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## Oral Health Knowledge, Practice and Dental Plaque Maturity Status of Hearing-Impaired Children

(Pengetahuan, Amalan Kesihatan Oral dan Status Plak Pergigian Matang  
dalam Kalangan Kanak-kanak Bermasalah Pendengaran)

HALIZA TUGEMAN, NORMASTURA ABD RAHMAN\*, AZIZAH YUSOFF & MOHD KHAIRI MD DAUD

### ABSTRACT

*Hearing impairment is an unseen handicapped that lead to communication barriers which might impede knowledge transfer. The aim of this study was to compare the oral health knowledge, practice and dental plaque maturity between hearing-impaired (HI) and normal children. A cross sectional study was conducted among children aged 7-14 years old. The HI children were recruited from a special school for the deaf while the normal children were from the primary and secondary schools in Bachok, Kelantan. The oral health knowledge and practice was assessed by face to face interview whilst the dental plaque maturity status was evaluated using GC Tri Plaque ID Gel™ (TPID). The data was analysed using IBM SPSS version 22. HI children had poor oral health knowledge and oral health practice compared to normal children ( $p < 0.05$ ). HI children had significantly more matured plaque compared to normal children with mean (SD) DPMS of 1.8 (0.57) and 1.3 (0.20), respectively ( $p < 0.001$ ). In conclusion, there were poor oral health knowledge, poor oral hygiene practice and high plaque maturity among HI children.*

*Keywords: Dental plaque; hearing impaired; oral hygiene*

### ABSTRAK

*Gangguan pendengaran adalah sejenis kecacatan yang tidak boleh dilihat serta mengakibatkan halangan untuk berkomunikasi dan boleh menjejaskan proses penyebaran pengetahuan. Tujuan kajian ini adalah untuk membandingkan tahap pengetahuan dan amalan penjagaan kesihatan oral serta tahap plak matang dalam kalangan kanak-kanak bermasalah pendengaran (HI) dan kanak-kanak normal. Satu kajian rentas telah dijalankan dalam kalangan kanak-kanak berumur 7-14 tahun. Kanak-kanak HI dalam kajian ini adalah daripada sekolah pendidikan khas manakala kanak-kanak normal daripada sekolah rendah dan menengah di daerah Bachok, Kelantan. Tahap pengetahuan dan amalan kesihatan mulut telah dinilai melalui temu duga bersemuka manakala tahap plak matang telah dikaji menggunakan GC Tri Plaque ID Gel™ (TPID). Data telah dianalisis menggunakan IBM SPSS versi 22. Kanak-kanak HI mempunyai tahap pengetahuan kesihatan mulut yang rendah secara signifikan berbanding kanak-kanak normal ( $p < 0.05$ ). Kanak-kanak HI mempunyai plak matang lebih tinggi secara signifikan berbanding kanak-kanak normal dengan min (SD) tahap plak matang masing-masing 1.8(0.57) dan 1.3(0.20) ( $p < 0.001$ ). Kesimpulannya tahap pengetahuan dan amalan berkaitan kesihatan mulut adalah rendah manakala kadar plak matang adalah tinggi dalam kalangan kanak-kanak HI.*

*Kata kunci: Kebersihan mulut; masalah pendengaran; plak pergigian*

### INTRODUCTION

Hearing impairment has crucial impact on childhood as severity of the impairment is associated with communication barriers that may lead to difficulties in exchanging information (Dalton et al. 2003; Munoz-Baell & Ruiz 2000). Hearing screening done on babies in neonatal unit of a tertiary center in Malaysia showed a total of one per cent with hearing loss (Mohd Khairi et al. 2005). HI children need support from their parents or interpreters to help in communicating with others as they learn from visual stimulation rather than oral communication.

