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ORIGINAL ARTICLE

Reconstruction of facial nerve after radical parotidectomy

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Abstract

Conclusion: Most patients benefitted from immediate facial nerve grafting after radical parotidectomy. Even weak movement is valuable and can be augmented with secondary static operations. Post-operative radiotherapy does not seem to affect the final outcome of facial function. *Objectives:* During radical parotidectomy, the sacrifice of the facial nerve results in severe disfigurement of the face. Data on the principles and outcome of facial nerve reconstruction and reanimation after radical parotidectomy are limited and no consensus exists on the best practice. *Method:* This study retrospectively reviewed all patients having undergone radical parotidectomy and immediate facial nerve reconstruction with a free, non-vascularized nerve graft at the Helsinki University Hospital, Helsinki, Finland during the years 1990–2010. There were 31 patients (18 male; mean age = 54.7 years; range = 30–82) and 23 of them had a sufficient follow-up time. *Results:* Facial nerve function recovery was seen in 18 (78%) of the 23 patients with a minimum of 2-year follow-up and adequate reporting available. Only slight facial movement was observed in five (22%), moderate or good movement in nine (39%), and excellent movement in four (17%) patients. Twenty-two (74%) patients received post-operative radiotherapy and 16 (70%) of them had some recovery of facial nerve function. Nineteen (61%) patients needed secondary static reanimation of the face.

Keywords: *Salivary gland, cancer, surgery, radiotherapy, management*

Introduction

Malignant salivary gland tumours are rare, accounting for ~ 3–5% of all head and neck tumours. In 2011, there were 66 new cases of salivary gland cancers in Finland, with a population of 5.3 million (Finnish Cancer Registry; http://www.cancer.fi). For tumours with affected facial nerve the treatment of choice is radical parotidectomy, which entails resection of the nerve along with the parotid gland [1]. Sacrifice of the facial nerve results to both functional and aesthetic deficits.

Even a mild improvement in nerve function, resulting from reconstruction procedures, will lead to improved quality-of-life [2]. Dynamic reanimation techniques include immediate reconstruction with an interposition nerve graft or direct nerve transfer. Delayed cross-face nerve grafting can also be used. However, it is tempting to attempt reconstruction immediately in the same operation, as the cut nerve ends are clearly visible and identifiable [2–5]. Static restoration procedures aim to improve facial outlook without contributing to motor functions, for example with eyelid weights and fascial slings [6].

Traditionally, non-vascularized nerve grafts are used for facial nerve reconstruction, and there are various alternatives for donors, e.g. greater auricular nerve, sural nerve, medial or lateral antebrachial cutaneous nerve, superficial radial nerve, or thoracodorsal nerve. Lately, some authors have advocated the use of

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a vascularized nerve graft, for example with vastus lateralis, but no comparative studies exist [4,7–10]. The appropriate caliber of the graft nerve and its branching patterns are to be considered in the decision-making. In the literature, direct nerve transfers with hypoglossal, spinal accessory, glossopharyngeal, and masseter branch of trigeminal nerve have been reported as options for cable nerve grafting when having no direct access to the proximal stump of the facial nerve [11]. It is also possible to combine inter-positional nerve grafting and nerve transfers with or without a jump graft [12]. These transfers have been used at our institution only after the year 2010.

Recurrences are common among locally advanced parotid malignancies, which supports the use of post-operative radiotherapy in selected cases, and this seems to correlate with improved local control and overall survival [1,3,6]. Yet, the effect of post-operative radiotherapy on the outcome of facial nerve graft function has been controversial. Earlier, post-operative radiotherapy was in most studies reported to have a damaging effect on the recovery of facial function and, therefore, muscle transfers and static slings rather than nerve grafts were recommended [13,14]. Several reports have, however, showed feasible function with nerve grafts, despite the given radiotherapy [3,10,15]. Other potential factors affecting nerve graft function are age, gender, extensive surgery, pre-operative facial nerve palsy and its long duration, and previous operations in the parotid field [3].

Due to the rareness of the disease, data on the principles and outcome on facial nerve reconstruction in surgical oncology are limited and no consensus exists. In this study, we retrospectively reviewed all patients having undergone radical parotidectomy and facial nerve reconstruction with a peripheral nerve graft at the Helsinki University Hospital during the years 1990–2010.

Materials and methods

Retrospective clinical data on all patients who had undergone radical parotidectomy and facial nerve reconstruction during the 21-year period between 1 January 1990 and 31 December 2010 at the Helsinki University Hospital (HUH), Helsinki, Finland, were reviewed. This healthcare district covers ~ 1.6 million inhabitants, representing almost one-third of the whole country. During the study period a total of 228 patients had undergone either radical (facial nerve sacrificed) or subtotal to total (facial nerve not sacrificed) parotidectomy (ELB50) at our institution, and 31 patients with radical parotidectomy had facial nerve reconstruction with a peripheral nerve graft. It is evident that, during the same study period, there were several patients who underwent a radical parotidectomy and did not have their facial nerve reconstructed and are, thus, not included in this series. Eighteen (58%) patients were men and 13 (42%) women. At the time of the first operation, mean age was 54.7 years (range = 30–82) and median age was 54 years.

