ADITUM
Enrich your Research

Neurosurgery and Neurology Research

Research Article

# Comparative Analysis of Pediatric Traumatic Head Injury Care: 2006-2010 vs. 2013-2015 - Pediatric Surgeon vs. Neurological Surgeon

**Obande JO[1*], Obande EI[2]**
[1]Division of Neurosurgery, Department of Surgery, University of Abuja Teaching Hospital, Abuja
[2]Post-Basic School of Critical Care Nursing, University of Abuja Teaching Hospital, Abuja.

**Article Info**

**Received:** April 29, 2024
**Accepted:** May 03, 2024
**Published:** May 06, 2024

***Corresponding author:** Dr. JO Obande, Division of Neurosurgery, Department of Surgery University of Abuja Teaching Hospital, Abuja.

**Citation:** Obande JO, Obande EI, (2024) "Comparative Analysis of Pediatric Traumatic Head Injury Care: 2006-2010 vs. 2013-2015 - Pediatric Surgeon vs. Neurological Surgeon". J Neurosurgery and Neurology Research, 6(1). DOI: 10.61148/2836-2829/NNR/051



## Abstract:

**Background**: Pediatric traumatic head injuries (PTHIs) pose significant challenges in healthcare, demanding specialized care and evolving treatment modalities. In Nigeria, over the past two decades, there has been a notable shift in the paradigm of care for PTHIs, particularly concerning the specialization of surgical expertise with the increasing presence of neurological surgeons. The beneficial accruals if any need to be evaluated.
**Methods**: This manuscript compares the care provided for PTHIs during two distinct periods: 2006-2010, characterized by pediatric surgeon-led management, and 2013-2015, marked by the transition to neurological surgeon-led care. The analysis examines advancements in diagnostic tools, perioperative management, surgical techniques and outcomes.
**Results**: The patient turnover with the presence of neurological surgical care was twice in half the time of pre-neurosurgical arrival. The availability of advanced diagnostic and neurosurgical aids facilitated management in no small measures.
**Conclusion**: This study shed light on the impact of specialized surgical expertise and care for PTHIs on patient outcomes and healthcare practices.
**Keywords:** children; comparative analysis; paedaitric neurosurgical services; traumatic head injury

## Introduction:

The relentless expansion of medicine relevant to the practice of surgery and the evolving patterns of surgical specialization have driven and continue to drive the fabric of evolutionary process which opportune in-roads of novel specialties of practice, like neurosurgery, into communities hitherto, without them. In Nigeria, before the 1990s general surgeons catered for most neurosurgical head traumas, thereafter, paediatric surgeons came into the fray and began caring for paediatric head traumas, wherever they were available. But with Neurosurgical services beginning to enlarge in Nigeria in the 2000s, on the shoulders of a giant of neurosurgery - Prof. BB Shehu - in Northern Nigeria, the neurosurgical care for paediatric neurosurgery and invariably paediatric head traumas, PHTIs, got an upswing, with spread to major cities of the country. Just as mankind benefits from the steady advancement of all aspects of neurosurgery, children with PTHIs in Nigeria benefit from the existence and steady distribution of neurosurgical practice. The premise for this research was laid by the pivotal work of a paediatric surgeon at the index institution showcased in their published article.[1]

Pediatric traumatic head injuries (PTHIs) remain a leading cause of morbidity and mortality among children worldwide.[2] Effective management necessitates a multidisciplinary approach, with surgical intervention playing

a crucial role. In Nigeria, over the past two decades, there has been a notable shift in the paradigm of care for PTHIs, particularly concerning the specialization of surgical expertise. This manuscript delves into the comparative analysis of PTHI care during two distinct periods: 2006-2010, predominantly under the purview of pediatric surgeons, and 2013-2015, witnessing the rise of neurological surgeons as primary caregivers. Through an exploration of advancements in diagnostic techniques, surgical interventions, and perioperative care, this manuscript aims to elucidate the impact of surgical specialization on patient outcomes and healthcare practices.

