THE USE OF HALL'S TECHNIQUE PREFORMED METAL CROWN BY PAEDIATRIC DENTISTS IN MALAYSIA

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THE USE OF HALL'S TECHNIQUE PREFORMED METAL CROWN BY PAEDIATRIC DENTISTS IN MALAYSIA

by

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-	Minus
Δ	Precision of the study
n	Sample required
Z	Normal standard deviation
p	Population proportion required
%	Percentage
P	Significant level
SPSS	Statistical Package for the Social Sciences
HTPMC	Hall's Technique Preformed Metal Crown
PMC	Preformed metal crown
CT	Conventional Technique
ECC	Early childhood caries
GA	General anaesthesia
LA	Local anaesthesia
IS	Inhalation sedation
GIC	Glass ionomer cement
OVD	Occlusal vertical dimension
GDP	General Dental Practitioner
CDP	Community Dental Practitioner
MOH	The Ministry of Health
KKM	Kementerian Kesihatan Malaysia
HUSM	Hospital Universiti Sains Malaysia
JEPeM	Jawatankuasa Etika Penyelidikan

PPSG	Pusat Pengajian Sains Pergigian
USM	Universiti Sains Malaysia
UK	United Kingdom
US	United States
SDCEP	Scottish Dental Clinical Effectiveness Program

PENGGUNAAN KORONA BESI SIAP BENTUK TEKNIK HALL (HTPMC) OLEH PAKAR PERGIGIAN PEDIATRIK DI MALAYSIA

ABSTRAK

Korona besi siap bentuk Teknik Hall (HTPMC) juga dikenali sebagai kaedah unggul dalam menangani gigi molar desidus yang rosak tanpa bius setempat, penyingkiran karies dan persediaan gigi. Walaupun terdapat bukti yang menunjukkan keberkesanannya, penggunaan Teknik Hall di kalangan pakar dan pengamal pergigian umum masih agak berkurangan. Tiada kajian yang telah dilakukan mengenai penggunaan korona besi siap bentuk teknik Hall di Malaysia. Keputusan hasil kajian yang didapati daripada penyelidikan ini diharapkan dapat membantu kadar amalan dan mengenal pasti halangan dalam mengamalkan HTPMC di Malaysia. Ia juga diharapkan secara tidak langsung memberi galakan kepada pakar pergigian akan datang terhadap penggunaan HTPMC dalam amalan biasa mereka. Objektif kajian ini adalah untuk menilai penggunaan korona besi siap bentuk teknik Hall di kalangan pakar pergigian kanak-kanak di Malaysia. Ini merupakan kajian soalselidik keratan rentas di kalangan pengamal pergigian pediatrik di Malaysia. Soalselidik telah dihantar secara dalam talian kepada pengamal pergigian pediatrik yang bertugas di hospital (Kementerian Kesihatan Malaysia) dan universiti di Malaysia. Analisis deskriptif telah dilakukan termasuklah peratusan agihan untuk demografi profil dan soalan-soalan berkaitan dengan HTPMC. Perisian SPSS modeler telah digunakan untuk menganalisis kekerapan ulangan. Hasil kajian menunjukkan penggunaan HTPMC adalah agak tinggi. Daripada 32 pengamal pergigian pediatrik, 21 (65.6%) menggunakan HTPMC di Malaysia. Dalam pada itu, 66.7% (14%) responden sentiasa mahu menggunakan HTPMC sebagai pilihan rawatan, 19% (4) sebagai rawatan pilihan untuk molar desidus berkaries. Tambahan lagi, 47.5% lebih gemar

menggunakan HTPMC ke atas gigi berkaries inter-proksimal berlubang, 19.0% dalam gigi berkaries oklusal berlubang. Walaubagaimanapun, 23.8% (5) daripada mereka tidak mahu menggunakan HTPMC untuk gigi berkaries oklusal yang tidak berlubang dan hanya 9.5% (2) responden tidak mahu menggunakannya untuk gigi berkaries inter-proksimal tidak berlubang. Majoriti responden akan menggunakan HTPMC terutamanya ke atas kanak-kanak keperluan istimewa 95.2% (20). Responden juga akan mengaplikasikan korona besi di bawah sedasi inhalasi (76.2%). Selain itu, mengenai tanggapan halangan terhadap penggunaan HTPMC, 61.1% responden menyatakan bahawa mereka tidak dapat menjumpai saiz yang betul untuk korona. 60.0% responden juga tidak menggunakannya kerana mereka tidak suka mengenakan korona tanpa membuang karies sepenuhnya. Kesimpulannya, penggunaan korona besi siap bentuk teknik Hall dalam kalangan pengamal pergigian pediatrik di Malaysia adalah agak tinggi. Menurut tinjauan, kebanyakan responden ingin menggunakan HTPMC untuk kanak-kanak keperluan istimewa dan lebih daripada separuh mahu menggunakannya di bawah sedasi inhalasi. Tambahan lagi, jawatan responden menentukan faktor mempengaruhi yang tertinggi dalam penggunaan HTPMC. Responden yang merupakan pensyarah, pakar dan konsultan telah menggunakan HTPMC selama lebih daripada 5 tahun. Responden yang telah menamatkan pengajian pasca siswazah di inar negara juga menggunakan HTPMC dengan lebih kerap.

