ORIGNAL ARICLE

RESULTS OF IMMEDIATE FACIAL NERVE RECONSTRUCTION IN PATIENTS UNDERGOING PAROTID TUMOUR RESECTION

Haroon Ur Rashid, Ishtiaq Ur Rehman, Mamoon Rashid, Shumaila Yousaf, Nasir Khan, Aqsa Akhtar

Plastic Surgery Department, Shifa International Hospital, Islamabad-Pakistan

Background: Facial nerve is usually sacrificed in total parotidectomy. The objective of this study is to present results of immediate reconstruction of facial nerve in total parotidectomy cases where facial nerve is sacrificed. **Methods:** This is a prospective study done in patients who had total parotidectomy including facial nerve and immediate reconstruction was done with inter-positional nerve grafts (sural n=12 and greater auricular n=10) from December 2017 till February 2018 by single surgeon (MR). Wounds were closed primarily (n=15), local flap (n=2) and free flap (n=5). Clinical evaluation was done at four months minimum follow up (those operated in January to February 2018) and eight months maximum follow up (those operated in December 2017), for facial nerve functional recovery using House and Brackmann grading system by single author (MR). **Results:** Total of 22 (male n=7, female n=15) patients included in study from December 2017 till February 2018. Sural nerve grafts were used in 54% (n=12) and greater auricular nerve grafts in 45% (n=10) patients for reconstruction of facial nerve. On clinical evaluation using House and Brackmann grading system, showed grade V (n=4), grade IV (n=7), grade III (n=8) and grade II (n=3) repairs. **Conclusion:** Although primary end to end facial nerve repair is ideal but in situation where a significant segment of nerve is lost or where the repair is under tension, inter-positional nerve grafting is a simple and reliable reconstructive technique with good outcomes.

Keywords: Facial nerve immediate reconstruction; Total parotidectomy; Sural nerve grafts; Facial nerve palsy; House and Brackmann grading; Facial reanimation

Citation: Rashid HU, Rehman IU, Rashid M, Yousaf S, Khan N, Akhtar A. Results of immediate facial nerve reconstruction in patients undergoing parotid tumour resection. J Ayub Med Coll Abbottabad 2019;31(3):340–5.

INTRODUCTION

Malignant salivary glands tumours accounting for 3–5% of all head and neck tumours. Radical resection of malignant parotid tumours may include facial nerve to achieve clean tumour free margins. Injury to facial nerve results in functional and aesthetic deficits ranging from mild to most severe forms assessed with House and Brackmann grading system.[1] The goals of facial nerve rehabilitation are to restore voluntary and involuntary facial expressions during speaking, smiling, eating, drinking, blinking and lips pursing.[2,3]

Facial reanimation surgeries are of two main types, i.e., static and dynamic. Static corrections can achieve near normal appearance of face at rest while dynamic corrections can achieve voluntary facial muscles movements along with resting normal appearance of face. Immediate primary repair by suturing nerve ends and inter-positional nerve grafts if primary repair is not possible, gives satisfactory rehabilitation of facial nerve functions.[4–9] Dynamic reconstructive techniques include nerve transfer from neighbour motor nerves or interposition nerve grafts between the cut ends. Interposition nerve grafts are indicated when nerve ends are more than 1cm a part and tension free repair is not possible.[10] Usually, non-vascularized nerve grafts are used which act as conduits for regenerating nerve fascicles. There are various options for donor nerve grafts, i.e., sural nerve, greater auricular nerve, superficial radial nerve, lateral and medial cutaneous nerve of forearm. Of the other dynamic techniques like nerve transfer from hypoglossal nerve, spinal accessory nerve, masseteric branch of trigeminal nerve and glossopharyngeal nerve have been described in many studies.[11]

Sometimes after large resections the upper face branches are anastomosed with main trunk proximally and lower face branches are anastomosed with hypoglossal nerve through jump graft. This prevents synkinesia between upper and lower face muscles.[12] Static procedures include facial slings and gold weights in eye lids, and they only improve symmetry of face in resting state. Common autologous materials are fascia lata or palmaris slings. Sling plasties add on dynamic procedures most of the times. Dynamic muscle transfer (i.e., temporalis muscle

or masseter muscle) is yet another option for late presenting scenarios.[13] In 1901 Korte described the first end to side facial-hypoglossal nerve anastomosis.[14] Since then there are many modifications, i.e., end to end, end to side jump graft and split XII-VII transfer.[15] We present our results with simple interposition nerve grafts technique.

