Journal of Otology 17 (2022) 116–122

Contents lists available at ScienceDirect

Journal of Otology

journal homepage: www.journals.elsevier.com/journal-of-otology/

Traumatic facial nerve paralysis dilemma. Decision making and the novel role of endoscope

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A R T I C L E I N F O

Article history:
Received 12 February 2022
Received in revised form
14 March 2022
Accepted 17 March 2022

Keywords:
Posttraumatic
Facial nerve
Decompression
Endoscopic
Transcanal
Electrodiagnostic

A B S T R A C T

Objective: The management of traumatic facial nerve paralysis (FNP) has remained a controversial issue with conflicting findings arguing between surgical decompression and conservative management. However, recent advances in endoscopic surgery may consolidate the management plan for this condition.

Methods: This prospective clinical study included patients with posttraumatic FNP at a tertiary referral center. Patients were categorized in two main groups: surgical and conservative. Indications for surgery included patients with immediate and complete FNP, no improvement in facial function on medical treatment, with electroneurography showing >90% degeneration or electromyography showing fibrillation potential. Patients who did not satisfy this criterion received the conservative approach. The transcanal endoscopic approach (TEA) or endoscopic assisted transmastoid approach was performed for facial nerve decompression in the surgical group.

Outcome: The main outcome was facial function improvement, assessed using the House Brackmann grading scale (HBGS) 6 months after surgery, and hearing state assessed using the air bone gap (ABG).

Results: The study included 38 patients, of whom 15 underwent had surgical decompression and 23 underwent conservative therapy. A significant improvement in facial nerve function from a mean of 4.66 ± 0.97 to 1.71 ± 0.69 ($P = 0.001$) and ABG from a median of 30 (10–40) to 20 (10–25) ($P = 0.002$) was observed.

Conclusion: Decision-making in cases of traumatic FNP is critical. The geniculate ganglion and tympanic segment were the most commonly affected areas in FNP cases. The TEA represents the most direct and least invasive approach for this area.

1. Introduction

Facial nerve paralysis (FNP) is the most common and noticeable cranial neuropathy, with several functional and psychological consequences (Geiβler et al., 2021). Posttraumatic FNP can be considered the second common cause of peripheral facial palsy following Bell's palsy (Misron et al., 2020). The condition usually follows temporal bone trauma and can be associated with numerous other complications due to the magnitude of the trauma (Patel and Groppo, 2010). FNP occurs in 7–10% of patients with temporal bone fractures (Gordin et al., 2015), which have been traditionally classified as longitudinal or transverse with respect to its orientation to the longitudinal axis of the petrous bone (Rafferty et al., 2006). The recent classification, which carries better prognostic relevance, has shifted towards either otic capsule sparing or violating fractures (Johnson et al., 2008).

Posttraumatic FNP still remains controversial given the lack of consensus on the best management option, as well as the considerable variability in the management approaches reported in the literature (Vajpayee et al., 2018). The two main approaches for the management of FNP include surgical decompression and conservative management with steroid therapy (Lee et al., 2018). A review of the recent literature revealed that combining function-based clinical evaluation, such as The House-Brackmann grading scale (HBGS), and electrodiagnostic testing, particularly electroneurography (ENoG) and electromyography (EMG), has been

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Peer review under responsibility of PLA General Hospital Department of Otolaryngology Head and Neck Surgery.

https://doi.org/10.1016/j.joto.2022.03.003
1672-2930/

effective in determining the surgical candidates (Guntinas-Lichius et al., 2020). However, controversy still remains regarding the indications, timing, and most suitable approach for surgical decompression (Yadav et al., 2018).

The approaches utilized for facial nerve decompression (FND) include the trans mastoid, middle cranial fossa, and trans labyrinthine approaches depending on the site of injury and hearing status (Fernandez et al., 2021). The middle cranial fossa approach has been used for nerve decompression in patients with serviceable hearing and those whose affected area span from the geniculate ganglion (GG) and labyrinthine segment to metal portion of the facial nerve (Aslan et al., 2014). However, the translabyrinthine approach has been used for the decompression of these segments when hearing was non-serviceable (Yetiser, 2012). Transmastoid facial decompression remains the most widely used approach (Liu et al., 2015) given its good access to the mastoid and most of the tympanic segment (Gur et al., 2021). However, decompression of the GG and the most anterior portion of the tympanic segment through this approach has been limited. As such, some have advocated for combined transmastoid and MCF approaches, which can be a lengthy and morbid approach (Sim et al., 2021). A review of the literature revealed that the GG, tympanic segment, and lateral labyrinthine segments are the most commonly affected in cases of posttraumatic facial palsy, accounting for over 90% of the cases (Kong and Sevy, 2017). This finding highlights the importance of the newly described technique, namely the transcanal endoscopic approach (TEA), for the decompression of these segments considering its less invasiveness, direct approach, and least morbidity (Marchioni et al., 2016).

