

Usage of Coronal Restorative Materials among Dental Practitioners in Riyadh, Saudi Arabia

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Abstract

Objective: This study was conducted to determine coronal restorative materials currently used by dental practitioners in Riyadh and reasons for placement of those restorations.

Design: Cross-sectional epidemiological survey.

Method: Registered dental practitioners working in different dental clinics (governmental and private) in 5 zones of Riyadh city were randomly selected by stratified random sampling method. Following consent, they were requested to provide data on 25 consecutively placed restorations starting from a definite date. Data requested were dentist's gender, years of experience and place of practice. Others were patient's demographics, tooth restored, reason(s) for restoration, type of restoration and material used.

Results: Of 1837 restorations placed by 103 dental practitioners, 61.5% were resin composite; 12.5% glass ionomer; 3.7% amalgam and 1.1% stainless steel crown for primary molars.

Conclusions: Tooth colored composite resin followed by glass ionomer were the predominant materials for restoring all types of cavities for primary and permanent dentitions and dental caries was the major reason for initial placement.

Keywords: Dental Materials; Coronal Restoration; Permanent Teeth; Primary Teeth

Introduction

Restorative materials selection is an essential part during treatment planning. It is a decision making process that might vary depending on many factors including dentist's beliefs, education, experience, preferences, type of practice (public or private) clinical resources, patient factors and different clinical scenarios.

When teeth are afflicted with dental caries, trauma, wear or dental anomalies, the structural integrity and esthetics are damaged or compromised. Preservation of damaged teeth helps maintain oral health and achieve high optimal levels of patient satisfaction. The placement of effective long-lasting restorations is important because it reduces the long-term cost of dental treatment [1]. The ultimate objective of restorative material selection is to enhance each patient dental condition in order to fulfill the esthetic and functional needs as well as to preserve the remaining tissues in a healthy condition and prevent recurrence of disease.

Studies to determine types of dental restorative materials used by dentists are important means to understand the pattern of usage of these materials and to follow the continuous development of new ones. Furthermore, it will form a base for future investigations to monitor the changing pattern in restorative materials usage. These studies could also be useful for the local environment [2].

Since the 1800s, dental amalgam was the preferred filling material in dentistry. Its ease of use, strength, durability and low cost offered an alternative to the expensive gold foil used at that time. Dental amalgam is an alloy that consists of mercury, silver (40 - 60%), tin (27 - 30%), copper (13 - 30%) and other trace metals (1%) [3]. Although its popularity diminished in recent years with the development and innovation of other dental materials, it is still being fairly used in some cases as some dentists and patients still prefer it over other materials.

Changes in restoration beliefs and techniques empowered the search and demand for direct filling materials. Composite resin was introduced into the field of conservative dentistry in the 1950s. It offered a superior substitute to acrylic resin that had many drawbacks. Composite resins are composed of resin matrix most commonly BisGMA/UEDMA/TEGDMA, inorganic filler material, a coupling agent to bond the filler to the organic resin and other components such as photoinitiators, inhibitors, color stabilizers and pigments [4].

Glass ionomer cements (GIC) was introduced in 1972 by Wilson and Kent. It is based on a reaction of silicate glass powder, polyacrylic acid and water or an ionomer. Glass Ionomer cements have some unique properties that make them desirable to be used in so many clinical situations. In order to improve and strengthen glass ionomer cement, a different approach was introduced via resin modification in the 1980s. Resin-modified glass ionomer cements (RMGIC) were developed to replace conventional GIC. Compomer, also known as polyacid-modified resin composites was introduced in the early 1990s to combine the benefits of composite and GIC. This material is particularly used in pediatric dentistry [5].

Zinc oxide eugenol (ZOE) has been used extensively in dentistry since the 1890s due to its sedative effect on the dental pulp. It is created by mixing powder and liquid. It can be used as temporary filling, liner or base in deep cavities. When applied as a temporary filling small quantity of eugenol diffuses through dentin to reach the pulp and exert anti-inflammatory and local anesthetic effects on the dental pulp [6]. The powder is composed of zinc oxide: 69%, white rosin 29.3%, zinc acetate 1% and zinc stearate 0.7%. The liquid is composed of eugenol 85% and olive oil 15%. Intermediate restorative material (IRM) is a ZOE cement reinforced by the addition of 20% polymethyl methacrylate to the powder. This reinforcement provides the restoration with improved compressive strength, abrasion resistance and hardness. Cavit is a calcium sulphate based material. Cavit is soft when placed into the cavity. It has a high linear expansion that is caused by water sorption which results in excellent marginal sealing ability. This sealing ability makes it a favorable restoration for endodontically treated teeth [6].

