

Neuroguided Surgery: A Safe Technique to Prevent Nerve Injuries in Rhytidoplasty

Cirurgia neuroguiada: uma técnica segura para prevenir lesões nervosas em ritidoplastia

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Abstract

Rhytidoplasty (facelift surgery) ranks among the most frequently performed esthetic procedures worldwide. However, the growing volume of surgeries has increased the incidence of complications, particularly nerve injuries. Among these complications, facial nerve damage remains one of the most feared, due to its potential to cause facial paralysis, resulting in both esthetic and functional issues. In response to this challenge, neuronavigation has emerged as a viable, effective tool. By providing real-time, millimetric location of facial nerve branches, neuronavigation enables safer surgical dissection, even in cases with altered or challenging anatomical landscapes. The present article introduces the concept of *neuroguided facial surgery*, a technique that can be integrated into facelift procedures to minimize the risk of iatrogenic facial nerve injury. The current study has the goal of describing the neuroguided approach in facelift surgery, highlighting its efficacy in reducing the incidence of nerve-related complications.

Keywords

- neuroguided surgery
- facial nerve injury
- rhytidoplasty

Resumo

A ritidoplastia (cirurgia de *lifting* facial) está entre os procedimentos estéticos mais frequentemente realizados em todo o mundo. O aumento do volume de cirurgias tem sido acompanhado por uma maior incidência de complicações, especialmente lesões nervosas. Entre essas, a lesão do nervo facial continua sendo uma das mais temidas, devido ao seu potencial de causar paralisia facial, com consequências tanto estéticas quanto funcionais. Em resposta a esse desafio, a neuronavegação surgiu como uma ferramenta viável e eficaz. Ao fornecer a localização milimétrica e em tempo real dos ramos do nervo facial, a neuronavegação permite uma dissecação cirúrgica mais segura, até mesmo em casos com anatomia alterada ou de difícil identificação. Este artigo apresenta o conceito da *cirurgia facial neuroguiada*, uma técnica que pode ser incorporada aos procedimentos de ritidoplastia para minimizar o risco de lesões iatrogênicas do nervo facial. Este estudo tem como objetivo descrever a abordagem neuroguiada na cirurgia de *lifting* facial, com destaque para sua eficácia na redução da incidência de complicações relacionadas a lesões nervosas.

Palavras-chave

- cirurgia neuroguiada
- lesão de nervo facial
- ritidoplastia

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Introduction

Facelift surgery (rhytidoplasty) is one of the most popular cosmetic procedures, with several techniques for facial rejuvenation. As this surgery has evolved, so have its complications. Among these complications, facial nerve injuries are a critical concern. Damage to a facial nerve branch can result in facial muscle paralysis, leading to facial asymmetry, functional impairments, and psychosocial issues.¹

Nerve injuries occur in up to 4% of the cases,² and permanent damage leads to facial-muscle atrophy, oral asymmetry, nasal collapse, lower-lip deformities, ectropion, lagophthalmos, and keratitis. These complications vary depending on the etiology, the level of injury, the duration of the paralysis, and individual biological characteristics.^{3,4} They are often irreversible and can have profound esthetic and functional repercussions. The treatment of facial paralysis remains a challenge for plastic surgeons and has limited results. Restoring a symmetrical facial expression to its fullness is virtually impossible.⁵⁻⁷

As surgical techniques become more complex, the risk of nerve damage increases. The deep-plane facelift technique, for instance, involves deeper dissection planes and releases facial ligaments close to facial nerves. Moreover, the increasing use of collagen biostimulators, thread lifts, and fillers in previous facial treatments can alter healthy anatomical structures, presenting an additional challenge for surgeons. In this context, the need for more precise and reliable methods to prevent nerve injury is evident.

In neurosurgery and craniofacial surgery, nerve injury is also a concern, and neuronavigation has proven invaluable. This technology enables the precise identification of key anatomical structures, including cranial nerves. As such, it enhances the surgeon's ability to perform procedures with millimetric precision and minimizes the risk of injury.^{2,8}

Inspired by this approach, the current article presents the *neuroguided facial surgery* technique. This technique can be widely combined with facelift procedures, employing intraoperative navigation and monitoring to protect the facial nerve and its branches, preventing iatrogenic injuries during facelifting.

