Value of the Use of Facial Nerve Monitoring in Otorhinolaryngological Surgeries

A Systematic Review/Meta-Analysis

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Submitted by

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بسم الله الرحمن الرحيم

قالوا

سبحانك لا علم لنا
إلا ما علمتنا إنك أنت
العليم الحكيم

صدق الله العظيم

سورة البقرة الآية: ٣٢

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List of Abbreviations

Abb.	Full term
Abbr.	*Full term*
CI	*Confidence interval*
CMAP	*Compound muscle action potential*
CN VI	*Abducent nerve*
CN VII	*Facial nerve*
CN VIII	*Vestibulo-cochlear nerve*
CN	*Cranial nerve*
CPA	*Cerebello-pontine angle*
CSF	*Cerebrospinal fluid*
DC	*Direct current*
DES	*Direct electrical stimulation*
df	*Degree of freedom*
EMG	*Electromyography*
FEM	*Fixed effects method*
FN	*Facial nerve*
FNM	*Facial nerve monitoring*
GSPN	*Greater Superficial Petrosal Nerve*
Hz	*Hertz*
I^2	*I-square index*
IAC	*Internal auditory canal*
IOFNM	*Intraoperative facial nerve monitoring*
IOVM	*Intraoperative video monitoring*
LED	*Light emitting diode*

List of Abbreviations Cont…

Abb.	Full term
mA	*Milliampere*
mS	*Milliseconds*
OR	*Odds ratios*
REM	*Random effects method*
SE	*Standard error*
SMD	*Standardized mean differences*
vs	*Versus*
VS	*Vestibular schwannoma*

ABSTRACT

Background: The anatomy of the facial nerve is among the most complex of the cranial nerves. Facial nerve is not just a pure voluntary motor nerve but comprises parasympathetic, general sensory, and special sensory components as well. Facial nerve monitoring is one of the most exciting innovations in neurotologic surgery in the past decade.

Objective: To determine the effect of intraoperative facial nerve monitoring on postoperative facial nerve function and on operative time.

Patients and Methods: In general terms, FNM means electrophysiological monitoring. This technique provides for monitoring of facial muscle activity via electromyography (EMG).The EMG is typically recorded with needle electrodes placed in facial nerve muscles. Voluntary activation of the facial nerve in the alert patient as well as intraoperative electrical stimulation or mechanical irritation during surgery generates motor evoked potentials. In this meta-analysis, the included studies are ten in number with total 593 patient (control= 311, IOFNM = 282)

Results: Comparison of facial nerve monitoring vs. no monitoring as regards incidence of facial nerve dysfunction shows there is no evidence of heterogeneity and statistically significant (p-value <0.01) which indicate that the incidence of FN dysfunction in the monitoring group is lower than the dysfunction in the no monitoring group. Comparison of facial nerve motoring vs. no monitoring as regards operative time shows there is no evidence of heterogeneity. Under the random effect model, the standardized mean difference (SMD) is -0.62 which is statistically significant (p-value <0.01) favoring facial nerve motoring over no monitoring. Which indicate that the mean surgery time was lower in the group of patients operated with facial monitoring as compared with the unmonitored group.

Conclusion: So, our meta-analysis shows statistically significant results which favor facial nerve monitoring over no monitoring as regards decreasing the operative time and improving of postoperative facial nerve dysfunction.

Keywords: Facial nerve monitoring, standardized mean difference, electromyography

INTRODUCTION

The anatomy of the facial nerve is among the most complex of the cranial nerves. Facial nerve anatomy is categorized in terms of its relationship to the cranium or temporal bone (intracranial, intratemporal, and extratemporal). Facial nerve is not just a pure voluntary motor nerve but includes parasympathetic, general sensory, and special sensory components as well. Notably, the facial nerve has numerous interconnections with other cranial, parasympathetic, and sympathetic nerves along its course ***(Terence and Susan, 2004).***

The facial nerve can be injured by direct mechanical disruption from a rotating burr, transection with a sharp instrument, accidental evulsion (e.g., from traction), or a crushing injury. A rotating surgical burr can produce thermal injury without directly contacting the facial nerve. Thermal injury is more likely when diamond burrs are used than when cutting burrs are employed. Mechanical trauma and thermal injury can lead to progressive inflammation, neural edema, and ischemia, which may in turn result in immediate or early onset or delayed facial palsy ***(Stanislas et al, 2016).***

Facial nerve monitoring is one of the most exciting innovations in neurotologic surgeries in the past decade. The importance of such monitors is borne out by the devastating complications that can result from facial nerve injury during surgery including alteration of facial appearance, exposure of the eye to vision-threatening dryness and infection, and impairment of competence of the oral sphincter causing drooling and alterations in vocal quality ***(Chen et al, 2009).***

The underlying principle for intraoperative monitoring is that some types of injury can be reversed, Facial nerve monitoring may be useful to identify the facial nerve when it is not clearly visible in the surgical field, Localizing distal nerve fragments in trauma cases, and identifying sites of nerve compression.