MATERIAL AND METHODS

This is a prospective cohort study approved by the ethics committee of Shifa International Hospital and Shifa College of Medicine. This study is carried in patients who had total parotidectomy involving facial nerve and immediate reconstruction was done with inter-positional nerve grafts in the months of December 2017 till February 2018. Pre-operatively all patients were informed about the possible involvement of facial nerve branches and in-case sacrificed, immediate reconstruction would be done.

All patients with resection of parotid tumours, in which facial nerve was sacrificed, and immediate reconstruction was done, were included in this study after informed consent was obtained. Patients with parotid tumour resections in which facial nerve was salvaged were excluded from study. The pathologies were adenoid cystic carcinoma (n=9, 40%), mucoepidermoid carcinoma (n=6, 27%) and non-invasive carcinoma ex-pleomorphic adenoma (n=7, 31%). Endotracheal anaesthesia was given in all patients without muscle relaxant. All cases included in this study were operated by single surgeon (MR). A modified blair parotidectomy incision was used in all cases. Skin flap was raised to approach masseteric-parotid region.

All the facial nerve branches proximally and distally identified at this point using nerve stimulator and tagged with sutures. Careful dissection done with blunt tip scissors and tumour was resected with tumour free margins in all cases (checked by frozen section evaluation). Sural nerve graft in 54% (n=12) and greater auricular nerve graft in 45% (n=10) of cases was used. Good calibre branches were selected from grafts and coapted under loupes magnification of 4x. Prolene 8'0 and 9'0 was used and epineural anastomosis was done with two or three sutures. Wounds were closed primarily (n=15), local flap (n=2) and free flap (n=5). Postoperatively active facial exercises were started at day first. To support facial musculature and reduce oedema, elastic chin belt was applied in all patients. To avoid local recurrence of disease radiotherapy was given in 19 patients after four weeks. Transcutaneous electrical nerve stimulation (TENS) machine was used by all patients postoperatively to prevent muscle atrophy. Clinical evaluation was done at four months minimal follow up (those operated in January to February 2018) and eight months maximum follow up (those operated in December 2017), for facial nerve functional recovery using House and Brackmann grading system.[1] All patients were advised to practise smiling and frowning exercises in front of mirror and record self-images and video clips. Patients were advised to report any improvements in voluntary or involuntary facial expressions and document exact dates.

RESULTS

There were total of twenty-two patients. All the patients recovered uneventfully with good wound healing. Fifteen patients were female and seven were male, with an age range of 25–64 (mean 47) years. A palpable mass on clinical examination was present in all patients and facial palsy was observed preoperatively in eight patients. All the patients underwent fine needle aspiration cytology evaluation for histologic diagnosis. Patients were diagnosed as a case of adenoid cystic carcinoma (n=9, 40%), mucoepidermoid carcinoma (n=6, 27%) and non-invasive carcinoma ex-pleomorphic adenoma (n=7, 31%).

No distant metastases were found in any of the patient. Facial nerve was sacrificed in all twenty-two cases and was reconstructed immediately with inter-positional nerve grafts. Main trunk of facial nerve was involved in 18 patients, zygomaticotemporal branch was involved in two patients and cervicofacial was involved in two patients. Donor nerve being used as inter-positional nerve grafts were greater auricular (n=10, 45%) and sural nerve (n=12, 54%). In five patient's palmaris tendon graft was used for oral commissure symmetry and competence.

Nerve reconstruction was done by epineural suture technique using polypropylene 8/0 and 9/0 suture under the magnifying loops of 4x. Facial activity was noticed at different intervals in different patients (at 2 months n=5, 3 months n=6, 4 months n=3, 5 months n=6, 7 months n=2). Facial nerve function was recovered in patients with HB grade II (n=3), grade III (n=8), grade IV (n=7) and grade V (n=4). In this study 19 out of 22 patients received radiotherapy after surgery.

