

Assessment of knowledge, attitude & implementation of green dentistry among Prosthodontic practitioners and dental laboratory technicians in Maharashtra: A cross sectional study

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Abstract:

Background: With growing awareness, many businesses, are striving to alter their practices by taking environmental responsibility. Similarly, the field of dentistry, especially “Prosthodontic” practice, which experiments with wide variety of materials and ultimately generates significant amount of waste on a regular basis, has adopted the concept of “Going Green” so as to make it environment-friendly.

Materials and Methods: A cross-sectional survey was conducted to determine the awareness of green dentistry among Prosthodontist and dental laboratory technicians in Maharashtra. The study included 150 prosthodontist and dental laboratory technicians from all over Maharashtra. The survey included self structured, close-ended questionnaire designed after an intensive literature review by the research team. Final questionnaire consisted of three parts: demographic information, knowledge and implementation of eco-friendly practice (disposal, recycle, reuse and possible digital substitutes), and information about dentists perceived barriers to implementation of eco-friendly strategies. The data obtained was tabulated and analysed statistically.

Results: It was observed that, though the prosthodontist are willing to implement eco-friendly practice; the cost factor and lack of awareness were the major perceived barriers.

Conclusion: This study explains the current status of eco friendly dentistry and implements that with proper training lack of awareness of proper material disposal and its reuse can be substantiated; and creates a positive attitude among prosthodontist to change from conventional dentistry to green dentistry.

Key words: Green dentistry, eco-friendly dentistry, environmental pollution

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I. Introduction

The problem of global warming is one of the biggest outcomes of environmental pollution. Each and every individual is either directly or indirectly responsible for this situation, and dentistry is not an exception to this.¹ Dental health care is devoted to endorsing and enhancing oral health and well-being and to achieve such goals, dentists use a diversity of materials and instruments.² Unfortunately, particular materials that are currently used include heavy metals as well as biomedical waste, which offer impending challenges to the environmental balance.³ Dentistry has a substantial contribution to the pollution generated by the waste material, source of energy used, use of paper and use of toxic material in dental practice. This emphasizes that although dentistry deals with promotion and maintenance of health, at the same time contributes to pollution.

To counter the ill-effects as stated, more recently, the term “Eco-Dentistry or Green Dentistry” has been pioneered which has taken dentistry beyond the point of preventing pollution to a place of promoting sustainability^{4,5}. Today, the dental education system throughout the globe lacks incorporation of such a subject. Dental health care workers also have an important task of analysing and carrying out their bit of responsibilities for the eco-friendly environment. This concept should be made accessible to all dental health care professionals students. However, the aspect and its extent whether known to the professionals, remains a query to be analysed².

In 2008, Eco-friendly Dental Association (EDA) was cofounded by Dr. Fred Pockrass and his wife Ina Pockrass⁶. EDA provides “Education, standards and connection to patients and dentists who practice green dentistry.” EDA aims to help dentists “Come up with safe and reusable alternatives that lower a dentists operating cost by replacing paper with digital media whenever possible⁷.”

The objective of this study was to investigate the implementation of eco-friendly strategies by Prosthodontic practitioners and dental laboratory technicians of Maharashtra.

II. Materials And Methods

A cross-sectional survey was conducted to determine the awareness of eco-friendly dentistry among 150 participants (prosthodontic practitioners and dental laboratory technicians) of Maharashtra; from August to October 2020. A self-structured, closed-ended questionnaire of 18 questions was designed on an online survey platform (Google Forms) and distributed to participants via Email; after an intensive literature review by the research team. Final questionnaire consisted of three parts: demographic information, implementation of eco-friendly practice, and information about dentists perceived barriers to implementation of eco-friendly strategies. The sample size was estimated for the main study (n=150). Out of 150 participants 149 responses were collected from the participants. Inclusion criteria included the Prosthodontic practitioners and dental laboratory technicians among different districts of Maharashtra. Exclusion criteria involved the unwilling participants, dental practitioners from speciality other than Prosthodontics and incompletely filled surveys. Statistical analysis was done using Wilcoxon’s matched paired test and one-way ANOVA. Data was analysed using Statistical Package for Social Sciences (SPSS) Inc. version 20 Chicago, USA (IBM Statistics Inc., Chicago, USA).