Kata kunci: Korona besi siap bentuk teknik Hall, molar desidus, soalselidik.

THE USE OF HALL'S TECHNIQUE PREFORMED METAL CROWN BY PAEDIATRIC DENTISTS IN MALAYSIA

ABSTRACT

Hall's technique preformed metal crown (HTPMC) has been established as a novel method for managing decayed primary molars without local anaesthesia, caries removal and tooth preparation. Despite good evidence of its effectiveness, the usage of Hall's technique among specialists and general dental practitioners are still noticeably low. Previously, no study has been carried out about Hall's technique preformed metal crown in Malaysia. The expected outcome of this study will help to find out the practice rate and the barrier of practising HTPMC in Malaysia which could encourage the future dental practitioner for using HTPMC in their regular practice. The aim of the study is to assess the usage of Hall's technique preformed metal crown among the paediatric dentists in Malaysia. This is a cross-sectional questionnaire-based study among the paediatric dentists in Malaysia, and the questionnaire was distributed online to the paediatric dentists who are working in hospitals (MOH) and universities in Malaysia. Descriptive analysis was performed including percent distributions for demographic profile and questions related to HTPMC. SPSS modeler software was used to analysis the co-occurrence frequencies. The outcome of this study suggests a relatively high use of HTPMC. In this study, the response rate was 49% whereas only 32 paediatric specialists responded out of 65. Out of 32 paediatric dentists, 21 are (65.6%) using HTPMC in Malaysia. On the other hand, 66.7% (14) respondents always want to use HTPMC as a treatment option, 19% (4) as a treatment choice for a carious primary molar. On the other hand, 47.6% would prefer to use HTPMC in cavitated interproximal carious teeth, 19.0% in cavitated occlusal carious

teeth. However, 23.8% (5) of them did not want to use HTPMC for non-cavitated occlusal carious teeth and only 9.5% (2) respondents who did not want to use it for non-cavitated interproximal carious teeth. Majority of the respondents would like to use HTPMC for special needs children 95.2% (20). However, they prefer to fit the metal crown under inhalation sedation 76.2%. Among all the perceived barriers of using HTPMC, 61.1% of respondents stated that they are unable to find the right size of the crown. About 60.0% of respondents are not using it because they do not like to fit the crown without removing caries completely. In conclusion, the usage of Hall's technique preformed metal crown among the paediatric dentists in Malaysia is significantly high. According to the survey, most of the respondents would like to use HTPMC for special need children and more than half of them want to use under inhalation sedation. In addition, the working position of the respondent determined as the highest influencing factor of using HTPMC. Respondents who are lecturer, specialist and consultant using HTPMC for over 5 years. Moreover, respondents who completed their post-graduation from abroad are using HTPMC more frequently.

Keywords: Hall's technique preformed metal crown, primary molar, questionnaire.

CHAPTER 1

INTRODUCTION

1.1 Background of the study

Dental caries is one of the most frequent dental problems especially in children. At present, caries management in children has been changed remarkably in many developed countries, which approach more preventive and preservative management for caries. In spite of the remarkable fact that caries rates fluctuate enormously between individuals, groups, and countries (Goyal *et al.*, 2007). There are several caries management methods available for managing carious primary dentition such as pit and fissure sealants, conventional restoration with various restorative materials (glass ionomer cement, composite, compomer etc.), and stainless-steel crown. However, some of these convenient methods undoubtedly require local anaesthesia and tooth preparation as well. There are dentists who prefer to leave the carious primary teeth and wait for exfoliation depending on the age of the patient (Levine *et al.*, 2002). A systematic review result revealed that a preformed metal crown has a better outcome than amalgam restorations for class two cavities (Randall *et al.*, 2000). Another study results suggested that preformed metal crown (PMC) was better than conventional restorations during managing carious lesions involving more than one surface. Moreover, it was recommended in the UK National Clinical Guidelines in Paediatric Dentistry (Kindelan *et al.*, 2008) as treatment of choice for lesions of two or more surfaces, and extensive one surface lesions. Another study in the US was aimed to compare the placement of PMC conventionally and unconventionally (without using LA and tooth preparation). Similar success was found in both techniques (Ludwig *et al.*, 2014).

This unconventional technique is known as Hall's technique. In 1997, a general dental practitioner Dr Norna Hall from North Scotland was treating carious primary molars with the preformed metal crown in an unconventional way without local anaesthesia, caries removal or tooth preparation (Innes et al., 2017). From that, this unconventional technique was named as Hall's technique. Hall's technique represents as a novel method with minimum intervention for managing carious primary molars, where there is no need for local anaesthesia, tooth preparation and removal of caries. The fundamental aim of Hall's technique is to determine the efficacy of the carious primary molars with caries extending only to dentine. Before Hall's technique preformed metal crown (HTPMC), the metal crown was typically used to fit on primary molars with local anaesthesia and with crown preparation; something that is not necessarily practical for young children. HTPMC does not require local anaesthesia and crown preparation. It can be practised on children as young as three years old. In a recent study of European postgraduate students in paediatric dentistry, HTPMC was chosen as an option more often for anxious children than children who were unanxious, i.e., not as the treatment of choice for non-anxious children (Foley, 2012). HTPMC is an effective option for anxious children which may suggest future specialists more pragmatic in their approach to the use of this technique.