The current study aimed to describe a management plan for cases with posttraumatic FNP, including the two main treatment approaches: conservative management with medical treatment and surgical decompression of the intratemporal facial nerve. Our primary aim was to highlight the novel role of endoscopy in the surgical management of these cases, focusing on the application and feasibility of the exclusive transcanal endoscopic approach and endoscopy-assisted transmastoid approach while clarifying the indications for each. Our secondary aim was to clarify the decision-making process and the inclusion criteria for each management option, as well as describe the outcomes of this management plan.

2. Patients and methods

This prospective clinical study included cases with post-traumatic FNP admitted at Mansoura university hospitals and emergency hospitals (tertiary referral hospital) from 2018 to 2021. This prospective evaluation obtained approval from the institutional review board, after which data were collected using the reference number *MD.19.02.140*. Patients with posttraumatic FNP either immediate or delayed were included. Patients with evidence suggesting the involvement of a facial nerve distant from the intratemporal portion and those who did not complete the follow-up period of at least 6 months were excluded. Data for the included patients were collected and included sex; age; type of fracture elucidated on high-resolution computed tomography (HRCT) of the temporal bone; etiology of the injury; House-Brackmann (HB) grade of the FNP; and electrophysiological function reported via electroneurography (ENoG), nerve excitability test (NET) performed 3–14 days after the injury, or electromyography EMG performed 2 weeks after injury and audiological data. Preoperative and postoperative air–bone gaps (ABG) were reported.

The patients included herein were categorized into two main groups: **the Surgical group**, in which patients were subjected to surgical facial nerve decompression, and **the conservative approach group**, in which patients were managed by medical and rehabilitation treatments. Decision-making and role categorization depended on the following: Onset of facial palsy following the trauma, either immediate or delayed; facial nerve function evaluated according to HBGS, patients with grades 2, 3, and 4 were considered as having partial palsy, whereas those with grades 5 and 6 were considered as having complete palsy and electrodiagnostic studies comprising either the ENOG, NET, or EMG. Patients with immediate and complete paralysis, those with non-improving facial function on 2 weeks of medical therapy and those with an ENOG showing >90% degeneration or with EMG showing fibrillation potentials were considered surgical candidates. However, those with delayed or immediate onset palsy with ENOG showing <90% degeneration or with EMG showing regeneration potentials were considered as conservation candidates.

For surgical decompression, two main approaches have been proposed: Exclusive transcanal endoscopic approach (TEA) for cases with GG and tympanic segment involvement and the endoscopic assisted approach for cases with added mastoid segment involvement.

2.1. Transcanal endoscopic approach

All cases underwent surgery under general anesthesia with a hypotensive modality. A wide posterior tympanomeatal flap was created from 1 to 6 clock to obtain an access for the attic. The flap was elevated and dissected from the malleus and umbo and transposed anteroinferiorly. A posterior atticotomy was performed via transcanal drilling of the scutum to visualize the incudo-malleolar joint, which was then disarticulated with disarticulation of the incudo-stapedial joint, if present, with removal of the incus. Endoscopic assessment was performed to obtain a wide view of the attic and the tympanic segment of the facial nerve from the GG to the pyramidal eminence and second genu. Nibbling of the malleus head was performed in some cases to obtain a wide view of the GG when affected by the trauma. Lateralization of the malleus head after stretching of the anterior malleolar ligament was performed in other cases to visualize the GG area with the aid of 30-degree endoscope. The latter maneuver preserves the malleus and enables incus replacement in its original place allowing for better closure of ABG postoperatively. The cochleariform process and the transverse crest represented valuable landmarks for the GG. The bony fragments, if present, were carefully dissected from the GG and tympanic segment (Figs. 1 and 2). Nerve decompression was performed using a bony curette and blunt dissector. Occasionally, diamond drilling was used to decompress portions of the tympanic segment when affected. Considerable care was taken not to injure the underlying nerve integrity. Decompression was performed on the compressed segment until a normally looking fallopian canal was achieved. Ossiculoplasty was then performed either by refashioning the incus between the malleus and stapes or repositioning it in its original place and stabilizing it with bone cement (Fig. 3). A small piece of tragal cartilage and perichondrium was used to reconstruct the scutum and tympanic membrane, if needed, with repositioning of the tympanomeatal flap.