Objective

The present article describes the technique of nerve monitoring during facelift surgery. The study focused on the safe identification of facial nerve branches and emphasized its benefits in the prevention of nerve injuries.

Materials and Methods

The current study involved 10 patients (7 women and 3 men) eligible for deep-plane facelift surgery, aged between 45 and 67 years, who were selected sequentially. None of the patients had undergone previous facial surgeries. Two patients had never undergone previous esthetic procedures.

The remaining eight subjects had already undergone treatments with injectable collagen biostimulators (polylactic acid and calcium hydroxyapatite) and non-permanent fillers (hyaluronic acid).

All selected patients underwent electroneuromyography (ENMG) no later than 30 days before surgery to rule out preexisting nerve lesions. No abnormal findings were identified on the ENMG.

Surgical procedure

The patients were in the supine position under general anesthesia with no muscle relaxants to avoid interfering with nerve stimulation. A sterile preparation using 2% chlorhexidine degerming solution and 0.2% chlorhexidine alcohol solution was performed on the face, followed by the application of sterile drapes. Neuronavigation was then installed bilaterally on the face to monitor areas at risk of nerve injury during dissection.⁹

Before starting the surgery, the patients received a subdermal infiltration (25 mL per hemiface) of a 0.5% saline solution with adrenaline (1:200,000), without local anesthetics, covering an area in the shape of a 4-cm radius semicircle, centered on the anterior border of the tragal tubercle, to minimize bleeding during subcutaneous dissection before proceeding to the sub-submuscular aponeurotic system (sub-SMAS) layer.

Lead placement

Five pairs of leads were placed bilaterally along the main branches of the facial nerve:

- **Temporal branches:** 1 cm above the orbital rim, on the midpupillary line;
- **Zygomatic branches:** 2 cm below the orbital rim, on the midpupillary line;
- **Buccal branches:** Midway between the labial commissure and the nasal ala;
- **Mandibular branches:** 2 cm laterally to the midline of the chin; and
- **Cervical branches:** 1.5 cm below the mandible, on the anterior border of the sternocleidomastoid muscle.

The leads were inserted obliquely (30–45°) into the subdermal plane and protected with sterile, transparent dressings (–Fig. 1). Placement and preparing of all leads, as well as setting up the device, took 15 to 20 minutes.

Intraoperative neuromonitoring

During the surgeries, the NIM Response 3.0 system (Medtronic plc) monitored facial nerve activity. The surgeon used an electrical stimulation probe connected to the system. The distal portions of the leads and the probe were also attached to the same interface. The parameters included a variable intensity between 0.5 mA and 1.0 mA, which ensured a depth and approximation margin of 0.3 to 0.5 mm between the stimulation point and the nerve.

The risk of injury to any branch of the facial nerve, either from direct contact or excessive traction, triggered an

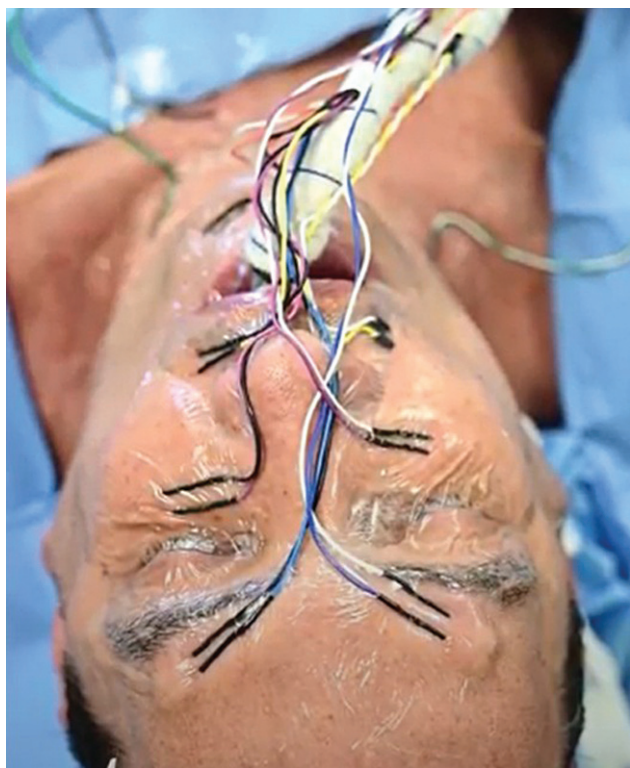


Fig. 1 Bilateral facial monitoring.