The essential concept behind the success of HTPMC is based on sealing caries with a preformed metal crown. There are precisely three contributing factors (tooth quality, carbohydrate and bacteria) with the passage of time, responsible for caries development. By opposing the microorganism from their source of proper nutrition, dietary carbohydrate and eliminate this access prevents the advancement of caries (Fejerskov and Kidd, 2009; Schwendicke et al., 2016). The dental pulp is then able to

lay down reparative dentine. A recent systematic review demonstrated the advantage of avoiding caries removal in terms of preventing pulpal exposure (Ricketts et al., 2013).

Placing preformed metal crowns using Hall's technique revealed a more promising result than conventional restoration in managing primary carious molars. The HTPMC assure a good seal is achieved, and it can be cemented with glass ionomer cement with a considerable degree of predictability (Randall, 2002). The success rate of HTPMC is measured as reduced pain and further infection which is the key objective of dental caries management. In the previous study, they compared the conventional restorative method with HTPMC result showed HTPMC has a more satisfactory outcome and restoration longevity than conventional restorations (Rosenblatt, 2008). Previously research evidence indicated that HTPMC is effective in managing dental caries in a primary molar. That was a pilot study carried out by Dr. Norna Hall who audited her own data of using HTPMC. She carried out the study with four GDPs and four specialists. The result showed that HTPMC is more satisfactory to the patients and their parents in comparison to conventional restorative methods (Innes et al., 2009).

The Hall's technique preformed metal crown is now being widely used in developed countries like United Kingdom, United States and Germany (Innes et al., 2017). In addition, HTPMC was introduced to the undergraduate paediatric dentistry curriculum before 2010 (Innes et al., 2017). Nowadays, HPTMC is taught in all UK and New Zealand dental schools, and in some dental schools across Europe (Welbury, 2017). The use of HTPMC is increasing worldwide apart a great deal of considerable

controversy in the past over its potential effectiveness. Despite the evidence has been presented to show the HTPMC has shown benefit to the child without being a harmful effect, there is sufficient evidence of reluctance by experienced practitioners to exercise it in practice. There are some practitioners who refused to use HTPMC because of technical difficulty and aesthetic concern (Santamaría *et al.*, 2018). In addition, a study result showed most of the dentists does not prefer to fit the hall crown without removing caries completely (John, 2016). In another study, some mentioned their concern about the appearance of the metal crown as well (Page *et al.*, 2014). There were some GDPs who stated that they are reluctant to use HTPMC because they were not confident enough with this new technique. In addition, GDPs were recommended that they need further training on the Hall technique (Dean *et al.*, 2011).

In brief, the principal purpose of the study was to assess the use of HTPMC by paediatric dentists in Malaysia.

1.2 Gap Statement

HTPMC was first introduced in Scotland. The technique has been employed and found particularly in developing countries. In the case of high-risk caries incidence, teeth with preformed metal crown showed benefits due to their adequate coverage (Hickel et al., 2005). Nowadays this technique is practised widely, and many dental schools are demonstrating this novel technique to undergraduate students as well. There are clinical evidence showed that Malaysian paediatric dentists has been practising HTPMC for managing primary carious molar. However currently there is

no adequate information regarding the implementation of this technique (HTPMC) in Malaysia.

In addition, the Ministry of Health Malaysia (MOH) / Kementerian Kesihatan Malaysia (KKM) has formalized paediatric dentistry as an independent department in all KKM hospitals (Oral Health Program, Ministry of Health). At present, there are more than 30 hospitals with more 40 specialists providing paediatric dentistry services in the KKM. They obtain a total of 13 recognized dental schools which private and government universities maintained by the Malaysian Dental Council. Each dental school has a paediatric dentistry unit which consists of paediatric dentists from different background. In a recent study in Germany, aimed to evaluate the use and views on the preformed metal crown by paediatric dentists. The study result showed that majority of the dentists (66%) does not use HTPMC and 77% of the respondents were not familiar with HTPMC as well (Santamaría *et al.*, 2018). After reviewing all the published literature on HTPMC, there have been no studies found about HTPMC in Malaysia.

1.3 Justification of the study

HTPMC is one of the acceptable novel techniques to efficiently manage primary carious molar. It is a simplified version, involves compressing an oversized, cement-filled stainless steel crown form upon a primary molar infected with dental caries, using no local anesthesia, no removal of carious tooth structure, no cutting the crown margins to natural length and no marginal crimping or finishing, as opposed to the usual stainlees steel crown procedure. Earlier on, no study has been carried out about Hall's technique preformed metal crown in Malaysia. Since the caries

prevalence among young children in Malaysia is very high (Nordin *et al.*, 2019). Previous research evidence showed HTPMC as a promising approach for managing young children with multi-surface caries and high caries risk. Hence, there is need for this study to give valuable information about the implementation of HTPMC and its acceptance among the paediatric dentist in Malaysia. In addition, this study will help the paediatric dentists to bring it forward to the community. Hence, this current study is going to be the first step to assess the usage of HTPMC in Malaysia.

The anticipated outcome of this study will help to find out the practice rate and the barrier of practising HTPMC in Malaysia which could encourage the future dental practitioner for properly using HTPMC in their frequent practice.

