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A Cross-Sectional Study to Assess the Choice of Dental Cements among Dental Practitioners in Kolkata, West Bengal, India

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Abstract: ***Background**: With significant advances in material science, dentists now have numerous choices regarding dental cements. Therefore, knowing their properties, indications, advantages and disadvantages have become necessary so as to keep oneself updated to provide the best dental care. However, data on the choice of these cements among dentists in West Bengal is scarce. Aim: This study aimed to assess the preferences for dental cements among dental practitioners in Kolkata, West Bengal, in light of ongoing advancements in dental material science. **Material and Methods**: This cross-sectional, questionnaire-based study was conducted over four months using a close ended, prevalidated questionnaire distributed among 200 dental practitioners in Kolkata, West Bengal. Statistical analysis was done using descriptive and inferential statistics using SPSS version 20. **Results**: Results indicated a strong preference for glass ionomer cement, followed by resin cements. Additionally, the study highlighted varying levels of knowledge and application of dental cements among practitioners based on their experience and patient exposure. These findings underscore the need for ongoing education to optimize dental care outcomes. **Conclusion**: It was observed that the majority of dentists preferred glass ionomer cement, followed by resin cements.*

Keywords: biocompatibility; dental cements; glass ionomer cement; resin cements; zinc phosphate cement

1. Introduction

About half a century ago, zinc phosphate cement was the undisputed leader among dental cements ruling the shelves of the clinics of dentists old or young. However, researchers in dental materials science were constantly attempting to create a dental cement which was more metal free, restorative, natural looking and so aesthetically pleasing [1]. Zinc phosphate cement suffered from the problem of mixing, low strength, being a metal-based restoration with high solubility and thus started losing fervour among the dentists all over the world. Thanks to modern technology, there are many dental cements available now and the dentist needs to have sufficient knowledge about each of them [2]. Although each kind of cement has its own benefits in the procedures being carried out, it is essential for the dentist to comprehend which cement will work best in which condition. It is essential to understand which substrate will bond with which material in the right manner. The cements which turn out the best should be able to outdo superlatively in adhesion, should have a long life and should have the accurate mechanical properties. The cement should be biocompatible and aesthetically pleasing [3]. No single cement can fulfil all the requirements and so a wise decision needs to be taken which can vary from one dentist to another [4]. The purpose of this study is to assess the preferences and knowledge of dental practitioners in Kolkata regarding various dental cements, with the aim of identifying trends and gaps in knowledge that may impact clinical practice.

2. Material and Methods

This study was conducted in accordance with the Helsinki Declaration of 1975, as revised in 2000. This cross-sectional questionnaire-based study was conducted over four months (September- December 2023) among dental practitioners in Kolkata, West Bengal, India. Though 220 dentists were approached for the study, 20 opted out. Total sample size was 200 (152 males and 48 females) and was distributed among different dentists around the city to achieve a diversified approach. The close ended, pre-validated questionnaire consisted of demographics related questions followed by questions assessing the knowledge about various cements. The questions were framed to gather information as to how the dentists decide what kind of cement is supposed to be used in each case, which cement works best under different circumstances for longevity and many such questions. Data obtained was entered in Microsoft excel sheets. SPSS version 20 was utilized for statistical analysis. For comparison between groups, Chi square test was used.

3. Results

The results of the descriptive analysis are presented in tables 1-5.

Table 1: Distribution of demographic details of the dental practitioners

Variable		Frequency	Percentage
Gender	Male	152	76.0
	Female	048	24.0
Total work experience	Under 5 years	060	30.0
	5 to 10 years	062	31.0
	More than 10 years	078	39.0
Daily patients in clinic	1-10 patients	097	48.5
	11-20 patients	063	31.5
	More than 21 patients	040	20.0
Total		200	100

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Table 2: Reponses of the dental practitioners to the questionnaire