Study in India reported that HI children have poor oral hygiene, high prevalence of caries and unmet needs of treatment (Jain et al. 2008; Kumar et al. 2008). The

reason might be explained by the difficulties in mastering skills and knowledge. Previous studies indicated that HI children do not have adequate oral health knowledge and oral health care which might impair the oral hygiene practice (Doichinova & Peneva 2011; Oredugba 2004). A study in China showed upon comparing 229 HI individuals studying in special school and healthy 196 individuals aged 17-19, the HI group was lacking in oral health knowledge, lacking in effective oral health practice with the caries prevalence of 55.9% compared to normal individual, 13.3% (Wei et al. 2012). Strong knowledge on oral health has been demonstrated towards a better oral health practice among children (Smyth et al. 2007). Appropriate oral health education can help nurture good oral health practice

(Murat & Watt 2006). The change in healthy attitude and practice may occur by giving adequate health information, motivation and practice to the subjects (Smyth et al. 2007). Oral health status plays an important role in the general well-being of an individual. Dental caries and periodontal disease are the most global oral health burdens (Petersen et al. 2005). Dental plaque was associated as the aetiology of both the diseases (Rode et al. 2012; Sambunjak et al. 2011). Thus adopting effective oral hygiene practice can prevent dental plaque from becoming mature due to disruption of continuous plaque accumulation (Axelsson et al. 2004).

Dental plaque is a diverse microbial community on tooth surfaces embedded in a matrix of polymers of bacterial and salivary origin (Marsh et al. 2009). Immature dental plaque can be regarded as normal since it is present continuously on the tooth surface. However, dental plaque becomes mature *in vitro* after 24-72 h while *in vivo* generally after 72 h (Seneviratne et al. 2011). Mature dental plaque is dominated by pathogens linked to dental caries and periodontal disease (Walsh 2009).

Various methods of assessing dental plaque were being established as a dental plaque indices such as simplified oral hygiene index (OHI-S) (Greene & Vermillion 1964), plaque index (PI) (Löe & Silness 1963), plaque component of periodontal disease index (PDI) (Ramfjord 1966), patient hygiene performance index (PHP Index) (Podshadley & Haley 1968) and plaque control record by O'Leary et al. (1972). However, the limitation of using the dental plaque indices is the failure in detecting small plaque area but potentially relevant clinically (Pretty et al. 2005). Therefore, a simpler method to identify dental plaque in a minimal time period might be more useful and practical to be used in epidemiological studies; an example is GC tri Plaque ID Gel™ (TPID).

Oral health awareness in terms of knowledge and practice is very important as this would trigger the motivation towards improvement in oral health care. Knowledge and practice regarding oral health care and plaque maturity level among HI children in Kelantan are still unknown. Therefore this study aimed to determine the oral knowledge and practice as well as the plaque maturity of HI children. This study would provide a baseline data for further improvement in increasing the knowledge which hopefully would be translated into practice, thus ensuring a better oral health among HI children.

#### MATERIALS AND METHODS

Prior to the study, ethical approval was obtained from the Human Research and Ethics Committee, Universiti Sains Malaysia, Reference No: FWA Reg. No: 00007718; IRB Reg. No: 00004494. This was followed by permission and approval from the Ministry of Education and Kelantan Education Department, Malaysia to conduct the study at schools. A cross sectional study was conducted between June and July 2014 where the case group comprised of HI children from Sekolah Kebangsaan Pendidikan Khas

(Pendengaran), while the comparative group comprised of the normal children from Sekolah Kebangsaan and Sekolah Menengah Kebangsaan Kandis, Bachok, Kelantan. The two study groups were compared to determine the oral health knowledge, practice and severity of dental plaque maturity. The inclusion criteria were HI and normal children aged 7-14 years old and without impaired manual dexterity. For the HI, those who were unable to read or understand sign language were excluded. The hearing impairment is graded as mild, moderate, severe and profound based on the hearing threshold during the hearing test. Hearing threshold between 26-40 dB is graded as mild, 41-60 dB is graded as moderate, 61-80 dB as severe and when the threshold reached 81 dB and above, the hearing impairment is graded as profound (WHO 2013). The diagnoses of the types of HI were retrieved from the patients record at the school.

A face to face interview using a questionnaire adopted from Siddibhavi et al. (2011) was done to determine the oral health knowledge and practice among children. The knowledge domain consisted of 20 items with 'yes' and 'no' answer. The oral health practice domain consisted of six (6) items which HI children has to select the correct answer. A proforma was used to record data such as date of birth, sex, race, level of parents' education and household income.

After an interview, a plaque maturity test was done using TPID. It was carried out in a classroom while the child seated in supine position on a portable dental chair under good lighting by using Waldman portable lamp. Standardization and calibration exercises on plaque assessment were conducted at the dental clinic, School of Dental Sciences, Universiti Sains Malaysia (USM) prior to the data collection. The calibration was done on five children who were not included in this study to achieve consistency and minimize intra-examiner variability. The percentage agreement was at 95% and the *kappa* score was 0.95. The data collection procedures and examination of dental plaque maturity was done by a single examiner.