Pits and Fissure sealing is one of the preventive measures in dentistry. It is considered the most effective clinical technique to prevent pit and fissure caries. Sealants act as a physical barrier to decay. They are classified into filled and unfilled resin systems based on the presence and absence of fillers. Unfilled sealants are clear and do not contain the glass or quartz particles, therefore, they are less resistant to wear. The filled sealants which are more resistant to wear contain fillers coated with silane, to facilitate their combination with the bisphenol A and glycidyl methacrylate (BIS-GMA) resin. They contain microscopic glass beads, quartz particles, and other fillers used in composites resins.

Since 1950s dentists have been using stainless steel crowns to restore teeth. Stainless steel crown is a cemented crown that is made of a blend of iron, nickel, carbon, chromium and other metals. They have proved to have high strength, durability and corrosion resistance but lack in esthetics due to its metallic color. They are mainly indicated for rehabilitation of primary dentition. Rehabilitation of anterior primary dentition wasn't an easy task. This challenge led to development of so many preformed crowns and techniques through the years to restore function and esthetics of anterior teeth. Esthetic crowns include Composite Clearfix Crowns, Polycarbonate Crowns, Resin Veneer Crowns, Zirconia Ceramic Crowns and Cheng Crowns.

Full metal crowns as their name indicate consist entirely of a single piece of alloy. Metals used in crowns and bridges include gold alloy, other noble alloys such as palladium or a base-metal alloy such as nickel, chromium or titanium. These crowns are highly biocompatible especially when a noble or precious metal alloy is chosen. They are durable, offer good corrosion resistance and require less tooth preparation. Metal ceramic crowns are a hybrid between all-metal and all-ceramic dental crowns. It has the advantage of providing reasonable esthetics while maintaining adequate strength. It is one of the most widely used fixed restorations. It consists of a complete coverage cast metal substructure that is veneered with a layer of fused porcelain to mimic natural tooth structure. Despite the success of Metal ceramic restorations, the increasing demand for better esthetics led to the introduction of all ceramic crowns. They provide excellent esthetics and biocompatibility [3].

In the recent past, there have been an influx of new restorative materials into the dental market hence clinicians are faced with decisions regarding choice of dental materials to restore deteriorated dentitions. Studies conducted in Jordan [7]; Finland [8]; Norway [9]; Florida [10] and UK [11] showed large variations exist in the use of restorative materials in different countries. Till date, there is paucity of information on the use of restorative dental materials in Riyadh.

Aim of the Study

The aim of this study therefore, was to determine coronal restorative materials used by dental practitioners in Riyadh and factors that determine the choice of those materials.

Materials and Methods

Study design: Cross-sectional epidemiological study.

Method

Registered dental practitioners working in various dental clinics in Riyadh were contacted to participate in this study. From the five zones (North, South, Central, East and West) of the city, two hundred and eleven practitioners working in both government and private clinics were requested to provide data on twenty-five consecutively inserted restorations starting from 13th of December 2015 until 13th of April 2016. Selection of participants was by stratified simple random sampling method. From each zone 5 dental clinics (both private and government) were randomly selected taking into consideration number of dentists working in each clinic. the clinics were chosen in such a way as to broaden the socioeconomic characteristics to make the groups more diverse and representative of Riyadh as a whole.

Special forms provided included information on: Practitioner’s gender, years of experience, and place of practice. Others were: Patient age, gender, tooth restored, type of restoration/cavity (Black classification), reason(s) for restoration (possible reasons provided) and type of restorative material used.

Statistical analysis

The SPSS program (version 20.0) was used to analyze the data after collection. Data analysis was done at King Saud University College of dentistry with the help of a faculty statistician. Frequency tables were generated for all responses to display the number of occurrences of different values. A chi-square test of independence was calculated to determine if there is a significant relationship between the use of different dental restorations (Amalgam, Composite, GIC etc.) with the cavity Classification. Level of significance was set at $\alpha = 0.05$.

Results

Data on 1837 newly placed dental restorations (direct and indirect) were collected from 103 dental practitioners who filled the forms out of 150 forms that were distributed. The response rate was thus 68.7%. Seventy-three (70.9%) of the respondents were males and 30 (29.1%) were females. Over 15% of them were in private practice. Tables 1 and 2 show years of experience and place of practice respectively of the respondents.