**2006-2010: Pediatric Surgeon-Led Care**

During the period from 2006 to 2010, pediatric surgeons were at the forefront of PTHI management at our institution, the University of Abuja Teaching Hospital, Abuja. Diagnostic modalities primarily included skull X-ray, though, limited in their ability for accurate assessment of the extent and severity of intracranial injuries. Surgical interventions focused on exploratory burrholes, being a non-specific and inaccurate determinator of localization of intracranial haematomas, hematoma evacuation, and craniectomies. Mitigating secondary brain injury was couched in the speed of diagnosis and intervention and use of dexamethasone for control of cerebral edema. Rehabilitation strategies centred mainly on physical needs of PHTIs patients. Advancements during this period primarily centered on refinements in surgical techniques and perioperative management.

**2013-2015: Neurological Surgeon-Led Care**

Within he decade spanning from 2013 to 2015 witnessed a paradigm shift in the care of PTHIs, with neurological surgeons assuming a prominent role in management. This transition was driven by the entry of neurosurgical expertise into the patient care armamentarium of our hospital. This entrenched the recognition of the complex pathophysiology of traumatic brain injuries, TBIs, and the need for specialized neurosurgical expertise. Diagnostic capabilities became augmented in 2013, with the hospital's adoption of advanced imaging modalities of computed tomography (CT) scans and magnetic resonance imaging (MRI) that allowed for accurate assessment of the localization, extent and severity of injuries. Surgical interventions evolved to encompass targeted-therapies of craniotomies for acute haematoma evacuation, burrhole evacuation of chronic haematomas, elevation of depressed skull fractures, placement of ventriculoperitoneal shunt for posttraumatic hydrocephalus and decompressive craniectomies for intractable raised intracranial pressure. Neurological surgeons leveraged their expertise in neuroanatomy and microsurgical skills to optimize surgical outcomes and minimize iatrogenic damage. Moreover, the advent of informed use of pharmacological agents, such as mannitol, offered promising avenues for mitigating secondary brain injury and improving neurological recovery.

Postoperative care protocols underwent refinement, with an emphasis on individualized management strategies tailored to the unique needs of each patient, including meticulous monitoring of ICP, maintenance of cerebral perfusion pressure (CPP), both derived from close clinical monitoring, and prevention of complications such as hydrocephalus and cerebral edema. Early mobilization protocols and aggressive rehabilitation efforts aimed to maximize functional recovery and mitigate long-term disabilities associated with PTHIs.

## Methods and materials

Our study is a descriptive and a retrospective one, at an institution that was privileged to have a paediatric surgeon with an interest in PTHIs and committed to surgical excellence. He led the 2006 – 2010 (a 5-year period) era of care for PTHIs and had published their findings in 2014. It was the findings from that study that formed the basis for our study. The lead author of the index study was the pioneer neurosurgeon who commenced operative neurosurgical services of the hospital in January, 2013. Though, just commenced, but, in mid-2015, just 2 and ½ years later, it was observed that the volume of patients treated with PTHIs had doubled. So, it was imperative to compare the findings from the publication by the Paediatric surgeon group with the clinical information obtained from paediatric patients' case records who were managed for PTHIs from January, 2013 to June, 2015, including their demographics, diagnosis, surgical procedure, associated injuries, and requirement of intensive care, ICU, duration of hospitalization and outcome measure of Glasgow Outcome Score.

Ethical approval was not sought for this study as the study was an audit of the routine clinical practice of neurosurgical services.

