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# The surgical management of frontal branch of the facial nerve injuries

**Mohamad Nazmi Nordin[1], Elena Pescarini[2], Ruben Yap Kannan[1]**

[1]Department of Plastic Surgery, Queen Victoria Hospital, East Grinstead RH19 3DZ, UK.
[2]Department of Plastic Surgery, San Bortolo Hospital, Vicenza 36100, Italy.

**Correspondence to:** Mr. Mohamad Nazmi Nordin, Department of Plastic Surgery, Queen Victoria Hospital, Holtye Road, East Grinstead RH19 3DZ, UK. E-mail: mohamad.nordin@nhs.net

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## Abstract

**Aim:** The frontal branch of the facial nerve is particularly vulnerable to traumatic injury or during surgery. While the larger branches of the facial nerve, such as the buccal branch, are more easily identifiable and amenable to repair, the repair of the frontal branch is not common due to its complex branching pattern and smaller size. The description of the surgical approach to repair the frontal branch of the facial nerve is limited in the literature. In this study, we aim to explore the outcomes of patients who underwent frontal branch facial nerve repair in our centre.

**Method:** In a retrospective case review at a single, tertiary Plastic Surgery centre, we performed frontal branch repair for eight patients ($n$ = 8) who sustained complete or partial division of the frontal branch of the facial nerves. These patients were followed up postoperatively and assessed with the Sunnybrook Facial Grading System.

**Results:** Using super microsurgical techniques, primary nerve coaptations, fascicular nerve flaps, and direct neurotisations were performed. All eight patients (100%) demonstrated improvements in terms of resting brow symmetry. There was a significant improvement in brow and frontalis function following surgical repair of the frontal branch, with 87.5% (seven patients) demonstrating improvement in forehead movement.

**Conclusion:** In this case series, we demonstrated that the repair of the frontal branch of the facial nerve is relevant, with reasonably good functional outcomes. Repair of the frontal branch of the facial nerve should ideally be done as early as possible following the injury. Nevertheless, delayed repair may still be beneficial within 18 months after the injury.

**Keywords:** Microsurgery, frontal branch of facial nerve, facial nerve injury, facial nerve repair

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## INTRODUCTION

The facial nerve is particularly susceptible to injury from blunt or penetrating trauma to the head and neck, as well as during craniofacial or dermatological surgery. Injuries to the facial nerve may result in ipsilateral paralysis of the muscles of the face, which has debilitating functional, psychosocial, and aesthetic consequences for patients. Depending on the extent and location of the facial nerve injury, surgical repair of the damaged nerve in the context of microsurgery may provide a promising outcome. Larger branches of facial nerve, such as the buccal branch, are easier to identify and, hence, more amenable to repair. The frontal branch of the facial nerve, on the other hand, has a complex branching pattern and is relatively smaller in size, which poses a constant challenge to repair once damaged. Generally, it is not a common practice to repair the damaged frontal branch of the facial nerve. In this study, we present the outcomes of eight patients who underwent frontal branch facial nerve repair in our centre.

## PATIENTS & METHODS

We performed a retrospective case review of practice at a single, tertiary Plastic Surgery centre over the course of three years from 2016 to 2019, performed by the senior author *(RYK). Patients who had sustained complete or partial division of the frontal branch of the facial nerves, and subsequently underwent either immediate or delayed surgical repair, as shown in [Figures 1A and B], were followed up. As these were traumatic lacerations, the frontal branch of the facial nerve was found in the vicinity of the scar itself, with the help of a battery-operated nerve stimulator. The mechanism of injury included in this study was either due to iatrogenic injury or traumatic injury, in the immediate or delayed (within 18 months) phase. Immediate repair was defined as less than 72 h, whereas delayed repair was between six to eighteen months. None of the patients included had any surgical intervention between 72 h and six months because most of these patients would have been managed conservatively anyway during this period.

Postoperatively, these patients were followed up clinically, and they were assessed with the Sunnybrook Facial Grading System. Those with muscle denervation lasting longer than 18 months were excluded from this study, as were masseteric-facial nerve transfers.

## RESULTS

In this cohort, eight patients underwent either immediate or delayed repair of the frontal branch. There were five males and three females, with the age between 22 and 83 years. Using super microsurgical techniques, primary nerve coaptations, fascicular nerve flaps, and direct neurotisations were performed. Denervation times ranged between 0 to 9 months. Of the eight patients ($n$ = 8) in this cohort, 75% of the injuries (six patients) were repaired immediately (denervation time < 72 h), and two repairs were performed at 9 months post-onset [Table 1]. All eight patients (100%) demonstrated improvements in terms of resting symmetry. 87.5% (seven patients) demonstrated improvement in the function of brow and frontalis movement, with 37.5% (three patients) showing complete movement recovery (5/5 Sunnybrook score postoperatively), 25% (two patients) showing almost complete movement recovery (4/5 Sunnybrook score postoperatively), and 25% (two patients) demonstrating improvement in initiating movement (3/5 Sunnybrook score postoperatively). This is graphically depicted in [Figure 2]. One patient, who underwent an immediate repair following Atypical Fibroxanthoma removal, failed to demonstrate significant improvement following the frontal branch repair. Images and videos of patients who had immediate and delayed frontal branch facial nerve repair are shown in [Figures 3 and 4], respectively, with [video 1] showing the postoperative improvement after frontal branch facial nerve repair.

