



Perception Among Dental Health Care Workers on Use of Biomimetic Materials in Conservative Dentistry and Endodontics.

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ABSTRACT

Introduction:

Dentistry was one of the fields where biomimetic methods were thoroughly investigated. Our goal was to assess the amount of knowledge and willingness to use these materials among general practitioners, endodontists, and postgraduate students of endodontics and dental interns in the Qassim region.

Methodology: The cross-sectional study was carried out among two dental clusters, of Qassim region among the four groups of postgraduate students, Operative dentist, General practitioners & Interns. To measure the awareness and attitude, a study-specific questionnaire of 10 questions was used. Data was analysed using IBM SPSS statistic version 25, chi square test and Fisher's exact test have been utilized.

Results: The majority of dental health care workers 92 (92.0) were aware about the use of biomimetic material in dentistry. The knowledge about biomimetic material was found to significantly high among Operative Dentist/ Endodontist 20 (90.0), followed by dental intern 28 (70.0) and general dentist 19 (63.3).

Conclusion: Based on the opinions of the majority of dental healthcare professionals, the current study supports the use of biomimetics and applications in the field of restorative dentistry.

Introduction:

Biophysicist and biomedical engineer Otto Schmitt first used the term "biomimetic" in the 1950s. ^[1] The term "biomimetic" is derived from the Latin word "bio," which means "life," and "mimetic," which refers to the imitation or replication of a biological process by drawing inspiration from the natural world. ^[1, 2] Dentistry was one of the fields where biomimetic methods were thoroughly investigated. As a result, a variety of concepts from biology, chemistry, materials science, and bioengineering have been incorporated into the understanding of emerging biomimetics techniques.^[3] These materials have received more acceptability as a result of their biological and physico-chemical characteristics, potential biocompatibility with live tissues, and ability to work in concert with body tissues to correct defects like bone loss.^[4] Due to their outstanding biocompatibility, biomimicry, bioactivity, and remineralization potentials, a range of bioactive formulations have lately been promoted.

These include micro- and nano-hydroxyapatite (HA), tricalcium phosphate, mineral trioxide, casein-phosphate, and bioactive glasses. ^[5,6]

As the modalities were successfully used in various endodontic and restorative procedures, biomimetics was claimed to have a broad appeal in the area of dentistry. ^[4,5] Biomimetic materials have been employed for regeneration, repair, and rebuilding in the fields of conservative dentistry and endodontics. In addition to promoting tissue healing and repair and maintaining pulp vitality, they directly affect important tissues.^[7] The goal in clinical dentistry is to create new biomaterials that can replicate teeth in both shape and function. ^[8,9] The primary goal of introducing these materials is to effectively remineralize tissues while using biocompatible and maximally performing materials that can be used to control diseased and defective tissues in a minimally invasive approach.^[4] Biomimetic materials are expected to achieve



unprecedented advancements in the future and will likely become quite popular. It is crucial to know what the next generation of endodontists believe in this regard.^[7] Our goal was to assess the amount of knowledge and willingness to use these materials among general practitioners, endodontists, and postgraduate students of endodontics and dental interns in the Qassim region.

Methodology

The cross-sectional study was carried out among two dental clusters, of Qassim region, Buraydah city and Alrass of Qassim province. A list of endodontic postgraduate students, Operative dentist, General practitioners & Interns were obtained from the college authorities.

Setting and location:- Study was carried out among the four groups of postgraduate students, Operative dentist, General practitioners & Interns working in College of Dentistry, Mulya and Alrass branch.

Sample size estimation: The sample size was calculated based on the power of previously published research. The lowest perception was taken for the calculation of sample size, based on the effect size 90 participants were required to reject the null hypothesis.

Participants: - Total 130 doctors were provided study proforma from three above mentioned institutes. Among them only 100 subjects participated in the main study. The questionnaires were handed to the subjects in the hospitals where they worked. Those doctors who were not present on spot at the time of study were excluded.

Ethical Clearance: -Informed consent was also collected from each participant in addition to receiving ethical approval from the College of Dentistry's institutional ethical council at Qassim University.