Experience (Years)	Frequency	Percentage
< 5	76	73.8
5 - 10	14	13.6
11 - 15	5	4.9
16 - 20	2	1.9
> 20	6	5.8

Table 1: Years of experience of respondents.

Most of the respondents completed the requested data on 25 restorations but a few reported on less than 25. Thus 1837 restorations were placed in 1453 patients comprising of 56.6% males and 43.4% females. Their mean age was 25.5 (Range: 3 - 83) years.

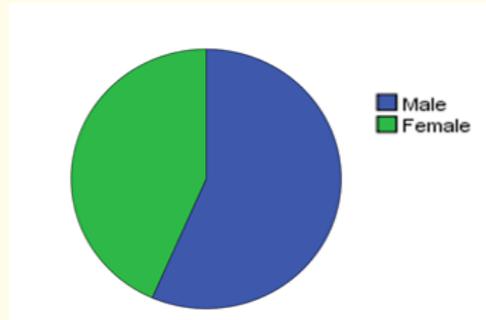


Figure 1: Distribution of patients' gender.

Place of practice	Frequency	Percentage
Ministry of Health	14	13.6
Colleges of Dentistry	64	62.1
Private clinics	16	15.5
Military, NG. and SF*	9	8.7

Table 2: Place of practice of respondents.

*Military: Military Hospital; NG.: National Guard Hospital; SF: Security Forces Hospital.

Of the 1837 restorations placed, the significant majority (61.5%) were composite resin followed by glass Ionomer (12.5%). Amalgam and stainless steel crown constitute 3.7% and 1.1% respectively (Table 3).

Restorative material	Frequency	Percentage
Amalgam	68	3.7
Composite resin	1130	61.5
Glass Ionomer	230	12.5
Fissure sealant	133	7.2
Metal	2	0.1
Porcelain	57	3.1
Metal ceramic	13	0.7
ZOE/IRM*	108	5.9
Cavit	72	3.9
Stainless steel crown	20	1.1
Esthetic crown	2	0.1
Compomer	2	0.1
Total	1837	100

Table 3: Distribution of restorative materials used.

*ZOE/IRM: Zinc Oxide Eugenol/intermediate Restorative Material.

The teeth restored were: Permanent molars 45.7%; premolars 28.8%; anteriors 16.1%; primary molars 7.9%; and primary anteriors 1.5% (Tables 4a and 4b). Regarding specific teeth restored, the first molar constitute 38.5% followed by premolars. The least restored teeth are mandibular incisors (Table 4a). Similarly, in the primary dentition molars constitute largest number of restored teeth (Table 4b).

Tooth type	Frequency	Percentage
Maxillary molars	394	21.4
Maxillary premolars	332	18.1
Maxillary anteriors	263	14.3
Mandibular molars	445	24.2
Mandibular premolars	197	10.7
Mandibular anteriors	33	1.8

Table 4a: Distribution of permanent teeth restored.

Tooth type	Frequency	Percentage
Maxillary molars	68	3.7
Mandibular molars	77	4.2
Maxillary anteriors	22	1.2
Mandibular anteriors	6	0.3

Table 4b: Distribution of primary teeth restored.

Reasons for placement of restorations: In all patients, more than 80% of all restorations were placed due to primary caries and its sequelae such as recurrent caries (8.8%); fractured restoration (3.3%); fractured tooth (1.9%) and endodontic treated/pulpotomised teeth (8.9%); while non-cariou defects including discoloration, deep/ retentive fissures and abrasions constitute 16.4% (Table 5).

Reasons	Frequency	Percentage
Primary caries	1111	60.5
Recurrent caries	161	8.8
Fractured tooth	34	1.9
Fractured restoration	61	3.3
Endo treated tooth	103	5.6
Pulpotomized tooth	66	3.6
After pulp extirpation*	118	6.4
Non-cariou defect	20	1.1
Retentive fissures	117	6.4
Esthetics	32	1.7
Others	14	0.8
Total	1837	100

Table 5: Distribution of reasons for placement of restoration.

*: Temporary Restoration.