Otologic procedures in which the nerve is at risk include cochlear implantation, revision tympanomastoidectomy, and repair of external auditory canal bony stenosis. Monitoring may augment safety in cases where the anatomy is altered by infection, trauma, or congenital malformation ***(Huang et al, 2009).***

Facial nerve monitoring was created in early 1900s. However, to our knowledge its advantages is still controversial and under discussion.Some of the risks of facial nerve monitoring are false positive or negative results which lead to misrecognition of facial nerve. Also, it may lead to overconfidence, which can give a false sense of security and result in less caution when performing surgical procedures ***(Stanislas et al, 2016).***

Aim of the Work

The aim of this study is:

To determine the effect of intraoperative facial nerve monitoring on postoperative facial nerve function and on operative time.

Chapter One

ANATOMY OF FACIAL NERVE

The course of the facial nerve is very complex. There are many branches, which transmit a combination of sensory, motor and parasympathetic fibers.

Anatomically, the course of the facial nerve can be divided into four parts.

A- Supranuclear pathways

1. Somatomotor cortex: controlling motor component of facial nerve lies in precentral gyrus (Broadmann area 4,6,8).
2. Volitional component: Corticonuclear tracts descend and cross to supply both ipsilateral and contralateral facial (mainly to the contralateral side) nucleus i.e. frontal branch components of the facial nucleus receives bilateral cortico-nuclear tract innervation.
3. Emotional component: Input to the facial nucleus from the basal ganglia and limbic system control involuntary facial expression associated with emotion.

4. Other inputs:

From visual system (involved in blink reflex), Trigeminal nerve and nuclei (involved in corneal reflex) and auditory nuclei (involuntary closure of eye in response to loud noise).

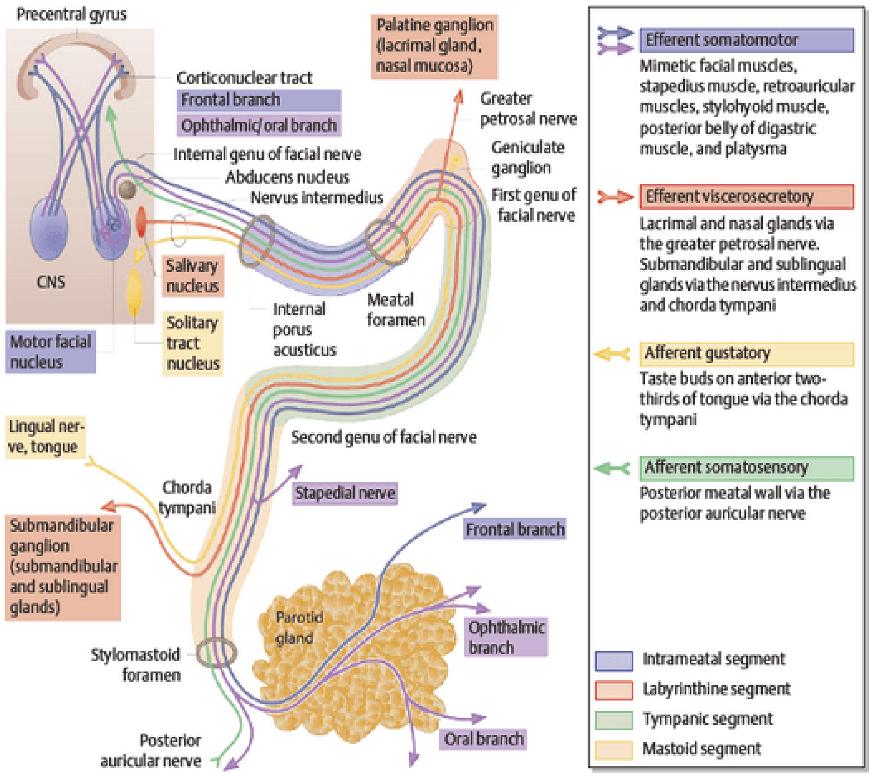

Figure (1): Course of the facial nerve.

B- Intracranial part (15-17 mm)

1. Nucleus:

- Motor nucleus (pons) – to motor fibers.
- Superior salivatory nucleus (pons) – parasympathetic component to nerve of Wrisberg or Nervus intermedius.

- Nucleus of solitary tractus (medulla) – receives sensory component from nerve of Wrisberg or Nervus intermedius.

2. **Before leaving brainstem:** motor fibers wind around the abducent nucleus (CN VI) to form an internal genu
3. **Leaves brainstem:** at pontomedullary junction
4. **After leaving brainstem:** motor fibers align with nervus intermedius and together enters Internal acoustic meatus, along with vestibulo-cochlear nerve (CN VIII)

FN leaves brainstem in close association with vestibulocochlear nerve at Cerebello-pontine angle (CPA). Vestibular schwannoma and other tumors arising in the region of the cerebellopontine angle, may compress the facial nerve ***(Brazis et al, 1996).***

C- Intratemporal part

It starts at internal acoustic meatus to Stylomastoid foramen and divided into:

1. Meatal segment (8-10 mm): Within internal acoustic meatus – upto fundus:

- Location: At the fundus or lateral end of the internal auditory canal (IAC), the transverse or falciform crest divides the IAC into superior and inferior portions. The superior portion is in turn further divided by the smaller and