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## Kap Survey on Management of Defective Amalgam Restorations Among Dental Practitioners In Chennai

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**Abstract: Background:** Dental restorations were a requirement since the time dental cavities have been prevalent in humans and that has been so for ages and it has not always been treated the best way. The time and availability of the technique and methods as it is now were not so in the earlier times. Amalgam restorations are one of the old restorative materials that are to be performed with great skill, patience, and proper technique. Defective amalgam restorations can be made to serve the purpose with the advent of repair techniques.

**Aim:** To assess the knowledge and perception regarding the management of defective amalgam restorations among dental practitioners in Chennai.

**Methods:** A survey questionnaire regarding the management of defective amalgam restorations was prepared on a survey platform and distributed among 100 dentists randomly to analyze the perception of the participants towards the management of defective amalgam restoration. The survey questions are such that they try to assess the knowledge, experience, and the level of improvisation of the dentists regarding the repair of amalgam restorations. Convenient sampling was done and a sample size of 100 was chosen. The results obtained from the survey were then analyzed using SPSS 22.0 and the chi square test was done to assess the significant association between the field of practice and their responses to the questions and the graphs were plotted.

**Results:** From the survey results it was evident that the dental practitioners find removal and replacement quite hectic and hence would like to have the alternate option of repair of the existing restoration if it is possible. Repair does seem to be a valuable idea on ways to manage defective amalgam restorations. Repairing an amalgam restoration would save time for the dentist and money for the patient but due to the lack of certain techniques and instruments, it is not widely practiced. Replacement is mostly carried out for management of defective amalgam restorations. It does involve more time and expense but the purpose of managing a defective amalgam restoration is served. There was no significant association between the field of practice of the dentists (specialists/ general practitioners) and their response to the question for the majority of the survey questions.

**Conclusion:** Repair does seem to be a valuable idea on ways to manage defective amalgam restorations rather than replacing it, but majority of the participants preferred replacing the restoration as they were not confident on methods to repair, and believed replacement would benefit the patients by increasing the longevity of the restoration.

**Keywords:** Dental restorations; Amalgam; Repair; Replacement

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### INTRODUCTION

Dental restorations were a requirement since the time dental cavities have been prevalent in humans and that has been so for ages and it hasn't always been treated the best way (Foster, 1994). The lack of time and unavailability of the current ways, methods, and techniques in the earlier days when compared to the current generation had made it difficult for people to tackle defective restorations (Stern, 1995; Casagrande et al., 2017). Numerous restorative materials and techniques have been advocated since then for management of dental caries (Hanson et al., 1982). One such material was amalgam. Amalgam restoration is 'not-so-recent' but recent enough technique of tooth filling restorations (Moncada et al., 2017; Spencer et al., 2019). Amalgam as restorative material was used for the posterior teeth. They were popular enough since amalgam restorations have a finite life span as long as the restoration is done properly with the required skill (Hilgert et al., 2016). The issue is when their very same restoration fails or fractures due to lack of skill and improper restoration. It even

leads to secondary caries which can be a worse complication (Sharif, Catleugh, et al., 2014). Amalgam restorations have various advantages such as resistance to wear, and excellent load-bearing. When a restoration such as that of amalgam which is resistant to wear, becomes defective, the skill of a dentist is put to question (Devlin, 2012; Gordan et al., 2015).

There are certainly traditional and conventional solutions that involve complete removal and then replacement of the amalgam restoration (Sharif, Merry, et al., 2014; Kopperud et al., 2016). The second placement or replacement of the restoration can also include certain minor imperfections. Hence removal of the further structure of the tooth and then replacement of the entire restoration is quite a hectic job and also one of the major concerns of restorations in the dental practice (Abraham, Svare and Frank, 1984). Even then minimal invasive dentistry prefers repair as it reduces the amount of the tooth structure removed which hence retains and preserves the healthy natural tooth (Skare and Engqvist, 1994). Preservation and conservation of maximum tooth structure is required as it helps in maintaining a healthy tooth with better retention and the possibility of success of the restoration (Mortazavi et al., 2008). Repair of amalgam restorations will last for years to serve the purpose of repairing and could be a better choice than replacing amalgams for localized defects (Dahl and Eriksen, 1978; Trester, 2001). But since it has not been effectively employed due to lack of instrument and extensive knowledge on considering repair as an option to manage defective amalgam restoration, the conventional methods are used (Carotte, 2001). Repair is ideal but remove and replace is more of a realistic technique now (Moncada et al., 2015).

