# Surgical outcomes of transmastoid facial nerve decompression: Preliminary data from a Malaysian tertiary hospital from 2013-2018

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## ABSTRACT

**Introductions: Facial nerve palsy (FNP) occurs in 7-10% of temporal bone fractures. The aim of this study was to review the surgical outcome of nine patients with severe to complete traumatic facial nerve (FN) injury.**

**Methods: The patients were evaluated clinically and FNP was graded using the House Brackmann (HB) scale. High resolution computerized tomography (HRCT) of the temporal bone was used to evaluate temporal bone fractures. Transmastoid facial nerve decompression was performed and the facial nerve function was re-evaluated in subsequent follow ups.**

**Results: There were five cases with immediate onset and four with delayed onset of FNP. Only three cases had pure temporal bone fractures, the others were associated with other life threatening injuries. The sensitivity and specificity of HRCT temporal bone to detect the obvious facial canal fracture line were 50% and 40% respectively. 75% of patients with immediate onset of HB grade VI FN palsy who were operated within a month recovered completely. Surgeries for the delayed onset FNP were performed at a mean of 70 days (range 51-94). All recovered to HB grade II-III from severe FNP.**

**Conclusions: Our study demonstrated that transmastoid FN decompression surgery was beneficial to traumatic nerve injury. Early intervention resulted in better outcomes. However, FN function could still be salvaged even in delayed FN decompression.**

**KEY WORDS:**
*Traumatic facial nerve palsy, facial nerve decompression*

## INTRODUCTION

The facial nerve (FN) possesses the longest intraosseous course with its narrow, complex and tortuous in the temporal bone. Temporal bone fractures will lead to FN injury in 7-10% of cases.[1] These fractures typically occur as a result of motor vehicle accidents, falls, assaults, and penetrating wounds such as gunshot wounds. Traditionally, temporal bone fractures are classified as longitudinal, transverse or mixed depending on their orientation relative to the petrous ridge. New classification schemes designate temporal bone fractures as violating or sparing the otic capsule.[2] Intratemporal facial nerve injury may manifest as facial paralysis, dysgeusia, decreased lacrimation and hyperacusis depending on segment(s) involved. Onset of the symptoms was found to be immediate in 27% and delayed in 73% of those injured. However, a large number of patients also had brain injury and or multi-organ involvement, resulting in the inability to determine the onset of facial nerve injury. The House Brackman (HB) scale (grade I-VI) is commonly used for the grading of the facial nerve palsy (FNP).

The aim of this study is to present the surgical outcomes of nine patients with HB grade IV-VI FNP who underwent FN decompression.

## MATERIALS AND METHODS

This study was registered with the National Medical Research Registry (NMRR-19-3927-50894) and it received ethical approval from the Ministry of Health Medical Research & Ethic Committee (MREC). [Ref: KKM/NIHSEC/P20-478(4)]

This retrospective review was done on patients who had traumatic temporal bone fractures, sustained FNP and underwent FN decompression at the Sarawak General Hospital from 2013 to 2018. Nine patients fit the following criteria: 1) severe or complete traumatic FNP grade: HB IV-VI, 2) consented for FN decompression, 3) transmastoid FN decompression was performed, 4) neither nerve transplanation nor anastomosis for transected FN was performed, and 5) follow up for at least six month or up to complete recovery.

All patients were assessed and managed fully at the Sarawak General Hospital by the department of nose, ear and throat (ENT). Their facial nerve palsy was graded with HB scale and hearing assessment was performed with pure tone audiogram (PTA). All patients had high resolution computerised tomography (HRCT) done as part of the temporal bone evaluation.

In immediate onset traumatic HB grade IV to VI FNP, the FN decompression was offered immediately. Whereas in delayed onset traumatic FNP regardless of the HB grading, a course of

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tapering dose steriod therapy was offered and facial nerve palsy was re-evaluated. Proper counsel for facial nerve decompression was given to the patients of whom facial nerve palsy remained severe to complete (HB IV-VI) and informed consents were taken prior to the surgery.