**Table 1. Qualitative and quantitative outcomes following immediate or delayed surgical repair of frontal branch of facial nerve**

| No | Age | Gender | Aetiology | Denervation time | Procedure | Outcomes | Resting symmetry | | Movement | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Pre-op | Post-op | Pre-op | Post-op |
| 1 | 22 | M | Trauma | < 72 h | Direct coaptation | Excellent | -5 | 0 | 1 | 4 |
| 2 | 23 | F | Trauma | < 72 h | Direct coaptation | Excellent | -5 | 0 | 1 | 4 |
| 3 | 32 | F | Trauma | < 72 h | Direct coaptation | Excellent | -5 | 0 | 1 | 5 |
| 4 | 82 | M | Iatrogenic | < 72 h | Direct coaptation | Excellent | -5 | 0 | 1 | 5 |
| 5 | 82 | M | Iatrogenic | < 72 h | Frontal branch fascicular nerve flap ( × 2) | No improvement | -5 | 0 | 1 | 2 |
| 6 | 83 | F | Iatrogenic | < 72 h | Fascial flap cover over coaptation | Excellent | -5 | 0 | 1 | 5 |
| 7 | 27 | M | Trauma | 9 months | Direct coaptation | Excellent | -5 | 0 | 1 | 3 |
| 8 | 81 | M | Trauma | 9 months | Direct coaptation | Excellent | -5 | 0 | 1 | 3 |


**Figure 1.** (A and B) Intra-operative images of the divided branches of the frontal branch of the facial nerve pre- and post-repair.

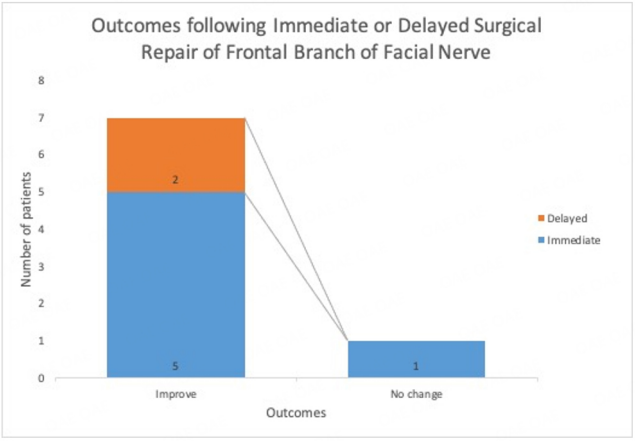


**Figure 2.** Outcomes following Immediate or Delayed Surgical Repair of Frontal Branch of Facial Nerve.

## DISCUSSION

The extratemporal portion of the facial nerve begins as the nerve exits the temporal bone through the stylomastoid foramen. The pathway continues as the facial nerve enters the parotid gland, where the main trunk divides into upper and lower division, before further division into five main branches (temporal, zygomatic, buccal, marginal mandibular, and cervical) that innervate muscles of the face.

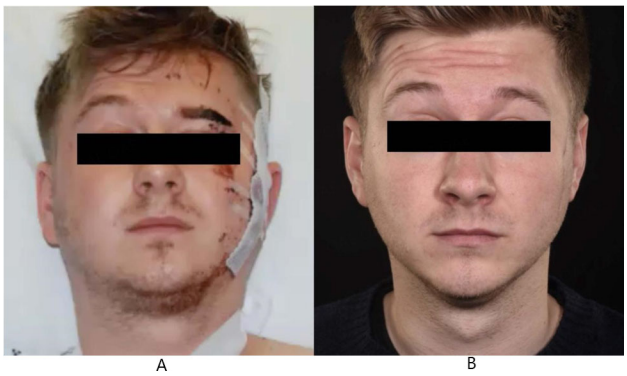


**Figure 3.** (A and B): Preoperative (left) and postoperative results (right) of an Immediate Frontal Branch Facial Nerve Repair in the acute trauma setting (patient 1).