2.2. Endoscopic assisted approach

The TEA was performed as described before for evaluation of the GG and tympanic segment being the most commonly affected. The microscopic transmastoid approach was performed to decompress the mastoid segment when proved to be affected radiologically or when the TEA did not reveal an injury site.

A standard postauricular incision was performed. Temporalis facia graft was harvested. A U-shaped periosteal flap was elevated over the mastoid process based anteriorly. A standard canal wall up

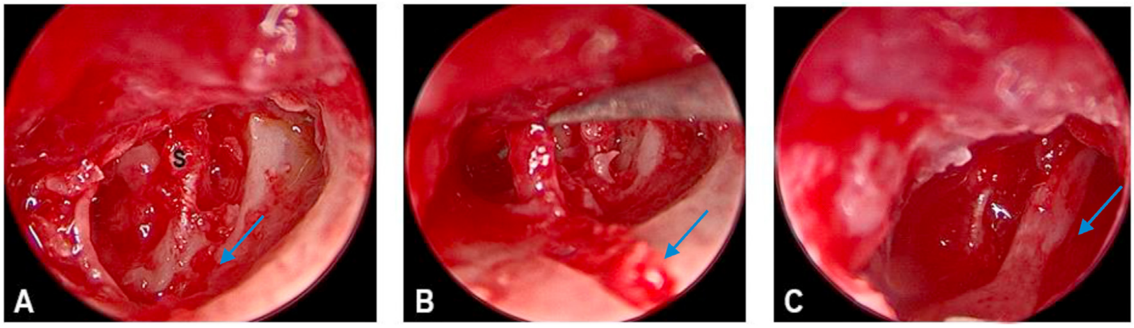

Fig. 1. A. Endoscopic view of the left ear showing a fracture line crossing the second genu of facial nerve. S. indicates stapes head. The arrow refers to the fracture line B. Removal of bone fragments compressing the second genu, notice the fracture line in the EAC. The arrow refers to the fracture line. C. View after decompression of the tympanic segment and 2nd genu. The arrow refers to the tympanic segment.

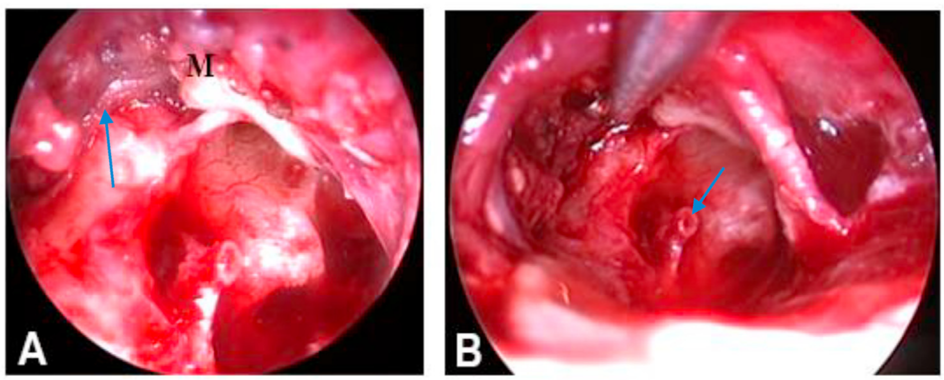

Fig. 2. A. Endoscopic view of the right ear after incus removal and nibbling of malleus head showing bone fragment and hematoma compressing the GG. The arrow refers to the hematoma. B: Decompression of the GG, M. refers to the malleus. The arrow refers to the stapes head.