Facial nerve decompression was done in all nine patients via the trans-mastoid approach. A posterior auricular incision was made, followed by the cortical mastoidectomy. Superior landmarks (short process of incus, fossa incudis and lateral semicircular canal) and the inferior landmark (digastric ridge) were identified under the operating microscope. A posterior tympanotomy via facial recess was performed to access the sinus tympani. Later, the access into the sinus tympani was widened. The incudostapedial joint, the pyramidal eminence and the round window niche were identified. The posterior buttress was removed and the 2nd genu and the mastoid segment of the facial nerve could be identified at this stage of operation. If obvious fracture line was seen over the mastoid segment, 2nd genu and lateral third of tympanic segment without the involvement of the medial two third of the tympanic segment of FN and 1st genu, then FN decompression performed from lateral third onward laterally. If the fracture line involved medial two third of the tympanic segment of FN and 1st genu, the incus removed by separating it at the incudostapedial joint and the malleoincudal joint. The supralabyrinthine cells would be removed to gain access to the geniculate ganglion. The fibrotic tissues, blood clots and/or bone spicules surrounding the FN were removed. The incus was repositioned and stabilised with gel foam/tympanoplasty type III performed. The FN function was tested with FN monitor before the skin was closed.

After their operation, all patients were followed up at first, third, sixth months and up to one year or more post-surgery to review the outcome of their surgery and any complications of the FNP.

## RESULTS

There were nine patients with a total of ten temporal bone fractures (one of the patients had sustained bilateral temporal bone fractures but with only one sided FNP). The mean age of the patients was 35.6 years old (range 17-62 year old) and all patients were males. Motor vehicle accidents (MVA) were the major cause of traumatic FNP and only one was a case of workplace related cause (tyre explosion).

The right to left temporal bone fracture ratio was 3:7. Longitudinal fractures were the most common fracture (six cases) followed by transverse fractures (three cases) and comminuted fractures (one case). Among the temporal bone fractures, only one case was spared from traumatic FNP while the rest of the nine cases developed FNP. Temporal bone fractures accompanying with the obvious fracture lines over the facial canal were identified in five cases by HRCT temporal bone. The sensitivity of HRCT temporal bone to detect the facial canal fracture line is calculated by five temporal bone fractures with the obvious facial canal fracture line as reported divided by total 10 temporal bone fractures which was 50%. And its specificity is calculated by two temporal bone fractures without facial nerve palsy or no facial canal fracture found intraoperatively (# no.3/L & no.5/R) divided by five temporal bone fractures with no obvious facial canal fracture line as reported which was 40%.

There were five cases of immediate onset of FNP (56%) and four cases of delayed onset of FNP (44%). According to the HB grading system, two patients had grade IV FNP (22.2%), one patient had grade V FNP (11.1%) and six patients had grade VI FNP (66.7%).

Blood clots were found in the external acoustic canal (EAC) in most patients. A laceration of the posterior EAC was seen in one patient. There were six perforated tympanic membranes (TM) and four intact TMs. One hemotympanum was seen in one patient with intact TM. All the temporal bone fracture cases were accompanied with hearing loss (HL), ranging from mild to profound HL. In these six longitudinal fracture cases, four fractures caused mixed HL, one fracture caused conductive hearing loss (CHL) and one fracture caused sensory HL. In the three transverse fracture, two fractured sides caused mixed HL and one fractured side caused CHL. In the comminuted fracture group, one fractured side (50%) developed mixed HL. Mild HL was observed in one mixed temporal bone fracture.

The most common injury accompanying the temporal bone fractures was intracranial bleeding which was observed in four out of nine patients (44.4%), followed by limb fractures in two out of nine patients (22.2%). The other injuries included rib fractures, pneumothorax, periorbital hematoma, and vertebral fractures. Only three patients had pure temporal bone fractures.

All the surgeries were performed at the mean of 47.2 days (range 13-94 days). Intraoperative findings of the facial canal fractures were situated at the mastoid segment (four cases, 44.4%), second genu (four cases, 44.4%) and combination of the second genu and mastoid segments (one case, 11.1%). In most cases, the facial nerves were surrounded by fibrous, granulation tissue and bony spicules. All FNs were responsive to the FN monitor with the stimuli ranged from 0.5mA to 3mA.

