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## Original Research Article

# A comparative study of OAE (OTO acoustic emission) and BERA (brainstem evoked response audiometry) / ASSR (auditory steady state response) as a screening of hearing loss among the children (<12 years of age) for hearing assessment in ENT OPD

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## ABSTRACT

**Introduction:** Normal speech and language development depend upon a child's ability to hear spoken language. The most important period for language and speech development is generally regarded as the first 3 years of life. Pediatric hearing loss is a major concern in India due to high incidence of hearing loss in this age, high birth rate, lack of facilities and awareness for early diagnosis. Therefore, early detection and early identification of hearing loss is very important.

**Materials and Methods:** The study was carried out in ENT Department, Sir T Hospital, Bhavnagar. A total of 100 children <12 years of age with hearing loss who were screened with OAE (OTO acoustic emission) and BERA (brainstem evoked response audiometry).

**Results:** Among 100 children (<12 years of age), majority of the cases were in age group of 6 to 12 yrs. Male patients are predominantly affected than other patients.

**Conclusion:** The earlier intervention, better were results. It is important to have more awareness programs focusing on importance of early hearing screening in children. This current study indicated the importance of screening for hearing loss among children.

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## 1. Introduction

Hearing is one of the very important five senses. Helen Keller called deafness "A worse misfortune than being blind because when you lose your vision you lose contact with things, when you lose your hearing you lose contact with people". Hearing loss is invisible, and usually occurs gradually. It can mimic forgetfulness, inattentiveness or mental dullness. Significant hearing impairment is one of the most common major abnormalities present at birth and, if undetected, will impede speech, language, and cognitive development. Universal detection of pediatric

hearing loss requires universal screening of all children. The impact of hearing loss on early language development has been well documented. Although published studies on efficacy of early intervention are more limited, the majority demonstrates that children with hearing loss who received early intervention had higher score of improvement on acquired language than those not connected to service early (NIDCD 1997).<sup>1,2</sup>

A study by (Yoshinagaitano et al., 1998 and Gopal et al., 2000) indicated that early identification followed by proper intervention as early as 6 months of age results in essentially normal language acquisition later on and minimize the negative effects of hearing loss. In contrast,

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a delay in detection of up to 2 to 4 years may result in abnormal language acquisition. Hearing impairment may be conductive or sensorineural or a combination of two (mixed) hearing loss. Hearing impairment affects one or both ears, varies from mild to profound in degree. It may be congenital, acquired, transient, fluctuating, recurrent, progressive or permanent.

As per WHO Hearing impairment refers to complete or partial loss of the ability to hear from one or both ears. The level of impairment can be mild, moderate, severe or profound. The world health organization (2021) estimates that 430 million people and 34 million children worldwide have disabling hearing impairment, 80% of them live in low – and middle – income countries. About 139 million cases of disabling hearing impairment could be prevented. WHO estimates that around seven million children in developing countries have disabling hearing difficulties. As per WHO estimates in India, there are approximately 63 million people, who are suffering from significant auditory impairment; this places the estimated prevalence at 6.3% in Indian population.

For the past 15 years, electrophysiological methods are most commonly used which include Otoacoustic Emission (OAE) and Brain Stem Evoked Response (BERA). The use of OAE together with BERA was shown to be reliable and provided high sensitivity and specificity in universal hearing screening programs. Brain stem evoked response (BERA) has been established as the most reliable screening tool for hearing assessment in neonates since its first use in 1978 for this purpose. However, technical expertise required and time consumed in performing BERA in a neonate or a child makes this modality fall short of being an ideal screening tool.<sup>3,4</sup>

## 2. Aim and Objectives

To compare screening of hearing loss by OAE and BERA among the children come for hearing assessment in ENT OPD (<12 year of age), to assess age and gender wise comparison of test result of OAE and BERA and to assess deafness category wise comparison of test result of OAE and BERA.

## 3. Materials and Methods

The study was carried out in ENT Department, Sir T Hospital, Bhavnagar. A total of 100 children <12 years of age with hearing loss who were screened with OAE (OTO acoustic Emission) AND BERA (brainstem evoked response audiometry).

Informed consent was obtained from parents\* prior to the study.

### 3.1. Inclusion criteria

Children age group of <12 years age, Patient comes in ENT OPD for hearing assessment, Children referred by paediatrician on the basis of suspicious hearing loss/speech delay/presence of any high risk factor, Children brought by parents suspicious of hearing loss or speech delay.

### 3.2. Exclusion criteria

Patient with absent external auditory canal, meatal atresia, anomalies of the external where probe insertion not possible, Tympanic membrane perforation, Children with purulent ear discharge, acute suppurative otitis media conditions of ear like external impacted wax were included in study after the condition was treated.

## 4. Results

Among this screening test nearly 41% children fall under 0-5 year age group and 48% fall under 6-12 year age group children with decrease hearing according to BERA. 39% children fall under 0-5 year and 53% children fall under 6-12 year with decrease hearing according to OAE.

The male & female distribution was 89% & 72% respectively. 59 screened males 31 has OAE refer and 22 has BERA abnormal in comparison to screened 41 females among whom 26 has OAE refer and 17 has BERA abnormal. Male: Female ratio for decrease hearing as per study is (2:1).