## Results

Demographics were similar between the 2 care periods, as was injury severity as assessed by GCS score, as displayed in Table 1 66 patients with PTHIs were managed during the 2 and ½ year period of the study. The age range was from 10 months to 16 years with a median age of 7 years. The sex ratio was 46 males to 20 females giving a sex ratio of 70:30 (2.3:1). The remainder of the findings are given in Table 1. Relevant cardinal findings extracted from the publication by the Paediatric Surgeon-led group has been juxtaposed in the table where appropriate for ease of comparison

| **1.Sex** | **Index study (N=66)** | **Olori et al study(N=34)** |
|---|---|---|
| Female | 20(30.3%) | 11(32.4%) |
| Male | 46(69.7%) | 23(67.6%) |
| **2.Age group (Years)** | | |
| 0-4 | 25(37.9%) | 1-5(11, 32.4%) |

| | | |
|---|---|---|
| 5-9 | 19(28.8%) | 6-10(11, 32.4%) |
| ≥10 | 22(33.3%) | 11-15(12, 35.2%) |
| Mean±SD, median, CI, Range | 7.1±4.3, 7, 6.0-8.1, 0.83-16 | |
| **3.Diagnosis (GCS) of PTHIs** | | |
| Mild | 26(39.4%) | |
| Moderate | 28(42.4%) | |
| Severe | 12(18.2%) | |
| **4.Cause** | | |
| Assault | 2(3.0%) | |
| Fall from Height | 3(4.5%) | |
| RTA | 61(92.4%) | |
| **5.Polytrauma** | | |
| No | 55(83.3%) | 24(70.6%) |
| Yes | 11(16.7%) | 10(29.4%) |
| **6.Treatment** | | |
| Non-operative | 54(81.8%) | 30(88.2%) |
| Operative | 12(18.2%) | 4(11.8%) |
| **7.Outcome/GOS** | | |
| **Death** | 0(0.0%) | 1(2.9%) |
| 2 | 3(4.5%) | |
| 3 | 3(4.5%) | Poor: 1(2.9%) |
| 4 | 21(31.8%) | |
| 5 | 39(59.1%) | Good: 32(94.1%) |
| Mean±SD, median, CI, Range | 4.4±0.8, 5, 4.3-4.6, 2-5 | |
| **8.Duration of hospitalization** | | |
| 1 week | 30(45.5%) | 1-5 Days: 9(26.5%) |
| 2 weeks | 19(28.8%) | 6-10 Days: 9(26.5%) |
| 3 weeks | 7(10.6%) | 11-15 Days: 8(24.5%) |
| 4 weeks | 3(4.5%) | 16-20 Days: 3(8.8%) |
| 1 month and beyond | 7(10.6%) | >20 Days: 5(19.7%) |
| **9.ICU Care** | | |
| No | 62(93.9%) | |
| Yes | 4(6.1%) | |

**Table 1**: Summary of demography, cause, severity and outcome of management of paediatric traumatic head injuries

## Discussion and Comparison:

The article by Olori and colleague addressed a 5-year experience of management of paediatric traumatic head injuries, PTHIs at our Centre in North-Central Nigeria in a pre-neurosurgery period.[1] The information presented was timely and important to the growth and development of paediatric surgical care. This descriptive study provides important primary data that offer insight into barriers to neurosurgical care at the time and efforts at surmounting them in our environment. It is remarkable that the volume of PTHIs seen from their study was 34 while for half of the same duration almost twice that figure (66) was recorded in our study, as documented in Table 1. We believe that the attractive force responsible for this finding was the presence of specialist neurosurgical care and therefore, there was pooling towards our Centre to assess same.

There was a bimodal age presentation as seen in Table 1. Olori and colleague found a median age of 6-10 years, but ours was bimodal of 0-4 years and 10-16 years. In both studies the peak age of incidence was 7 years, while Rabiu and colleagues from South-Western Nigeria found a peak incidence of 8 years.[3] This age bracket corresponds to the period of onset of commencement of schooling and a lot of the school pupil go to school on foot, making them prone to pedestrian road traffic accidents. Our study aligned with international findings as noted by De Souza et al, who found peak incidences of 38.58% and 27.45% for ages 15-19 and 0-4 respectively.[4-8]

While male to female ratio in the study by Olori and colleague was 2:1, we had a similar finding of 2.3:1. Yusuf et al from Ilorin, of North-Central Nigeria found a ratio of 13:7 being 1.9:1.[9] Interestingly, a study from South-South Nigeria found a ratio of 1.2:1.[10] And a study from South-East Nigeria, 2.6:1 and South-West of 2.5:1.[11, 12] All the various geographical regions of Nigeria had similar age ratio concordance but for the study from North-East Nigeria with a ratio of 5:1.[13] A collaborative nationwide prospective study will be needed to define a national figure.