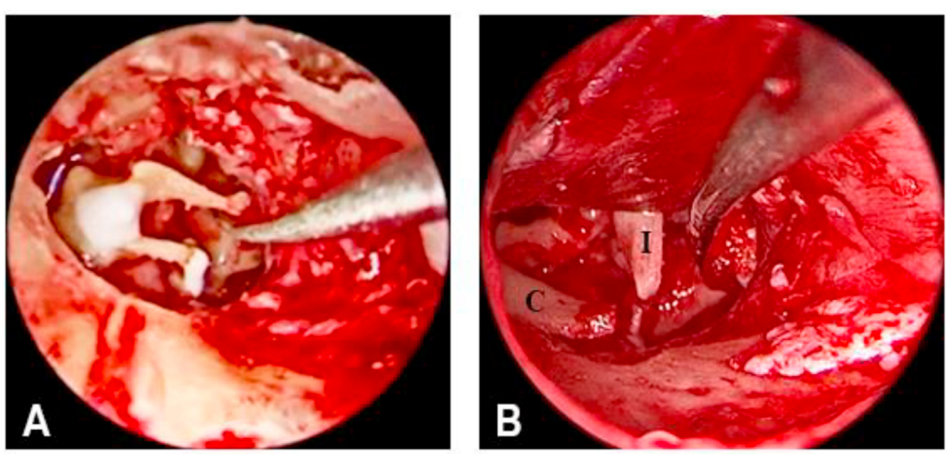

Fig. 3. A. Endoscopic view of right ear showing incus replacement in its original position with bone cement stabilization B. Endoscopic view of right ear showing incus refashioning between the malleus and stapes. I. indicates the refashioned incus. C refers to cartilage reconstruction of attic that will be lateralized lateral to the ossicular reconstruction.

mastoidectomy was performed. The mastoid segment was identified by observing its relation to the digastric ridge and the lateral semicircular canal. Posterior tympanotomy was performed with identification of the mastoid segment at the medial boundary. Decompression of the mastoid segment was performed with removal of any bone spicules compressing the nerve and opening the sheath over the edematous area. In cases with discontinuity of the nerve integrity, the choice was to harvest a great auricular nerve graft and utilize the same to bridge the gap between the cut ends of the nerve followed by coverage of the reconstruction site with temporalis facia graft.

For patients receiving the conservative approach, systemic steroid therapy was provided in the form of prednisolone at a dose of 1 mg/kg/day for 10 days with gradual withdrawal over the following 3 weeks. Additionally, patients were instructed to perform active and passive physiotherapy.

The main outcome was the improvement of facial nerve function, which was measured by the improvement of the 6-month postoperative HBGS to grade 1–2 over the follow-up period. The secondary outcome was the hearing improvement for patients with posttraumatic conductive hearing loss, which was measured using a tuning fork test 2 weeks after surgery and 2 months postoperative pure tone audiometry. The follow-up sessions were designed to occur on the first postoperative day, 1 week after surgery, weekly in the first postoperative month, every 2 weeks in the second and third months, and monthly until the sixth postoperative month.

2.2.1. Statistical analysis and data interpretation

Data were analyzed using IBM SPSS, version 22.0. Qualitative data were described using numbers and percentages. Quantitative data were described using median (minimum and maximum) and means, standard deviations for parametric data after testing normality using the Kolmogorov–Smirnov test. Significance of the obtained results was set at 0.05. The Chi-square test, Mann–Whitney *U* test, and Wilcoxon signed rank test were utilized. Spearman's correlation was also performed.

3. Results

From January 2018 to June 2021, 41 cases of posttraumatic FNP were identified. Three cases were excluded due to missed follow-up. Ultimately, 38 cases of posttraumatic FNP were included in this study. The mean age of the included patients was 27.08 ± 12.68 years, with males outnumbering females. Road traffic accidents were the most common cause for trauma (75%), followed by falling from height (25%). HRCT showed that a longitudinal fracture pattern was the most commonly encountered, followed by the mixed pattern and transverse pattern. No fracture line was encountered in four cases. All patients with temporal bone fracture had otic capsule-sparing fractures, except for one case who had a preoperative sensorineural hearing loss. The choice between surgical decompression and conservative management was made following electrodiagnostic studies, HBGS and HRCT. Electrodiagnostic testing was of utmost importance especially in cases with concomitant injury rendering the judgement over the onset of paralysis and HBGS difficult. Accordingly, 15 cases underwent surgical decompression of the facial nerve, whereas 23 cases received conservative management with systemic steroids with a tapering dose. Table 1 shows the demographic features of both groups.

For the surgical group, HRCT was able to detect the affected site in all 15 cases. Intraoperatively, the injury site occurred at the GG in 10 cases, tympanic segment in 3 cases, second genu in 2 cases, and mastoid segment in 2 cases, with 2 cases having 2 sites of injury. Bony spicules compressing the affected site were encountered in 7 cases, hematoma and blood clots were encountered in 4 cases, edema of the affected segment was encountered in 3 cases, and complete nerve transection at the junction of second genu and mastoid segment was encountered in 1 case. Great auricular nerve graft was utilized for reconstruction in this case. A significant improvement in facial nerve function was achieved 6 months after HBGS [from a median of (6 (5–6) to 2 (1–3); $P < 0.001$] (Fig. 4). Incus removal was necessary in all cases and two main ossiculoplasty techniques were utilized, namely incus replacement with bone cement stabilization and incus remodeling between the malleus and stapes. A significant improvement in the ABG was encountered after HBGS [from a median of 30 (10–40) to 20 (10–25); $P = 0.002$]. Table 2 shows the results for both groups.