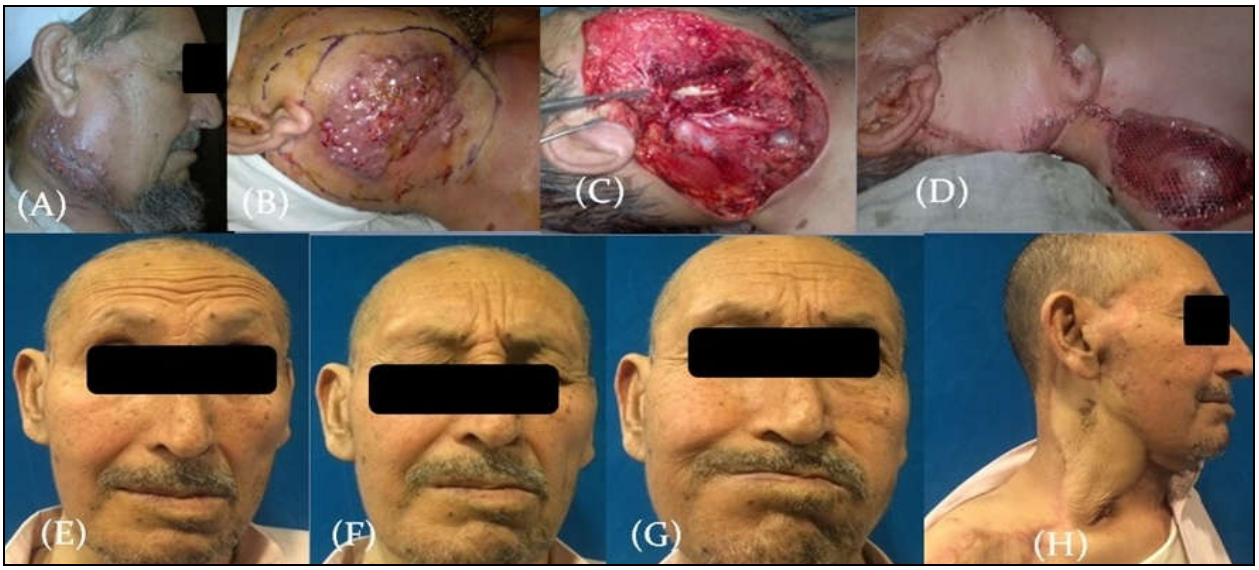

Figure-1: A, B: A 60 years old male with adenoid cystic carcinoma right parotid gland. C, D: Reconstruction of facial nerve with inter-positional nerve grafting and coverage of defect with local (supra clavicular artery based) flap. E, F, G, H: Post-operative result at 7 months follow-up.

