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A new electroneurography as a prognostic tool for marginal mandibular nerve paralysis after parotid gland surgery: A preliminary evaluation

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ABSTRACT

Objective: Marginal mandibular nerve paralysis is the most frequent complication of benign parotid tumor surgery and results in cosmetic deformity. The purpose of this study was to develop a new electroneurography method for marginal mandibular nerve paralysis using electroneurography (ENoG) and judge its usefulness for clinical practice.

Methods: Twenty-seven patients who underwent surgery for benign parotid tumor were enrolled. We proposed and use the mandibular angle method, in which the recording electrode was placed on the skin above the depressor anguli oris muscle while the reference electrode was placed on the skin of the parietal region, and percutaneous electrical stimulation was applied to enclose the mandibular angle that could measure the function of the marginal mandibular nerve solely. Preoperative and postoperative ENoG values were compared in paralytic and non-paralytic patients.

Results: The mean postoperative ENoG value (35.0%) was lower than the preoperative value (90.5%) in paralytic patients, whereas no difference was observed between preoperative (79.3%) and postoperative (69.5%) ENoG values in non-paralytic patients.

Conclusion: A new ENoG method (mandibular angle method) was thought to reflect marginal mandibular nerve injury and might be useful for determining the likelihood of paralysis.

1. Introduction

Parotid tumors are relatively rare in the head-and-neck surgery field. The majority of parotid tumors are benign tumors: parotid gland cancer is uncommon [1]. For patients with a benign parotid tumor, surgical resection is the first choice for treatment, especially in cases of pleomorphic adenoma, which has the potential to develop malignancy. Preserving all facial nerve branches running through the parotid gland and their function is a fundamental goal in benign parotid tumor surgery. However, transient postoperative hemifacial nerve paralysis occurs in 25%–46% of patients and permanent paralysis in 2%–6% [2–4]. The incidence of facial palsy depends on where the tumors are located in the parotid gland: cases with superficial lobe or lower pole tumors show low frequency of postoperative facial palsy in contrast to that of deeper tumors [4,5]. Postoperative paresis of the marginal mandibular branch of the facial nerve that innervates the depressor anguli oris, depressor labii inferioris and mentalis muscles [6] is the most frequent, at up to 66% [4]. Most of the postoperative facial palsy is transient; however, for patients, it is crucial to know when the palsy will recover.

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Electroneurograms (ENoGs) have been worldwidely used to assess the prognosis in hemifacial palsy, especially Bell's palsy and Ramsay Hunt syndrome. In ENoG, the main trunk of the facial nerve is electrically stimulated percutaneously. Then, the amplitude of the compound muscle action potentials (CMAPs) from the facial muscles are measured bilaterally. The ENoG value, which is the ratio of the CMAP on the paralyzed side to that on the healthy side multiplied by 100, reflects the percentage of facial nerve degeneration on the paralyzed side [7,8]. From the perspective of prognosis, recovery from facial palsy occurs soon after onset in patients with idiopathic facial palsy ENoG values above 10% (up to 90% degeneration) and the probability of recovery is good. Below the 10% value (more than 90% degeneration), recovery is typically delayed and patients may experience poor recovery, with an increased probability of synkinesis, due to the misdirection of regenerating axons [9,10]. ENoG performed 10–14 days after the onset is suitable because Wallerian degeneration in the facial nerves needs at least 7 days to reach the distal end of its branches [11]. Then, ENoG can provide useful information to predict the course of the facial palsy. However, standard ENoG is considered not to be appropriate for postoperative facial palsy within 2 weeks of parotid tumor resection because postoperative wound swelling of the parotid region makes it difficult to deliver precise percutaneous electric stimulation to the main trunk of the facial nerve.

In the present study, we proposed and applied a new ENoG method for patients with benign parotid tumor to reflect the transmission of nerve impulses in the marginal mandibular nerve alone, both preoperatively and postoperatively. The aim of this preliminary study was to determine whether this ENoG value could reflect marginal mandibular nerve paralysis and whether it could be used clinically to estimate the prognosis of postoperative facial palsy after parotid tumor surgery.