Pilot study:- To measure the awareness and attitude, a study-specific questionnaire ^[7] was adopted, rewritten and evaluated among a sample of 30 professionals. Ten questions in a questionnaire that can be divided in three categories—knowledge, attitude, and practice—about the usage of biomimetic materials. Two academics with experience in the design of questionnaires read the responses and gave feedback in order to assess and improve the tool. Modest formatting and coding adjustments were performed.

Data Collection: -All participants were sent this questionnaire via electronic means, and the responses were compiled in an excel spreadsheet before being decoded by an independent investigator.

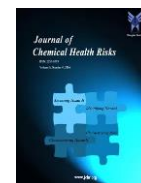
Statistical analysis:- Data was analysed using IBM SPSS statistic version 25 predictive analytics software. To determine the significance of research parameters on a categorical scale between two or more groups, the chi square test and Fisher's exact test have been utilized. Statistical significance was considered when $p < 0.05$ at 95% confidence interval (CI).

Results:

A cross sectional study was conducted among dental professionals of college of dentistry for 6 months from Jan 2022 to June 2022. Before start of the study, institutional ethical clearance was obtained from College of Dentistry, Qassim University and written consent was taken from participants. The collected data was analyzed in accordance with established quantitative research methodology, principal research question and the research methodologies that were designed to provide answers to the same were analyzed and interpreted. The present study questionnaire was given to 130 out of which 100 participants completed the questionnaire (response rate = 76%). Out of these 100 participants, 61 (61.0) were males and 39 (39.0) were female participants. It was observed that, out of 100 participants, majority of them were working full time 86 (86.0) while 14 (14.0) were working part time in hospitals or clinics (Table 1).

Comparative analysis of different dental care professionals and their knowledge, attitude and practices are shown in Table 2. It was observed that majority of dental health care workers 92 (92.0) were aware about the use of biomimetic material in dentistry. The knowledge about biomimetic material was found to be significantly high among Operative Dentist/Endodontist 20 (90.0), followed by dental intern 28 (70.0) and general dentist 19 (63.3). When it came to use of bioactive glass in conservative dentistry, majority of participants noted its use in dentine hypersensitivity 56 (56.0) and this response was significantly high among interns 31 (77.5) compared to Operative Dentist/Endodontist 3 (13.6).

It was obvious to see the impact of their knowledge of biomimetic material in their clinical practice, and therefore majority of participants prefer and recommend the use of biomimetic materials 86 (86.0); 82 (82.0) respectively. However, use of bioactive dentin was restricted to some of the cases of deep dental caries 69 (69.0). It was detected that, on an average 2-5 cases per month were filled by majority of participants 82 (82.0) with biomimetic material and most commonly used biomimetic material was MTA 62 (62.0). It was also most commonly used material for pulp capping 57 (57.0). Moreover, majority of participants 85 (85.0)



also agreed that they evaluate a success rate of MTA in apexification.

Table 1: Demographic Profile of study participants

Demographic Characteristics		Academic Position				Total
		Intern	General dentist	Operative Dentist/ Endodontist	Postgraduate student	
Sex	Male	25 (62.5)	18 (60.0)	10 (45.5)	8 (100.0)	61 (61.0)
	Female	15 (37.5)	12 (40.0)	12 (54.5)	0 (0.0)	39 (39.0)
Type Of Practice	Fulltime	40 (100.0)	21 (70.0)	17 (77.3)	8 (100.0)	86 (86.0)
	Part-time	0 (0.0)	9 (30.0)	5 (22.7)	0 (0.0)	14 (14.0)
Total		40 (100.0)	30 (100.0)	22 (100.0)	8 (100.0)	100 (100.0)