The TPID was a useful product since it showed low pH region on dental plaque. In the TPID, a readily fermented substrate was included to allow recognition of highly acidogenic plaque based on the pH response of the dyes. The original dark blue TPID colour changed to light-blue/aqua colour when the sucrose in TPID metabolised by acidogenic bacteria in the plaque (pH less than 5), whilst for mature non-fermenting plaque it turn to violet/blue and immature health-associated plaque turn to pink/red (Brostek & Walsh 2014). Thus, as stated by Brostek and Walsh (2014), TPID was able to detect immature, mature and acid producing plaque based on 'real-time' fermentation, especially in demonstrating adequate plaque removal among patient.

TPID was applied to all tooth surfaces using a microbrush. The children were then instructed to lightly rinse their mouth with tap water. Immediately after rinsing, the colour changes were observed and were coded into different score in order to assess the stage of maturity of dental plaque on each surface (Table 1). All tooth surfaces

TABLE 1. Colour indication based on TPID colour changes

Colour	Indication	Score (clinical examination)
No colour	No plaque	0
Pink or red	Immature plaque	1
Blue or purple	Mature plaque	2
Light blue	Mature and acid producing plaque	3

(buccal, lingual, mesial and distal) were assessed except for the occlusal. Partially erupted teeth or badly carious tooth were also excluded from the assessment. Based on the colour changes on the total surfaces, the sum of dental plaque maturity scores (DPMS) was obtained by using a formula:

$$DPMS = \frac{\text{No plaque}(0) + \text{immature plaque}(1) + \text{mature plaque}(2) + \text{acid producing plaque}(3)}{\text{Number of surface evaluated}}$$

The range of DPMS is between 0 and 3. The children were allowed to look into a mirror to see the stained plaque area and advised on good oral hygiene practice, especially among children with mature dental plaque.

#### STATISTICAL ANALYSIS

IBM SPSS version 22.0 statistical software was used for data entry and analysis. The numerical variables were described using mean and standard deviation (SD) or median and interquartile range (IQR). The categorical variables were presented as frequency and percentage (%). Chi-square test ( $\chi^2$ -test) was used to compare the oral health knowledge and practice between HI and normal children while independent

t-test was used to compare dental plaque maturity scores between them. The p-value was set at  $p < 0.05$ .

#### RESULTS

Table 2 shows the sociodemographic profiles of the children. The mean (SD) age was 12.0 (2.12) and 11.7 (2.23) years old for the HI and normal children, respectively. There were more females in both groups. All subjects were Malays with the majority of parents had secondary school education level. The household income was lower among family of HI group compared to family of normal children. More than half (61.0%) of HI children had profound hearing impairment.

Table 3 shows that HI group had significantly poor knowledge on sign of dental caries, causes of dental caries, prevention of dental caries and role of fluoride compared to the group of normal children ( $p < 0.05$ ). Less than half (43.8%) of HI group perceived that caries would affect the appearance. For knowledge on gum disease, HI children had significantly poorer knowledge on the causes of gum disease related to bacteria and cigarette smoking and prevention of gum disease as compared to the control group ( $p < 0.05$ ).

TABLE 2. Sociodemographic characteristics of HI children and normal children

Variable	HI Children ( <i>n</i> =64)		Normal Children ( <i>n</i> =69)	
	Mean (SD)	<i>n</i> (%)	Mean (SD)	<i>n</i> (%)
Age (years)	12.0 (2.12)		11.7 (2.23)	
Sex				
Male		30 (46.9)		20 (29.0)
Female		34 (53.1)		49 (71.0)
Ethnic				
Malay		61 (100)		68 (100)
Parents'				
Primary school		3 (4.8)		1 (1.5)
Secondary school		48 (76.2)		47 (69.1)
Tertiary education		12 (19.0)		20 (29.4)
Family's household income (RM per month)	705 (738.00) <sup>a</sup>		1000 (2500) <sup>a</sup>	
Level of hearing impairment				
Mild		2 (3.4)		
Moderate		4 (6.8)		
Severe		17 (28.8)		
Profound		36 (61.0)		