Various Clinical trials (Ramamoorthi, Nivedhitha and Divyanand, 2015; Hussainy et al., 2018; Janani, Palanivelu and Sandhya, 2020), in vitro studies (Ramanathan and Solete, 2015; Khirtika, Ramesh and Muralidharan, 2017; Nandakumar and Nasim, 2018; Teja, Ramesh and Priya, 2018; Rajendran et al., 2019; Siddique et al., 2019), reviews (Noor, S Syed Shihaab and Pradeep, 2016; Kumar and Antony, 2018; Ravinthaar and Others, 2018; R, Rajakeerthi and Ms, 2019; Teja and Ramesh, 2019) and surveys (Manohar and Sharma, 2018; Jose, P. and Subbaiyan, 2020) have been conducted by our team in the field of conservative dentistry and endodontics which has paved us the way to take up this survey. Our team has rich experience in research and we have collaborated with numerous authors over various topics in the past decade (Deogade, Gupta and Ariga, 2018; Ezhilarasan, 2018; Ezhilarasan, Sokal and Najimi, 2018; Jeevanandan and Govindaraju, 2018; J et al., 2018; Menon et al., 2018; Prabakar et al., 2018; Rajeshkumar et al., 2018, 2019; Vishnu Prasad et al., 2018; Wahab et al., 2018; Dua et al., 2019; Duraisamy et al., 2019; Ezhilarasan, Apoorva and Ashok Vardhan, 2019; Gheena and Ezhilarasan, 2019; Malli Sureshbabu et al., 2019; Mehta et al., 2019; Panchal, Jeevanandan and Subramanian, 2019; Rajendran et al., 2019; Ramakrishnan, Dhanalakshmi and Subramanian, 2019; Sharma et al., 2019; Varghese, Ramesh and Veeraiyan, 2019; Gomathi et al., 2020; Samuel, Acharya and Rao, 2020) The purpose of this survey was to analyse the knowledge, awareness and practice regarding the management of defective amalgam restorations.

## **MATERIALS AND METHODS**

A cross-sectional study was conducted across various dental practitioners in Chennai. Convenient sampling was done and questionnaires were randomly distributed to 100 dental practitioners chosen with no limit in the age groups. A self-administered questionnaire was created using google forms in English and was distributed. It took about 5-10 minutes to complete the survey. Convenient sampling was done, and the survey involved 100 randomly chosen dental practitioners. The results obtained from the survey were then analyzed using SPSS 22.0 and the chi square test was done to assess the significant association between the field of practice and their responses to the question. The graphs were plotted accordingly to compare results.

## **RESULTS**

Completed responses were received by 120 dentists from Chennai. No incomplete responses were received. The overall responses of the survey was given in table 1. Figure 1 shows that 21.67% of the specialists and 20.83% of general dental practitioners considered that the lifespan of an amalgam restoration is 10 years. 36.67% of the general dental practitioners and 27.50% of the specialists consider an amalgam restoration to be defective when secondary caries is caused and the restoration fractures. Figure 2 shows that 30.83% of the general dental practitioners and 25% of the specialists agreed that defective amalgam restorations can cause secondary caries. Figure 3 shows that 31.67% of the general dental practitioners and 24.17% of the specialists consider that when the seal between tooth and the restoration breaks, it causes the amalgam restoration to be defective. 31.67% of the general dental practitioners and 26.67% of the specialists agreed that by both facilitating contaminant free bonding and reducing microleakage, the restoration turning defective can be prevented. 22.5% of the specialists and general dental practitioners consider that the composition of amalgam does have an effect on the restoration turning defective. Figure 5 shows that 22.5% of the specialists and 18.33% of the general dental practitioners reported that repairing an amalgam restoration is possible. 21.67% of the specialists and 21.67% of the general dental practitioners conveyed that 'removal' is the most preferred method in managing a defective amalgam restoration. 25.83% of the specialists and 22.5% of the general dental practitioners consider that a defect can

occur both during and after the procedure. Figure 6 shows that 25% of the specialists and 20% of the general dental practitioners consider replacing as their choice of preference.