1.4 Conceptual framework of the study

Figure 1.2 showing the conceptual framework of the study. In this study, we are going to determine the usage of HTPMC by surveying the paediatric dentists using a questionnaire. In the questionnaire, we are going to assess the demographic profile of the respondents their clinical use and the barriers they are facing during the use of HTPMC.

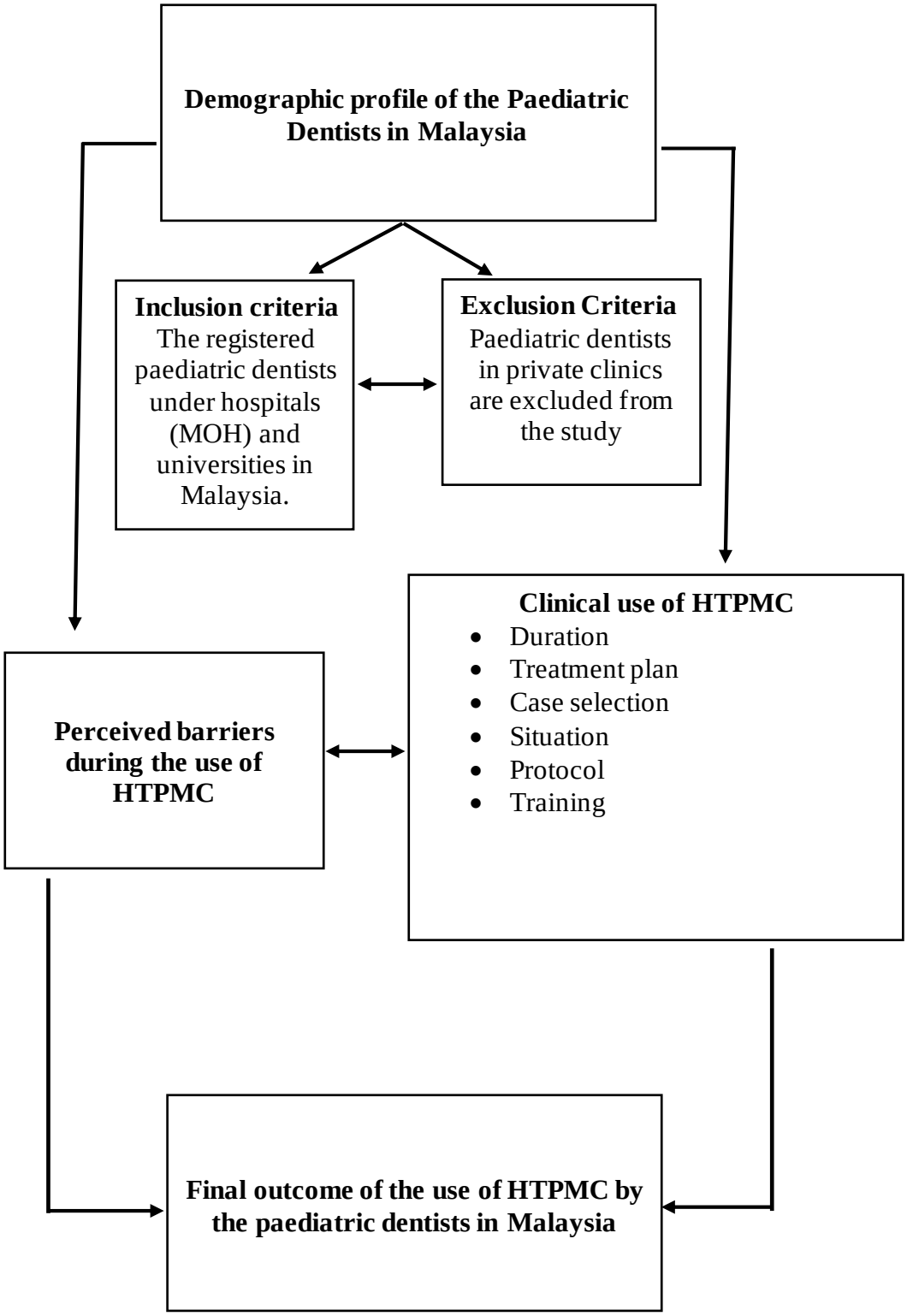

Figure 1.1 Conceptual framework of the study

1.5 Objective

1.5.1 General objectives

The aim of the study is to assess the usage of Hall's technique preformed metal crown among the paediatric dentists in Malaysia.

1.5.2 Specific Objectives

a) To determine the proportion of the usage of HTPMC among the paediatric dentists in Malaysia.
b) To determine the proportion of the perceived barrier during the use of HTPMC between paediatric dentist working in universities and hospitals in Malaysia.
c) To determine the co-occurrence between the use of HTPMC, respondents working place and the perceived barriers during using HTPMC.
d) To determine the influencing factors among the working position and place of post-graduation of the respondents with the duration of using HTPMC.
e) To determine the co-occurrence frequencies of the usage of HTPMC with the demographic profile of the respondents.

1.5.3 Research Questions

a) What is the proportion of the usage of HTPMC among the paediatric dentists in Malaysia?

b) What is the proportion of the perceived barrier during the use of HTPMC between the working place of the respondents?

c) What is the co-occurrence between the use of HTPMC, respondents working place and the perceived barrier during using HTPMC?

d) What is the proportion of the usage of HTPMC among the working place of the respondents and the perceived barrier during using HTPMC?

e) What are the co-occurrence frequencies of the use of HTPMC with the demographic profile of the respondents?