2. Materials and methods

2.1. Patients

Twenty-seven patients (12 males and 15 females; mean age, 52.0 years [age range, 26–73]) with benign parotid tumor (21 pleomorphic adenomas; 4 Warthin's tumors; 2 basal cell adenomas) who underwent resection of the tumor at our hospital were enrolled. No patient had preoperative facial palsy before the surgery, histories of facial palsy or systemic neurologic disorders. This study was conducted in accordance with the guidelines for good clinical practice [12] and the Declaration of Helsinki [13], and was approved by the ethics committees of Osaka Medical College (Approved #1496). Informed consent was obtained from all patients before the measurement and surgery.

2.2. Recording electrode setting

CMAP measurements were performed 1 day before surgery and 8 days after surgery. Wallerian degeneration of the facial nerve occurs around the geniculate ganglion in the temporal bone and needs 7 days to be completed with extension to the distal end of the nerve in Bell's palsy [11]. In cases with intraoperative marginal mandibular branch injury, the damaged site of the nerve was much more peripheral than the geniculate ganglion, and it may take fewer days to complete the nerve degeneration. Therefore, we performed the second measurement 8 days after surgery.

In our new ENoG method, the recording electrode (cathode), connected to the negative input of the amplifier, was fixed to the skin over the depressor anguli oris muscle (1 cm inferior and posterior to the angle of the mouth) while the reference electrode (anode), connected to the positive input, was placed on the skin of the parietal region (Fig. 1). The reason why we chose the cathode put over the depressor anguli oris muscle was because the marginal mandibular branch innervates the depressor anguli oris, depressor labii inferioris and mentalis muscles [6]. Those 3 muscles are partially overlapped, and the depressor anguli oris muscle is the most superficial of these muscles [6]. Both electrodes (6 mm in diameter) were filled with electrode paste and taped firmly to the skin. After recording CMAPs on one side, the cathode was repositioned contralaterally, but the anode was not repositioned. Then, the CMAPs were then measured on the contralateral side.

2.3. Apparatus and procedures

All measurements were made by the same medical technologist. Moist hook-and-loop tape with a ground electrode was wound around one wrist. Percutaneous electrical stimulation was produced with moist bipolar surface electrodes that were enclosed in a plastic block. The electrodes in the stimulator were 6 mm in diameter and 23 mm apart. Basically,

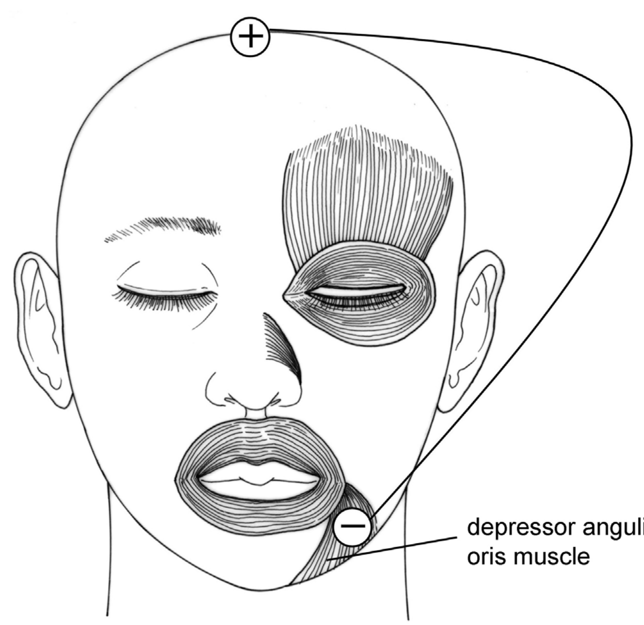

Fig. 1. Positions of recording and reference electrodes. The recording electrode connected to the negative input of the amplifier (cathode) was fixed to the skin above the depressor anguli oris muscle (1 cm inferior and posterior to the angle of the mouth) and the reference electrode connected to the positive input (anode) was placed on the skin of the parietal region. −: recording electrode; +: reference electrode.