## DISCUSSION

Amalgam restorations are quite strong restorations that are to be performed with great skill, patience, and proper technique. In case the above mentioned three things are not followed, it can lead to what we call a defective restoration (Going, 1972). The survey sought to analyse the knowledge, awareness and practice of the management of defective amalgam restoration. From the varied responses of the dental practitioners, it was clear that knowledge regarding the management of defective amalgam restoration was present among the dentists of Chennai. The technique of repair has not yet been improvised enough to be helpful in treating defective amalgam restorations but it is on the preferred list of dentists since it takes lesser time and manpower and also reduces the chair time. Repair is an alternative treatment choice for management of faulty amalgam restorations. This includes removing part of the filling and any distorted hard tissues adjacent to the damaged area, and restoring the prepared site. This technique allows maintaining the sound structure of the tooth.

A defective amalgam restoration is not a good sign since it can ruin the tooth's health and also cause secondary caries. But it can be prevented by facilitating contaminant free bonding and also by reducing microleakage. Most of the respondents of the survey preferred replacing the amalgam restoration, rather than repairing, as they found repair increases the longevity of the restoration and will serve the purpose. Repair of defective amalgam restorations are technique sensitive and requires operator skill (Popoff et al., 2011). Though respondents agreed repair would be a valid option, their confidence level in performing these treatments were not good, which made them prefer replacement over repair. Henceforth training regarding the repair of defective restorations should be taught in undergraduate level, which enhances their clinical skills in future (Setcos et al., 2004).

Limitations of this survey are small sample size, false responses and irrelevant answers. Future scope will be conducting this survey on a large scale population to assess the overall trend regarding the management of defective amalgam restorations. Our institution is passionate about high quality evidence based research and has excelled in various fields (Pc, Marimuthu and Devadoss, 2018; Ramesh et al., 2018; Ezhilarasan, Apoorva and Ashok Vardhan, 2019; Ramadurai et al., 2019; Sridharan et al., 2019; Vijayashree Priyadharsini, 2019; Mathew et al., 2020)

## CONCLUSION

Repair does seem to be a valuable idea on ways to manage defective amalgam restorations rather than replacing it. But the majority of the participants preferred replacing the restoration as it benefits the patients by increasing the longevity of the restoration. There was no significant association between the field of practice of the dentists (specialists/ general practitioners) and their response to the question for the majority of the survey questions. Henceforth knowledge should be imparted regarding the methods of managing the defective amalgam restorations by means of repair whenever possible, which would make them better clinicians in the near future.

## AUTHOR CONTRIBUTIONS

All authors have equal contributions in carrying out this survey.

## ACKNOWLEDGEMENTS

I would like to thank the Department of Conservative Dentistry and Endodontics, Saveetha Dental College, Chennai for their valuable inputs in this survey.

## CONFLICT OF INTEREST

The authors declare no conflict of interest

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**List of tables and figures**

**Table 1-** Denotes the responses obtained for various questionnaires regarding the knowledge, awareness and practice of the general dental practitioners and the specialists regarding the management of defective amalgam restorations.

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**Figure 4-** Denotes the respondents opinion regarding the composition of amalgam having an effect on the restoration being defective.

**Figure 5-** Denotes the respondents opinion regarding the possibility of repairing an amalgam restoration.

**Figure 6-** Denotes the respondents opinion regarding their preferred choices and improvisations in managing defective amalgam restorations.