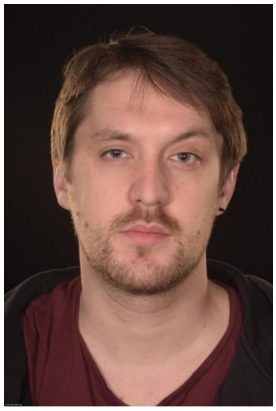

**Figure 4.** Preoperative image of patient 7, who had a Delayed Frontal Branch Facial Nerve Repair.

The cutaneous course of the frontal branch runs along the Pitanguy line, which is 0.5 cm from the tragus to 1.5 cm lateral to the supraorbital rim[1]. The temporal branch of the facial nerve (also known as the frontal branch) typically emerges from the parotid as the zygomatic frontal trunk, which then divides into terminal branches of zygomatic and frontal branch, about 1 to 2 cm from the exit point of the parotid gland[2]. The frontal branch travels over the zygomatic arch, where it lies deep to the SMAS above the zygomatic arch. At this point, the frontal branch has an additional fascial layer protecting it, called the parotid temporal fascia, which is separate from the SMAS.

The anterior frontal branches of the facial nerve play an essential role in innervating the orbicularis oculi, the frontalis, and the corrugator supercilia muscles. Injury to these branches may result in the inability to frown or wrinkle one's forehead. The frontal branch of the facial nerve is particularly vulnerable during head and neck surgeries due to the complexity of its course, and the damage to these branches is the most complicated as they are mostly terminal branches with no anastomotic connections[3].

The repair of the damaged frontal branch of facial nerve is not a common practice and very little of this surgical approach is described in the literature. In this study, we reported reasonably good outcomes of frontal branch repair, with seven out of eight patients demonstrating improvement in brow and frontalis function [Figure 3A and B]. In such cases of acute traumatic injuries following penetrating wound or iatrogenic nerve sectioning, primary neurorrhaphy or direct repair of the nerve is said to provide the best

outcome, with the best results achievable with a tension-free coaptation[4,5]. This is because the presence of tension on the suturing of severed nerves will likely reduce perfusion and neural regeneration[6]. In 2015, Emamhadi and Mahmoudi described a case of a 24-year-old gentleman who presented with a sharp penetrating trauma to the right temporal region, causing unilateral paralysis of muscles of the right forehead[7]. Frontal nerve reconstruction was performed a month after the trauma, with end-to-end anastomosis of branches of the frontal nerve done. The outcome was good, and the paralysis improved after several months. In another case report by Shafaiee in 2016, a 35-year-old gentleman had a stab wound causing deep laceration in the left temporal area and complete muscle paralysis of the left half of the face[8]. End-to-end anastomosis of frontotemporal, zygomatic, buccal, and mandibular nerves was undertaken, and 1.5 years later, gradual improvement in facial muscle was observed, except the branches of the frontal nerve.

In cases where primary repair is not feasible, an interpositional graft may be considered. Interestingly, in 2019, Ali *et al.* described a successful non-microsurgical grafting for facial nerve branches[9]. A 49-year-old gentleman underwent radical parotidectomy with the excision of four facial nerve branches (frontal, zygomatic, buccal, and mandibular). Immediate non-microsurgical reconstruction was performed, with branches of the great auricular nerve used to repair the defects of the four facial nerve branches. Postoperatively, excellent functional outcome was reported with full recovery after one year without any fasciculation or muscle dyskinesia.

Fascicular nerve flap is another approach that can be used for frontal branch repair. This involves using a vascularised fascicular flap to repair a nerve gap. Fascicular nerve flap offers fast and accurate nerve sprouting, which results in excellent nerve regeneration[10].

In our study, we focussed on immediate versus delayed facial nerve repair. While a comparison between complete palsy or partial weakness (paresis) would be ideal, we did not have sufficient paretic patients to compare this data significantly. This is a limitation of this study, pending further clinical research beyond the current retrospective case review.

## CONCLUSION

Supermicrosurgery has given us an extra dimension necessary to repair minute structures, such as the frontal branch of the facial nerve. In this case series, we demonstrated that the repair of the frontal branch of the facial nerve is relevant, with reasonably good functional outcomes. Repair of the frontal branch of the facial nerve should be done as early as possible following the injury. However, in late presentations of cases, delayed repair is still doable within 18 months after injury. It is vital for us to understand the anatomical course of the nerve, and to pay attention to details when repairing every possible nerve branch.

## DECLARATIONS

### Authors' contributions

Made substantial contributions to the conception and design of the study, performed data analysis and interpretation: Nordin MN

Performed data acquisition, as well as providing administrative, technical, and material support: Kannan RY, Pescarini E

### Availability of data and materials

The data supporting the findings of our study was retrieved from our patients' electronic database.

### Financial support and sponsorship
None.

### Conflicts of interest
All authors declared that there are no conflicts of interest.

### Ethical approval and consent to participate
The study was conducted in accordance with the principles of the Queen Victoria Hospital's Clinical Research and Governance and ethical approval was obtained (Study ID: 1461). Written informed consent to participate was obtained.

### Consent for publication
Written informed consent for publication was obtained from the patients involved.

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