



Neurotization of nasal mucosa by end-to-side nerve graft: preliminary report of smell restoration

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Received: 11 September 2017 / Accepted: 17 May 2018 / Published online: 12 June 2018
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Abstract

Nerve regeneration after an end-to-side neurotization had been well established in the literature. Both sensory and motor functions could be achieved using this technique. Autonomic and special sensory restoration (e.g., smell sensation) were not studied extensively before. Post-traumatic anosmia has an overall prevalence rate of 7%, with a variable rate of recovery. In this preliminary report, olfactory sensation was restored in a case with a long-standing anosmia using end-to-side nerve graft. The patient reported regaining of smell, which was confirmed by a smell identification test. This technique has the potential to be a promising method for smell restoration; however, it needs further workup and investigations.

Level of Evidence: Level V, therapeutic study.

Keywords End-to-side neurotization · Anosmia · Smell restoration

Introduction

End-to-side neurotization is a technique in which the recipient's nerve is coapted to the side of a donor's nerve leading to collateral sprouting and neurotization of this nerve and subsequent neurotization of its end organ, whether motor or sensory targets [1]. Beyond the somatic neurotization, autonomic or special sense recovery has not been investigated extensively. Gao et al. (2015) reported improvement of bladder function using somatic to autonomic end-to-side neurotization in rats [2].

Olfactory dysfunction is a common complaint in a large number of people; 5% of the population has some olfactory or gustatory disorders, although most do not complain about it. Head trauma is one of the leading causes of anosmia [3]. In this report, we used nerve graft and end-to-side neurotization to neurotize nasal mucosa in a patient with long-standing post-traumatic anosmia.

Case report

A 40-year-old male complained of right side facial paralysis and complete anosmia 10 years ago after a motorcycle accident. The patient was prepared for temporalis muscle transfer to smile reanimation and neurotization of nasal mucosa by an end-to-side nerve graft (Fig. 1).

The supraorbital nerve was exposed on the left side through an upper blepharoplasty incision (Fig. 2). After stripping of the periosteum, a 3-mm hole in the cephalic part of the frontal process of the maxilla is created by a drill. An incision in the nasal mucosa between the upper and lower lateral nasal cartilage allows dissection of the nasal mucosa. A tunnel was done under the nasal mucosa and extended from the bony hole until the nasal mucosal incision. Sural nerve graft harvested from the leg and tiny windows along the length of the graft was done (Fig. 3). Eight French catheters were introduced into the bony hole and grasped inside the nose to retrieve the nerve graft from the bony hole to the nasal mucosa. The cephalic end of the graft coapted to the supraorbital nerve in an end-to-side fashion. The sural nerve was buried under the nasal mucosa caudally. Closure of the nasal incision by chromic catgut 5/0 and skin in the upper eyelid by 6/0 Nylon. Three months after the surgery, the patient reported partial regaining of his smell, which started with strong scents followed by better recovery after 6 months. The finding was confirmed by Brief Smell Identification test which consists of 40 questions in different ten pages, and the score was compared to scores in the standard database. The patient recognized 35 odors out of 40.

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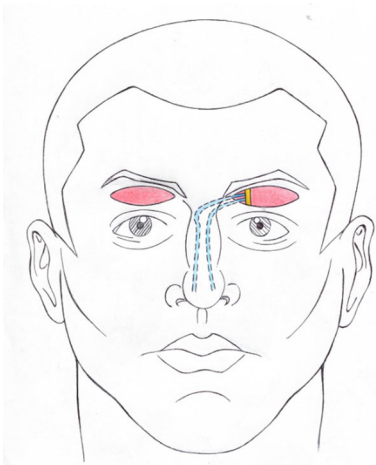


Fig. 1 Two graft cables (blue) connected to the supraorbital nerve (yellow) in an end-to-side fashion and tunneled under the nasal mucosa

Discussion

Smell impairment significantly affects the quality of life and its frequency increases with age. The most common causes of smell disorders are aging, upper respiratory tract infection, sino-nasal disease, and head trauma [3, 4].

Anosmia reported as a possible complication following head injury or neurosurgical procedures [4–6]. The incidence of post-traumatic anosmia varies according to the severity of the injury and has an overall estimated prevalence of 7% with 10% expected recovery within 8 weeks to 2 years [5].

Ikeda et al. reported 20 patients with post-traumatic anosmia that were subjected to olfactory function testing, and the severity of olfactory dysfunction showed no correlation with background factors such as the site of head trauma, the presence of skull fracture, the presence of unconsciousness, or the presence of head operation. They showed 23.5% slight recovery with topical or oral steroids [7].

The regaining of either motor or sensory function with an end-to-side nerve repair is well established in the literature [8], while there are no reports of special sense restoration by this technique. The explanation for how the axons from nasal mucosa referred back to the olfactory center via the supraorbital nerve could be explained by the presence of a network of intracerebral



Fig. 2 Supraorbital nerve exposed via an upper blepharoplasty incision



Fig. 3 Two sural nerve graft cables with the tiny windows created by a micro scissor along the course of the grafts

connections. This hypothesis needs more complicated experimental neuroscience and neurological studies.

Although the olfactory receptors located in the sphenoidal recess and superior concha, we decide to insert the nerve grafts in the nasal roof mucosa anteriorly since it is much easier, expecting the growing axons could reach the olfactory receptors located more posterior. So a simple surgical procedure can be used to neurotize the olfactory epithelium using end-to-side nerve repair. This proposed technique solved an annoying problem of long-standing post-traumatic anosmia, resembling the restoration of sensation after an extended period, in contrary to motor function. The finding, in this case, was exciting and would open the door for more investigations on how the sensory nerve can neurotize special sense.

Compliance with ethical standards

Conflict of interest Fausto Viterbo, Ahmed M. Gad, and Ryane S. Brock declare that they have no conflict of interest.

Ethical approval For this kind of article formal consent is not required.

Informed consent Informed consent was obtained from the patient included in this case study.

References

- Viterbo F, Trindade JC, Hoshino K, Mazzoni A (1992) Lateroterminal neurorrhaphy without removal of the epineural sheath: an experimental study in rats. *São Paulo Med J* 110:267–275
- Geo W, Liu Q, Li S, Zhang J, Li Y (2015) End-to-side neurorrhaphy for nerve repair and functional rehabilitation. *J Surg Res* 197:427–435
- Schriever VA, Merkonidis C, Gupta N, Hummel C, Hummel T (2012) Treatment of smell loss with systemic methylprednisolone. *Rhinology* 50(3):284–289
- Ribas ES, Duffau H (2012) Permanent anosmia and ageusia after resection of a left temporoparietal low-grade glioma: anatomofunctional considerations. *J Neurosurg* 116(5):1007–1013
- Jimenez DF, Sundrani S, Barone CM (1997) Posttraumatic anosmia in craniofacial trauma. *J Craniomaxillofac Trauma* 3(1):8–15
- Lafreniere D, Mann N (2009) Anosmia: loss of smell in the elderly. *Otolaryngol Clin North Am* 42(1):123–131
- Ikeda K, Sakurada T, Takasaka T, Okitsu T, Yoshida S (1995) Anosmia following head trauma: preliminary study of steroid treatment. *Tohoku J Exp Med* 177(4):343–351
- Viterbo F, Amr AH, Stipp EJ, Reis FJ (2009) End-to-side neurorrhaphy: past, present, and future. *Plast Reconstr Surg* 124(6 Suppl):e351–e358