CHAPTER 2

LITERATURE REVIEW

2.1 Dental Caries

Dental caries is a chronic, multifactorial disease, which causes localised destruction and demineralisation of dental hard tissues (enamel, dentine, cementum) of the teeth by acid by-products from micro bacterial fermentation of food. Dental caries is not self-limiting because it can be reversed in early detection. If caries remains untreated, it can progress until the destruction of the affected tooth. There are three factors (tooth quality, diet, bacteria) that influence caries formation with the passage of time. Dental caries can be detected in both the crown and root portion, and also in smooth or pit and fissure surface of the tooth in both primary and permanent dentition.

There are different types of caries found and they are as follows:

- **Primary or Incipient caries** New carious lesion with a chalky white or brown appearance on the tooth surface known as primary or incipient caries. Commonly the primary caries is located in the susceptibility areas such as pits, fissures and some smooth surfaces of the teeth and sometimes in the root surfaces (Machale *et al.*, 2013).
- **Secondary or Recurrent caries** It is caused due to incomplete removal of initial caries around or beneath the restoration or the area where caries previously occurred. This type of caries is generally seen in the gingival margins of class II through class V restorations (Mjör, 2005).

- **Arrested caries** It is a non-progressive type of caries without any signs of further progression or extended into enamel or dentinal structure. It is mostly seen in the labial or lingual surface of the tooth (Nyvad and Fejerskov, 1997).

- **Rampant caries** It is a rapidly progressive type of caries involved mostly in anterior teeth.

Early childhood caries. In the year of 2019, International association of paediatric dentistry (IADP) have declared a new definition for early childhood caries. On that declaration, Childhood Caries (ECC) is defined as the presence of one or more decayed (non-cavitated or cavitated lesions), missing or filled (due to caries) surfaces, in any primary tooth of a child under six years of age (Childers, 2019). If the carious tooth left untreated, It can led to other complication such as disruption of growth and development, pain and life threatening infections. Its consequences can also affect the immediate and long term quality of life of child and family.

Based on the location (G.V. Black), caries can be classified into;

- **Class I** seen in the pit and fissure caries involving anterior and posterior tooth.
- **Class II** seen in the proximal surface of the posterior tooth.
- **Class III** seen in the proximal surface of the anterior teeth without involving the incisal edge.
- **Class IV** seen in the proximal surface of the anterior teeth involving the incisal edge.
- **Class V** seen in the gingival or cervical surfaces on the lingual or facial aspect of both anterior and posterior teeth.

- **Class VI** seen in the incisal edge of anterior and the cusp height of the posterior teeth.

2.2 Dental caries among children in Malaysia

National Oral Health Survey of School children (NOHSS 2017) showed that 33.3% of Malaysian school children had dental caries experience with mean DMFT of 0.78 (Oral Health Division, Ministry of Health, Malaysia, 2017). A study on caries prevalence, severity and pattern in children which conducted in Cameron Highlands, Malaysia showed that among 249 children 66.6% were detected with caries. The study concluded that high prevalence of caries in primary teeth was associated with poor oral health-related quality of life (OHRQoL) (Nordin *et al.*, 2019). The negative impact of dental caries in children's life includes chewing difficulties, decreased appetite, weight loss, sleeping difficulties, changes in behaviour and decrease in school performance. However, the Early Childhood Oral Health Impact Scale (ECOHIS) is currently the only instrument available to measure the impact of dental diseases/treatment experiences on OHRQoL of preschool children or their families (Abanto *et al.*, 2011).

Oo et al. published a study to evaluate the prevalence of caries and treatment need among mixed dentition in North-East Malaysia. A total of 319 children, 300 (93%) were affected by one or more carious lesions (Oo *et al.*, 2011). After reviewing other literature, they found caries prevalence is high in mixed dentition than 6-12 years old group of children (Dye *et al.*, 2010; Goyal *et al.*, 2007). The study concluded that health promotion programmes should be introduced in schools as early as mixed dentition stage.

Mani et al. published a study in 2012 which was a questionnaire-based study. The aim of the study was to determine the parents' knowledge, attitude and practice towards caries prevention in Malaysia. A 30-item close-ended questionnaire consisting 10 items, each addressing knowledge, attitudes and prevention practice by visiting pediatric dentists & community dental health specialists showed that the parents have good knowledge but attitude and practice towards oral health is poor. In some aspects, their knowledge was better than other countries especially knowledge about dietary factors that cause caries (Mani *et al.*, 2012).

Dental caries is a remarkable oral health disease in children. Early loss of primary teeth due to untreated dental caries may affect permanent teeth development. In a recent study among 5 years old children in the state of Kelantan, it has been reported that the mean decay, missing and filled teeth for deciduous dentition is 7.56 and caries prevalence is 88.7% in which children in Kelantan continue to have the highest caries prevalence among other states. Among 169 preschool children in the district of Kota Bharu, 74.6% of children had experienced caries. (Dolah *et al.*, 2019).