In the immediate onset of FNP group, the FN decompression were performed within two weeks from the day of trauma. If it was possible, we would have performed in the following few days after the trauma. However, many had other life-threatening injuries, for examples, chest injury and intracranial bleed, hence the surgeries were delayed until they were clinically stable. The interval of the trauma to surgery was within two weeks in two patients, between two weeks to one month in two patients, and between two to three months in one patient. Three patients (75%) who underwent surgery within one month had a complete recovery to HB grade I and only one patient (25%) had HB grade III recovery. And one who was operated between two to three months had HB grade III recovery.

However, in the delayed onset of FNP group, the interval of the trauma to surgery was between one to two months in one patient, between two to three months in two patients and

**Table I: Demography of the patients & clinical findings**

| No | Age/ Sex | Mode of trauma | # no / side | #type/# line seen over the FC | Otoscopy findings: | Hearing assessment | Other Injuries |
|---|---|---|---|---|---|---|---|
| 1 | 47/M | MVA | 1/R | Longitudinal/ No obvious | Blood clot at EAC, TM intact | Mild to severe CHL | Right temporal EDH, left pneumothorax |
| 2 | 30/M | MVA | 2/R | Longitudinal/ Obvious | EAC clear, TM perforated | Mild to severe mixed HL | Left clavicular fracture, left periorbital hematoma |
| 2 | | | 3/L | Longitudinal/ No obvious | EAC clear, TM perforation | Mild to severe mixed HL | - |
| 3 | 62/M | MVA | 4/L | Comminuted/ Obvious | Blood clot at EAC, TM perforation | Moderate-profound mixed HL | Pan facial fracture |
| 4 | 32/M | MVA | 5/R | Transverse/ No obvious | Blood clot, TM perforation | Mild to severe mixed HL | Nil |
| 5 | 43/M | MVA | 6/L | Longitudinal/ No obvious | Blood clot at EAC, TM perforation | Mild to severe mixed HL | Right temporoparietal EDH, open supracondylar of left femur fracture, right 1st to 3rd rib fractures, T5 vertebral body fracture, fingers fractures |
| 6 | 23/M | MVA | 7/L | Transverse/ No obvious | Blood clot at EAC, TM perforation | Mild to severe mixed HL | Left EDH, closed communuted fracture of left femoral supracondyle |
| 7 | 46/M | Workplace | 8/L | Longitudinal/ Obvious | Blood clot at EAC, TM intact | Mild to moderate mixed HL | Nil |
| 8 | 17/M | MVA | 9/L | Transverse/ Obvious | Blood clot at EAC, hemotympanum | Mild CHL | Nil |
| 9 | 20/M | MVA | 10/L | Longitudinal/ Obvious | Laceration wound over posterior wall with blood clot, TM intact | Moderate to severe HL | Left EDH, SAH, left frontoparietal cephalohematoma |

Pt - Patient
M - Male
F - Female
R - Right
L - Left
# - fracture
FC - Facial canal
EAC - External acoustic canal
TM - Tympanic membrane
HL -Hearing loss
CHL - Conductive Hearing loss
EDH - Extradural hemorrhage
SAH - Subarachnoid hemorrhage

