Journal of Otolaryngology and Rhinology Research
Received 20 Feb 2024| Revised 28 Feb 2024 | Accepted 08 Mar 2024 | Published Online 20 Mar 2024

DOI: https://doi.org/10.52845/JORR/2024/5.1.2

JORR 05 (01), 203–210 (2024)

ISSN (O) 2693-9282

ORIGINAL-RESEARCH-ARTICLE

Epidemiology of Facial Nerve Palsy in Temporal Bone Fractures and It's Treatment Outcome: A Prospective Longitudinal Study from Central Kerala

Dr. Ambily Sahadevan MBBS, DNB (ENT) [1] | Dr. Preethy Mary MBBS, DLO, MS, DNB (ENT) [2] Dr. Mathew Dominic MBBS, DLO, MS, FRCS [3] | Dr. George Varghese MBBS, MS, DLO [4] | Dr. Haripriya G R MBBS, DNB (ENT) [5] | Dr Kailash Prasad Verma MBBS MS (ENT) [6]

1. ADMO, Department of ENT, Central Hospital, South Eastern Railway, Kolkata, West Bengal, India
2. Consultant, Department of ENT, Medical Trust Hospital, Kochi, Kerala, India.
3. Consultant and Head, Department of ENT, Medical Trust Hospital, Kochi, Kerala, India.
4. Consultant & Director, GV clinic, Kochi, Kerala, India
5. Consultant, Department of ENT, MGM Health Care, Chennai, Tamil Nadu, India.
6. ACHD, Department of ENT, Central Hospital, South Eastern Railway, Kolkata, West Bengal, India

Abstract

As the majority of temporal bone fractures are associated with concurrent intracranial and cervicospinal injuries, facial nerve examination is given least importance. But it affects the quality of life in all aspects. A prospective longitudinal study was conducted in 61 consecutive patients with temporal bone fractures admitted in a time period of 18 months. Detailed analysis including mode of injury,otoscopic examination,clinical examination of facial nerve by House Brackmann grading, topodiagnostic test ,electrodiagnostic tests ,audiological tests and radiological evaluation and mode of intervention were done. Patients were followed up in a three monthly basis for a period of one year or earlier until complete recovery. Road traffic accidents(80.3%) were the most common mode of injury The incidence of facial nerve palsy in temporal bone fractures in our study was 14.75%. All the patients with facial nerve palsy were given conservative medical management which included oral steroids on a tapering regime, eye care and facial physiotherapy. Immediate onset higher grade facial palsy with no clinical improvement and electroneuronogram showing less than 5 % response , supported by radiological evidence were taken up for surgical intervention. In this study,85.7% of patients who were managed conservatively had recovery. Even though there was improvement in clinical outcome , none of the patients who underwent surgical management recovered fully. The timely diagnosis and management of facial nerve palsy improves the post traumatic quality of life. So a team work of otolaryngologists, neurosurgeons, radiologists, ophthalmologists and physiotherapists are needed for the efficient management of facial nerve palsy.

1 | INTRODUCTION

Temporal bone fractures (TBF)are not rare following head trauma. They are clinically suspected when there is bleeding from ear, hemotympanum, Battle's sign or laceration of external auditory canal. Usually, the temporal bone fractures are unilateral.In Brodie's study of 699 patients with temporal bone fractures, 82.69% were unilateral [(1)].

As the majority of temporal bone fractures are associated with other concurrent intracranial and cervico spinal injuries [(2)], facial nerve palsies are given least importance at the time of admission. But

it affects the quality of life. The face is the mirror of the mind. The facial expressions help people connect socially and emotionally. Facial nerve palsy is associated with significant morbidity[3]. Patients with facial nerve palsy have significant functional, aesthetic, and psychological disability from impairment of facial expression, communication, eye exposure, and oral competence [4]. This is an area where the timely identification and management can significantly improve the post traumatic quality of life. The role of CT brain in the detection of skull fractures is well documented [5],[6]. But, the routine CT brain for central nervous system evaluation is inadequate for the evaluation of temporal bone fractures. A HRCT scan of temporal bone should be performed when clinical criteria warrant its use [7].

HRCT temporal bone provides excellent delineation of bony anatomy and allows for evaluation of the facial canal, ossicular chain and otic capsule. HRCT scans with bone algorithms are the standard in diagnosis of temporal bone trauma [8].