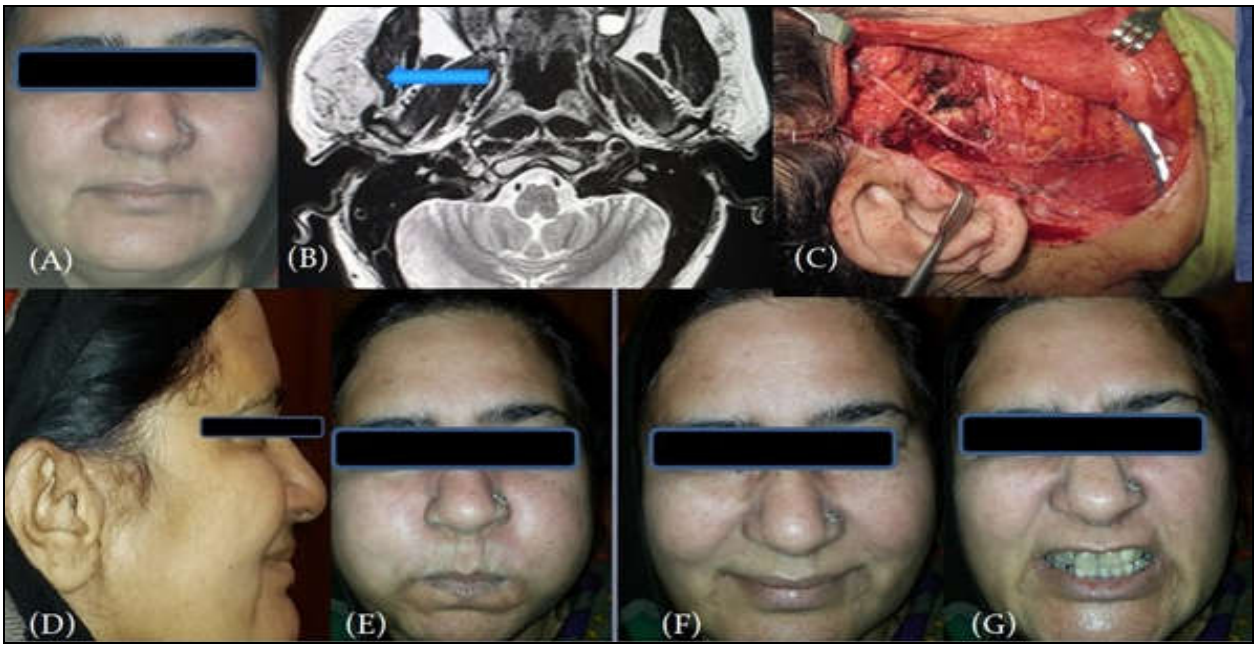

Figure-2: A, B: Middle aged lady with parotid tumour right side, shown in MRI scan. C: nerve grafts used for reconstruction of facial nerve upper and lower trunk branches. D, E, F, G: Post-operative functional recovery of facial nerve at 6 months follow-up.

DISCUSSION

Salivary gland tumours consist of a heterogeneous group of lesions with a wide range of histological types, biological behaviour and prognosis. Parotid tumours are mostly benign and malignant tumours represent up to 3% of all head and neck carcinomas.[16–18] The management of salivary gland malignancies remains primarily surgical.[18]

In radiological assessment, CT scan is indicated to assess the involvement of the temporal bone and the skull base, and MRI better defines soft-tissue planes and facial nerve relations.[19]

The primary objective of rehabilitation surgery is to restore at least some of the important functions like eye closure, nasal airflow, oral competence, symmetric appearance of face at rest and during voluntary or involuntary movements.[11,20,21]

Table-1: Population data, pathologies and functional outcomes.

S. No	Age/Sex (average age 47yr)	Histopathology	Donor nerve used	Time of onset of recovery	Outcomes (HB*) Grade
1.	40/M	Adenoid cystic Ca	Sural nerve	Two months	II
2.	64/F	Mucoepiderm oid Ca	Greater auricular nerve	Four months	III
3.	40/M	Adenoid cystic Ca	Sural nerve	Three months	II
4.	39/F	NICEPA~	Sural nerve	Seven months	V
5.	42/M	Mucoepiderm oid Ca	Greater auricular nerve	Three months	III
6.	60/M	Adenoid cystic Ca	Sural nerve	Five months	IV
7.	51/F	Adenoid cystic Ca	Sural nerve	Four months	III
8.	61/F	Adenoid cystic Ca	Sural nerve	Five months	IV
9.	59/F	NICEPA~	Sural nerve	Three months	III
10.	63/F	Mucoepiderm oid Ca	Greater auricular nerve	Three months	IV
11.	29/M	Adenoid cystic Ca	Greater auricular nerve	Five months	IV
12.	56/M	Adenoid cystic Ca	Greater auricular nerve	Three months	III
13.	48/F	Adenoid cystic Ca	Sural nerve	Two months	II
14.	40/M	NICEPA~	Greater auricular nerve	Two months	III
15.	46/F	NICEPA~	Greater auricular nerve	Four months	III
16.	37/F	NICEPA~	Greater auricular nerve	Five months	V
17.	38/F	Mucoepiderm-oid Ca	Sural nerve	Two months	III
18.	41/F	Mucoepiderm-oid Ca	Sural nerve	Two months	IV
19.	49/F	Adenoid cystic Ca	Greater auricular nerve	Five months	V
20.	25/F	Mucoepiderm-oid Ca	Greater auricular nerve	Seven months	V
21.	57/F	NICEPA~	Sural nerve	Three months	IV
22.	62 /F	NICEPA~	Sural nerve	Five months	IV