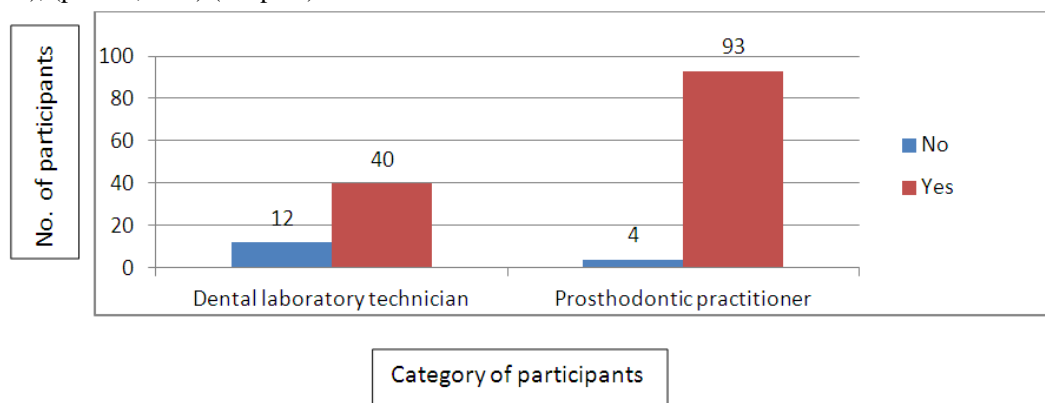
III. Results

The results revealed that among 149 participants, 97 were Prosthodontic practitioners (65.1%) and 52(34.9%) were dental laboratory technicians.

Table 1 explains about the awareness about the concept of eco friendly dental practice. The awareness was statistically higher among prosthodontic practitioners (95.87%), when compared to dental laboratory technicians

	Are you aware about the concept of green dentistry?			Chi square test		
	Prosthodontic practitioner (%)	Dental laboratory technicians (%)	Total (%)	Value	df	p-value
Yes	93(95.87)	40(76.92)	133(89.26)	12.687 ^a	1	.000
No	4(4.13)	12(23.08)	16(10.74)			
Total	97(65.1)	52(34.9)	149			

(76.92%), (p<0.01, 0.05).(Graph 1).



Graph 1: Awareness about the concept of green dentistry

Table 2 depicts responses of participants to questionnaire.

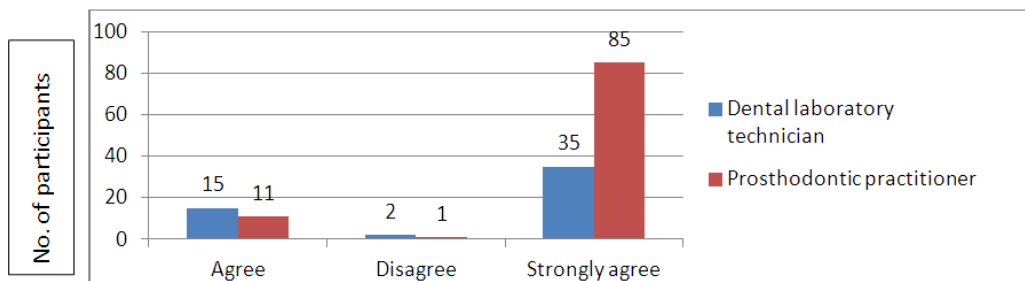
	Prosthodontic practitioner (%)	Dental laboratory technicians (%)	P value
Are you aware about the concept of eco-friendly or green dentistry?			
a. Yes	93(95.87)	40(76.92)	0.000
b. No	4(4.13)	12(23.08)	
Do you take any measures to reduce the use of material consumption (like taking needed amount of material with measuring device, careful dispensing and proper manipulation of materials, etc.)?			
a. Yes	34(35.05)	13(25)	0.444
b. No	23(23.72)	15(28.84)	
c. Sometimes	40(41.23)	24(46.15)	