Facial nerve palsy following TBF can be immediate or delayed. Immediate paralysis usually indicates tearing of the facial nerve, injury of the nerve by bone or entrapment in a fracture line. Delayed onset of facial paralysis confirms that, anatomically, the facial nerve is intact and there has not been any direct gross trauma. So, in temporal bone fractures it is crucial that the onset of the facial nerve palsy is ascertained. Evaluation of the facial nerve includes assessment of history of previous status of facial nerve, time of onset and progression of facial nerve palsy and clinical grading. House Brackmann (HB) grading system is one of the most helpful and frequently used clinical grading system of facial nerve function.

It is well documented that the patients with facial nerve palsy experience severe psychological and social problems [9]. In TBF, although the priority is accorded to the management of life-threatening complications, the initial assessment of facial nerve function and its timely management is critically important. This study also highlights the various causes of TBF and suggests recommendations for the reduction of its associated morbidity.

2 | MATERIALS AND METHODS

A prospective longitudinal study was conducted on sixty-one consecutive patients with temporal bone fractures presented to a tertiary care centre in Central Kerala during the time period from June 2017 to December 2018. Institutional ethics committee and scientific committee clearance were obtained prior to the study. The inclusion criteria were radiological evidence of TBF in either sex, with a Glasgow Coma Scale score of more than nine. Patients with a previous history of facial nerve palsy, cerebrovascular accidents or head injury were excluded from the study. A written informed consent was obtained from all the participants. As per Neurosurgery protocol in our hospital, Non-Contrast Computed Tomography brain is taken for all head injury patients using the multi row detector CT scanner (Ge 128 slice multidetector Optima scanner). The patients with temporal bone fracture were thus identified. Depending upon the pattern of fractures they were classified into longitudinal, transverse and mixed. Detailed history, which includes the cause of injury was documented and was categorised into RTA, fall from height, physical assaults, worksite injury and others. Usage of protective equipment like helmets and alcohol intoxication were also documented. Detailed clinical examination including otoscopic evaluation of tympanic membrane and facial nerve examination were done. Assessment of hearing was done using Tuning Fork tests and confirmed with pure tone audiogram.

Facial nerve function was graded using the House Brackman Grading System (HBGS). HBGS has good inter- and intra-rater agreement [10]. According to this system, all patients were categorised into 6 grades: HB Grade I to HB Grade VI. Top diagnostic tests like Schirmer's test, stapedial reflex test and taste sensation of the anterior two third of tongue were done for localisation. High Resolution Computed Tomography

(HRCT) Temporal Bone was done in all the patients with HBGS grade 2 or higher. All the patients were monitored daily for a period of 12 days, as literature review showed delayed onset palsy as late as 12 days

Supplementary information The online version of this article (https://doi.org/10.52845/JORR/2024/5.1.2) contains supplementary material, which is available to authorized users.

Corresponding Author: *Dr. Ambily Sahadevan, ADMO, Department of ENT, Central Hospital, South Eastern Railway, 11 Garden Reach Road, Kolkata, West Bengal,India-700043*
E-mail: ambily.sahadevan@gmail.com

days [11]. Electroneuronography was done on all the patients with HBGS grade 2 or higher on the third day and was repeated at a 5-day interval in case of lesser responses. All the patients were given conservative medical management which included a tapering course of oral steroids, facial physiotherapy and eye care. The decision to do facial nerve decompression was based on clinical improvement, electroneuronography showing more than 90% degeneration and HRCT temporal bone findings. The approach for the surgery was decided on the basis of the segment of facial nerve involved, radiological features and the hearing status of the ear. Every intervention done for the patient, whether medical or surgical was recorded. Then follow up was done on a three-monthly basis for a period of one year or earlier until complete recovery was made. Tuning fork tests and pure tone audiogram were done to assess hearing and HBGS was used for assessing the facial nerve function during follow up. The recovery made in the follow up period was analysed. Statistical tests used for drawing inferences are Student's t-test and Fisher's exact test. Student t-test was used to compare the mean age among males and females with temporal bone fractures. Fisher's exact test is used to find the association of age group, gender and side of fracture with the facial nerve palsy and to find the association between intervention and improvement in facial nerve function.