*House-Brakmann scoring system[1]. ~Non-invasive carcinoma ex-pleomorphic adenoma

In the circumstances where facial nerve has to be sacrificed, then the immediate reconstruction with an inter-positional nerve graft should be done where possible. Good results have been reported in patients with malignant tumours, who received adjuvant radiotherapy.[22]

The longer the duration of denervation, the lesser the chances of recovery and reinnervation.[23] In case both ends are identifiable the ideal technique is primary repair or to avoid tension, inter-positional autogenous grafting.[24] If proximal end of facial nerve is not available ipsilateral masseter nerve and hypoglossal nerve should be selected for robust early innervation.[22,23] Hypoglossal nerve is preferred by some surgeons due to its close proximity and abundant number of mylenated axons and there are studies in animals which document that neuronal plasticity is easily achieved.[25–27]

Other options like vascularized nerve grafts can be considered, especially in scarred wound beds and if the gap between two ends is more than 6 cm.[24,28,29]

The principles and results of facial nerve rehabilitation in total parotidectomy patients vary with different techniques applied and no consensus exists.

This study comprises largest number of patients with total parotidectomy and sacrifice of facial nerve, in which inter-positional grafting was done in same sitting in Pakistan. We prefer to use the greater auricular nerve due to its proximity to the surgical site if being preserved during resection of the tumour, or alternatively, the sural nerve. It is noteworthy that during this period in other patients total parotidectomy was done without the sacrifice of facial nerve and were excluded from study.

In patients with high grade tumours, advanced stages, positive margins and cervical metastases radiotherapy is indicated and plays a main role in the management.[30] Preoperative radiotherapy and previous surgery leads to scarring and compromise vascularity of that zone and so retards any regeneration process in that zone.[31]

Adjuvant radiotherapy effect on results of facial nerve grafting is controversial. Some studies suggest that there is no difference in results of facial nerve regeneration in patients who receive radiotherapy compared with patients who did not.[32]

In our study, 19 out of 22 patients received radiotherapy with difference in outcomes. Hontanilla *et al*. compared two groups after radical parotidectomy and immediate facial nerve reconstruction using sural nerve, one group received radiotherapy and another group dint receive anything post-operatively. His results suggest no difference in outcomes of both groups.[30]

As the results are unpredictable specially in older age group, static reanimation options should be considered to support dynamic procedures at the same sitting.[33]

Palmaris sling is most commonly used and achieve good results in static resting symmetry of face. In our series of patients, we used palmaris sling in 5 patients for oral commissure symmetry and competence.

It should be kept in mind that only 20–50% original facial nerve fibres grow through a graft and the results of facial nerve regeneration cannot exceed 75% recovery.[34]

The timing of onset of outcomes is variable in each individual, depending on many factors as discussed previously like wound bed vascularity, previous surgery scarring and distance to be travelled by regenerating fascicles. Vaughan presented his study of 14 cases, in which immediate reconstruction was done with inter-positional nerve grafts. In half of his cases time of onset of recovery was before 8 months (at 2 months n=1, 5 months n= 1 ,6 months n=1, 8 months n=1).[35] In our series patients had onset of recovery at different intervals (at 2 months n=5, 3 months n=6, 4 months n=3, 5 months n=6, 7 months n=2). Contradictory to study of Mohamed *et al*[36] which states that grade III functional recovery of a reconstructed facial nerve is near to impossible, in our series of patients we have achieved better results up to grade II recovery in 3 (13%) patients (at eight months follow-up) and grade III recovery in 8 (36%) patients (with mean follow up of seven months). Good (39%) and excellent (17%) results were noted by Suvi Renkonen in study of 31 patients with radical parotidectomy performed and facial nerve reconstruction was done with non-vascularized nerve graft.[37]

Hence facial nerve in cases when sacrificed, preferably reconstructed in same sitting, with easily approachable reconstructive options tailored accordingly.