Do you take proper precautions to prevent wasting of dental materials (like storage as per recommendations, keeping track of shelf life of material, etc.)? a. Yes b. No c. Sometimes	43(44.32) 12(12.37) 42(42.85)	14(26.92) 7(13.46) 31(59.61)	0.103
Which coloured plastic bag/container you dispose off dental materials in ? a. Yellow b. Red c. Black d. Blue/White	85(87.62) 7(7.21) 3(3.09) 2(2.06)	32(61.53) 9(17.30) 9(17.30) 2(3.84)	0.002
Which coloured plastic bag/container you dispose off solid waste (like cotton, soiled plaster cast) contaminated with blood and body fluids? a. Yellow b. Red c. Black d. Blue/White	73(75.25) 18(18.55) 4(4.12) 2(2.06)	27(51.92) 11(21.15) 12(23.07) 2(3.84)	0.002
Are you aware about the fact that disposed off dental alginate impression material (0.01%-0.1%) can be recycled and reused as an effective additional fertiliser? a. Yes b. No c. Maybe	34(35.05) 37(38.14) 26(26.80)	30(57.69) 11(21.15) 11(21.15)	0.023
Are you aware about the fact that automix impression techniques are more cost effective than tubed impression material techniques when recording impressions? a. Yes b. No c. Maybe	41(42.26) 37(38.14) 19(19.58)	16(30.76) 16(30.76) 20(38.46)	0.043
Which method/s of recycling of gypsum do you know about? a. Chemical method with 20% ammonium bicarbonate solution b. Physical/closed loop recycling method c. Both d. None	5(5.15) 6(6.18) 23(23.71) 63(64.94)	2(3.84) 5(9.61) 17(32.69) 28(53.84)	0.501
Are you aware about the fact that after milling of PEEK (polyetheretherketone) block the remaining waste fibres can be used (in concentration of 1 or 2%) as an effective filler in PMMA denture base? a. Yes b. No c. Maybe	40(41.23) 44(45.36) 13(13.40)	30(57.69) 9(17.30) 13(25)	0.002
Are you aware about the fact that 80-90% of dental wax can be recollected and reused after removing adhering impurities? a. Yes b. No c. Maybe	35(36.08) 38(39.17) 24(24.74)	22(42.30) 11(21.15) 13(25)	0.070
How much casting alloy do you think is wasted (which can be reused) after each casting in the form of sprues and buttons? a. 30-40% b. 50-60% c. 70-80%	31(31.95) 36(37.11) 30(30.92)	16(30.76) 20(38.46) 16(30.76)	0.984
Are you aware about the fact that base metal casting alloys can be effectively reused for casting new restorations or appliances by proper cleaning techniques (sandblasting, electro polishing) ; with just 5-10% reduction in mechanical properties even after 20 th recast? a. Yes b. No c. Maybe	38(39.17) 37(38.14) 22(23.40)	28(53.84) 10(19.23) 14(26.92)	0.057
Are you aware about the fact that the impression copings can be retrieved, cleaned, sterilised and reused up to twelve times without compromising the accuracy of the implant transfer while making impressions? a. Yes b. No c. Maybe	40(41.23) 39(40.20) 18(18.55)	16(30.76) 19(36.53) 17(32.69)	0.136
Are you aware about the digitalisation in dentistry? a. Yes b. No	95(97.93) 2(2.06)	34(65.38) 18(34.61)	0.000
Are you aware about the digital impressions that actually reduce the overall consumption and wastage of dental materials? a. Yes b. No c. Maybe	62(63.91) 16(16.49) 19(19.58)	28(53.84) 8(15.38) 16(30.76)	0.302

Are you aware about the fact that additive technology (like DMLS, Stereo lithography) leads to less consumption and wastage of dental materials as compared to subtractive technology (like milling)?			
a. Yes	63(64.94)	27(51.92)	0.145
b. No	16(16.49)	2(3.84)	
c. Maybe	18(18.55)	17(32.69)	
Would you like to incorporate green dentistry strategy in your dental practice or laboratory and suggest the same to your co-workers?			
a. Strongly agree	85(87.62)	35(67.30)	0.011
b. Agree	11(11.34)	15(28.84)	
c. Disagree	1(1.03)	2(3.84)	
d. Strongly disagree	0(0)	0(0)	
What is the biggest barrier you perceive in implementing eco friendly dental practice?			
a. I was unaware about the idea of such practice	52(53.60)	32(61.53)	0.793
b. Such practice requires more cost	40(41.23)	20(38.46)	
c. Other reason....specify	5(5.15)	0(0)	

Majority of the participants showed strong agreement to incorporate green dentistry strategies in their routine practice. There was a statistically significant / highly significant difference seen for the frequencies between the groups ($p < 0.01, 0.05$) with higher frequency for response strongly agree with Prosthodontic practitioners (87.62%). (Table 3)(Graph 2)

	Prosthodontic practitioner (%)	Dental laboratory technicians (%)	Chi square test		
			Value	df	p-value
Strongly agree	85(87.62)	35(67.30)	9.014 ^a	2	.011
Agree	11(11.34)	15(28.85)			
Disagree	1(1.04)	2(3.85)			
Strongly disagree	0	0			