2.3 Dental caries management in children

2.3.1 Pit and fissure sealant

Dental sealants are an effective preventive method for cavities. Teeth have recesses on their biting surfaces; the posterior teeth have fissures and anterior teeth have cingulum pits. These pits and fissures are most susceptible to tooth decay due to food impaction and they are hard-to-clean. Dental sealants are placed in these pits and fissures to fill them in, creating a smooth surface which is easy to clean. Dental sealants are used in children who are at higher risk of tooth decay. There are two types of

sealants; resin-based sealants and glass ionomer sealants. 30 to 40% of US children aged six to eleven years have at least one dental sealant (Dye *et al.*, 2015). In European countries such as Denmark (about two thirds), Germany (about two thirds) and Portugal (more than half), the rates are significantly higher (Veiga *et al.*, 2015). In Saudi Arabia, approximately 9% of all children's molars have been sealed (Al Agili *et al.*, 2012). Previously, A study was carried out in Malaysia to assess the knowledge, attitude and utilization of fissure sealant among Malaysian dentists. The result of the study revealed that, only 13.7% of the respondents used fissure sealant routinely in their daily practise. Although, 57.5% dentists were acquainted with the guidelines for fissure sealant use (Chin *et al.*, 2016). According to the recent guidelines from American Dental Association Council on Scientific Affairs, sealants are effective in caries prevention and can restrict the progression of early non cavitated carious lesions (Beauchamp *et al.*, 2008).

2.3.2 Restoration

There are various materials generally which have been used such as; glass ionomer cement (GIC), composite resin, amalgam and stainless-steel crown (SSC) for dental caries restoration in children. The use of amalgam restoration is now declined due to the health hazards and environmental reasons and health promotion campaign. In a recent study, amalgam use rate was 27% compared to composite restoration (60%) in the management of caries in posterior teeth in children (Lynch *et al.*, 2018). The need to reduce the use of amalgam as a mercury-containing material is inevitable when aiming to reduce environmental contamination. Recently, the British Dental Association has made a statement regarding the European Parliament regulation on mercury, which mentioned that amalgam cannot be used for children under 15 years

of age, unless considered strictly necessary by the practitioner on the grounds of medical needs of the patient (Harford *et al.*, 2018).

The aesthetic concern is undoubtedly most important for patients and practitioners. Restoring of the posterior teeth using composite resin became popular as it needs more experience and needs to be placed under good moisture control. Due to cost-effectiveness and technique difficulty, some dentists are still not confident enough to use composite for restoring primary carious molar (Gilmour *et al.*, 2009).

In addition, most of the previous studies supported that glass ionomer cement is not a definitive restoration material for class II cavities. Although, few studies mentioned that highly viscous glass ionomer cement can be used in small class II cavities (Heck *et al.*, 2020).

The use of stainless steel crowns has been started from the year 1950 (Seale and Randall, 2015). SSCs are recommended for managing high risk of caries in children, enamel, dentin defects and gross caries followed by pulp therapy (Innes *et al.*, 2015). On the other hand, in small cavities, glass ionomer cement and composites can be successfully used in a great number of cases (Hickel *et al.*, 2005). Traditional SSCs are available in different sizes to match primary molars. SSC is flexible enough to allow chairside trimming, crimping, and shaping in order to obtain a good fit. Conventionally, the placement of an SSC is necessary to remove caries completely, prepare the tooth according to the desired size of the SSC which needs local anaesthesia as well (Kindelan *et al.*, 2008).

2.3.3 Pulp therapy

Management of multi-surface caries in children is difficult to achieve due to the morphology of the primary teeth. Primary teeth have a short crown, large pulp chamber, thin enamel and dentin which causes difficulties to restore without exposing the pulp (Kassa *et al.*, 2009). Pulp –therapy is indicated when the pulp is inflamed or exposed due to gross caries. There are a few pulp therapies according to the signs and symptoms which includes pulp capping, pulpotomy and pulpectomy. The aim of pulp therapy is to treat, restore and save the affected tooth. Pulp therapy is very painful for children because it needs local anaesthesia, drilling of the tooth. Under many circumstances, pulp therapy cannot be done in a single visit if infection, an abscess and chronic sinus exist. In addition, where there is a non-vital primary tooth single visit pulp therapy cannot be performed (Sevekar and Gowda, 2017).

2.3.4 Extraction

Previously there were no resources available for the restoration of the primary teeth other than extraction to remove the pain and infection (Honkala and Behbehani, 2013). In the year 2002, a retrospective study was conducted in England among 677 children who had received treatment from 50 general dental practitioners for 5 years. The result of the study showed that 44% of teeth were extracted due to pain and sepsis (Tickle *et al.*, 2002). On the other hand, there are some cases where the primary teeth are suggested to be extracted due to malalignment, root resorption and dental trauma. Nowadays, various treatment procedure has been introduced for dental caries treatment in children rather than leaving the affected tooth untreated for exfoliation or extraction.

2.4 Modern approaches to dental caries management in children

When prevention of dental caries fails, and a child is exposed to the risk of pain and infection, the disease must be managed to reduce this risk. There is a shred of growing evidence supporting more 'biological' and fewer 'surgical' approaches to managing dental caries in primary teeth. These biological methods include partial and stepwise caries removal procedures, as well as techniques where no caries is removed. Seven clinical trials were assessed to compare the modern approach with the conventional method. In a study by Magnusson et al., 1977 total 62 children with occlusal caries were included for the clinical trial and the authors concluded that complete removal of caries with calcium hydroxide inlay could be an effective approach to avoid pulp therapy (Magnusson and Sundell, 1977). 'Application of an adhesive restorative system to irreversibly infected dentin did not affect the clinical performance of the restoration' as stated by Riberio et al. (Maltz *et al.*, 2013).