For the conservative approach group, a significant improvement in facial nerve function was encountered 6 months after therapy [from a median of 4 (3–5) to 1 (1–3); $P = 0.001$]. Five cases in this group underwent endoscopic ossiculoplasty for conductive hearing loss. A significant improvement in the ABG was observed from a median of 10 (5–50) to 10 (5–10); $P = 0.04$].

The current study showed a statistically significant association between the onset of FNP, type of temporal bone fracture and the favorable prognosis with post-intervention HBGS with a median and range of 1 (1-2) (P 0.001). Besides, A statistically significant relation between initial HB grading and the outcome was reported $P = 0.004$ with better outcome with the incomplete paralysis (HB 2–4). Delayed onset and incomplete FNP with longitudinal type fractures have a correlation with the favorable prognosis. In addition, a statistically significant association was encountered regarding the effect of the time before decompression in the surgical group and the improvement of the HBGS with better improvement when the decompression was performed early before 2 weeks following the trauma $p < 0.001$. in addition, a statistically significant association between the age and the postoperative improvement of the HBGS was encountered with better improvement in the younger age patients $p = 0.005$.

No major complications, such as postoperative bleeding, persistent otorrhea, or profound sensorineural hearing loss, were encountered during the follow-up period. Residual tympanic membrane perforation was encountered in two cases, one from the surgical group and the other from the conservative group. Both cases refused tympanoplasty for this perforation given that facial nerve function improved to HBGS 2 in both cases.

Table 1
Demographic data and comparison between the surgical and conservation groups, N. number.

	Surgical group N = 15	Conservation group N = 23	Test of significance
Age/years (mean ± SD)	27.13 ± 14.15	27.87 ± 11.76	p = 0.863
Sex N (%)			
Male	12(80.0%)	16(69.6%)	p = 0.475
Female	3(20.0%)	7(30.4%)	
Onset of palsy N (%)			
Immediate	11(73.3)	11(47.8)	
Delayed	4(26.7)	12(52.2)	p = 0.120
Cause N (%)			
Fall	3(20.0)	6(26.1)	
RTA	12(80.0)	15(65.2)	p = 0.422
Assault	0	2(8.7)	
Type of fracture N(%)			
No	0	4(17.4)	
Longitudinal	11(73.3)	15(65.2)	p = 0.305
Mixed	2(13.3)	3(13.0)	
Transverse	2(13.3)	1(4.3)	
Pre ABG (median& range)	30(10–40)	10(5–50)	P = 0.007*
Preop HB scale (median& range)	6(5–6)	4(3–5)	p < 0.001*

Fig. 4. A. Preoperative complete left facial palsyb. 6 months postoperative improvement. C. Pre-conservative approach complete right facial palsy. D. 6 months post-conservative approach improvement.

Table 2
The outcome of the study showing the facial nerve function outcome and the hearing outcome.

	Surgical group N = 15	Conservation group n = 23
Preop HB scale **(median & range)**	6(5–6)	4(3–5)
6months Postop HB scale **(median & range)**	2(1–3)	1(1–3)
Wilcoxon signed rank test	P < 0.001*	P < 0.001*
Pre ABG **(median & range)**	30(10–40)	10(5–50)
Post ABG **(median & range)**	20(10–25)	10(5–10)
Wilcoxon signed rank test	P = 0.002*	P = 0.04*

4. Discussion

Posttraumatic FNP still remains an area of dispute in the literature, with no consensus regarding the best management protocol (Yadav et al., 2018). Surgical decompression and conservative management with steroid therapy have been primary approaches for the management of FNP (Singh et al., 2020). Nash et al., who reported the outcomes of 612 patients of posttraumatic facial palsy through a systematic review study, disputed the effectiveness of surgical decompression of facial nerve considering their findings of only a 23% complete recovery in the surgical group but a complete recovery rate of 66% in the conservative approach group who achieved complete recovery (Nash et al., 2010). However, Darrouzet et al., who offered surgical decompression to over 50% of their patients, reported that 94% who had decompression achieved good recovery (Nash et al., 2010). Meanwhile, Hato et al. reported that this conflict and differing opinions may be associated with differences in decision-making and management choice for each patient (Hato et al., 2011). In addition, the surgical skills and approach had been found to affect the outcomes of patients undergoing surgical decompression (Kong and Sevy, 2017). In the current study, good outcomes were achieved with postoperative HBGS of 1–2 in 87% of the included patients. This can be attributed to the solid criteria followed to select the management option for each patient mentioned in the methods section and utilize of recent endoscopic approaches for decompression in the surgical group.