<sup>a</sup> Median (interquartile range)

NA=not applicable

TABLE 3. Oral health knowledge among HI ( $n=62$ ) and normal children ( $n=69$ )

Variable	HI n (%)	Normal n (%)	$\chi^2$ stat (df)	p-value
Signs of dental caries				
Cavitation	33 (51.6)	48 (69.6)	4.52(1)	0.034
Toothache	29 (45.3)	46 (66.7)	6.16(1)	0.013
Causes of dental caries				
Amount of sugary diet	32 (50.0)	64 (92.8)	30.22(1)	<0.001
Bacteria	22 (34.4)	52 (75.4)	22.60(1)	<0.001
Infrequent tooth brushing	24 (37.5)	47 (68.1)	12.51(1)	<0.001
Dental caries may affect the appearance	28 (43.8)	59 (85.5)	25.69(1)	<0.001
Knowledge on caries prevention				
Regular tooth brushing	44 (68.8)	58 (84.1)	4.35(1)	0.037
Less sugary diet intake	36 (56.3)	62 (89.9)	19.34(1)	<0.001
Role of fluoride				
Strengthening the teeth	39 (60.9)	57 (82.6)	7.77(1)	0.005
Caries prevention	23 (35.9)	48 (69.6)	15.09(1)	<0.001
Knowledge of causes of gum disease				
Bacteria	27 (42.2)	55 (9.7)	19.78(1)	<0.001
Sugary diet	34 (53.1)	34 (49.3)	0.20(1)	0.657
Lack of vitamin	23 (35.9)	24 (34.8)	0.02(1)	0.889
Cigarette smoking	16 (25.0)	41 (59.4)	16.06(1)	<0.001
Gum disease prevention				
Good diet	36 (56.3)	58 (84.1)	12.39(1)	<0.001
Regular tooth brushing	35 (54.7)	52 (75.4)	6.28(1)	0.012
Dental visits	35 (54.7)	58 (84.1)	13.62(1)	<0.001

As for oral health practice, majority of HI subjects (56.5%) visited dentist during school dental service whereas most of the normal children group (44.1%) visited dentist because of toothache;  $p<0.001$  (Table 4). During the first visit, most of the HI children (35.5%) had significant fear and anxiety when compared to normal children (42.0%) who had only fear ( $p=0.027$ ). Two thirds of normal children (87.0%) feel that regular dental visits are necessary compared to only more than half HI children (62.9%) ( $p=0.001$ ). The percentage of HI children brushed the teeth twice daily especially in the morning and before bedtime at night was significantly lower compared to normal children. There were more parents or guardians of HI children who observed their kids when they brush the teeth compared to parents or guardians of normal children (41.9%) and (4.3%) ( $p<0.001$ ), respectively.

As for the plaque maturity level, Table 5 shows that there were 50.8% of HI children had matured plaque compared to normal children 13.2%. None of the normal children had acid producing plaque compared to HI children there were 14.8% had acid producing plaque.

Table 6 shows the mean (SD) DPMS between HI and normal children. The mean (SD) of the DPMS was significantly higher in HI children, 1.8 (0.57) when compared to normal children, 1.3 (0.20);  $p<0.001$ .

## DISCUSSION

In the current study, a comparison of oral health knowledge, practices and the severity of dental plaque maturity

between the HI and normal children was carried out. The mean age of HI and normal children was almost similar 12.0(2.12) and 11.7 (2.23) years old, respectively, which was almost similar as in previous study (Doichinova & Peneva 2011). All the respondents were Malays which reflects the composition of Malay ethnic in Kelantan which was 95.7% (Statistic Department 2010). Majority of HI children in this study were having severe (28.8%) to profound (61.0%) hearing impairment since children with mild hearing impairment were able to attend the ordinary class at main stream school. However, study has shown that children with mild hearing impairment were significantly associated with poor academic performance which might be due to their inability to hear clearly (Daud et al. 2010). The HI children had poor knowledge especially items on the causes of dental caries and periodontal disease, prevention of periodontal disease and role of fluoride which concurs with previous study done in Jiangsu province of East China (Wei et al. 2012) that concluded normal children might have more advantages in term of comprehending oral health message delivered at school compared to HI children. In Malaysia, there is an improvement of oral health status especially among the school-going population since emphasis is given on prevention and incremental dental care approach. However, for children with special needs, healthcare providers need to be trained in the management of such children with passion and compassion besides the required clinical skills in order to make sure the children enjoy the same benefit as the normal children (Oral Health Division 2004).