Variable		Frequency	Percentage
Which cement do you use commonly?	Zinc Phosphate	10	05.0
	Polycarboxylate	10	05.0
	Glass Ionomer	130	65.0
	Resin Cement	050	25.0
Which cement has maximum strength?	Zinc Phosphate	012	06.0
	Polycarboxylate	018	09.0
	Glass Ionomer	030	15.0
	Resin cement	140	70.0
Which is the oldest cement?	Zinc Phosphate	160	80.0
	Polycarboxylate	032	16.0
	Glass Ionomer	004	02.0
	Other	004	02.0
Which cement can be used in restorations?	Zinc Phosphate	011	05.5
	Polycarboxylate	007	03.5
	Glass Ionomer	140	70.0
	Resin cement	042	21.0
Which cement is cost effective?	Zinc Phosphate	068	34.0
	Polycarboxylate	010	05.0
	Glass Ionomer	116	58.0
	Resin cement	006	03.0
Which cement does not bond with the tooth?	Zinc Phosphate	052	26.0
	Polycarboxylate	140	70.0
	Resin cement	008	04.0
	Glass Ionomer	000	00.0
Which cement causes sensitivity?	Zinc Phosphate	120	60.0
	Polycarboxylate	034	17.0
	Glass Ionomer	010	05.0
	Resin cement	036	18.0
Do you think you need more knowledge on dental cements?	Yes	126	63.0
	May be	064	32.0
	No	010	05.0
Total		200	100

Table 3: Gender wise distribution of answers to the questionnaire

Variable		Gender	
		Female	Male
Which cement do you use commonly?	Zinc Phosphate	005	005
	Polycarboxylate	002	008
	Glass Ionomer	031	099
	Resin Cement	010	040
Which cement has maximum strength?	Zinc Phosphate	006	006
	Polycarboxylate	002	016
	Glass Ionomer	009	021
	Resin cement	031	109
Which is the oldest cement?	Zinc Phosphate	040	120
	Polycarboxylate	006	026
	Glass Ionomer	000	004
	Other	002	002
Which cement can be used in restorations?	Zinc Phosphate	001	010
	Polycarboxylate	000	007
	Glass Ionomer	036	104
	Resin cement	011	031
Which cement is cost effective?	Zinc Phosphate	008	060
	Polycarboxylate	001	009
	Glass Ionomer	038	078
	Resin cement	001	005
Which cement does not bond with the tooth?	Zinc Phosphate	009	043
	Polycarboxylate	035	105
	Glass ionomer	004	004
	Resin cement	000	000
Which cement causes sensitivity?	Zinc Phosphate	028	092
	Polycarboxylate	007	027
	Glass Ionomer	005	005
	Resin cement	008	028
Do you think you need more knowledge on dental cements?	Yes	043	083
	May be	004	060
	No	001	009
Total		048	152

Table 4: Work experience wise distribution of answers to the questionnaire

Variable		Work experience		
		< 5 years	5-10 years	> 10 years
Which cement do you use commonly?	Zinc Phosphate	01	02	07
	Polycarboxylate	02	03	05
	Glass Ionomer	37	44	49
	Resin Cement	20	13	17
Which cement has maximum strength?	Zinc Phosphate	02	02	08
	Polycarboxylate	01	07	10
	Glass Ionomer	03	12	15
	Resin cement	54	41	45
Which is the oldest cement?	Zinc Phosphate	49	49	62
	Polycarboxylate	10	11	11
	Glass Ionomer	00	01	03
	Other	01	01	02
Which cement can be used in used in restorations?	Zinc Phosphate	02	02	07
	Polycarboxylate	00	01	06
	Glass Ionomer	34	49	57
	Resin cement	24	10	08
Which cement is cost effective?	Zinc Phosphate	17	17	34
	Polycarboxylate	00	02	08
	Glass Ionomer	40	41	35
	Resin cement	03	02	01
Which cement does not bond with the tooth?	Zinc Phosphate	20	17	15
	Polycarboxylate	35	44	61
	Resin cement	05	01	02
	Glass Ionomer	00	00	00
Which cement causes sensitivity?	Zinc Phosphate	42	31	47
	Polycarboxylate	12	11	11
	Glass Ionomer	02	06	02

	Resin cement	04	14	18
Do you think you need more knowledge on dental cements?	Yes	37	41	48
	May be	23	21	20
	No	0	0	10
Total		60	62	78