There was more paediatric traumatic head injuries with associated polytruama encountered during the period under review when compared to the paediatric surgeon-led era. This is seen from Table 1 with the absolute ratio of 4.9 to 2.4. This indicates that there was twice the incidence of polytrauma in the present study comparatively. We attribute this finding to the growing

urbanization and the increased referral observed. Given that PTHI commonly occurs in the setting of other injuries, including long-bone fractures and soft tissue injuries severe PTHI is treated in a multidisciplinary setting.[14]

In the value of treatment, there was similarity in the overall treatment patterns of operative and non-operative care. However, there is a difference relative to the specificity of procedures performed. While only exploratotory burrholes were performed during the paediatric surgeon-led era, with its non-specificity, a variety of patient-tailored procedures of craniotomy, craniectomy and burrholes were documented during the neurosurgeon-led period. These treatments offered precise solutions to the needs of the patient, hence a more qualitative outcome.[15]

The outcome measure utilized in both studies was the Glasgow Outcome Scale score, GOS. While no death was recorded during the neurosurgeon-led era, there was one death in the Olori study. The GOS defined a good outcome as 5. The paediatric surgeon-led era found a 94.1% good outcome score and the neurosurgeon-led era had 59.1%. The difference may not be unconnected with the stratification process of the GOS as used by the paediatric surgeon-led group; as it was stratified into Good, Poor, and death. No explanation as to their various constituents was offered. Nevertheless, the outcome observed during the paediatric surgeon –led era revealed an effective management strategy.

The most prevalent paediatric head trauma type in this study is Mild head injury (49.4%), though, this parameter was not elucidated in the study by Olori and colleague, it is an important epidemiological and management tool.[15] This finding is similar to report from other studies which have reported Mild head injury as the most prevalent.[16, 17] While Ibrahim et al. reported severe head injury as the most prevalent in their study.[18] More studies have shown congruence of higher prevalence of mild head injury than any other types of head injury, these disparities across differing studies may be difficult to explain but geographical variations and various pathophysiologic mechanisms may hold the answer.

Concerning aetiology of injury, unintentional road traffic accidents, RTA and falls were the most common causes followed by intentional assault injuries in our study. This is in accord with most studies done in developing countries.[19-23] In terms of length of hospital stay, majority (45.5%) of the patients in our study was hospitalized for 7 days or less, while the paediatric surgeon-led study showed 26.5% respectively for 4-5 days and 6-10 days. Shorter hospital stays could be due to the higher percentage of milder forms of TBI in both studies. Those with longer hospitalizations were those with severer forms of traumatic head injuries. These findings are comparable to similar studies done in Africa and China.[24-27]

There was a low uptake of Intensive Care Unit management services by the patients in our study. Patients with severe traumatic head injury who by definition ought to benefit from ICU care did not have it. This was due to financial incapability as the service was offered as out-of-pocket fee-for-service pattern. The paediatric surgeon-led group were silent on utilization of ICU for their patients during their management era. This may suggests a possible non-developed paediatric ICU care at the time. Nonetheless, a robustly good outcome was observed with their non-ICU-based care. Though it remains a subject of debate if outcomes can significantly be improved by ICU management.[28] These findings do not in any way suggests that patients should be managed without ICU for those who meet the indication. In fact, the findings underscore the need for preventive measures despite advances in management and neuro-monitoring in PTHI. So, preventive measures, such as speed limits, traffic education and the use of bicycle helmets enforcements should be entrenched and are key requirements in reducing early mortality and long-term morbidity.[29, 30]