The hospital records were reviewed and details collected on the patient's age, sex, symptoms, tumour histopathology, operative details including surgical reconstruction, adjuvant therapy, status at last follow-up, length of follow-up, function of the facial nerve, and cause of death.

The post-operative function of the facial nerve was assessed at a follow-up visit and described in the hospital chart, usually without using a standardized classification. The House-Brackmann grading scale was used for the assessment of only two patients.

Results

Symptoms and clinical findings were reported on all cancer patients (30) in this series. Mass in the parotid area was the most common symptom in 28 (90%) patients. Other symptoms were facial motor dysfunction in six (19%) and facial dysesthesia in two (6%) patients. As a sole presenting symptom, facial palsy was detected in two (6%) patients.

In 30 (97%) patients, tumour histology was classified as carcinoma, and one patient had recurrent pleomorphic adenoma. This patient, with a benign tumour, underwent a planned radical parotidectomy after a few earlier partial to total parotidectomies while still having persistent growth of a pleomorphic adenoma. Parotid surgery aiming to preserve the facial nerve had earlier been performed for 15 (48%) patients: two (13%) with total parotidectomy, eight (53%) with partial resection, and five (33%) with two or more resections.

Reconstruction of the facial nerve was performed for 31 patients and upfront at the time of primary radical surgery for 27 (87%) patients. The sural nerve was used in 24 (77%) patients and the greater auricular nerve in seven (23%) patients. In 28 (90%) patients, the number of reconstructed neural branches was reported in the patient journals and the mean number was 3.2. In 30 (97%) patients the neurorrhaphy was done by end-to-end sutures and typically vein, fascia, and tissue glue were used as support material. In one patient (3%), only tissue glue was used.

In 28 (90%) patients the post-operative function of facial nerve was reported in the hospital charts and for

24 (77%) patients the follow-up time was at least 2 years. Three patients died of the disease and three of other reasons during the follow-up. Twenty-three (74%) patients met both these criteria. Total loss of function was seen in five, slight facial function in five, moderate-to-good function in nine, and excellent function in four out of these 23 patients. Of the nine (39%) patients under the age of 50 years, none had total loss of function. Four patients at the ages of 36, 50, 52, and 66 years had secondary reconstruction after post-operative radiotherapy, and their facial function varied from total palsy to moderate.

Neck dissection was performed simultaneously with radical parotidectomy for 16 (52%) patients, mastoidectomy for 17 (55%) patients, and both procedures for nine (29%) patients. One patient had neck dissection during his follow-up and one had undergone it earlier. Mastoidectomy was performed at the cases where the proximal stump on the facial nerve was otherwise not available for anastomosis and in 12 (71%) patients there was at least a 2-year follow-up together with adequate assessments of post-operative facial function. Eight of these patients had some facial function: three patients had slight, four had moderate, and one had excellent facial movement.

Post-operative radiotherapy was given for 23 (74%) and chemotherapy for four (13%) patients. Seventeen out the 23 patients with post-operative radiotherapy had at least a 2-year follow-up and an adequate assessment of the facial function. In 13 of these 17 patients there was at least some facial function: slight in four, moderate-to-good in eight, and excellent in one patient.

Post-operative complications were reported in nine (29%) patients in the whole series. The most common complications were Frey's syndrome in three (10%) patients and skin flap necrosis, mild wound infection, and mild accessory nerve palsy each in two (6%) patients. Sural neuroma in one patient (3%) was the only donor site morbidity.

Most patients (19 patients, 61%) needed secondary procedures. Eyelid procedures were the most common, including eyelid weight, cantopexy, blepharoplasty, tarsorrhaphy, and lateral tarsal strip, which were performed for 16 (52%) patients. Brow lift was performed for 10 (32%), facelift for five (16%), and forehead lift for two (6%) patients. Other static reconstructive techniques were masseter muscle transfer and fascial slings.

Discussion

Facial nerve reconstruction remains a challenge for multidisciplinary head and neck oncology teams. Data on the principles and outcome of facial nerve reconstruction and reanimation after radical parotidectomy are limited, and no consensus exists on the best practice. The present series consists of 31 patients with radical parotidectomy and facial nerve grafting during the 21-year period of 1990–2010 at a tertiary care academic teaching hospital. Parotid surgery aiming to preserve the facial nerve had earlier been performed already for half of the present patients. Intra-operative circumstances caused by the earlier operations and other issues had necessitated the sacrifice of the facial nerve in this series, although only a few patients had had pre-operative nerve deficits. It is noteworthy that during the same study period a large number of patients even with a malignant parotid tumour were operated on at our institution without the sacrifice of the facial nerve.

In the literature, patient series with radical parotidectomy and facial nerve grafting are limited in terms of patients included (mean = 21, range = 4–66) [3,4,9,10,16–19]. Therefore, the present series of 31 patients can be considered as a study of significant size. The marked limitation of this study is it's retrospective nature and the paucity of follow-up notes regarding functional results.