Progression to normal or near normal function, i.e. to HB Grade I or II was considered as recovery and shift in grades to a lower category was considered as an improvement in function of facial nerve.

3 | RESULTS

In this study, 80.3% of temporal bone fractures were due to RTA. The other modes of injuries were fall from height (11.5%), physical assaults (4.9%) and worksite injury (3.3%) (Fig. 1).

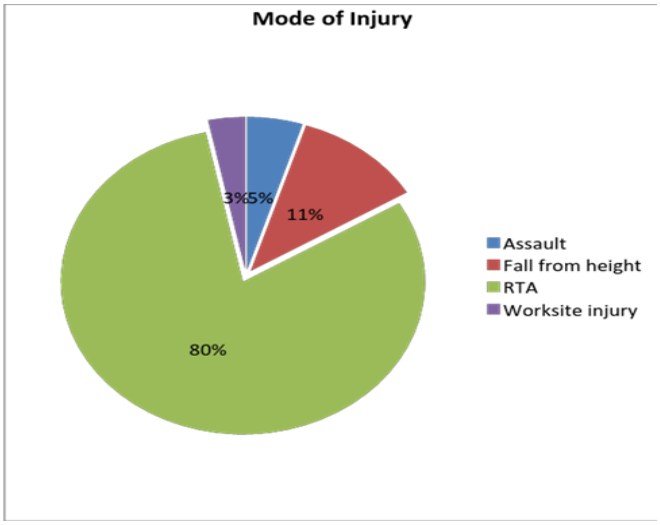

Figure 1: *Mode of injury in patients with temporal bone fractures.*

Right temporal bone fracture was present in 59% cases and remaining 41% had left temporal bone fracture. The analysis of type of temporal bone fractures is given in Fig. 2.

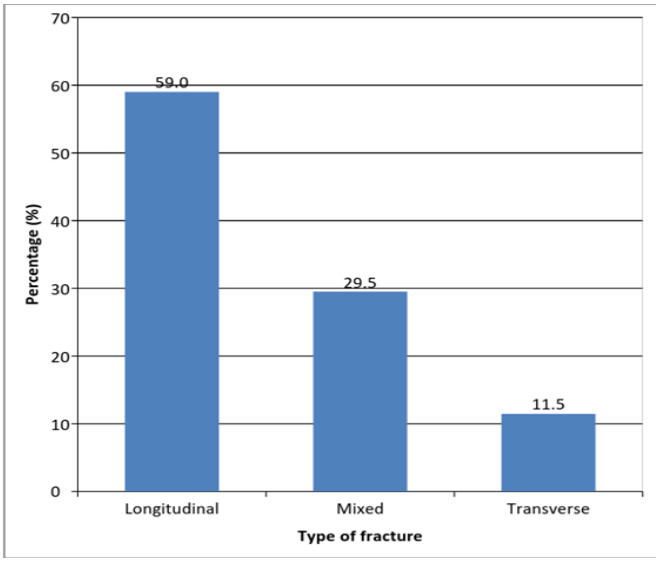

Figure 2: *Distribution of patients according to the type of fracture.*

The otoscopic findings included blood stains and clots in the ear(8.85%), hemotympanum(24.6%) and perforation of tympanic membrane(6.5%).

The age of patients with temporal bone fractures ranged from 11 to 68 years. Mean age with Standard Deviation was 37.6 ± 14.3. Most of the patients (29.5%) were of the age group 21 to 30 yrs. 78.7% were males and 21.3% were females. The mean age of male patients was 36.5years and that of female patients was 41.5years.As the p value

was >0.05, there was no significant difference in the mean age of males and females with temporal bone fractures. The incidence of facial nerve palsy in temporal bone fracture in this study is 14.75% . Among them 44.4% had immediate onset and the remaining 55.6% had delayed onset of facial nerve palsy. The onset of facial nerve palsy ranged from the same day of trauma to 7 days after trauma (Fig. 3)