TABLE 4. Comparison of oral health practice between HI ( $n=62$ ) and normal children ( $n=69$ )

Items	HI <i>n</i> (%)	Normal children <i>n</i> (%)	$\chi^2$ stat (df)	p-value
<b>Dental visits</b>				
6–12 months	15 (24.2)	2 (2.9)	32.43 (3)	<0.001
Occasionally	0 (0.0)	12 (17.6)		
When pain occurs	12 (19.4)	30 (44.1)		
School dental service	35 (56.5)	24 (35.5)		
Never	0	0		
<b>First dental visit</b>				
Fear and anxiety	22 (35.5)	17 (24.6)	9.21 (3)	0.027
Fear	12 (19.4)	29 (42.0)		
Less fear	10 (16.1)	12 (17.4)		
No fear	18 (29.0)	11 (15.9)		
<b>Regular dental visits</b>				
Yes	39 (62.9)	60 (87.0)	10.24 (1)	0.001
No	23 (15.1)	9 (13.0)		
<b>Time of tooth brushing</b>				
Morning	48 (77.4)	63 (91.3)	4.87 (1)	0.024
After lunch	25 (40.3)	37 (59.7)	0.74 (1)	0.246
Before bed time	41 (46.4)	57 (82.6)	4.71 (1)	0.024
<b>Duration of tooth brushing (minutes)</b>				
< 2	38 (61.3)	24 (38.7)	10.74 (2)	0.005
$\geq 2$	24 (38.7)	45 (65.2)		
<b>Observation while brushing</b>				
Parent/guardian	26 (41.9)	3 (4.3)	58.99 (3)	<0.001
Never but advice	8 (12.9)	53 (76.8)		
Never	6 (9.7)	6 (8.7)		
Mother only/guardian	22 (35.5)	7 (10.1)		

TABLE 5. Plaque maturity group among HI ( $n=61$ ) and normal children ( $n=68$ )

Children	Plaque maturity group		
	Immature plaque <i>n</i> (%)	Mature plaque <i>n</i> (%)	Acid producing plaque <i>n</i> (%)
HI children	21(34.4)	31(50.8)	9(14.8)
Normal children	59(86.8)	9(13.2)	0(0.0)

TABLE 6. Comparison of dental plaque maturity scores between HI and normal children

Children	Plaque scores	Mean difference (95% CI)	t-stat (df)	p-value
HI ( $n=61$ )	1.8 (0.57)	-0.56 (-0.71,-0.41)	-7.29(1)	<0.001 <sup>a</sup>
Normal ( $n=68$ )	1.3 (0.20)			

<sup>a</sup>Independent t-test. Population variance was significantly different (Levene's test  $p$  value <0.001) therefore  $t'$  statistic without assuming equal variance was used

With regards to oral health practice, HI children generally lack of proper oral health practice in term of dental visit and tooth brushing practice compared to normal children which concurs with previous studies (Doichinova & Peneva 2011; Wei et al. 2012). Brushing at least twice per day was significantly lower among HI children compared with normal children. This was in agreement with previous study in China which indicates the needs of reinforcement

on oral disease prevention especially among HI individuals (Wei et al. 2012). The proper tooth brushing practice twice daily was low among HI children which might be due to limited oral health knowledge that leads to poor oral health practices (Oredugba 2004). As for Malaysia, in 1993, children with special needs were formally recognized as one of the priority groups for oral health care in (Oral Health Division 2004). However the guidelines