Onset of facial paralysis following temporal bone trauma is an important element that was studied in the literature. The delayed onset of facial nerve palsy has been widely reported as the most important good prognosis factor with regards to full recovery as mentioned by Nash et al. (2010) and Lee et al. (2018). However, the true onset may not be obvious in all cases as many patients are polytrauma cases with possible intracranial complications that can require intensive care (Yadav et al., 2018). In this situation, the electrodiagnostic studies are important to help in decision making (Guntinas-Lichius et al., 2020). In the current study, a significant association had been observed between delayed onset paralysis and good postoperative outcomes (HBGS 1–2) ($P = 0.001$).

The site of facial nerve affection in cases of temporal bone trauma is an important aspect that best reflects on the approach for surgical decompression (Sim et al., 2021). Quaranta et al. showed that all patients included in their study had GG involvement. They demonstrated that GG is usually affected in cases of posttraumatic facial palsy and this can be combined with the involvement of other segments (Quaranta et al., 2001). Hato et al. also showed that GG was the most commonly affected in their study followed by the tympanic segment (Hato et al., 2011). Liu et al. described in their case series that the tympanic segment of the FN was edematous in all the cases treated via the transmastoid approach for TBF and FN palsy (Liu et al., 2015). Vajpayee et al. showed that 9 of their 10 treated patients who underwent surgical decompression had an affected GG area and tympanic segment (Vajpayee et al., 2018). In the current study, GG and tympanic segment affection was observed in 86.6% of the surgically treated cases. This can be attributed to the thin-walled fallopian canal or dehiscence sometimes at these sites and their medial relation to the ossicles.

One study showed that the more peripheral the site of affection of the intratemporal facial nerve, the more readily that decompression surgery can be performed (Hato et al., 2011). Theoretically, patients with an affected tympanic segment, which is an accessible area of facial nerve will, should have better prognosis (Sim et al., 2021). However, a study by Hato et al. on 66 patients of posttraumatic facial palsy concluded the opposite given their findings that the prognosis of patients with tympanic segment and GG involvement was worse than that in other patients with improvement of HB grade to 1-2 in only 65–70% of patients (Hato et al., 2011). They related such findings to the transmastoid approach performed in their patients and highlighted the difficulty of achieving accurate decompression of the tympanic segment and GG utilizing the transmastoid approach due to the proximity of the lateral semicircular canal and stapes. They recommended a modification of the surgical approach to this area (Hato et al., 2011). In the study of Alicandri-Ciufelli et al. on the role of TEA in surgical decompression of the tympanic segment and GG, they described a more direct approach and a better visualization of this area of the facial nerve with better outcome of the facial function postoperatively to HBGS 1–2 in 84% of included patients. Therefore, we investigated the role of endoscopy in surgical decompression among cases with posttraumatic facial palsy either through exclusive TEA or endoscopic assisted transmastoid approach and reported good outcomes with postoperative HBGS 1–2 in 80% of the included patients.

Cannon et al. reported an improvement in FN function to normal or near normal (HB I or II) in 72.7% within one year after surgery following middle cranial fossa approach. However, 16.7% of their patients experienced minor complications (e.g., vertigo, autophonia, tinnitus), whereas 5.5% developed wound infections and abscesses that required surgical drainage (Cannon et al., 2016). On the other hand, none of our patients developed perioperative or postoperative complications. This result was similar to what Alicandri-Ciufelli et al. encountered in their patients who received TEA, a more minimally invasive approach compared to the middle cranial fossa approach. In addition, better postoperative facial nerve function with good recovery (HBGS 1–2) was reported by Alicandri-Ciufelli et al. in 83.3% of their patients.