CONCLUSION

We conclude that facial nerve should be salvaged if possible, in cases sacrificed, immediate reconstruction with interposition nerve grafts is the simplest technique for reconstruction, with good results. The results and onset of recovery of functions vary individually. Close follow up to asses and monitor recovery of function is necessary.

Disclaimer: This is an original article and is not submitted anywhere for publication.

Conflict of interest: There is no conflict of interest.

Funding disclosure: None to declare.

AUTHORS' CONTRIBUTION

HUR: Writeup and proof reading. IUR: Literature review. MR: Study design. SY: Data analysis. NK: Sampling and photo records data. AA: Literature review

REFERENCES

1. House JW, Brackman DE. Facial nerve grading system. Otolaryngol Head Neck Surg 1985;93(2):146–7.
2. Berger A, Bargmann HJ. Functional reconstruction after facial paralysis: a survey. World J Surg1990;14(6):748–56.
3. Millesi H. Nerve suture and grafting to restore the extratemporal facial nerve. Clin Plast Surg 1979;6(3):333–41.
4. Sobol SM, May M, Mester S. Early facial reanimation following radical parotid and temporal bone tumour resections. Am J Surg 1990;160(4):382–6.
5. Chuang DC, Wei FC, Noordhoff MS. "Smile" reconstruction in facial paralysis. Ann Plast Surg 1989;23(1):56–65.
6. Jääskeläinen J, Pyykkö I, blomstedt G, Porras M, Palva T, Troupp H. Functional results of facial nerve suture after removal of acoustic neurinoma: Analysis of 25 cases. Neurosurgery 1990;27(3):408–11.
7. Barrs DM. Facial nerve trauma: optimal timing for repair. Laryngoscope 1991;101(8):835–48.
8. Draf W. Surgical rehabilitation of facial nerve. Acta Neurochir (Wien) 1988;92(1–4):67–75.
9. May M, Sobol SM, Mester SJ. Managing segmental facial nerve injuries by surgical repair. Laryngoscope 1990;100(10 Pt 1):1062–7.
10. Iseli TA, Harris G, Dean NR, Iseli CE, Rosenthal EL. Outcomes of static and dynamic facial nerve repair in head and neck cancer. Laryngoscope 2010;120(3):478–83.
11. Allan J, Cha J, Kwei J, Vandervord JG. Sequelae following radical parotidectomy: the role of the reconstructive surgeon. Eplasty 2014;14:ic9.
12. Guntinas-Lichius O, Streppel M, Stennert E. Postoperative functional evaluation of different reanimation techniques for facial nerve repair. Am J Surg 2006;191(1):61–7.
13. Terzis JK, Kalantarian B. Microsurgical strategies in 74 patients for restoration of dynamic depressor muscle mechanism: a neglected target in facial reanimation. Plast Reconstr Surg 2000;105(6):1917–31.
14. Körte W, Bernhardt M. Ein Fall von Nervenpfropfung: des Nervus facialis auf den Nervus hypoglossus. Dtsch Med Wochenschr 1903;29(17):293–5.
15. Conley J, Baker DC. Hypoglossal-facial nerve anastomosis for reinnervation of the paralyzed face. Plast Reconstr Surg 1979;63(1):63–72.
16. de Oliveira FA, Duarte EC, Taveira CT, Máximo AA, de Aquino EC, Alencar Rde C, *et al*. Salivary gland tumour: a review of 599 cases in a Brazilian population. Head Neck Pathol 2009;3(4):271–5.
17. Kane WJ, McCaffrey TV, Olsen KD, Lewis JE. Primary parotid malignancies: a clinical and pathologic review. Arch Otolaryngol Head Neck Surg 1991;117(3):307–15.
18. Bell RB, Dierks EJ, Homer L, Potter BE. Management and outcome of patients with malignant salivary gland tumours. J Oral Maxillofac Surg 2005;63(7):917–28.
19. Horowitz SW, Leonetti JP, Azar-Kia B, Fine M, Izquierdo R. CT and MR of temporal bone malignancies primary and secondary to parotid carcinoma. AJNR Am J Neuroradiol 1994;15(4):755–62.
20. Agrogiannis N, Rozen S, Reddy G, Audolfsson T, Rodriguez-Lorenzo A. Vastus lateralis vascularized nerve graft in facial nerve reconstruction: An anatomical cadaveric study and clinical implications. Microsurgery 2015;35(2):135–9.
21. Motomura H, Yamanaka K, Maruyama Y, Sakamoto M, Harada T. Facial nerve reconstruction using a muscle flap following resection of parotid gland tumours with thorough recipient bed preparation. J Plast Reconstr Aesthet Surg 2011;64(5):595–601.
22. Reddy PG, Arden RL, Mathog RH. Facial nerve rehabilitation after radical parotidectomy. Laryngoscope 1999;109(6):894–9.
23. Boahene K. Reanimating the paralyzed face. F1000Prime Rep 2013;5:49.
24. Iida T, Nakagawa M, Asano T, Fukushima C, Tachi K. Free vascularized lateral femoral cutaneous nerve graft with anterolateral thigh flap for reconstruction of facial nerve defects. J Reconstr Microsurg 2006;22(05):343–8.