Table 2: Perception of participants to Biomimetic material

Gender	Intern	General dentist	Operative Dentist/ Endodontist	Postgraduate student	Total	p-value
Are you familiar with the biomimetic materials used in endodontics and conservative dentistry?						
Yes	37 (92.5)	28 (93.3)	20 (91.0)	07 (87.5)	92 (92.0)	0.00
No	3 (7.5)	2 (6.7)	2 (9.0)	1 (12.5)	8 (8.00)	
Which of the following are biomimetic material?						
Bio dentine	3 (7.5)	2 (6.7)	0 (0.0)	3 (37.5)	8 (8.0)	0.00
MTA	2 (5.0)	4 (13.3)	0 (0.0)	2 (25.0)	8 (8.0)	
GIC	5 (12.5)	3 (10.0)	2 (9.0)	0 (0.0)	10 (10.0)	
Calcium Hydroxide	2 (5.0)	2 (6.7)	0 (0.0)	0 (0.0)	4 (4.0)	
All	28 (70.0)	19 (63.3)	20 (90.0)	3 (37.5)	70 (70.0)	
Are you aware of the use of bioactive glass in conservative dentistry?						
Class V cavity	4 (10.0)	2 (6.7)	2 (9.1)	0 (0.0)	8 (8.0)	0.00
Treatment of Dentin hypersensitivity	31 (77.5)	20 (66.7)	3 (13.6)	2(25.0)	56 (56.0)	
Pit and fissure sealants	5 (12.5)	2 (6.7)	17 (77.3)	5(62.5)	29 (29.0)	
Bleaching discolored teeth	0 (0.0)	6(20.0)	0 (0.0)	1 (12.5)	7 (7.0)	
How often do you use bio dentin in the management of deep carious lesion						
In every case	4	4 (13.3)	0 (0.0)	0 (0.0)	8 (8.0)	0.139
In most cases	8 (20.0)	3(10.0)	5 (22.7)	3 (37.5)	19 (19.0)	
In some cases	24 (60.0)	23 (76.7)	17 (77.3)	5(62.5)	69 (69.0)	
Don't use	4 (10.0)	0 (0.0)	0 (0.0)	0 (0.0)	4 (4.0)	
Do u recommend use of biomimetic materials in endodontics?						
In every case	32 (80.0)	22 (73.3)	22(100.0)	6 (75.0)	82 (82.0)	0.162
In most cases	4 (10.0)	4 (13.3)	0 (0.0)	2 (25.0)	10 (10.0)	
Don't use	4 (10.0)	4 (13.3)	0 (0.0)	0 (0.0)	8 (8.0)	
Would you prefer biomimetic material in your regular practice						
Yes	34 (85.0)	23(76.7)	21 (95.5)	8 (100.0)	86 (86.0)	0.407
No	3 (7.5)	5 (16.7)	1 (4.5)	0 (0.0)	9 (9.0)	
I don't know	3 (7.5)	2 (6.7)	0 (0.0)	0 (0.0)	5 (5.0)	
How often do you use biomimetic material in your regular practice						
2-5 cases per month	32 (80.0)	24 (80.0)	18 (81.8)	8 (100.0)	82 (82.0)	0.584
5-7 cases per month	8 (20.0)	6 (20.0)	4 (18.2)	0 (0.0)	18 (18.0)	
7 – 10 cases per month	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	



Most commonly used biomimetic material in your regular clinical practice is						
MTA	26 (65.0)	17 (56.7)	15 (68.2)	4 (50.0)	62 (62.0)	0.230
Biodentine	4 (10.0)	5 (16.7)	0 (0.0)	1 (12.5)	10 (10.0)	
Calcium Hydroxide	10 (25.0)	8 (26.7)	5 (22.7)	3 (37.5)	26 (26.0)	
Bioaggregate	0 (0.0)	0 (0.0)	2 (9.1)	0 (0.0)	2 (2.0)	
Which pulp capping agent do you often prefer						
Bio dentine	12 (30.0)	6 (20.0)	2 (9.1)	3 (37.5)	23 (23.0)	0.632
ZOE	4 (10.0)	4 (13.3)	1 (4.5)	1 (12.5)	10 (10.0)	
MTA	20 (50.0)	17 (56.7)	16 (72.7)	4 (50.0)	57 (57.0)	
Zinc Phosphate	4 (10.0)	3 (10.0)	3 (13.6)	0 (0.0)	10 (10.0)	
Do you evaluate success rate in follow-up visits after use of MTA in apexification cases?						
Yes	32 (80.0)	26 (86.7)	20 (90.9)	7 (87.5)	85 (85.0)	0.905
No	6 (15.0)	3 (10.0)	1 (4.5)	1 (12.5)	11 (11.0)	
Sometime	2 (5.0)	1 (3.3)	1 (4.5)	0 (0.0)	4 (4.0)	
Total	40 (100.0)	30 (100.0)	22 (100.0)	8 (100.0)	100 (100.0)	