The facial nerve palsy obtained were of the grade II to V

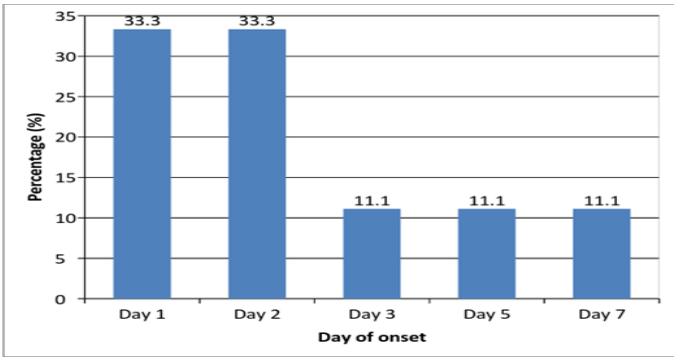

Figure 3: *Distribution of facial nerve palsy according to the day of onset.*

Table 1: *Grading of facial nerve according to HBGS on the day of onset.*

HB Grade	N	%
HB Grade II	2	22.2
HB Grade III	3	33.3
HB Grade IV	2	22.2
HB Grade V	2	22.2

Among the 9 patients with facial nerve palsy, 7 were males and 2 were females. In this study, the incidence of facial nerve palsy in temporal bone fractures in males is 14.6% and in females is 15.4%. The mode of injury in these patients who sustained facial nerve palsy were RTAs in 88.89% and work site injury in 11.11%. The ENoG showed reduced sustained response of less than 10% in two patients. The top diagnostic tests results are summarised in table 2

Table 2: *Top diagnostic test results in patients with facial nerve palsies*

Name of test	Test Result	frequency
Schirmer's test	Reduced lacrimation	22.2%
	Equal lacrimation	88.8%
Stapedial reflex test	Absent	66.7%
	Present	33.3%
Taste sensation in anterior two third of tongue	Normal	44.5%
	Reduced	55.5%

The incidence of facial nerve palsy in right sided temporal bone fractures was 16.7% and left sided temporal bone fractures was 12%. On statistical analysis there was no significance difference between the incidences on the right and left side (p value- 0.725). The incidence of facial nerve palsy was 11.11% in longitudinal temporal bone fractures, 16.66% in mixed temporal bone fractures and 28.57% in transverse temporal bone fractures. 73.8% of the TBFs had hearing loss and among them 8. % was conductive in nature as per pure tone audiogram. Among the patients with facial nerve palsy, 3 patients had conductive hearing loss and rest all had normal hearing.

Majority (70.3%) were not using personal protective equipment at the time of injury and more than half of the patients (55.73) were under the influence of alcohol.

All the patients with facial nerve palsy were given conservative medical management. This included oral steroids on a tapering regime, eye care and facial physiotherapy. The steroid regimen followed here was prednisolone 1 mg/kg/day for 1 week followed by a tapering dose over one month. In two cases of immediate onset higher grade palsy (HB Grade V), there was no clinical improvement and ENoG showed less than 5% response. The hearing was normal in both these cases. The HRCT temporal bone of these two patients showed involvement of facial canal. The findings included.

1. Fracture of right temporal bone squamous part extending longitudinally into petrous apex with extension of fracture into horizontal fragment of right facial canal.
2. Longitudinal fracture from squamo-petrous junction of left temporal bone upto petrous apex with an extension to the horizontal part of facial canal.

Both the cases were taken up for Surgical management. A trans mastoid approach was used in both the cases considering the involvement of the

tympanic segment and their normal hearing status. In both the cases,the entire mastoid segment was exposed and blood clots and fracture fragments of bones removed and a linear incision was made along the facial nerve sheath and decompression done.

Among the patients with only medical management 3 had HB Grade I, 3 had HB Grade II and 1 had HB Grade III facial nerve function on follow up. Even after 12 months follow up, both the patients who had undergone surgical management could achieve only a HB Grade 3 facial nerve function. 0n 6 months of follow up the hearing status recovered fully in all the 9 patients (Table 3)

Table 3: *Hearing status of patients with facial nerve palsies on initial assessment and on follow up*

Hearing status	Initial assessment	follow up
Conductive hearing loss	3(33.3%)	0
Sensorineural hearing loss	0	0
Normal hearing	6 (66.7%)	9 (100 %)

A recovery to HB Grade II or I facial nerve function was considered as recovery and a shift in grade to a lower category was considered as improvement. In this study, 85.7% of patients had recovery with conservative management. None of the patients who underwent surgical management recovered fully. As the p value was >0.05, there was no significant difference in improvement of facial nerve function on medical and surgical management.