for children for special needs are generalized to all types of disabilities and do not focus on any specific disability. Different approaches are needed for different types of disabilities. For example, for children with intellectual disability might suffer from reduced cognition whereas children with physical disability might be restricted due to lack of manual dexterity (Howell & Brimble 2013). Dental nurses visit schools annually to do dental check-up and treatment both for the normal and children with disability. The treatment for HI children usually will be done in the presence of teachers to act as interpreters due to communication barriers. As to date, there is no oral health education program specifically designed for HI children. The majority of parents (76.8%) of normal children only gave advice when the children brushing teeth but did not supervise them which concurs with study done by Al-Omiri et al. (2005). It was suggested that support from parents in children during tooth brushing especially among children age less than 10 years old was very useful to maintain the oral hygiene (Rajab et al. 2002). The percentage of children brushing the teeth in the morning in both groups in this study was higher compared to previous study among 6 and 12 years old school children in Belarus which is one of the developing country in Europe (Elena & Petr 2004). However, there was only nearly half (46.4%) of HI children brush their teeth before going to bed at night compared with normal children, 82.6% in this study. The lower frequency of brushing the teeth twice per day among HI children would expose higher risk of oral disease such as caries and periodontal disease (Jain et al. 2008; Kumar et al. 2008). In our study, fear and anxiety among HI were significantly higher compared to normal children. Dental fear was referred to the actual response to object or situation whilst anxiety was much related to the emotional state precede to a feared object or situation (Armfield & Heaton 2013). Dental fear might cause dental neglect and lack of dental uptake among children (Newton 2012; Purohit et al. 2010). Lack of communication also led to inequalities in access to health care among HI individual compared to normal individual (Ubido et al. 2002). Availability of assistant or services that cater the needs of HI individual while using the health service would expected to increase the utilization of the service among them. Good communication or good rapport was found to be able to overcome dental fear including good understanding from clinician with phased treatment approach (Armfield & Heaton 2013). Thus, it is important to have good communication with HI children and minimise the barriers in communication such as by removing face mask or reduce the background noise while communicating with HI children (Champion & Holt 2000). In this study, the mean DPMS was significantly higher among HI compared to normal children. Therefore, it is hypothesised that the risk of developing dental caries or periodontal disease would be increased among them. Bonito (2002) stated that many caregivers of the special needs children did not have the prerequisite knowledge or values to recognize the importance of oral hygiene and did not practice appropriate oral hygiene care for their own

children. Jain et al. (2008) suggested that dental health education should be provided to the parents, caregivers and school teachers of this group of special children. In order to target the HI children, as an oral health personnel, the dentists or dental nurses may also need to learn some basic sign language. This is because the oral health messages could not be delivered to these children using the common method delivered to normal children which might be associated with communication barriers.

To the best of our knowledge, direct comparison of plaque maturity with other studies is not possible because as yet there was no known epidemiological or clinical study done on the presence of immature or mature plaque using TPID. In previous studies the used of TPID solution was mainly suggested for educational purpose to engage the patient in proper oral hygiene practice and to assess the patient compliance to oral health care (Brostek & Walsh 2014). In our study, the TPID was selected due to its rapid changes on colours and it is easy to use for children without the need to use the dental probe. This technique was considered as non-invasive and would prevent dental fear and anxiety among children. Identification of mature plaque which highlighted in certain areas would help the children to focus on the high risk areas while brushing to prevent future dental caries or periodontal disease. In this study, the colour changes were shown to all children and advice were given accordingly. As mentioned earlier, dental plaque becomes mature *in vivo* generally after 72 h (Seneviratne et al. 2011) which contains high numbers of micro colonies. When the pH falls, calcium and phosphate will diffuse out of the tooth. The critical pH level is 5.5 which is sufficient for demineralization of enamel and dentin. Conversely, if the pH of the environment adjacent to the tooth is high, remineralisation can occur (Marya 2011). This can happen if there are lack of substrate for bacterial metabolism, low cariogenic bacteria in the plaque, buffering capacity of the saliva, elevated secretion rate of the saliva, rapid clearance time of food and the presence of fluoride.

## CONCLUSION

HI children had lower mean (SD) oral health knowledge score as well as lack of good oral hygiene practices compared to their normal children's counterpart in term of frequency and duration of brushing the teeth. The mean plaque score was significantly higher compared to normal children. An alternative oral health education method that fulfilled the needs of HI children should be developed to ensure the effectiveness of oral health education to this disadvantage group of children.

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Haliza Tugeman, Normastura Abd Rahman\* & Azizah Yusoff  
Dental Public Health Unit  
School of Dental Sciences  
Universiti Sains Malaysia  
16150 Kubang Kerian, Kelantan Darul Naim  
Malaysia

Mohd Khairi Md Daud  
Department of Otorhinolaryngology  
Universiti Sains Malaysia  
16150 Kubang Kerian, Kelantan Darul Naim  
Malaysia

\*Corresponding author; email: normastura@usm.my

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