Roshan et al. published a study which was aimed to assess the changes in clinical practice and attitudes towards the primary tooth management by the general and community dental practitioner (GDPs and CDPs) for over ten years (1986-1996) in the UK. A questionnaire was constructed to assess the views of 1290 GDPs and CDPs. Out of the total, 687 respondents replied and for caries prevention, GDPs used topical fluoride significantly ($p<0.01$) more than CDPs. On the other hand, CDPs gave more diet and oral hygiene instructions than GDPs. In this study, the result showed that 45% of CDPs used local anaesthesia and 35% pulpotomies and 15% pulpectomies were performed by the respondents. However, GDPs used amalgam more and CDPs used glass ionomer cement for the restoration of primary teeth. Among them, only 2% of them used a stainless steel crown in their regular practice (Roshan *et al.*, 2003).

2.5 Preformed Metal Crown

2.5.1 Conventional Preformed Metal Crown

Since the 1950s, the preformed metal crown was introduced in paediatric dentistry for the management of carious primary molars. The placement of a preformed metal crown over carious primary molar reduces pain and increases the risk of treatment failure. Previously, conventional stainless steel crowns (SSCs) was the most durable restorative material for primary molars (Sajjanshetty *et al.*, 2013).

Conventionally, before placing the SSCs, caries need to be removed from the tooth surface and crown preparation need to be performed with the help of burs (Round - for caries removal, Flame shaped diamond bur - for occlusal reduction, Long thin taped diamond bur - for proximal, buccal and lingual reduction, Rubber wheel or point/green stone - for finishing and polishing). Nevertheless, SSCs were indicated for the cases where pulp therapy has been performed, or in teeth with multi-surface restorations due to developmental defects or caries, or where other restorative materials are likely to fail (Sajjanshetty *et al.*, 2013).

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2.5.2 Hall's Technique Preformed Metal Crown (HTPMC)

Dr Norna Hall has started placing the preformed metal crown over carious primary molars without local anaesthesia, tooth preparation and removal of caries. After that, this method was named as 'Hall's Technique'. Previously, in a guideline of the Scottish Dental Clinical Effectiveness Programme (SDCEP), Hall's technique was included to help dentists to manage carious primary molars using less invasive approach (HT) over invasive surgical approach (conventional restoration) (Greig and Conway, 2012). In comparison with other restorative methods, Hall's technique

preformed metal crown showed evidence of minimum discomfort of patient during the treatment (Innes *et al.*, 2015)

However, a randomized control trial was held in Scotland by 17 GDPs and the result of the study showed that Hall's technique showed significantly, clinically and statistically better performance over other restorations. In another study by Phonghanyud et al., (2012), a randomized control trial was conducted to evaluate the clinical and radiographic outcome of GIC restoration. The study result showed that after 12 months of clinical and radiographic evaluation, partial removal of caries followed by GIC gave a better outcome than conventional restoration (Innes and Evans, 2013).

2.5.3 Acceptability of HTPMC over other restorative management

HTPMC is currently the most accepted method for managing more than one carious primary molars. It is also a clinically effective method for managing carious molars as the method is easy to perform and patient and parent acceptability rate is also significantly high. A study was conducted to evaluate the survival rate of HTPMC performed by Dr Norna Hall in primary carious molars. All the data was collected and analysed from the practitioner's record (1988-2001). The survival of HTPMC in three years and five years were 73.4% and 67.6% respectively which was not significantly different. On the other hand, 86% crown was lost in three years and 80% in five years. Overall the study result showed the similar success of HTPMC over other conventional methods (Innes *et al.*, 2006).

An in vitro study was conducted over 78 human primary maxillary molars and divided into two groups; 39 teeth for SSC with HT and 39 for SSC with CT (conventional technique). The purpose of the study was to evaluate the extent of marginal discrepancies and microleakage in two groups. According to the result, HT showed higher microleakage than CT using all types of filling materials. Moreover, resin cement showed the best outcome for preventing microleakage among both techniques (Erdemci *et al.*, 2014).

There were many studies carried out in European countries over the success of a preformed metal crown using the Hall technique. Nevertheless, no randomized control trial was carried out to assess the success of HT in Africa. In a recent study which was aimed to determine the survival rate and cost-effectiveness of PMC placement with CT and HT in Sudan (2014-2017). PMCs were placed using HT over 109 affected teeth and PMC were placed without using any local anaesthesia, no crimping and trimming were done during the procedure. Moreover, the procedure was carried out by dental therapists with 2 years of clinical experience after graduation. On the other hand, the placement of PMCs using CT over 103 affected teeth while all the traditional procedure was carried out by dentists with 5 years of clinical experience after graduation. Socioeconomic status, periodontal health, occlusion, anxiety, and procedure time were assessed. Survival rate was higher in both groups and no significant difference was found among both groups. In addition, the anxiety level was significantly higher in CT groups than HT groups. There were 2.7% and 5.8% minor failures, 6.4% and 5.8% major failures in HT and CT groups respectively. Furthermore, PMC cost for HT was US$2.45 and US$7.81 for CT. Thus, it can be concluded that HT can be carried out by less experienced dentists. This biological

approach provides a promising cost-effective option to manage caries in developing countries with limited resources (Elamin *et al.*, 2019).