4 | DISCUSSION

The RTAs are the major cause of death and injuries in the age group 15 to 29 worldwide [12]. While they are declining in many parts of the developed world, fatalities are still on the rise in many developing countries including India. Kerala has a high incidence of RTAs. In Kerala, more than half of the road accident victims are in the age group of 20 to 55, the key wage earning and child raising age group [13]. Our institution, being a tertiary centre receiving a higher number of RTA referrals, adds on to the result. As per the official website of Kerala police the rising incidence of road traffic accidents are the ignorance about correct driving habits, increasing number of new generation vehicles especially two wheelers, aggressive driving behaviour of heavy vehicle drivers especially of private buses and tipper lorries, drivers sleeping while driving especially of heavy vehicles & light motor vehicles after midnight due to fatigue and other reasons, over speeding, bad condition of roads and absence of different lanes, driver's ignorance of road conditions, road signs and the environmental factors, violation of traffic rules, drunken driving ,driving without seat belt and helmet [13]. Even though safety measures such as seat belts, airbags, and helmets have helped to reduce the number of vehicle accidents resulting in head trauma, RTAs remain the most common cause of temporal bone injury [14],[15],[16]. Gunshot injury is also described as a cause for temporal bone trauma [17]. The other causes for temporal bone fractures in this study are fall from height (11.47 %), physical assault (4.92%), and worksite injuries (3.28%). Personal protective equipment's should be provided to the workers and its usage to be encouraged.

In this study, most patients were males and were in the age group of 20 to 30 years (29.4%) which is in agreement with the largest study done on temporal bone fractures by Brodie and Thompson [1]. All of them were unilateral temporal bone fractures with a slight right side which parallels with other studies[14]. The higher incidence of longitudinal fractures agrees with most of the studies [18],[19],[20].

A comparison of the types of fracture in different studies is made in table 4

Table 4: *Comparison of types of fractures in different studies*

	Longitudinal	Transverse	Mixed/ other patterns
Lee et al [18]	64%	20%	16%
Aslan et al [19]	46.1%	15.3%	38.3%
Cvorovic et al [20]	50%	7.4%	42.6%
In this study	59.02%	11.48%	29.51%

The incidence of facial nerve palsy in temporal bone fractures in this study is 14.75%. A comparison of various studies is made in table 5[1,18,20,21].

Table 5: *Comparison of incidence of facial nerve palsies in different studies*

Study	Incidence of facial nerve palsy
Brodie et al [1]	7%
Gupta et al [21]	9%
Lee et al [18]	11%
Cvorovic et al [20]	13.46%
In this study	14.75%

Our study had a higher incidence when compared with most of the studies. The lower grade facial

nerve palsy may go unnoticed unless looked for. In such cases, some of the lower grade facial nerve palsy may be missed. The current study was a prospective study with daily monitoring up to a period of 12 days. This may be the reason for higher pick up of facial nerve palsy in our study.

The majority of facial nerve palsies occurred in the age group 20-30 yrs as it is associated with higher activity levels and risk-taking behaviour of people of that age. A paediatric series by Liu-Shindo and Hawkins showed a lower incidence (3%) of facial nerve palsy in children less than 18 years of age [22]. According to them the lower incidence of facial nerve palsy in less than 18 years is due to the decreased ossification and greater flexibility of paediatric skulls [22]. Our study also parallels this, as none of the patients less than 20 years of age sustained facial nerve palsy.

The efficacy of corticosteroids in the management of traumatic facial nerve palsy is well documented. Steroid therapy is relatively inexpensive and reduces the inflammation and thereby reduces the edema around the nerve. This will in turn reduce the nerve compression and thereby improve function [23],[24].

Darrouzet et al have reported a normal or near normal facial function recovery (HB grade I-II) in medically managed patients [25]. Immediate nerve repair for nerve transection offers the best chance for recovery, which usually begins within 9 to 12 months [26]. According to Kamerer and Thompson, once the facial nerve injury is located, any bone chips should be removed and the area should be examined for stretching, compression, laceration, or transection. If the nerve is largely intact, decompression of the epineural sheath is performed in proximal to distal direction[27]. Even though partial transection can be repaired with suture, separation of more than 50% of the axons usually requires an interposition nerve graft [27].