Table 5: Patient exposure wise distribution of answers to the questionnaire

Variable		Work experience		
		1-10 patients	11-20 patients	>20 patients
Which cement do you use commonly?	Zinc Phosphate	04	04	02
	Polycarboxylate	04	03	03
	Glass Ionomer	69	42	19
	Resin Cement	20	14	16
Which cement has maximum strength?	Zinc Phosphate	04	06	02
	Polycarboxylate	06	09	03
	Glass Ionomer	10	07	13
	Resin cement	77	41	22
Which is the oldest cement?	Zinc Phosphate	78	52	30
	Polycarboxylate	12	10	10
	Glass Ionomer	04	00	00
	Other	03	01	00
Which cement can be used in restorations?	Zinc Phosphate	06	04	01
	Polycarboxylate	03	02	02
	Glass Ionomer	71	43	26
	Resin cement	17	14	11
Which cement is cost effective?	Zinc Phosphate	25	25	18
	Polycarboxylate	04	03	03
	Glass Ionomer	66	33	17
	Resin cement	02	02	02
Which cement does not bond with the tooth?	Zinc Phosphate	20	17	15
	Polycarboxylate	72	43	25
	Glass ionomer	00	00	00
	Resin cement	05	03	00
Which cement causes sensitivity?	Zinc Phosphate	61	31	28
	Polycarboxylate	14	10	10
	Glass Ionomer	04	04	02
	Resin cement	18	18	00
Do you think you need more knowledge on dental cements?	Yes	70	37	19
	May be	24	20	20
	No	03	06	01
Total		97	63	40

4. Discussion

The cementation of indirect restoration is an important step in prosthodontic and restorative dentistry. An effective cementation averts biofilm formation at the tooth-restoration margin and thus cuts down on mechanical and biological complications. With the advancements in material science, dental cements have evolved in terms of handling, curing and bond strengths. We have included in our study those dental cements that are commonly used by the dental practitioners worldwide.

Zinc Phosphate Cement

The use of zinc phosphate cements began in 1878. It was the "gold standard" for fixing indirect restorations for many years and is still used for the same purpose. It has high compressive strength; reasonable working time and provides great mechanical retention [5]. It causes sensitivity which can be reduced by applying varnish on prepared teeth, though doing the same reduces the mechanical retention [6]. Disadvantages of this water-based material are high solubility in oral fluid, low viscosity, low tensile strength, lack of an anti-cariogenic effect and potential for hypersensitivity due to initially low pH [7].

Zinc Polycarboxylate Cement

The eon of polycarboxylate cements commenced in late 1960s. These luting cements have higher tensile strength as compared to zinc phosphate cements, but the compressive strength after 24 hrs is lesser (55–85 MPa) [8]. One of its benefits is the relative biocompatibility owing to the bulky size of the polyacrylic acid molecules that cannot breach the dentine tubules [9]. Furthermore, these cements have a specific chemical adhesion to the tooth because they generate chelating bonds with calcium. Therefore, these cements can be bonded to enamel and dentin. However, due to its high viscosity, this material is tough to handle [10]. If the dentist arbitrarily modifies the powder-to-liquid ratio, the solubility of the luting agent can upsurge by three times, which is a regular cause of clinical failures [11]. The working time (2.5 min) is considered shorter than zinc phosphate (5 min), which can be bothersome in cementing multiple restorations. The residual amount is also more cumbersome to remove compared to zinc phosphate. So, the excess should be

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removed before the resin phase or after curing. For this purpose, the choice of this cement should be restricted to preparations that have proper retention and stability [12].

Glass-Ionomer Cement

Glass-ionomer cements have been extensively used as a restorative material since the 1970s, then steadily, they started to be used as a luting agent as well. It has good compressive strength, tensile strength, a low thermal expansion coefficient and its bond to tooth tissues is analogous to polycarboxylate cements [13]. GICs are less soluble than zinc phosphate cements and release fluoride ions, which penetrate into tooth tissues, contributing to the remineralization of tooth tissues with an anti-caries effect [14]. The retention of GIC was 65% higher than those of zinc phosphate cements [15]. It has decent working properties and differs from zinc phosphate cements in its distinct semi-opacity, which is good when it is used to restore the ceramic labial margin [16]. After curing, GICs also exhibit bacteriostatic properties [17]. GIC has some downsides like low pH (of about 3.5) which can be related with some discomfort due to hypersensitivity after bonding [18]. GIC's strength is reduced by early exposure to moisture because water alters its mechanical properties [19]. GICs are also subject to substantial erosion during the initial setting period [20]. On the other hand, over-drying persuades shrinkage that leads to the creation of cracks and hypersensitivity [21]. For this reason, the marginal area of the restoration should be protected from exposure to liquids using varnish or petroleum-jelly-based products during the early period of the setting.