Recently, Midani et al., (2019) assessed the clinical success and survival rate of standard HT and modified HT. The modified HT involved proximal tooth slicing, allowing the PMC to fit without separation and providing a minimal reduction of occlusal cusps, but however without caries removal and local anaesthesia. The study result showed that the survival rate and clinical efficacy of Hall crowns were higher than the modified HT. The study concluded that HT is an effective and less invasive management option for asymptomatic carious primary molars with multiple advantages, including high clinical success rate, ease of use, high acceptance by children, dentists and parents and cost-effectiveness etc, could be a suitable technique for treating anxious children with specific fears (eg, injections and drilling) or as an alternative therapy for improving cooperation and building confidence (Midani *et al.*, 2019) .

2.6 Advantages and disadvantages of HTPMC

It has been already proven that HTPMC is a novel method for managing carious primary molars. Time limitation and the ease of performing HTPMC is a primary advantage because HTPMC does not need local anaesthesia, tooth preparation and removal of caries. Therefore, it reduces patient anxiety throughout the treatment. On the contrary, the foremost disadvantage of HTPMC can be considered as its limitation of use. HTPMC is only indicated for carious primary molars with no pulpal involvement. Moreover, a piece of evidence from a study by Innes showed that

HTPMC allows a reliable, low-maintenance seal which could be achieved by GDPs. Caries can be left untreated safely by using HTPMC (Innes *et al.*, 2007).

In a study by Van der et al. in 2010 found that the HTPMC caused 'no discomfort' to 'mild discomfort' in 89% of the cases compares to 78% with respect to conventional restoration. In areas with limited access to dental care, HTPMC remains an additional advantage due to its potential usefulness. This is because it could be used in underdeveloped areas where neither electricity nor running water is available since it does not require any electrically driven equipment.

It is inevitable that placing a crown will result in a premature contact and increase in the OVD (occlusal vertical dimension) and these two factors have become a concern regarding the influence of HTPMC on the OVD as it does not involve any occlusal reduction of tooth. It has been suggested that OVD would reach equilibrium after a few weeks. It can be concluded that patients with HTPMC have to cope with premature contact for a few weeks (Van der Zee and Van Amerongen, 2010).

Nevertheless, the American Academy of Paediatric Dentistry believes that SSC followed by complete caries removal is a better treatment option for multi-surface restorations among children with high caries risk (Fontana *et al.*, 2012).

HTPMC is placed in tight contact of the tooth whereas in 13% cases, orthodontic separators are used and required additional visits. On the other hand, a study by Innes et al. 2007 noticed that the vertical dimension of the tooth increases due to the placement of HTMPC without any tooth reduction. Moreover, the study result

showed that the increased vertical dimension of the crown was adjusted with time (Innes *et al.*, 2007). In another study by Rosenblat et al. (2008), it was stated that, if there is any discomfort, children or parents would report it (Rosenblatt, 2008). There has been no major failure found in HTPMC managing carious primary molars, according to the SORT (Strength of Recommendation Taxonomy) HTPMC which was evidenced as level 2. The indications and contraindications of HTPMC is given below (Table 2.1).

Table 2.1 Indications and Contraindications of HTPMC

Indication	Contraindication
1) Evidence of proximal caries in primary molars.	1) Evidence of carious lesion which involved dental pulp.
2) Radiographically clear band of dentine should be seen in between caries and dental pulp.	2) Radiographically no evidence of clear band of dentine in between caries and dental pulp.
3) Patient with a high risk of caries	3) More than half of root resorbed, and the primary tooth is about to exfoliate.
4) Special need children where regular oral hygiene is difficult to maintain.	4) Clinically symptoms which are showing irreversible pulpitis.
5) Extensive tooth tissue loss due to erosion, attrition and abrasion.	5) A fractured tooth which cannot be restored with a preformed metal crown.

2.7 Success and acceptability of HTPMC

Kindelan et al. in 2008 published an article on Stainless Steel Crowns for primary molars in the UK's national clinical guidelines which has been started to publish since 1997. In relation to the use of SSCs or preformed metal crowns, six clinical guidelines were published (one meta-analysis, four literature review & one prospective clinical trial). All papers concluded that the failure rate of SSC or PMC was better than plastic restoration. A randomized control trial was performed in order to assess the success of SSC or PMC in managing primary carious molar using Hall's technique preformed metal crown. This paper provides the dental practitioner with an update of current published literature and available evidence for the use of SSCs in managing carious primary molars (Kindelan *et al.*, 2008).

Ludwig et al. have done a retrospective study on the success of stainless-steel crowns placed with Hall's technique preformed metal crown in 2014. They evaluated the success rate by placing clinically and radiographically of stainless-steel crowns following HTPMC and traditional methods as well. They graded the restoration success by using a 4-point scale based on the presence or loss of SSC and whether the patient needed further treatment associated with pulpal pathology or secondary caries. The study result showed that 65 (97%) out of 67 SSCs placed with HT and 110 (94%) out of 117 placed with traditional methods were successful. A large prospective randomized clinical controlled trial will be needed to compare these two modalities to determine the result whether they are significantly different rates of restoration success (Ludwig *et al.*, 2014).