**Table II: Operative data & facial nerve palsy grading**

| Pt No. | # no/ side | Surgery delayed (days) | Type of Surgery | Op findings | Response to FN stimulator | PreOp HB | Post Op >6/12 |
|---|---|---|---|---|---|---|---|
| 1 | 1/R | 86 | RFND | Mastoid segment # with bony spicules & fibrous tissue, ossicles intact, TM intact | Yes, 0.5mA | V | II |
| 2 | 2/R | 23 | RFND | # crossed the 2nd genu with granulation & fibrous tissue | Yes, 3.0mA | VI | I |
| 2 | 3/L | - | - | - | - | - | - |
| 3 | 4/L | 51 | LFND | # line covered with fibrous tissue | Yes, 3.0mA | VI | III |
| 4 | 5/R | 15 | RFND | FN edema and fibrous tissue | Yes, 3.0mA | VI | I |
| 5 | 6/L | 67 | LFND | # at the 2nd genu filled with fibrous tissue, ossicles identified | Yes, 1.5mA | VI | III |
| 6 | 7/L | 13 | LFND | # crossed the 2nd genu with granulation & fibrous tissue | Yes, 2.5mA | VI | I |
| 7 | 8/L | 94 | LFND | # crossed the 2nd genu with granulation & fibrous tissue | Yes, 2.5mA | IV | II |
| 8 | 9/L | 8 | LFND | # at buttress & mastoid segment with granulation tissue | Yes, 3.0mA | VI | III |
| 9 | 10/L | 68 | LFND | # at the 2nd genu extending to the vertical segment filled with fibrous tissue, FN and ossicles were intact | Yes, 2.5mA | IV | II |

# - Fracture
R - Right
L - Left
RFND -Right facial nerve decompression
LFND - Left facial nerve decompression
FN - Facial nerve
Op- Operation
HB - House Brackmann

**Table III: Facial nerve decompression outcome**

| Time to op interval | Amount of patients | No #/side | Onset | Pre-Op HB | Post -Op > 6/12 | Post op hearing assessment ( ABG) |
|---|---|---|---|---|---|---|
| <2/52 | 2 | 7/L | Immediate | VI | I | 5dB |
| | | 9/L | Immediate | VI | III | 0dB |
| 2/52 to 1/12 | 2 | 2/R | Immediate | VI | I | 10dB |
| | | 5/R | Immediate | VI | I | 5dB |
| 1/12 to 2/12 | 2 | 4/L | Delayed | VI | III | 10dB |
| 2/12 to 3/12 | 4 | 6/L | Immediate | VI | III | 10dB |
| | | 10/L | Delayed | IV | II | 10dB |
| | | 1/R | Delayed | V | II | 5dB |
| > 3/12 | 1 | 8/L | Delayed | IV | II | 0dB |

# - Fracture
R - Right
L - Left
Op - Operation
HB - House Brackmann
ABG - Air bone gap

more than three months in one patient. Generally, the patients in this group showed improvement of facial nerve palsy to HB II- III after six months operation.

Post operation, their hearing generally improved with air bone gap ranging from 0-10dB.

## DISCUSSION

Over the past six years, in our centre, only nine cases of facial nerve decompression were performed. It is difficult to perform a prospective study or retrospective study to examine the usefulness of the surgical intervention in traumatic FNP. The outcome of facial decompression varies among the published reports. A systemic review of 612 cases of traumatic FNP done by Nash et al. concluded that the efficacy of the facial nerve decompression is debatable because the rate of full recovery was only 23% in the surgical group as compared to that 66% in patient without treatment.[3] Ping Hsun Lee et al. reported the outcome of conservative management with early steroid therapy for two weeks duration and concluded that the early steroid therapy was beneficial to the delayed onset or incomplete traumatic FNP and those delayed onset of FNP, less than 30 years old and without diabetes mellitus may have a chance of complete recovery.[4] Daurozzet et al. suggested the efficacy of the surgery by demonstration of the 65 patients with severe FNP who underwent surgical intervention and 93.8% of them recovered with HB grade I-III within two years. They also recommended that early surgery was indicated in the cases of immediate onset and electrophysiologically severe FNP with radiographic evidence of facial canal fracture. Late surgical intervention may be offered to those with severe FNP in the absence of visible fracture.[5]

In our study, a good surgical outcome was observed in four FN decompressions without obvious fracture line over the facial canals. Intraoperatively, the facial canal was intact in only one case (# no. 5/R), 2nd genu fracture was found in two cases and a mastoid segment fracture was found in one of these cases. The accuracy of HRCT in detecting the facial canal lesion varied according to location. One study showed that sensitivity and specificity of HRCT in detecting the mastoid segment of facial canal injury were 50% and 94%, respectively. Its sensitivity and specificity in detecting the tympanic segment of facial canal injury, dropped further to 33% and 64.5% respectively.[6] Therefore, no radiographic evidence of facial canal lesion does not rule out external or internal compression of the nerve or nerve transection and surgical intervention is needed, especially in the immediate onset group.