## Conclusion:

The comparative analysis of PTHI care during the two specified periods highlights several notable trends and advancements. While both pediatric surgeons and neurological surgeons demonstrated a commitment to optimizing patient outcomes, the latter period saw a greater emphasis on neurosurgical specialization and the integration of cutting-edge technologies into clinical practice. The transition to neurological surgeon-led care facilitated the adoption of advanced surgical techniques, refined perioperative management protocols, and personalized rehabilitation strategies, ultimately contributing to improved outcomes for pediatric patients with traumatic head injuries. The evolution of PTHI care from 2006 to 2015 reflects a dynamic interplay between technological advancements, surgical innovation, and multidisciplinary collaboration. While pediatric surgeons laid the foundation for effective management during the late 2000s, the subsequent decade witnessed a paradigm shift towards neurosurgical specialization and personalized care. Moving forward, continued research efforts and interdisciplinary collaboration will be essential in further refining treatment strategies and optimizing outcomes for pediatric patients with traumatic head injuries.

## Conflicts of Interest

The authors declare no conflicts of interests.

**Authors Contributions**

Both authors participated in the conception, data analysis, writing and proofreading.

## References:

1. Olori S, Salihu S. Management of Head Injured Children In a Non Neurosurgical Centre. New Nigerian Journal of Clinical Research. 2014 Jun;4(6):405-409.
2. Araki T, Yokota H, Morita A. Pediatric Traumatic Brain Injury: Characteristic Features, Diagnosis, and Management. Neurol Med Chir (Tokyo). 2017 Feb 15;57(2):82-93. PMID: 28111406; PMCID: PMC5341344.
3. Taopheeq Bamidele Rabiu, Habeeb Ogundipe. Profile of Pediatric Traumatic Brain Injury in South-West Nigeria. World Neurosurgery. 2022;166:e711-e720. ISSN 1878-8750.
4. De Souza LC, Mazzu-Nascimento T, De Almeida Ballestero