audible alarm and recorded a change in the ENMG waveform, reflecting the intensity of the stimulus (► **Videos 1–2**).

Video 1

Using an electrical stimulation probe, the surgeon identifies the buccal branch of the facial nerve. Online content including video sequences viewable at: <https://www.thieme-connect.com/products/ejournals/html/10.1055/s-0046-1816068>.

Video 2

Monitor view of intraoperative electroneuromyography showing the facial nerve and its branches. Online content including video sequences viewable at: <https://www.thieme-connect.com/products/ejournals/html/10.1055/s-0046-1816068>.

Dissection was performed with a high-frequency electro-surgical unit, set to coagulation mode at 10 MHz, which provided precise tissue separation while preserving nerve integrity. The surgeon monitored the neuronavigation screen and ENMG feedback to ensure safe dissection, making real-time adjustments as needed.

At the end of the procedures, the surgeon checked the integrity of each facial nerve branch using an electrical probe. Next, the leads were removed, and the surgery was completed with sutures and dressings.

Each patient underwent an ENMG of the face 30 days after surgery to confirm full functionality of the facial nerve and its branches.

Results

A comparative analysis of the pre-, intra-, and postoperative ENMG scans revealed that no patient presented with facial nerve injury. All branches of the facial nerve remained intact, with no record of damage during surgery or in the 30-day follow-up.

Discussion

The increasing complexity of facial rejuvenation surgeries, especially those involving deeper anatomical planes, has heightened concerns about nerve injury. The proximity of facial nerve branches to key surgical areas, combined with alterations in facial anatomy resulting from previous esthetic treatments, highlights the need for more precise surgical techniques to minimize the risk of injury. *Neuroguided facial surgery* involving neuronavigation and ENMG monitoring offers a highly-effective solution. Real-time identification of nerve branches and the ability to monitor proximity during surgery significantly reduce the risk of injury. Furthermore, this approach enables surgeons to perform precise dissections with greater safety, even under altered anatomical conditions. The current study demonstrates that neuro-guided facial surgery is an effective method to prevent nerve injury, offering valuable surgical safety and peace of mind to the surgeon. The integration of intraoperative monitoring has the potential to become standard practice in esthetic surgery, minimizing risks. It is strongly recommended that surgeons perform intraoperative monitoring of facial-nerve branches whenever possible. Moreover, the neuroguided facial surgery technique provides a crucial additional safety measure, which can pave the way for the development of new surgeries for facial rejuvenation.

Conclusion

In neuroguided facial surgery, the use of neuronavigation and ENMG results in a safe, effective, and precise technique to protect the branches of the facial nerve during facelifting. This method significantly reduces the risk of iatrogenic injuries, ensures safer dissection in the vicinity of facial ligaments, and enables a more effective release of the SMAS layer. The present article underscores the need for continuous innovation in cosmetic surgery, particularly in the integration of technologies to increase safety. The use of neuroguided surgery in facelifting paves the way for safer and more predictable results in the field of facial rejuvenation.

Data Availability

Data will be available upon request to the corresponding author.

Authors' Contributions

MOS: final manuscript approval, data collection, conceptualization, study conception and design, project management, methodology, performance of surgeries and/or experiments, and supervision; PL: statistical analysis, data collection, conceptualization, study conception and design, project management, methodology, performance of surgeries and/or experiments, writing – original draft, and writing – review & editing; and RMDMC: performance of surgeries and/or experiments and supervision.

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Clinical Trials

None.

Conflict of Interests

The authors have no conflict of interests to declare.

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