The surgical outcome of facial nerve decompression is multifactorial. The surgeons play a very important role. In this study, all cases were operated on by a single and experienced skull base surgeon. Furthermore, good exposure of the whole course of intratemporal facial nerve is important to achieve desired outcomes by providing adequate evaluation and intervention. Many have suggested a middle cranial fossa approach or a combination with transmastoid exploration for longitudinal and transverse or mix fractures if the hearing is serviceable. If hearing was not serviceable, translabyrinthine approach could be applied. Ulug and Arif Ulubil suggested the use of labyrinthine sparing techniques for cochlear reserve for the possibility of cochlear implantation if even the slightest amount of a hearing problem arises in the contralateral ear.[6] The advancement of HRCT provides a better resolution, thus, the accuracy of localising facial nerve lesions is much higher. In our cases, transmastoid approach was our choice after clinical and radiological review as it can reach up to the tympanic segment of the facial nerve without sacrificing hearing function. If intraoperative evidence of injury proximal to the geniculate ganglion is found, another approach will be applied accordingly.

There is no clear consensus on the timing of facial nerve decompression. It is generally recommended that early surgery to be offered to patients with electroneurography (ENog) of >90% degeneration within six days of onset of FN palsy.7 Due to the unavailability of electrophysiologic study in our centre, surgery was offered when there was no improvement after steroid therapy in delayed onset FN palsy. However, with immediate onset of HB IV-VI FNP, we would proceed with FN decompression within two weeks. In the meantime steroid therapy would be given while awaiting surgery. Hato et al. showed that patients who underwent facial nerve decompression within two weeks had a much

higher rate of complete or good facial nerve recovery (92.9%, n=14) compared to those who were operated on later (n=52).[1] Our case series showed a 75% of full recovery rate from the immediate onset of traumatic FNP observed in those operated within one month and those who operated later had a poorer recovery with HB grade II - III. It is worth highlighting that in the delayed onset group, three patients who were operated on after two months recovered well with HB grade II from HB grade IV -V.

Many patients who sustain temporal bone fractures are associated with poor GCS recovery secondary to intracranial or other general complicated injuries, hence, FNP detection is often delayed and the onset of the FNP will be difficult to determine. Hence, patients who sustain temporal bone fractures with impaired consciousness should be referred early to ENT surgeons for assessment and follow up. Once traumatic FNP is established and patients are stable, surgical intervention should be carried out within one month or as soon as possible for a better outcome. For those who have a delayed diagnosis of traumatic FNP, facial nerve decompression should be offered as good recovery was also observed in these cases.

After the surgery, patients should undergo rehabilitation especially in those with severe to complete FNP and received delayed intervention. This is because after prolonged palsy facial muscle atrophy would usually have developed.

We would like to address a limitation in this study as only 11 cases of facial nerve decompression were found in the medical records, and two of these were found to have transected facial nerves and were excluded from this study. This was because additional procedures - nerve transposition and primary repair were performed respectively. Also, comparison of patients with severe or complete traumatic facial nerve palsy who were treated conservatively only were not included. However, all our patients received a course of steroids and the operation waiting time was relatively long. Their facial nerve palsy did not show improvement prior to surgery. This gives us an indirect evidence that facial nerve decompression helps in treating those who failed conservative management.

## CONCLUSIONS

These nine cases demonstrated that generally FN decompression improved FN function in both immediate and delayed onset of moderate to complete traumatic FNP. The ideal time for surgical intervention in patients with immediate onset and complete FNP was within two weeks. Good facial nerve function was also seen to result from delay in surgery. Our study also showed that the transmastoid approach is adequate for tympanic and mastoid segment lesions. Future research with bigger samples and a proper designed study are recommended to further ascertain the present study findings.

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