25. Neiss WF, Guntinas Lichius O, Angelov DN, Gunkel A, Stennert E. The hypoglossal-facial anastomosis as model of neuronal plasticity in the rat. Ann Anat 1992;174(5):419–33.
26. Satoh Y, Kanzaki J, Yoshihara S. A comparison and conversion table of 'the House–Brackmann facial nerve grading system'and 'the Yanagihara grading system'. Auris Nasus Larynx 2000;27(3):207–12.
27. Tomov TL, Guntinas-Lichius O, Grosheva M, Streppel M, Schraermeyer U, Neiss WF, *et al*. An example of neural plasticity evoked by putative behavioral demand and early use of vibrissal hairs after facial nerve transection. Exp Neurol 2002;178(2):207–18.
28. Kimata Y, Sakuraba M, Hishinuma S, Ebihara S, Hayashi R, Asakage T. Free vascularized nerve grafting for immediate facial nerve reconstruction. Laryngoscope 2005;115(2):331–6.
29. Doi K, Tamaru K, Sakai K, Kuwata N, Kurafuji Y, Kawai S. A comparison of vascularized and conventional sural nerve grafts. J Hand Surg Am 1992;17(4):670–6.
30. Hontanilla B, Qiu SS, Marré D. Effect of postoperative brachytherapy and external beam radiotherapy on functional outcomes of immediate facial nerve repair after radical parotidectomy. Head Neck 2014;36(1):113–9.
31. Brown PD, Eshleman JS, Foote RL, Strome SE. An analysis of facial nerve function in irradiated and unirradiated facial nerve grafts. Int J Radiat Oncol Biol Phys 2000;48(3):737–43.
32. Gidley PW, Herrera SJ, Hanasono MM, Yu P, Skoracki R, Roberts DB, *et al*. The impact of radiotherapy on facial nerve repair. Laryngoscope 2010;120(10):1985–9.
33. Ch'ng S, Ashford BG, Gao K, McGuinness J, Clark JR. Reconstruction of post–radical parotidectomy defects. Plast Reconstr Surg 2012;129(2):e275–87.
34. Fisch U, Lanser MJ. Facial nerve grafting. Otolaryngol Clin North Am 1991;24(3):691–708.
35. Vaughan ED, Richardson D. Facial nerve reconstruction following ablative parotid surgery. Br J Oral Maxillofac Surg 1993;31(5):274–80.
36. Mohamed A, Omi E, Honda K, Suzuki S, Ishikawa K. Outcome of different facial nerve reconstruction techniques. Braz J Otorhinolaryngol 2016;82(6):702–9.
37. Renkonen S, Sayed F, Keski-Säntti H, Ylä-Kotola T, Bäck L, Suominen S, *et al*. Reconstruction of facial nerve after radical parotidectomy. Acta Otolaryngol 2015;135(10):1065–9.

Submitted: 18 December, 2018	*Revised: 19 December, 2018*	*Accepted: 24 December, 2018*

Address for Correspondence:

Haroon ur Rashid, Resident, Plastic Surgery Department, Shifa International Hospital Islamabad-Pakistan
Cell: +92 333 528 2095
Email: haroonpmc@hotmail.com