Hybrid Ionomer Cements or Resin-Modified Glass-Ionomer Cements

Glass-ionomer cements can be classified into two types: conventional and resin-modified glass-ionomer cements (RMGICs). Both types have alike mechanisms of adhesion, adhering to the tooth surface after forming ionic bonds due to the chelation between the carboxyl groups of the cements and the calcium and phosphorus of the dentin and enamel apatite. However, the bond strength of RMGICs to dentine is higher due to their composite part, while the bioactive effect is lower [22]. RMGICs have uses that are similar to GIC. However, they are characterized by high fracture resistance and greater wear resistance compared to conventional GIC. RMGICs are designated to retain total crowns and bridges, metal–ceramic crowns and bridges, zirconia frameworks and restorations, metal posts, metal inlays, orthodontic appliances and aesthetic post-core and core (fiber and ceramic) [23]. However, RMGICs are contraindicated for the fixation of more fragile all-ceramic constructions, as they expand due to water absorption, which can lead to the fracture of the restoration [24]. Excess can be removed from the marginal region of the restoration while in a gel state or after curing, whereas conventional GIC excess is recommended to be removed only after curing [25].

Resin Cements

Resin cements are the most recent luting material developed for dental applications. During the early stages, resin cements failed due to high polymerization shrinkage and inadequate biocompatibility. Currently, resin cements have the capability to form a chemical bond with dentin and enamel and have higher bond strength and more predictability [26]. Resin cements are composite materials with different chemical compositions. They consist of a resin matrix (e.g., Bis-GMA or urethane dimethacrylate) and fine particles of inorganic fillers. First of all, they differ from restorative composites by their low filler content (50–70% glass or silicon dioxide) and viscosity. In addition, there is a correlation between the amount of filler and the mechanical properties: the lower the number of fillers, the lower the mechanical strength [27]. The clinical advantages of resin cements include high resistance to compression forces, low thermal expansion coefficients, high flexural strengths and superior hardness when compared with other luting materials [28]. Also resin cements are characterized by high fatigue strength, adhesion to many materials, the ability to modify shade and color, high retention, resistance to wear at the margin of the restoration and low marginal permeability [29].

Resin cements can be divided into adhesive or self-adhesive cements. When applying adhesive cements, the tooth should be previously acid-etched with phosphoric acid, followed by the adhesive system application [30]. While using self-adhesive cements, acid treatment and the application of adhesives are not required, except for preparation in enamel, in which acid etching is still beneficial for increased bond strength values [31].

Resin cements are also classified according to the polymerization process: chemical-cure, light-cure, or dual-cure. Chemical or self-curing cements are polymerized due to a chemical reaction with peroxide as the initiator. Due to chemical components, self-curing resin cements have lower colour stability; thus, they are not indicated to bond with translucent or thin ceramic restorations [32]. For this, light-cure resin cements are used. Light-cure cements are cured due to the activation of photoinitiators. Light-curing cements are indicated to cement ceramic or indirect composite restorations that are less than 1.5 mm thick and deliver adequate light penetration [33]. Their main disadvantage is the controlled polymerization time when compared with self-curing materials while dual-cure cements contain amine initiators (chemical) and photoinitiators (light) that allow the start of the polymerization process with the help of a light source [34]. Then, this light-curing reaction triggers the chemical reaction that will happen in a long course. The catalyst in dual-cure cements endorses the final hardening of the cements in areas unreachable to light after initial rapid light polymerization. Dual-curing cements are recommended for ceramic and composite restorations with a thickness of 1.5–2.5 mm.

The disadvantage of resin cements is that they cannot avert secondary caries compared to RMGIC, as the resin cements have fewer caries-inhibitory effects [35]. In general, resin cements are less biocompatible than GICs. The success of resin cements is highly dependent on humidity control. Another issue is that, in case of necessity, the restoration is difficult to remove [36].

5. Conclusion

This study reveals a clear preference for glass ionomer and resin cements among dental practitioners in Kolkata, with significant variations based on experience and patient load.

These findings highlight the importance of continuous education in the selection and application of dental cements to enhance clinical outcomes. Future studies should focus on expanding the sample size and exploring the underlying factors influencing cement choice.

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