional recurrence and a mean time to recurrence of just over 12 months would support a more conservative facial nerve reanimation. Static reanimation ensures preservation of the quality of life, limiting the need for rehabilitation and physiotherapy[31,32].

65% of patients in the facial nerve resection group had free flap reconstruction. This has become the standard of care for reconstruction of large skull base and cutaneous defects and allow for a salvage pedicled option in case of flap failure [2]. Most of these free flaps were antero-lateral thigh flap (ALT) which allow for reconstruction of large cutaneous defects. Advantages of the ALT flap have been described including the possibility to harvest simultaneously with oncologic resection, harvesting as fasciocutaneous perforator flap or myocutaneous flap, low donor site morbidity, size and thickness which can cover most lateral skull base defect including in some cases dura or great vessels exposure.

The main limitation of this study is the small sample size which may have precluded identification of some prognostic factors and the absence of statistically significant difference in OS and LRR rates. Due to the retrospective nature of the study, a number of patients were lost to follow up and censored. Nonetheless, this study was appropriately designed to study the survival rates in the population and describe facial nerve reanimation strategies. Larger prospective studies incorporating objective quality of life measurement tools would be interesting to further characterize the functional outcomes of facial nerve reanimation in lateral temporal bone resection.

Conclusion

Facial nerve resection during lateral temporal bone surgery is associated with poor overall survival and locoregional control outcomes. Multidisciplinary surgical management and static facial reanimation should be offered to maintain function and quality of life in this group of patients.

Statements And Declaration

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Conflicts of interests : None

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Ethics approval : This study was approved by the local audit and ethics committee.

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Tables

Due to technical limitations, table 1-2 are only available as a download in the Supplemental Files section.