**TABLES AND GRAPHS**

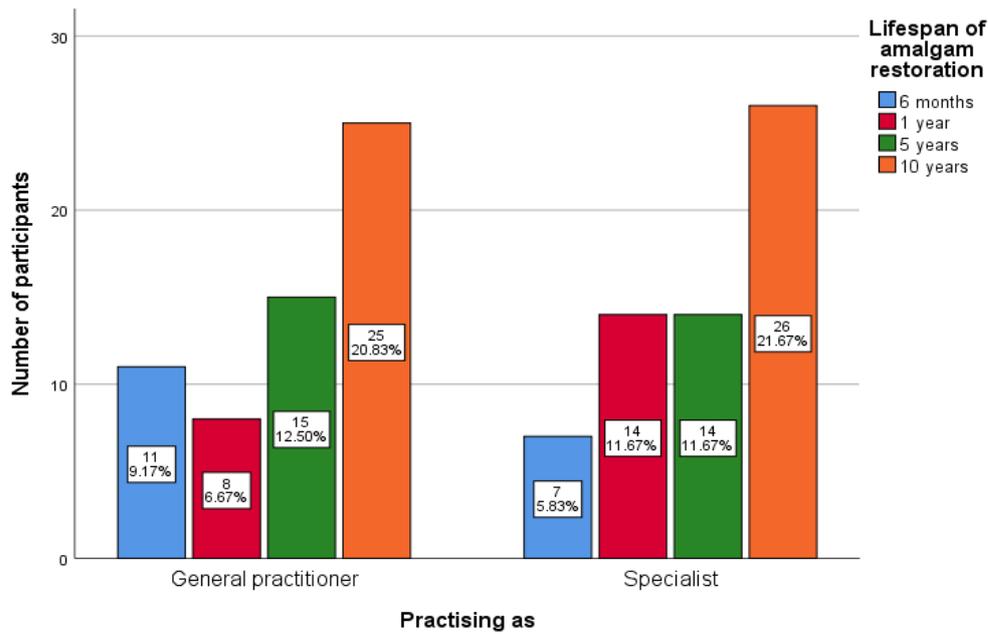
**Table 1.**

Questionnaire	Endodontists	General Practitioners	Dental	p-value (<0.05; statistically significant)
What is the lifespan of an amalgam restoration?	<ul style="list-style-type: none"> <li>● 6 months- 7 (5.83%)</li> <li>● 1 year- 14 (11.67%)</li> <li>● 5 years- 14 (11.67%)</li> <li>● 10 years- 26 (21.67%)</li> </ul>	<ul style="list-style-type: none"> <li>● 6 months- 11 (9.17%)</li> <li>● 1 year- 8 (6.67%)</li> <li>● 5 years- 15 (12.50%)</li> <li>● 10 years- 25 (20.83%)</li> </ul>		Pearson’s Chi-square value: 2.547 df: 3 p value = 0.467

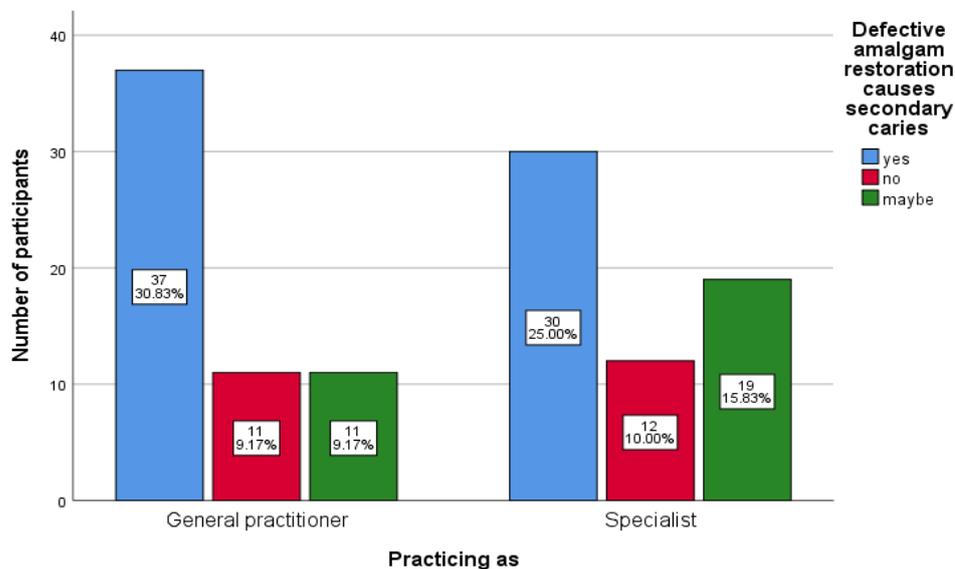
<p>What do you understand by a defective amalgam restoration?</p>	<ul style="list-style-type: none"> <li>● Discolored restoration- 20 (16.67%)</li> <li>● When it ends up as a secondary caries and tooth restoration fractures- 33 (27.50%)</li> <li>● Not sure- 8 (6.67%)</li> </ul>	<ul style="list-style-type: none"> <li>● Discolored restoration- 8 (6.67%)</li> <li>● When it ends up as a secondary caries and tooth restoration fractures- 44 (36.67%)</li> <li>● Not sure- 7 (5.83%)</li> </ul>	<p>Pearson's Chi-square value: 6.749 df: 2 p value = 0.034</p>
<p>Do you think that defective amalgam restorations can cause secondary caries?</p>	<ul style="list-style-type: none"> <li>● Yes- 30 (25%)</li> <li>● No- 12 (10%)</li> <li>● Maybe- 19 (15.83%)</li> </ul>	<ul style="list-style-type: none"> <li>● Yes- 37 (30.83%)</li> <li>● No- 11 (9.17%)</li> <li>● Maybe- 11 (9.17%)</li> </ul>	<p>Pearson's Chi-square value: 2.876 df: 2 p value = 0.237</p>