Fig. 1: OAE audiometer



Fig. 2: BERA audiometer

Among the 100 children screened for hearing assessment 47 has OAE refer on primary screening and 43 has BERA abnormal and 53 has OAE pass and 57 has BERA NORMAL according to BERA 4 children has no sensory neural hearing loss in which OAE shows refer test result. Among the 100 children 50 children has normal hearing in which 13 children has OAE refer and 11 children has BERA ABNORMAL so according to BERA 2 children has

**Table 1:** Age wise distribution

| Age     | Number of children | OAE  |       | BERA (ASSR) |          |
|---------|--------------------|------|-------|-------------|----------|
|         |                    | Pass | Refer | Normal      | Abnormal |
| 0 to 5  | 48                 | 29   | 19    | 28          | 20       |
| 6 to 12 | 52                 | 24   | 28    | 27          | 25       |
| Total   | 100                | 53   | 47    | 55          | 45       |

**Table 2:** Gender wise distribution

| Sex    | Number of children | OAE  |       | BERA (ASSR) |          |
|--------|--------------------|------|-------|-------------|----------|
|        |                    | Pass | Refer | Normal      | Abnormal |
| Male   | 59                 | 28   | 31    | 37          | 22       |
| Female | 41                 | 15   | 26    | 24          | 17       |
| Total  | 100                | 43   | 57    | 61          | 39       |

**Table 3:** Category wise hearing loss comparison

| Deafness category       | Number of children | OAE  |       | BERA (ASSR) |          |
|-------------------------|--------------------|------|-------|-------------|----------|
|                         |                    | Pass | Refer | Normal      | Abnormal |
| Normal hearing          | 50                 | 37   | 13    | 39          | 11       |
| Mild SNHL               | 10                 | 02   | 08    | 02          | 08       |
| Moderate SNHL           | 08                 | 03   | 05    | 03          | 05       |
| Moderate to severe SNHL | 11                 | 04   | 07    | 05          | 06       |
| Profound SNHL           | 21                 | 07   | 14    | 08          | 15       |
| Total                   | 100                | 53   | 47    | 57          | 43       |

no sensory neural hearing loss Among the 100 children 18 children has mild-moderate sensory neural hearing loss in which 8 children has OAE refer and 8 children has BERA abnormal so according to result 8 children has sensory neural hearing loss Among the 100 children 11 children has severe sensory neural hearing loss in which 7 children shows OAE refer and 6 children shows BERA Abnormal so according to BERA 1 children has no sensory neural hearing loss Among 100 children 21 children has profound sensory neural hearing loss in which 14 children shows OAE refer and 15 children shows BERA Abnormal so according to BERA 1 children has no sensory neural hearing loss.

## 5. Discussion

Since the first months and years of life are accepted as critical for normal language development, the early detection of hearing loss in neonates became an important objective in child care. Moving from the fact that only through neonatal hearing screening, early diagnosis, intervention and rehabilitation followed by a proper amplification are possible for congenitally hearing impaired; currently hearing screening in new born is performed by OAE and BERA/ASSR testing. The present prospective observational study was undertaken to compare Otoacoustic emissions and Brain stem evoked response audiometry for screening of hearing loss in children, to identify the type of hearing loss and to see the sensitivity and specificity of OAE taking BERA as gold standard.

This study comprised of comparative evaluation of Distortion product otoacoustic emissions (DPOAE) and Brain stem evoked response audiometry (BERA) / Auditory steady state response (ASSR) as a screening modality for hearing impairment in children. DPOAE and BERA/ASSR recordings were obtained for 200 ears of 100 children. We performed OAE and BERA at the same time, irrespective of the DPOAE pass/fail results. DPOAE was found to be simple and rapid test with relatively high acceptability. In fact, in two studies viz. Uus and Bamford, 2006, UK and Joseph, 2003, Singapore screening was carried out before 3 months of age. However in one Indian study, Jaymin A. Contractor et al., 2011, Surat screening was carried out in children in the age group of 5 years and less.<sup>5-7</sup>

From above observed study we can comment that in mild to moderate hearing loss patient OAE and BERA is equivalent with each other so in this type of hearing loss we can prefer OAE only can give better result and is cost effective so is preferable test for it and in severe to profound hearing loss BERA/ASSR is preferable as gold standard method to identifying the central cause of hearing according to result we can plan further for cochlear implant and also using hearing aid for hearing.<sup>8,9</sup>

There are certain factors that might bring about delays in diagnosis and intervention in children with hearing loss in our society including low literacy rate among parents, cultural consideration, doubts about degree of hearing loss, attitudes towards wearing hearing aids and cost and technical considerations.

## 6. Conclusion

This current study indicated the importance of screening for hearing loss among children. This study highlighted that BERA gives a perfect picture of hearing sensitivity. Regular follow ups should be done and rehabilitative measures must be initiated as early as possible. So present study concludes that in order to avoid any problem related to hearing function in children OAE hearing screening and BERA screening programs should be carried out in all the hospitals of India to assess hearing at an early age. This study reinforces the perception that like other developing countries, India should also implement neonatal screening programs for hearing in a cost-effective manner which will help us to reduce the influence of hearing impairment on children's social, emotional, intellectual and linguistic development

## 7. Source of Funding

None.

## 8. Conflict of Interest

None.

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