Discussion:

In the field of dentistry, particularly within the settings of restorative dentistry and endodontics, studying biomimetic mechanical properties has been an area of interest to researchers. In the field of restorative dentistry, biomimetic approaches were mainly conducted to processing the different restoration properties using the different materials by making them similar to the naturally-occurring oral environment and function at a similar efficacy. At the molecular level, evidence also shows that these modalities were efficaciously applied for other purposes, including hard- and soft-tissue regeneration, and wound healing augmentation.^[10] According to the current study, a remarkably high percentage of participants had a thorough understanding of biomimetic materials. As a result, these methods are now far more well-known than they were ten years ago. Each participant was prepared to incorporate biomimetic materials into their daily practice. The participants' awareness of biomimetic materials can be linked to their graduate and postgraduate training program.

In the present study, perception about use of bioactive glass was high which was similar to the study done by Krishnakanth J et.al.⁷ 139(90.3%) of participant in her study were aware of it use in pit and fissure sealants. Various authors in literature reported its use across various studies, Some of these include the well-established chemical bonding with teeth, the anti-coagulant properties, and being able to release fluoride adequately.^[23-25] It has also been indicated that these materials are mainly used for the restoration of small cavities, being used as luting modalities for cementing bridges and crowns, in addition to being used as cavity liners, particularly in the settings of deciduous dentition.^[10]

MTA has been noted as the most frequently employed biomimetic material in the current investigation, which is similar to a range of earlier literature. Due to its superior biological and physico-chemical characteristics, it has been regarded as the gold standard since being introduced in dentistry.^[1,4,7] The highest percentage of calcium hydroxide use was also noted, which may be related to its alkaline (pH 12.5), white, odorless qualities. It frequently serves a variety of endodontic purposes, including apexification and pulp-capping operations. Additionally, it promotes dentin repair and regeneration while also inhibiting resorption.^[13,14] Even though there is currently a lower inclination for biodentine, it has shown the capacity to address the main issues with MTA (such as discoloration) and is a viable option for anterior teeth when aesthetics is the primary consideration. It is a relatively new substance called Biodentine, and several writers have asserted that it can replace dentin and has similar indications to MTA but better qualities.^[1,15] In line with many writers in the literature, the majority of participants also mentioned use of biomimetic materials for root canal therapy. They claimed that these biomimetic materials had various properties including strengthening the root after obturation, good sealing ability, improved biocompatibility, and antibacterial capabilities. They also work as root canal sealers, filling materials, cements, and root and crown restoration materials.^[7] In the field of dentistry, the use of biomimetic technology has produced encouraging outcomes.^[16,17] A tooth that has been repaired with biomimetic material flexes similarly to real dentin. These restorations are more affordable, aesthetically pleasing, and long-lasting than standard restorations, with little to no post-operative sensitivity.^[4,7] Due to its interdisciplinary nature, biomimetic dentistry has the potential to revolutionize standard dental practice. It combines the strength of chemical, contemporary biological, and physical research to address pressing



therapeutic issues.^[7] The majority of participants in the current study, 85 (85.0), agreed that they assess the success rate of biomimetic material, and it has been noted in the literature that the survival rate of this material is up to 12 years.^[10,18] Opdam et al. evaluated the 1,955 resin dental composite restorations' 10-year survival rate and found a significant success rate (82.2 percent). Burke and Lucarotti observed that up to 28% of GIC repairs had survived after 15 years.^[1,19]

Conclusion:

Based on the opinions of the majority of dental healthcare professionals, the current study supports the use of biomimetics and applications in the field of restorative dentistry. The knowledge about biomimetic material was found to significantly high among Operative Dentist/ Endodontist 20 (90.0), followed by dental intern 28 (70.0) and general dentist 19 (63.3). Due to the complicated natural tooth structure, there are several obstacles and restrictions for clinical applications and predictable results. In order to assess the response on a bigger scale, more studies are required.

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Conflicts of Interest: The authors declare no conflict of interest.

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