<p>What can be the reason for defective amalgam restorations?</p>	<ul style="list-style-type: none"> <li>● Lack of experience of the dentist- 18 (15%)</li> <li>● Mastication induced stresses- 14 (11.67%)</li> <li>● Seal between tooth enamel and filling breaks down- 29 (24.17%)</li> </ul>	<ul style="list-style-type: none"> <li>● Lack of experience of the dentist- 13 (10.83%)</li> <li>● Mastication induced stresses- 8 (6.67%)</li> <li>● Seal between tooth enamel and filling breaks down- 38 (31.67%)</li> </ul>	<p>Pearson's Chi-square value: 3.619 df: 2 p value = 0.164</p>
<p>How can an amalgam restoration turning defective be prevented?</p>	<ul style="list-style-type: none"> <li>● Facilitate contaminant-free bonding- 13 (10.83%)</li> <li>● Reduce microleakage- 16 (13.33%)</li> <li>● Both A and B- 32 (26.67%)</li> </ul>	<ul style="list-style-type: none"> <li>● Facilitate contaminant-free bonding- 9 (7.5%)</li> <li>● Reduce microleakage- 12 (10%)</li> <li>● Both A and B - 38 (31.67%)</li> </ul>	<p>Pearson's Chi-square value: 1.780 df: 2 p value = 0.411</p>
<p>Do you think composition of amalgam has an effect on the restoration turning defective?</p>	<ul style="list-style-type: none"> <li>● Yes- 27 (22.5%)</li> <li>● No- 18 (15%)</li> <li>● Maybe- 16 (13.33%)</li> </ul>	<ul style="list-style-type: none"> <li>● Yes- 27 (22.5%)</li> <li>● No- 9 (7.5%)</li> <li>● Maybe- 23 (19.17%)</li> </ul>	<p>Pearson's Chi-square value: 4.224 df: 2 p value = 0.121</p>