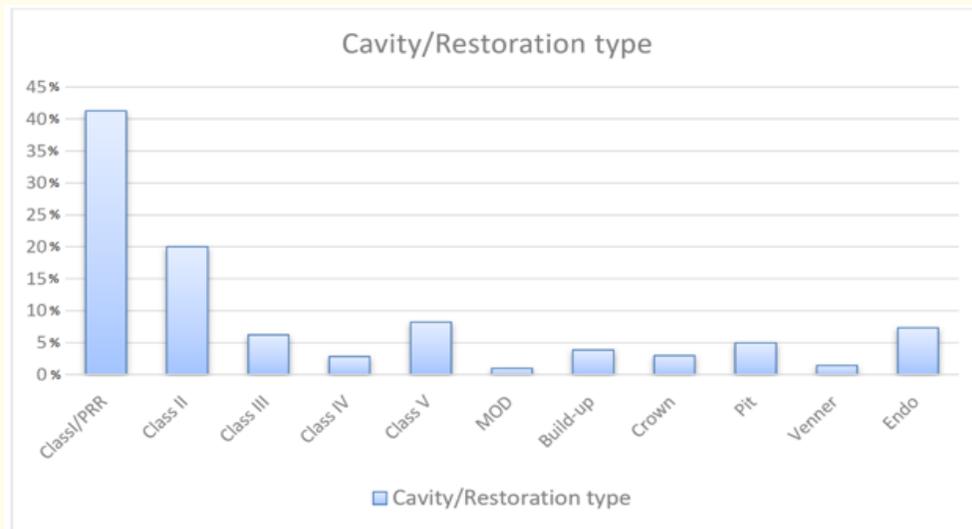


Figure 2: Distribution of cavity/restoration types.

Restoration type	Age group (Years)						
	3 - 6	7 - 14	15 - 20	21 - 30	31 - 40	41 - 50	51 - 83
Class I	34	188	166	174	92	34	24
Class II	21	49	47	117	53	35	28
Class III	4	7	22	32	24	7	5
Class IV	0	9	6	17	9	7	3
Class V	9	7	11	59	18	21	20
MOD*	0	4	1	8	1	1	0
Crown	8	4	9	10	8	5	7
Veneer	-	-	1	22	3	0	0

Table 6: Distribution of restoration type by age group.

*: MOD: Mesio-Occlusal-Distal Restoration.

(A)				(B)			
Restoration type	Amalgam	Composite	GIC	Restoration type	Metal	Porcelain	Ceramometal
Class I	36	542	44	Crown	2	31	13
Class II	25	244	59	Onlay/inlay	0	0	-
Class III	0	107	6	Veneer	-	26	-
Class IV	0	46	5				
Class V	1	105	40				
MOD	0	13	0				
Build-up	1	32	27				

Table 7: Frequency distribution of restorative material: (A) Direct restoration and (B) Indirect restoration by type of cavity/restoration.

A chi-square test of independence was calculated comparing the frequency of the use of different dental restorations (Amalgam, Composite and GIC) with every cavity Classification. A significant interaction was found ($p = 0.000$) (Table 8).

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	82.351	8	.000
Likelihood Ratio	88.114	8	.000
Linear-by-Linear Association	40.237	1	.000
N of Valid Cases	1260		

Table 8: Chi-square Test of Independence.

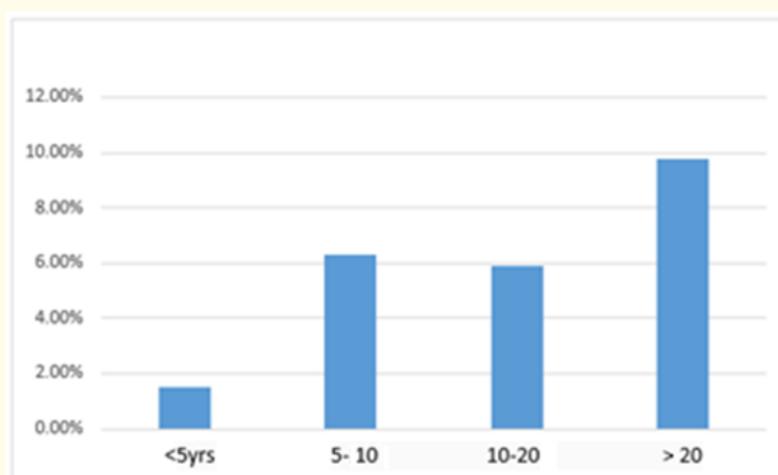


Figure 3: Use of Amalgam by dentists' years of experience.