Graph 2: Willingness of participants to incorporate green dentistry practices

Major barriers perceived are lack of awareness and more cost that is required to implement eco friendly dental practice. (Table 4)

	Prosthodontic practitioner	Dental laboratory technicians	Total
I was unaware about the idea of such practice	52	32	84
Such practice requires more cost	40	20	60
Difficult at college level	1	0	1
Much precision is required while manipulating materials also cost factor is there	1	0	1
Needs separate manpower ...not possible in daily practice where workload is too much	1	0	1
Not easy to imply in day to day practice	1	0	1
Not given specific attention	1	0	1
Total	97	52	149

IV. Discussion

In India, green dentistry is still in progressing state, while in several countries, it has been developed long ago⁸. In this study, the awareness of term green dentistry was higher among Prosthodontic practitioners (93.87%), as compared to dental laboratory technicians (76.92%).

The collected data showed that only 35.05% of prosthodontist and 25% laboratory technicians take strict measures like careful dispensing of dental materials and proper manipulation to reduce material consumption.

To prevent wasting of materials, measures like proper storage and keeping track of shelf life of material were taken by only 44.32% of prosthodontist and 26.92% of laboratory technicians.

For disposal of dental materials ideally the yellow coloured plastic bag or container is to be used; as per the current study only 85 prosthodontist (87.62) and 32 laboratory technicians (61.53%) were aware about this. But rest of the participants used different coloured container to dispose off dental material waste (red or blue or black).

For disposal of soiled waste ideally red coloured container or plastic bag is to be used but according to the results obtained in the current study only 75.25% of prosthodontist and 51.92% of dental laboratory technicians were aware about this.

Dental alginate impression material is the most common material used in dentistry. A study conducted by Tommy Frahdian et al, in 2018 suggests that the dental alginate can be used as an effective fertilizer just in concentration of 0.01-0.1%⁹. The current study shows that only 35.05% of prosthodontist and 57.69% of dental laboratory technicians were aware about this recycle and reuse strategy of dental alginate.

A randomised control trial conducted by Wilson N H et al in 2001 concluded that automix impression technique, found to be more cost effective than tubed impression material technique when recording impressions¹⁰. In the current study, 41.26% prosthodontist and 30.76% of dental laboratory technicians were known to this fact.

Gypsum is one of the most commonly used dental material in day to day practice and it contributes to large quantities of waste also. Hence it is desirable to recycle and reuse gypsum. In the research published by Shiyo S et al in 2020 regarding recycling of plaster of paris, two methods of recycling of gypsum has been explained. One uses 20% ammonium bicarbonate solution known as chemical method and the other is known as physical or closed loop recycling method¹¹. The current study showed that only 5.15% prosthodontist were aware about chemical method, 6.18% were aware about physical method and 23.71% were knowing both the methods of recycling; remaining large population of participants (64.94) were unaware about any of the method. On the other hand only 3.84% of laboratory technicians knew about chemical method, 9.61% were aware about physical method and 32.69% of technicians were aware about both the methods of recycling of gypsum and remaining 53.84% did not know about any of the two methods.

The study published by Aseel Hayder Salim et al in 2020 suggests that recycling of PEEK waste from CAD-CAM production method and reuse it as dental filler at 1% and 2% wt. concentration in PMMA reduces the surface roughness and enhances the surface hardness of PMMA denture base material¹². In the current study only 41.23% prosthodontist and 57.69% dental laboratory technicians were aware about this fact.

The dental wax is used mainly to construct occlusal rims during complete denture fabrication and these are made out of natural waxes, synthetic waxes, plant wax, animal wax and natural resins. During dewaxing procedure wax is softened and rejected. About 80-90% of this wax can be recollected and purified by simple laboratory technique by removing adhering impurities and new wax sheets of desired thickness are formed, which can be reused effectively without any deterioration of their original properties¹³. In the current study only 36.08% of prosthodontist and 42.30% dental laboratory technicians were aware about this.