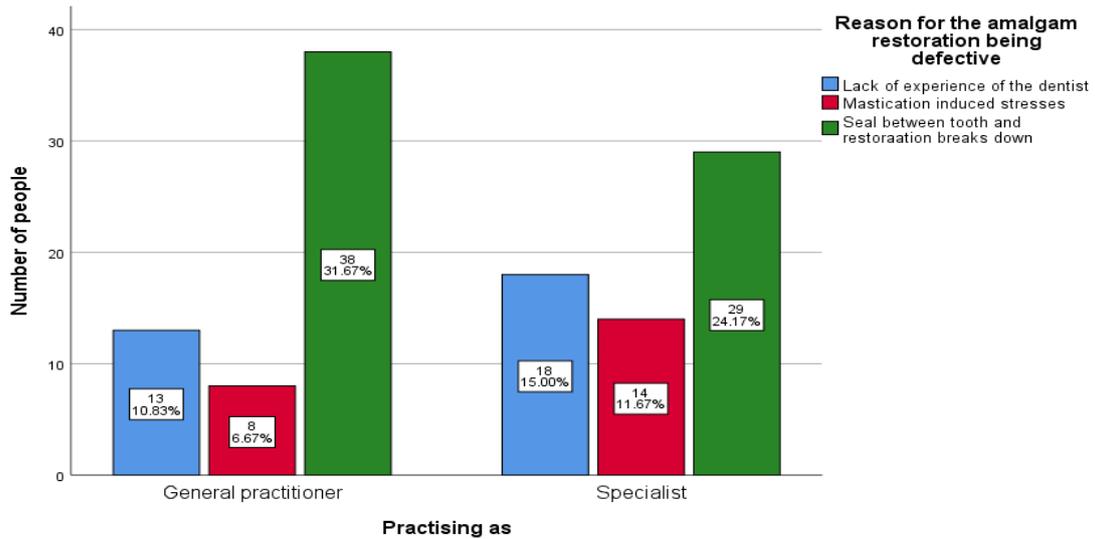
Can an amalgam restoration be repaired?	<ul style="list-style-type: none"> <li>• Yes- 27 (22.5%)</li> <li>• No- 15 (12.5%)</li> <li>• Maybe- 19 (15.83%)</li> </ul>	<ul style="list-style-type: none"> <li>• Yes- 22 (18.33%)</li> <li>• No- 16 (13.33%)</li> <li>• Maybe- 21 (17.5%)</li> </ul>	Pearson's Chi-square value: 0.609 df: 2 p value = 0.737
'Repair' or 'Remove', which is more preferred in defective amalgam restoration?	<ul style="list-style-type: none"> <li>• Repair- 14 (11.67%)</li> <li>• Remove- 26 (21.67%)</li> <li>• Not sure if repair is possible in the very same restoration- 21 (17.5%)</li> </ul>	<ul style="list-style-type: none"> <li>• Repair- 16 (13.33%)</li> <li>• Remove- 26 (21.67%)</li> <li>• Not sure if repair is possible in the very same restoration- 17 (14.17%)</li> </ul>	Pearson's Chi-square value: 0.521 <sup>a</sup> df: 2 p value = 0.771
At what time/duration of the procedure does a defect occur in an amalgam restoration?	<ul style="list-style-type: none"> <li>• During the procedure- 7 (5.83%)</li> <li>• Necessarily after the procedure- 13 (10.83%)</li> <li>• Can be both- 31 (25.83%)</li> <li>• After a period of time of completion of the restoration- 10 (8.33%)</li> </ul>	<ul style="list-style-type: none"> <li>• During the procedure- 10 (8.33%)</li> <li>• Necessarily after the procedure- 11 (9.17%)</li> <li>• Can be both- 27 (22.5%)</li> <li>• After a period of time of completion of the restoration- 11 (9.17%)</li> </ul>	Pearson's Chi-square value: 0.987 <sup>a</sup> df: 3 p value = 0.805
As a dentist, provide certain improvisations/choices	<ul style="list-style-type: none"> <li>• Repair- 19 (15.83%)</li> <li>• Replace- 30 (25%)</li> <li>• No idea- 12 (10%)</li> </ul>	<ul style="list-style-type: none"> <li>• Repair- 17 (14.17%)</li> <li>• Replace- 24 (20%)</li> <li>• No idea- 18 (15%)</li> </ul>	Pearson's Chi-square value: 1.945 <sup>a</sup> df: 2 p value = 0.378



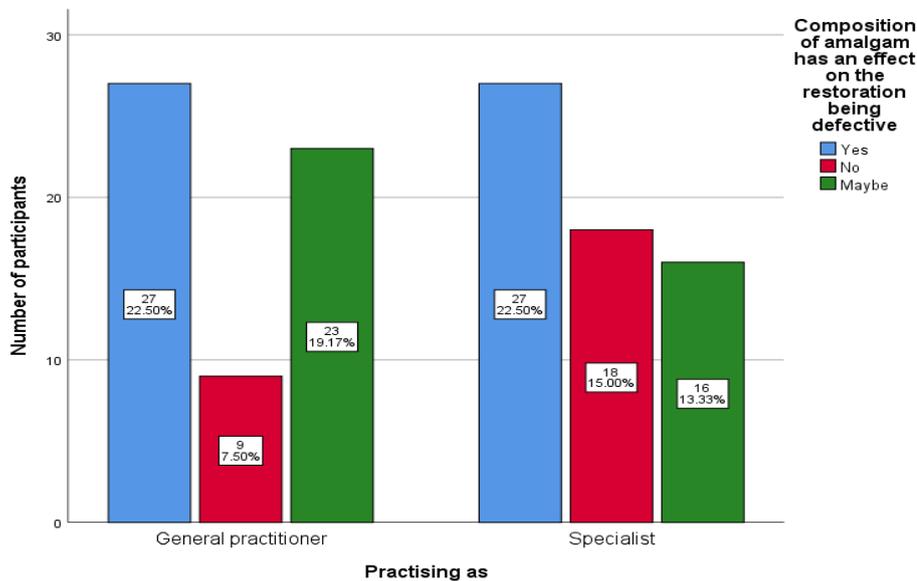
**Fig.1:** Bar graph represents the association between the field of practice (specialists/ general practitioners) and their opinion regarding the lifespan of amalgam restorations, X-axis represents the field of practice and Y-axis represents the number of participants. Lifespan of amalgam restoration was 10 years (orange), 5 years (green), 1 year (red) and 6 months (blue). Chi square test was done to find the association between the field of practice of the dentists (specialists/ general practitioners) and their response to the question which in turn was statistically not significant (p value- 0.467;  $p > 0.05$ ). Majority of the specialists reported that the life span of amalgam restoration was 10yrs (21.67%).