Because of the functional and aesthetic deficits after radical parotidectomy, some kind of facial reanimation is recommended. Primary goals for the reanimation procedures are preservation of critical functions such as vision, nasal airflow, and oral continence, restoration of facial symmetry in rest and in action, and enabling the expression of emotions with facial movements [8,11,17]. There are numerous procedures available when aiming to restore partial function of the facial nerve, but, in the case of disrupted nerve, only direct nerve anastomosis or nerve grafting are sufficient to restore the spontaneous emotional expressions of the face [3]. It is thought that the higher the number of distal nerve branches grafted, the greater the muscle tone and, thus, facial function [10]. The average number of repaired nerve branches (3.2) in our material is comparable with the literature. In the report of Reddy et al. [10], the mean number was 2.75 and, in the series reported by Brown et al. [3] 42% of the patients were treated with two branches and 21% with three.

The majority of the patients with facial nerve reconstruction and sufficient follow-up time (18/23) gained at least slight natural facial movement until the end of the follow-up period and, in more than half (13/23) of them, the facial function ranged from moderate-to-excellent. This result is comparable with other studies: in the material of Brown et al. [3], 66 patients underwent nerve grafting after parotid surgery and 87% of them gained at least some facial function – the

portion being 74% for moderate or better movement. Terhaard et al. [19] reported that 19 out of the 60 patients with radical parotidectomy were treated with facial nerve grafts and at least a partial recovery in facial function was seen in 74% of these patients – the portion being 22% for the group without nerve grafts [19]. In the material of Malik et al. [6], cable nerve grafting to restore facial function was done to 25 patients, with different underlying conditions warranting facial reanimation, and 56% of the patients ended up with at least moderate facial function. Of the 12 patients with radical parotidectomy and facial nerve reconstruction in the material of Reddy et al. [10], 75% of the patients showed at least moderate facial function.

The cable nerve graft is purposed to serve as a structural framework conducting the regenerating facial nerve axons towards distal facial muscle end plates [3,10]. Because the recovery rate for discontinuous facial nerve is ~ 1 mm per day, convalescence from the extratemporal nerve damage is always several months. Longer grafts are linked with a longer recovery time and with a smaller possibility to achieve functionality [5,20]. Thus, proper follow-up time for the final result of facial nerve recovery is thought to be 2 years [19]. Twenty-four (77%) of our patients had a follow-up period of more than 2 years.

In addition to surgery, radiotherapy is used as integrative therapy for patients with high-grade carcinomas, and with advanced stage (III and IV) tumours, positive surgical margins, nerve invasion, and cervical metastases [16]. Adjuvant radiotherapy treatment has been a subject of discussion in terms of facial nerve graft results. Studies assessing this issue are few, as is the number of patients in each study [3,13–15]. The latest two publications state that radiotherapy is not deleterious for nerve regeneration [3,15]. Some earlier studies have not made a difference between pre- and post-operative radiotherapy [14]. This might cause a bias, as pre-operative radiotherapy is a known factor to negatively affect the healing of normal tissues after surgery [3]. In 2014, Hontanilla et al. [16] studied the results of two groups (six and seven patients) after radical parotidectomy and immediate facial nerve repair with sural nerve – one group having no post-operative radiotherapy and the other group having both radiotherapy and brachytherapy. Radiotherapy and brachytherapy had no impact on the immediate outcome of the facial nerve repair with nerve graft. This is convergent with our results as 70% of patients with post-operative radiotherapy gained some facial function after neural grafting, the portion being 78% for all patients.

Besides the dynamic reanimations, also static corrections are recommended in selective cases. As the only treatment, they are thought to be inferior to the dynamic reanimation procedures but, due to the unpredictable nerve regeneration after grafting, especially in elderly patients, static procedures can be added to the nerve repair at the same operative setting [7]. It is also noteworthy that use of a sural nerve graft merely will produce facial tonus at rest and possibly movements in the cheek area. However, eye lids and more importantly frontal areas seldom benefit from the graft and, thus, the majority of patients will need static procedures. Potential primary procedures to the eye area are eyelid weight, lateral tarsal strip or lateral tarsorrhaphy. For the midface, static fascial slings are an option [7]. The effects of muscle tone deficiency can produce brow ptosis and brow lift can be made in long-standing paralysis [7]. Nineteen (61%) of our patients had additional corrective operations, of which 52% were directed to the eyelids. Gold weight was used in most of the cases. This is compatible with the reports by Reddy et al. [10] and Brown et al. [3], in which eyelid operations were needed for 42% and 67% of the patients. Because a number of cases with static procedures are obviously included in most of the published series, it is challenging to analyze the benefit of the sole nerve reconstruction.

To conclude, our experience suggests that most patients (78%) seem to benefit from immediate facial nerve grafting. Even a weak but natural movement is valuable and can be augmented with secondary static operations. Administration of post-operative radiotherapy does not seem to affect the final outcome of the facial function.

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