JG, De Oliveira RS, Ballestero M. Epidemiological study of paediatric traumatic brain injury in Brazil. World Neurosurg X. 2023 Apr 25;19:100206. PMID: 37181581; PMCID: PMC10172740.
5. Stanley R.M., Bonsu B.K., Zhao W., Ehrlich P.F., Rogers A.J., Xiang H. US estimates of hospitalized children with severe traumatic brain injury: implications for clinical trials. Pediatrics. 2012;129(1):e24–e30.
6. Murgio A., Andrade F.A., Sanchez Muñoz M.A., Boetto S., Leung K.M., ISHIP group International multicenter study of head injury in children. Childs Nerv Syst. 1999;15(6–7):318–321.
7. Hawley C.A., Ward A.B., Long J., Owen D.W., Magnay A.R. Prevalence of traumatic brain injury amongst children admitted to hospital in one health district: a population-based study. Injury. 2003;34(4):256–260.
8. Chan H.C., Aasim W.A.W., Abdullah N.M., et al. Characteristics and clinical predictors of minor head injury in children presenting to two Malaysian accident and emergency departments. Singap Med J. 2005;46(5):219–223.
9. Yusuf AS, Adeleke NA, Omokanye HK, Nasir AA, Kolade OA. Clinical Parameters, Management, and Outcomes of Childhood Traumatic Brain Injury in Ilorin. J Pediatr Neurosci. 2019 Jul-Sep;14(3):127-132. PMID: 31649771; PMCID: PMC6798270.
10. Nnadi MO, Bankole OB, Fente BG. Epidemiology and treatment outcome of head injury in children: A prospective study. J Pediatr Neurosci. 2014 Sep-Dec;9(3):237-241. PMID: 25624926; PMCID: PMC4302543.
11. Chikani MC, Aniaku I, Mesi M, Mezue WC, Chikani UN. Characteristics and outcome of paediatric traumatic brain injuries: An analysis of 163 patients in Enugu. Niger J Med. 2021;30:446-51.
12. Adeloye A, Olumide AA, Obiang HM. Acute head injuries in children in Ibadan, Nigeria. Child's Nerv Syst. 1986;2:309–313.
13. Ogunleye OO, Shuaibu SI, Obanife HO. Epidemiological Patterns of Head Injury in Bauchi, North-Eastern Nigeria. Acta Scientific Neurology. 2021;4(5):27-32.
14. Harnisch LO, von der Brelie C, Meissner K. Management of severe traumatic brain injury. Anesth Analg. 2021;133:66–67.
15. Marino MA, Siddiqi I, Maniakhina L, Burton PM, Reier L, Duong J, Miulli DE. Neurosurgical Outcomes in Severe Traumatic Brain Injuries Between Service Lines: Review of a Single Institution Database. Cureus. 2023 Apr 11;15(4):e37445. PMID: 37182018; PMCID: PMC10174636.
16. Emejulu JKC, Isiguzo CM, Agbasoga CE, Ogbuagu CN. Traumatic brain injury in the accident and emergency department of a tertiary hospital in Nigeria. East and Central African Journal of Surgery. 2010;15:28-38.
17. Bock-Oruma AA, Odatuwa-Omagbemi DO, Ikubor JE. Pattern of head injury in the emergency department of the Delta state university teaching hospital, Oghara, Nigeria. British Journal of Medicine and Medical Research. 2016;15:1-6.
18. Alnaami I, et al. Patterns, Types, and Outcomes of Head Injury in Aseer Region, Kingdom of Saudi Arabia. Neuroscience Journal. 2019.
19. Udoh D, Adeyemo A. Traumatic brain injuries in children: a hospital-based study in Nigeria. Afr J Paediatr Surg. 2013;10(2):154–159.
20. Emejulu JK, Shokunbi MT. Aetiological patterns and management outcome of paediatric head trauma: one-year prospective study. Niger J Clin Pract. 2010;13(13):276–279.
21. GBD 2015 Mortality and Causes of Death Collaborators. Global, regional, and national life expectancy, all-cause mortality, and cause-specific mortality for 249 causes of death, 1980–2015: a systematic analysis for the Global Burden of Disease Study 2015. Lancet. 2016;388(10053):1459–1544.
22. Punchak M, Abdelgadir J, Obiga O, et al. Mechanism of pediatric traumatic brain injury in southwestern Uganda: a prospective cohort of 100 patients. World Neurosurg. 2018;114:e396–e402.
23. Gupta PP, Malla GB, Bhandari R, Shah Kalawar RP, Mandal M. Patterns of injury and mortality in pediatric patients attending emergency department in a tertiary care center in eastern Nepal. J Nepal Med Assoc. 2017;56(207):331–334.
24. Okyere-Dede EK, Nkalakata MC, Nkomo T, Hadley GP, Madiba TE. Paediatric head injuries in the Kwazulu-Natal province of South Africa: a developing country perspective. Trop Doct. 2013;43(1):1–4.
25. Shao J, Zhu H, Yao H, et al. Characteristics and trends of pediatric traumatic brain injuries treated at a large pediatric medical center in China, 2002–2011. PLoS One. 2012;7(12):e51634.
26. Fink EL, von Saint Andre-von Arnim A, Kumar R, et al. Traumatic brain injury and infectious encephalopathy in children from four resource-limited settings in Africa. Pediatr Crit Care Med. 2018;19(19):649–657.
27. Bahloul M, Chabchoub I, Dammak H, et al. Outcome analysis and outcome predictors of traumatic head injury in childhood: analysis of 454 observations. J Emerg Trauma Shock. 2011;4(2):198–206.
28. Maas AIR, Menon DK, Adelson PD, et al. Traumatic brain injury: integrated approaches to improve prevention, clinical care, and research. Lancet Neurol. 2017;16(12):987–1048.
29. Olivier J, Creighton P. Bicycle injuries and helmet use: a systematic review and meta-analysis. Int J Epidemiol. 2017;46(1):278–292.
30. Maas AIR, Menon DK, Manley GT, et al. Traumatic brain injury: progress and challenges in prevention, clinical care, and research. Lancet Neurol. 2022;21(11):1004–1060.