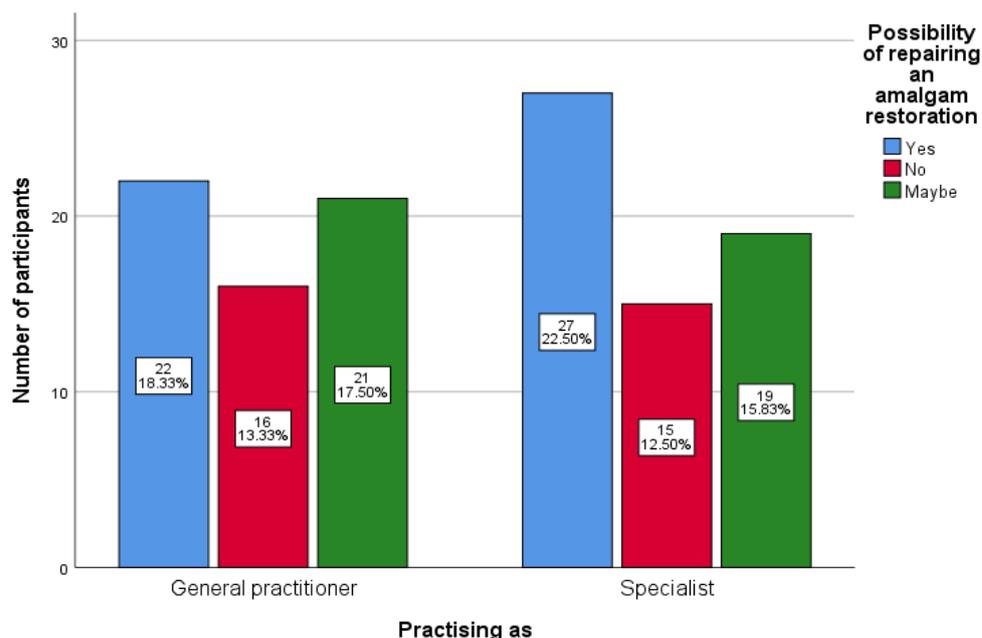
**Fig.2:** Bar graph represents the association between the field of practice (specialists/ general practitioners) and their opinion regarding defective amalgam restorations causing secondary caries, X-axis represents the field of practice and Y-axis represents the number of participants. Defective amalgam restorations can cause secondary caries (blue), defective amalgam restorations cannot cause secondary caries (red) and uncertain (green). Chi square test was done to find the association between the field of practice of the dentists (specialists/ general practitioners) and their response to the question which in turn was statistically not significant (p value- 0.237;  $p > 0.05$ ). Majority of the general dental practitioners reported that yes, defective amalgam restorations can cause secondary caries (30.83%).