Facial nerve decompression should be done from two weeks to two months following surgery [28]. Delayed onset facial nerve palsy responds well with medical management alone[16] Surgical management is indicated if there is no improvement of facial nerve function along with supportive electrodiagnostic and radiological evidence.[16],[25].

The various approaches for facial nerve decompression include trans mastoid approach, trans labyrinthine approach and middle cranial fossa approach. The selection of approach depends upon the segment of nerve involved and hearing status of that ear. The goals for surgical approaches are to decompress the nerve are to prevent ischemic injury, to remove bony fragments impinging on the nerve and to re-establish continuity of nerve in case of transection. Trans mastoid approach which is associated with less morbidity should be used wherever feasible. Middle cranial fossa approach is recommended for geniculate ganglion injury[21]. Usually longitudinal fractures, delayed onset and incomplete facial nerve palsies are associated with good prognosis [23]. Also, there are case reports documenting complete recovery following delayed facial nerve decompression in an immediate onset facial nerve palsy[29].

There is no general consensus regarding the management of traumatic facial nerve palsy. It is tailor made according to time of onset, severity, electrodiagnostic tests and radiological evaluation. Most patients of posttraumatic facial nerve palsy recover with conservative treatment and time, and surgical and reanimation procedures are only rarely required [23].

5 | CONCLUSION

Most of the TBFs resulted from RTAs when protective equipment was not used. Alcohol usage was also noted in half of the patients. The hearing loss which occurred were mostly conductive type and reversed completely in majority. Although the facial nerve function was improved at least by one grade in all the patients, complete recovery was achieved only in 87.5% of those treated by medical management alone. This study recommends strict implementation of the usage of protective equipment and to encourage promotion of safe driving habits. The initial assessment of the facial nerve should be made mandatory in all cases of head injury with temporal bone fractures. Prompt identification and management of facial nerve palsy definitely improves the quality of life.

Acknowledgement:
We acknowledge Mr. Abish Sudhakar for the statistical assistance.

REFERENCES

1. Brodie HA, Thompson TC. Management of complications from 820 temporal bone fractures .Am J Otol.1997 Mar; 18(2):188-97.