Careful selection of patients for initial surgical decompression and subsequent endoscopic approach is critical (Alicandri-Ciufelli et al., 2020). It has been widely accepted now that cases with immediate complete FNP and those with ENOG showing more than 90% degeneration or with EMG showing fibrillation potentials are candidates for surgical decompression (Guntinas-Lichius et al., 2020). The HRCT of the temporal bone predicts well about the site of affection in the facial nerve, which can help with the selection of patients for TEA, making it more feasible for those whose affection site ranged from the GG until the second genu. This approach can be considered the most direct and least invasive for this area of the facial nerve, which has been considered in the literature as the most commonly affected area in traumatic cases (Alicandri-Ciufelli et al., 2020). Additionally, endoscopic-assisted transmastoid approach can be utilized in cases of mastoid segment affection and can manage the facial nerve from the GG until the stylomastoid foramen (Alicandri-Ciufelli et al., 2020). Moreover, the selective decompression of the affected segment in our study was successful and resulted in a significant improvement in facial nerve function ($P = 0.001$). This approach avoids unnecessary bone drilling and normal segment decompression with their further morbidity (Vajpayee et al., 2018).

One limitation of the TEA is that it does not avoid incus removal, which had been adopted by the transmastoid approach for decompression of the GG and tympanic segment (Alicandri-Ciufelli et al., 2020). Optimum evaluation and decompression of the GG and most of the tympanic segment would be difficult in presence of the incus. However, in cases of isolated mastoid segment affection identified by the preoperative HRCT, incus removal is not required and evaluation of the tympanic segment can be performed with gentle lateralization of the incus body and short process., the wide angled view provided by the endoscope permits an excellent view of the attic and the ossicular joints giving the opportunity for both incus repositioning or incus remodeling between the malleus and stapes after nerve decompression, with good postoperative hearing results (Kim et al., 2020). The current study found a significant hearing improvement after performing endoscopic ossiculoplasty in cases of facial nerve decompression ($P = 0.001$). In addition, a significantly better closure of the ABG was encountered with incus replacement in its original position than incus remodeling between malleus and stapes ($P = 0.001$).

Another limitation of the current study is our relatively small number of cases, especially in the surgical group. This can be attributed to the prospective nature of the study design, which, to the best of our knowledge, may be the first prospective study in the literature to be performed for the management of cases with posttraumatic facial palsy. In addition, one limitation is the relatively low number of cases compared to studies on standard transmastoid FND due to the recent application of endoscopic approach in neurotology. However, this study included the largest number of surgically treated cases with the exclusive endoscopic or endoscopy-assisted approach.

5. Conclusion

Combining the House Brackman grading scale, facial nerve electrodiagnostic studies, and the HRCT of the temporal bone best guides the management protocol for cases with posttraumatic facial nerve paralysis. GG and tympanic segment are the most commonly affected areas in the facial nerve by the trauma. Therefore, the transcanal endoscopic approach is the most direct and least invasive approach that provides best exposure for this area of the facial nerve in surgically treated cases. TEA can be utilized exclusively in cases of facial nerve affection from the GG till the 2nd genu. This can be combined with transmastoid approach for decompression of the mastoid segment when affected.

Financial disclosure and conflict of interests

The authors declared that this study has received no financial support. The authors declare that they have no conflict of interest. The study performance was in accordance with the ethical standards of Mansoura University IRB and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent

"Informed consent was obtained from all individual participants included in the study."

References

Alicandri-Ciufelli, M., Fermi, M., Di Maro, F., Soloperto, D., Marchioni, D., Presutti, L., 2020. Endoscopic facial nerve decompression in post-traumatic facial palsies: pilot clinical experience. Eur. Arch. Oto-Rhino-Laryngol. 277 (10), 2701–2707.

Aslan, H., Songu, M., Eren, E., Başoğlu, M.S., Özkul, Y., Ateş, D., et al., 2014. Results of decompression with middle cranial fossa approach or traumatic intratemporal fascial nerve injury. J. Craniofac. Surg. 25 (4), 1305–1308.

Cannon, R.B., Thomson, R.S., Shelton, C., Gurgel, R.K., 2016. Long-term outcomes after middle fossa approach for traumatic facial nerve paralysis. Otol. Neurotol. 37 (6), 799–804.

Fernandez, I.J., Fermi, M., Manzoli, L., Presutti, L., 2021. Suprameatal–transzygomatic root endoscopic approach to the geniculate ganglion: an anatomical and radiological study. Eur. Arch. Oto-Rhino-Laryngol., 0123456789

Geißler, K., Urban, E., Volk, G.F., Klingner, C.M., Witte, O.W., Guntinas-Lichius, O., 2021. Non-idiopathic peripheral facial palsy: prognostic factors for outcome. Eur. Arch. Oto-Rhino-Laryngol. 278 (9), 3227–3235.

Gordin, E., Lee, T.S., Ducic, Y., Arnaoutakis, D., 2015. Facial nerve trauma: evaluation and considerations in management. Craniomaxillofacial Trauma Reconstr. 8 (1), 1–13.