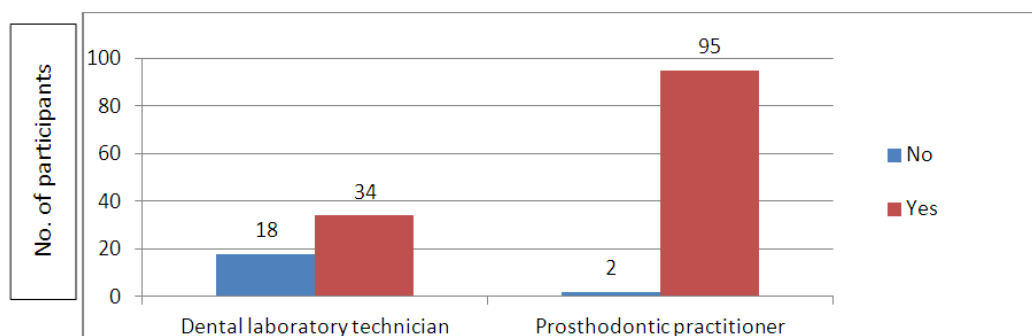
About 50-60% of casting alloy remains as wastage in the form of sprues and buttons, and it can be effectively reused for fabricating new restorations or appliances by proper cleaning techniques (sand blasting, electro polishing). There is only 5-10% decrease in their mechanical properties even after 20th recast, which is much higher than our natural tooth¹³. The current study showed that only 39.17% prosthodontist and 53.84% laboratory technicians are aware about this.

An in vitro study was conducted to evaluate the accuracy of implant transfer by Reshma Babu et al in 2016, concluded that the impression copings can be retrieved, cleaned,

Sterilized and reused upto twelve times without compromising the accuracy of the implant transfer while making impressions¹⁴. In the present study, out of 149 participants, 41.23% of prosthodontist and 30.76% of laboratory technicians were aware about this.

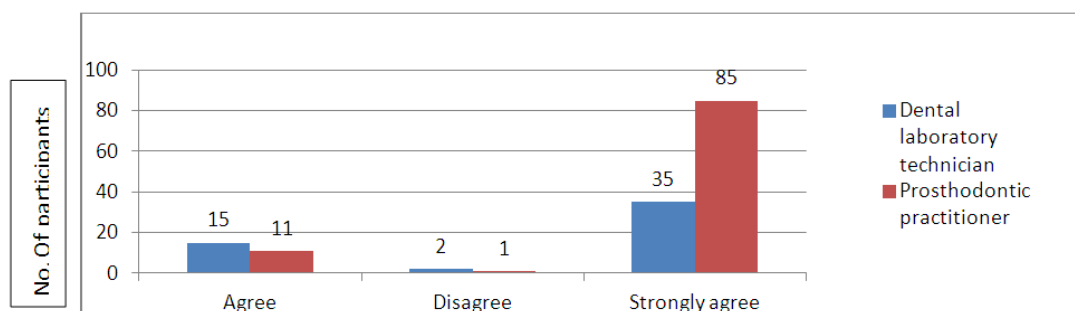
The current study also shows that the huge population (97.93% prosthodontist and 65.38% dental laboratory technicians) is aware about the digitalisation that is taking place of conventional dentistry in the form of CAD-CAM and 3D printers(p 0.000) (Graph 3). The digital impression making reduces overall consumption and wastage of dental materials. Also the additive technology like DMLS, Stereo lithography reduce the

consumption and wastage of materials as compared to subtractive technology like milling (aware prosthodontist=64.94 and laboratory technicians = 51.92).



Graph 3: Awareness about digitalisation in dentistry

87.62% prosthodontist and 67.30% dental laboratory technicians showed strong agreement towards incorporating green dentistry strategies in their dental practice and suggesting the same to their co-workers (Graph 4).



Graph 4: Willingness to incorporate green dentistry strategies in day to day practice

Despite their willingness they perceived some barriers while actually implementing these practices. Some of the major barriers identified were lack of awareness of these strategies and the financial burden that is experienced by the participants to carry out the same.

Hence, each and every possible effort should be made to reduce environmental pollution and improve the quality of dentistry. Dentistry can limit its burden on the environment by employing the “Four R’s of Going Green” namely, “Re-think, Reduce, Reuse and Recycle”^{5, 15-22}.

V. Conclusion

The current study suggests that awareness of eco-friendly dental practice is more amongst prosthodontic practitioners as compared to the dental laboratory technicians.

As majority of participants showed willingness to incorporate eco-friendly dentistry in their routine practice, different measures are needed to be taken to improve the awareness through various sources, especially in laboratory technicians through formal and continuing dental education.

The major barriers were lack of awareness and financial burden as responded by the participants, which should be looked after so as to improve the overall impact of dentistry on the environment and the quality of dental practice.

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