Figures

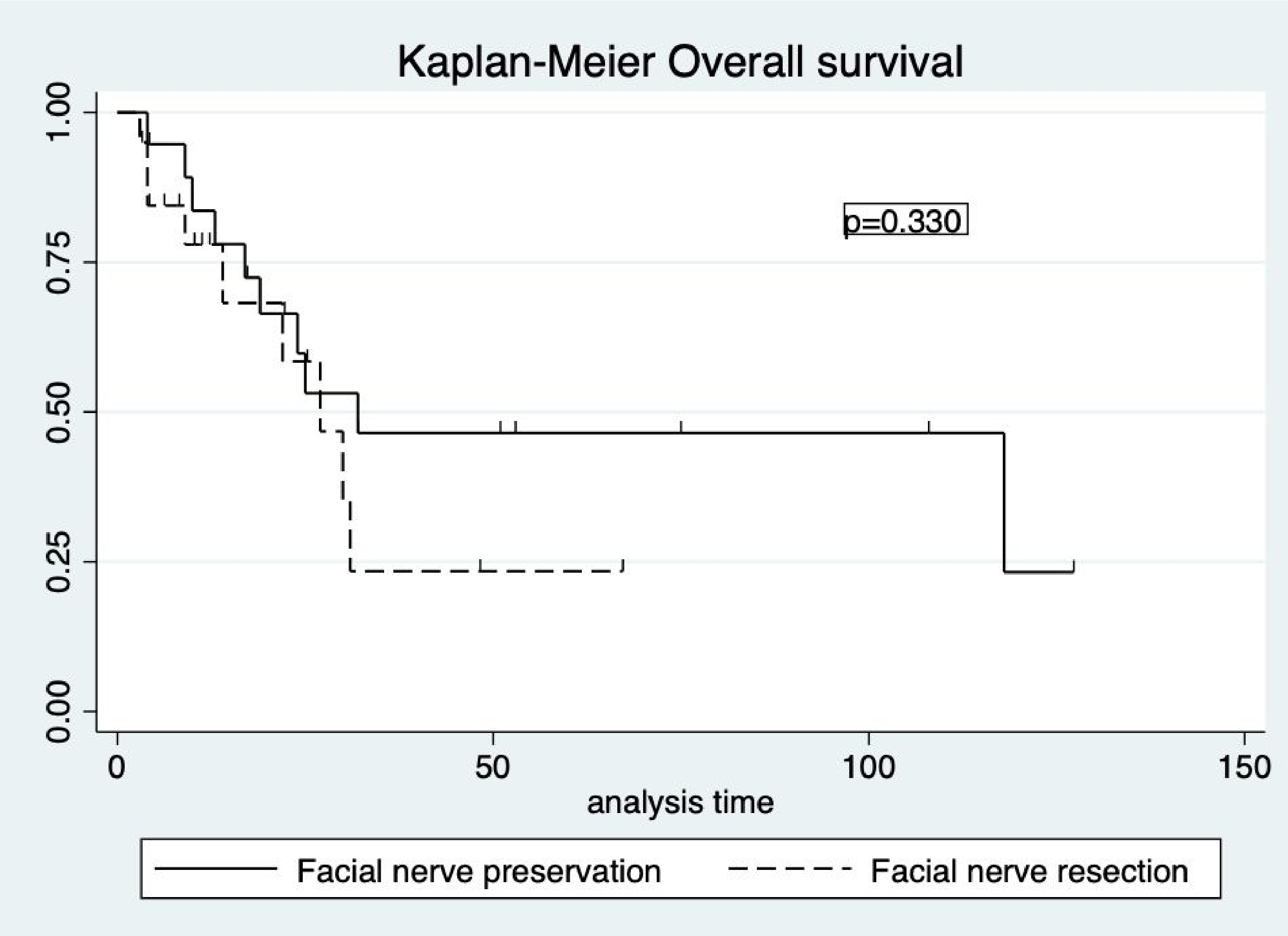

Figure 1

Overall survival analysis [in months]

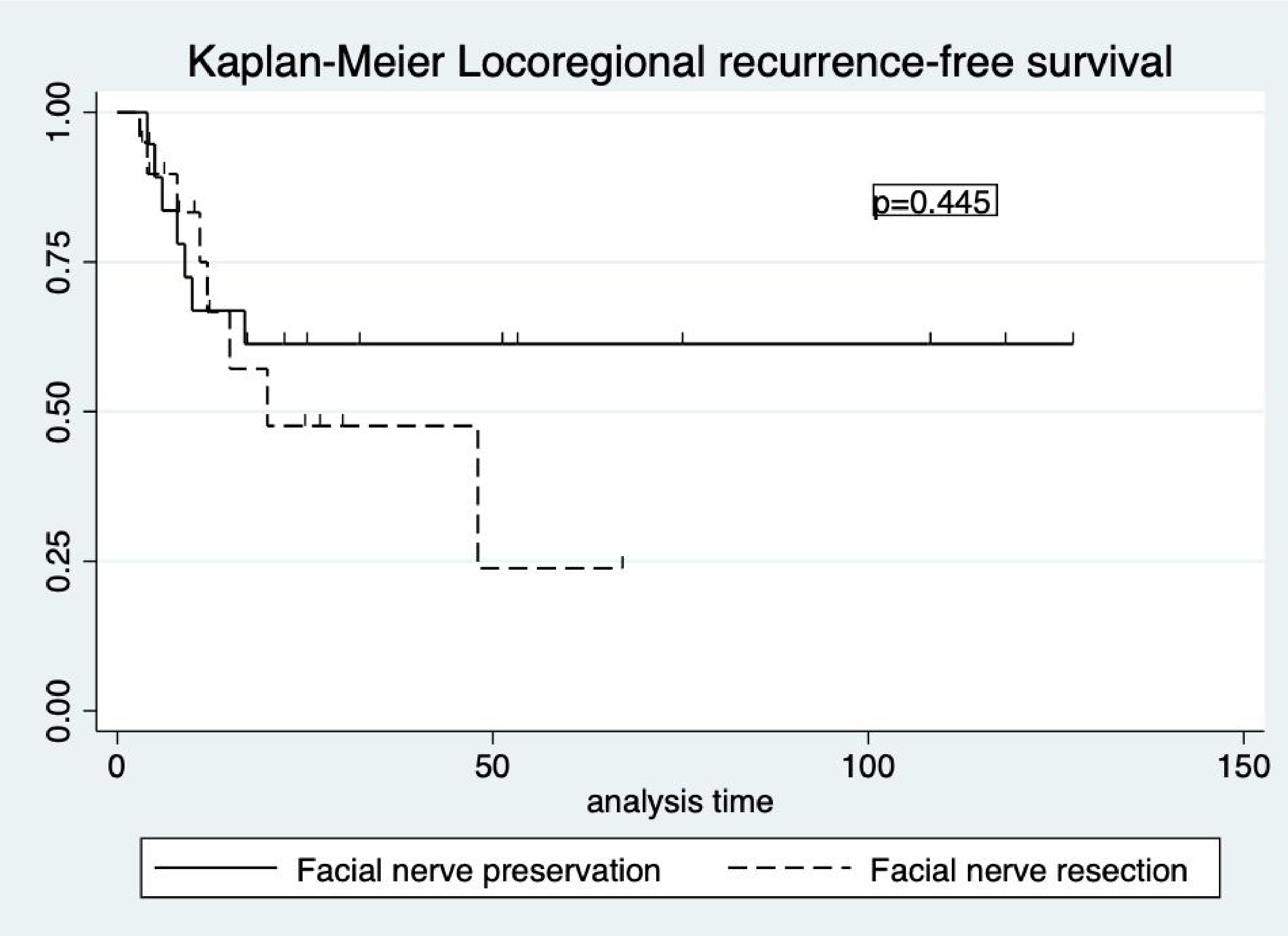

Figure 2

Locoregional recurrence-free survival analysis [months]

Supplementary Files

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- table1.pdf
- table2.pdf