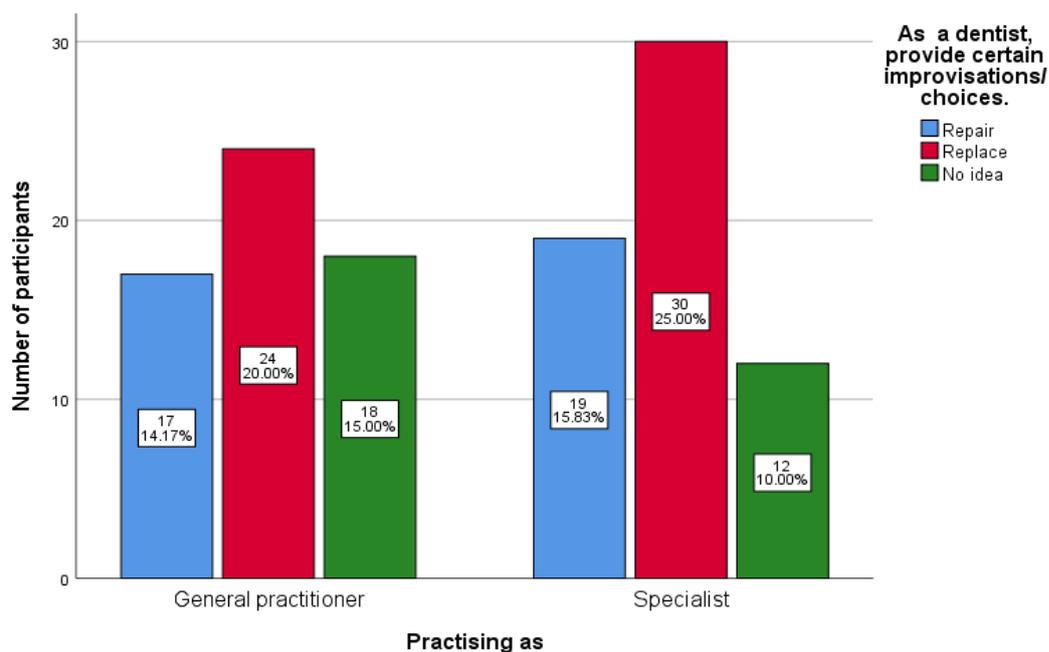
**Fig.3:** Bar graph represents the association between the field of practice (specialists/ general practitioners) and their opinion regarding the reason for the amalgam restorations turning defective, X-axis represents the field of practice and Y-axis represents the number of participants. Reason for amalgam restoration turning defective is lack of experience of the dentist (blue), or due to mastication induced stresses (red) or when the seal between the teeth and restoration breaks down (green). Chi square test was done to find the association between the field of practice of the dentists (specialists/ general practitioners) and their response to the question which in turn was statistically not significant (p value- 0.164;  $p > 0.05$ ). Majority of the general practitioners reported that when the seal between teeth and the restoration breaks down, it can lead to defective amalgam restoration (31.67%).



**Fig.4:** Bar graph represents the association between the field of practice (specialists/ general practitioners) and their opinion regarding the composition of amalgam having an effect on the restoration turning defective, X-axis represents the field of practice and Y-axis represents the number of participants. Composition does have an effect on the restoration being defective - Yes (blue), No (red) and uncertainty (green). Chi square test was done to find the association between the field of practice of the dentists (specialists/ general practitioners) and their response to the question which in turn was statistically not significant (p value- 0.121;  $p > 0.05$ ). Majority of the specialists reported that yes, the composition of amalgam would have an effect on the restoration turning defective (22.50%).



**Fig.5:Bar graph represents the association between the field of practice (specialists/ general practitioners) and their opinion regarding the possibility of repairing an amalgam restoration, X-axis represents the field of practice and Y-axis represents the number of participants. Possibility of repairing amalgam restoration - yes (blue), no (red) and uncertainty (green). Chi square test was done to find the association between the field of practice of the dentists (specialists/ general practitioners) and their response to the question which in turn was statistically not significant (p value- 0.737;  $p > 0.05$ ). Majority of the specialists reported that yes, there is a possibility of repairment of amalgam restorations (22.5%).**



**Fig.6:Bar graph represents the association between the field of practice (specialists/ general practitioners) and their opinion regarding the improvisations/ choices put forward by themselves (the dentists), X-axis represents the field of practice and Y-axis represents the number of participants. Repair is the preferred choice (blue), replace is the preferred choice (red) and uncertainty (green). Chi square test was done to find association between the field of practice of the dentists (specialists/ general practitioners) and their response to the question which in turn was statistically not significant (p value- 0.378;  $p > 0.05$ ). Majority of the specialists preferred replacing the restoration (25%).**