Guntinas-Lichius, O., Volk, G.F., Olsen, K.D., Mäkitie, A.A., Silver, C.E., Zafereo, M.E., et al., 2020. Facial nerve electrodiagnostics for patients with facial palsy: a clinical practice guideline. Eur. Arch. Oto-Rhino-Laryngol. 277 (7), 1855–1874.

Gur, H., Gorur, K., Ismi, O., Vaysioglu, Y., Bal, K.K., Ozcan, C., 2021. Surgical outcomes of transmastoid facial nerve decompression for patients with traumatic facial nerve paralysis. J. Int. Adv. Otol. 17 (4), 294–300.

Hato, N., Nota, J., Hakuba, N., Gyo, K., Yanagihara, N., 2011. Facial nerve decompression surgery in patients with temporal bone trauma: analysis of 66 cases. J. Trauma Inj. Infect. Crit. Care 71 (6), 1789–1792.

Johnson, F., Semaan, M.T., Megerian, C.A., 2008. Temporal bone fracture: evaluation and management in the modern era. Otolaryngol. Clin. North Am. 41 (3), 597–618.

Kim, M.S., Chung, J., Kang, J.Y., Choi, J.W., 2020. Transcanal endoscopic ear surgery for traumatic ossicular injury. Acta Otolaryngol. 140 (1), 22–26.

Kong, K., Sevy, A., 2017. Temporal bone fracture requiring facial nerve decompression or repair. Operat. Tech. Otolaryngol. Head Neck Surg. 28 (4), 277–283.

Lee, P.H., Liang, C.C., Huang, S.F., Liao, H.T., 2018. The outcome analysis of traumatic facial nerve palsy treated with systemic steroid therapy. J. Craniofac. Surg. 29 (7), 1842–1847.

Liu, Y., Liu, S., Li, J., Chen, X., Sun, J., Li, Y., 2015. Management of facial palsy after temporal bone fracture via the transmastoid approach. Acta Otolaryngol. 135 (3), 307–311.

Marchioni, D., Soloperto, D., Rubini, A., Nogueira, J.F., Badr-El-Dine, M., Presutti, L., 2016. Endoscopic facial nerve surgery. Otolaryngol. Clin. North Am. 49 (5), 1173–1187.

Misron, K., Tengku Kamalden, T.M.I., Lamry, N.A., 2020. Endoscope-assisted facial nerve decompression for traumatic tympanic segment of facial nerve paresis, 3 Proc. Singapore Healthc.

Nash, J.J., Friedland, D.R., Boorsma, K.J., Rhee, J.S., 2010. Management and outcomes of facial paralysis from intratemporal blunt trauma: a systematic review. Laryngoscope 120 (7), 1397–1404.

Patel, A., Groppo, E., 2010. Management of temporal bone trauma. Craniomaxillofacial Trauma Reconstr. 3 (2), 105–113.

Quaranta, A., Campobasso, G., Piazza, F., Quaranta, N., Salonna, I., 2001. Facial nerve paralysis in temporal bone fractures: outcomes after late decompression surgery. Acta Otolaryngol. 121 (5), 652–655.

Rafferty, M.A., Mc Conn Walsh, R., Walsh, M.A., 2006. A comparison of temporal bone fracture classification systems. Clin. Otolaryngol. 31 (4), 287–291.

Sim, L., Othman, N.A.N., Hoe, K.C., Saad, M.S.M., 2021. Total transcanal endoscopic approach for selective facial nerve decompression in traumatic facial nerve palsy. Indian J. Otolaryngol. Head Neck Surg.

Singh, G.B., Kumar, P., Krishna, A.R.A., 2020. A paradigm shift in the management of post traumatic complete facial nerve palsy. Indian J. Otolaryngol. Head Neck Surg. 72 (4), 532–534.

Vajpayee, D., Mallick, A., Mishra, A.K., 2018. Post temporal bone fracture facial paralysis: strategies in decision making and analysis of efficacy of surgical treatment. Indian J. Otolaryngol. Head Neck Surg. 70 (4), 566–571.

Yadav, S., Panda, N.K., Verma, R., Bakshi, J., Modi, M., 2018. Surgery for post-traumatic facial paralysis: are we overdoing it? Eur. Arch. Oto-Rhino-Laryngol. 275 (11), 2695–2703.

Yetiser, S., 2012. Total facial nerve decompression for severe traumatic facial nerve paralysis: a review of 10 cases, 2012 Int. J. Otolaryngol. 1–5.