2. Sun GH, Shoman NM, Samy RN, Cornelius RS, Koch BL, Pensak ML. Do contemporary temporal bone fracture classification systems reflect concurrent intracranial and cervical spine injuries?.Laryngoscope.2011 May.121(5):929-32.
3. Chan JY, Byrne PJ. Management of facial paralysis in the 21st century. Facial Plast Surg. 2011 Aug;27(4):346-57
4. Aggarwal SK, Gupta AK, Modi M, Gupta R, Marwaha N. Safety Profile of Bone Marrow Mononuclear Stem Cells in the Rehabilitation of Patients with Posttraumatic Facial Nerve Paralysis-A Novel Modality (Phase One Trial). Journal of Neurological Surgery Part B, Skull Base. 2012;73(4):245-52.
5. Ringl H, Schernthaner RE, Schueller G, Balassy C, Kienzl D, Botosaneanu A, et al. The skull unfolded: a cranial CT visualisation algorithm for fast and easy detection of skull fractures. Radiology 2005; 255(2):553-62
6. Zayas FO, Feliciano YZ, Hadley CR, Gomez AA, Vidal FA. Temporal bone trauma and the role of multidetector CT in the emergency department. Radiographics 2011; 31(6):1741-55
7. Aguilar E A, Yeakley J W., Ghorayeb BY., Hauser M, Cabrera J, Jahrsdoerfer R. A. High resolution CT scan of temporal bone fractures: association of facial nerve paralysis with temporal bone fractures. Head Neck Surg. 1987; 9:162–6.
8. Exadaktylos AK, Sclabas GM, Nuyens M, et al. The clinical correlation of temporal bone fractures and spiral computed tomographic scan: a prospective and consecutive study at a level I trauma center. J Trauma 2003;55(4):704–706
9. Fu L, Bundy C, Sadiq SA. Psychological distress in people with disfigurement from facial palsy. Eye. 2011;25(10):1322-26.
10. Fonseca KM, Mourão AM, Motta AR, Vicente LC. Scales of degree of facial paralysis: analysis of agreement. Braz J Otorhinolaryngol. 2015 May-Jun;81(3):288-93
11. Kumar R, Mittal RS. Post Traumatic Delayed Bilateral Facial Nerve Palsy (FNP): Diagnostic Dilemma of Expressionless Face. Journal of Clinical and Diagnostic Research: JCDR. 2015 Apr;9(4): PD15-PD16
12. World Health Organisation-Global Health Observatory data- Road Safety. available from: http://www.who.int/gho/road_safety/en/
13. Kerala police. Road Accidents in Kerala - Official website of Kerala Police. [internet] 2015; available from: http://keralapolice.gov.in/newsite/road.html
14. Amin Z, Sayuti R, Kahairi A, Islah W, Ahmad R. Head injury with temporal bone fracture: one year review of case incidence, causes, clinical features and outcome. Med J Malaysia. 2008 Dec;63(5):373-6.
15. Yetiser S, Hidir Y, Gonul E.Facial nerve problems and hearing loss in patients with
16. Patel A, Groppo E. Management of Temporal Bone Trauma. Craniomaxillofacial Trauma Reconstr. 2010 Jun; 3(2): 105–13.
17. Coker NJ, Kendall KA, Jenkins HA, Alford BR Traumatic intratemporal facial nerve injury: management rationale for preservation of function. Otolaryngology Head Neck Surg. 1987 Sep;97(3):262-9.
18. Lee H, LumC, Means K, Chandrasekhar S, Brown L, Holodny A. Temporal bone fractures and complications: Correlation between high-resolution computed tomography and audiography. Emerg Radiol. 1998 Jan:5(1):8-12.
19. Aslan H, Songu M, Eren E, Başoğlu MS, Özkul Y, Ateş D, Katilmiş H, Güvenç G. Results of decompression with middle cranial fossa approach or traumatic intratemporal facial nerve injury. J Craniofac Surg. 2014 Jul;25(4):1305-8
20. Cvorovic L, Jovanovic MB, Markovic M,Milutinovic Z,Strbac M.Management of complication from temporal bone fractures.Eur Arch Otorhinolaryngol. 2012 Feb;269(2):399-403.
21. Gupta N, Varshney S, Bist SS, Bhatia R. A study of temporal bone fractures. Indian Journal of Otolaryngology and Head & Neck Surgery. 2008;60(3):223-6.
22. Liu-Shindo M, Hawkins DB. Basilar skull fractures in children. Int J Pediatr Otorhinolaryngology 1989;17(2):109–117.
23. Turel Keki E, Sharma NK, Verghese Joy,Desai Sanjeev. Posttraumatic facial palsy: Treatment

options and strategies. Ind J Neurotrauma 2005;2(1):33-4.

24. Chang CYJ, Cass SP. Management of facial nerve injury due to temporal bone trauma. Am J Otol 1999;20(1):96–114
25. Darrouzet V, Duclos JY, Liguoro D, Truilhe Y, De Bonfils C, Bebear JP. Management of facial paralysis resulting from temporal bone fractures: our experience in 115 cases. Otolarygol Head Neck Surg.2001; 125:77–84.
26. May M. nerve repair. In: May M, Schaitkin BM, editors. The facial nerve. May's 2nd edition. New York: Thieme; 2000. p.571-609
27. Kamerer DB, Thompson SW. Middle ear and temporal bone trauma. In: Bailey BJ, ed. Head and Neck Surgery— Otolaryngology. 3rd ed. Philadelphia: Lippincott Williams & Wilkins; 2001
28. Hato N, Nota J, Hakuba N, Gyo K, Yanagihara N. Facial nerve decompression surgery in patients with temporal bone trauma: analysis of 66 cases. J Trauma.2011Dec;71(6):1789-93
29. Kulkarni AS, Karnik P, Nataraj U.Post traumatic immediate onset facial palsy-delayed exploration with complete recovery. Int J Head Neck Surg 2013;4(3):148-51

How to cite this article: Sahadevan A, Mary P, Dominic M, Varghese G, Haripriya GR, Verma K P. Epidemiology of Facial Nerve Palsy in Temporal Bone Fractures and It's Treatment Outcome: A Prospective Longitudinal Study from Central Kerala. Journal of Otolaryngology and Rhinology Research. 2024 ;5(2):203 -210. https://doi. org/10.52845/JORR/2024/5.1.2