Discussion

This study confirms significant use of tooth colored materials especially resin composite for direct restoration of carious teeth. Similar findings have been reported in other countries [7-10]. However, this is in contrast to previous study that reported dental amalgam as the most preferred material for 2- and 3-surface class II restorations of permanent molars amongst dentists in Riyadh [12].

In most clinics (government or private), the use of amalgam for cavity restoration has declined tremendously with marked increase of the use of tooth colored restorative materials (Table 3). The reasons for this trend is probably due to improved physical and mechanical properties of resin composite over the past years and patient increasing demands for esthetic restorations even in the posterior teeth [7-10]. Apart from that, with the increasing environmental concerns about dental amalgam waste, the environmentalist pressure group urged the United Nations for a worldwide phase out of mercury by the year 2020 in a treaty that was signed by 114 countries including Saudi Arabia to reduce the use of mercury containing dental amalgam fillings [13].

Although only 3.7% of the respondents utilized amalgam in their practice, majority of the users were among those with more than 20 years of experience (Figure 3). This clearly shows their continued preference for amalgam because of their long time use of this material.

Composite and glass ionomer are the most widely used whether in permanent or primary teeth (Tables 3 and 4), although they are highly technique sensitive material. The improvement of composite and glass ionomer over the past years led to this change, these restorations provide excellent esthetics, bound to the tooth structure and doesn't require special designs of cavity preparation which means it is more conservative although its life span isn't as long as in amalgam fillings [1]. It is interesting to note that the frequency of use of compomer as restorative material was quite low. Although it's recommended only for the primary dentition, the reason for low usage could probably be due to supply issues or handling characteristics.

More than 80% of the primary restorations placed in the current study were due to dental caries: primary and recurrent (Table 5). This is a reflection of high caries prevalence in both primary and young permanent dentition of the Saudi population [2]. In our study first permanent molars (FPMs) were the most restored teeth. These teeth are known for their high caries prevalence in several previous studies [14-16]. FPMs erupt approximately at age 6 and occupy the most posterior part of the dental arch for several years until permanent second molars erupt. The morphologic and functional characteristics of these teeth make them more vulnerable to dental caries especially when inappropriate diet is consumed. In view of the threat of dental caries to the society, there's need for more community-based programs in Riyadh to raise awareness among the population and disseminate the importance of maintaining optimal oral health especially among young children.

The use of stainless steel crowns in private and security/military-based hospitals was found to be low by general practitioners. In our survey, most of stainless steel crowns were done mainly in the dental colleges. This could be so because dental colleges are essentially training institutions where skills are provided to potential dental practitioners. The cost implications could also be a factor for low usage of stainless steel crowns in other health facilities because government provides services free of charge to citizens

As for full coverage coronal restorations, the use of all ceramic crowns was found to be higher than the ceramometal and full-metal crowns (Table 7b). The pursuit for optimum esthetics and development of different ceramic types that can provide pleasing appearance and withstand the masticatory forces could be some of the main factors for this finding [17]. Ceramometal crowns are viable option and still widely used in contrast to the full metal crowns which has almost vanished [17].

Veneers have been a popular choice of restoration especially for un-esthetic or non-carious defect involving anterior teeth. Patients who received veneers were mostly females aged between 20 - 30 years. This is a further testimony to increasing demands of esthetic and optimal smile in this group of young adults.

Cavit and glass ionomer were the most used materials for temporization especially for endo-treated teeth. Cavit was the most common temporary filling after pulpal debridement mostly due to its ease of use, placement and removal; while glass ionomer was the most common temporary filling after finishing root canal treatment. This might be due to the good coronal seal provided by the glass ionomer. Intermediate restorative material (IRM) was mainly used in cases with severe sensitivity and cases of vital pulp treatment (direct or indirect pulp capping).

The respondents represented clinicians with wide range of experience practicing at different areas in Riyadh city. Although majority are in government health institutions and only 15% in private practice, this probably reflects the spread of dental care providers in Riyadh [18].

Conclusion

Based on the results of this study, the following conclusions can be made:

- Composite resin followed by glass ionomer were the predominantly used restorative materials by dental practitioners in Riyadh.
- Quite a few dental practitioners now use amalgam for cavity restorations.
- Dental caries is the major reason for placement of initial restorations.
- First permanent molars and primary molars were the most restored teeth.
- All ceramic crowns were increasingly used by general practitioners in comparison with metal and ceramometal crowns.

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