

Original Article

Patient Preference and Perceptions Regarding Amalgam and Tooth-Colored Restoration in an Iraqi Subpopulation

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Abstract

Objective: Patient perception increasingly influences the selection of restorative dental materials, especially as aesthetic expectations grow within modern dental practice. This study aimed to evaluate patient awareness, attitudes, and preferences regarding amalgam and tooth-coloured restorative materials in the Iraqi subpopulation.

Methods: A descriptive cross-sectional survey was conducted using a structured questionnaire distributed to patients attending various dental clinics. The questionnaire obtained demographic information, previous restorative experiences, aesthetic expectations, and perceptions of the functional, aesthetic, and biological characteristics of amalgam and composite resin materials.

Results: The results showed that most participants preferred tooth-coloured restorations due to their natural appearance and higher aesthetic compatibility. Amalgam was favoured by a smaller proportion of respondents who emphasized its durability, strength, and relative affordability. Younger patients and those with higher educational levels demonstrated stronger preference for aesthetic materials, while awareness of possible health concerns associated with amalgam varied considerably among participants.

Conclusions: Overall, the findings reflect a noticeable shift toward aesthetic-driven choices in restorative dentistry within the region. The study concludes that dental practitioners should acknowledge patient preferences during treatment planning and provide balanced, evidence-based information about the advantages and limitations of available restorative materials to support informed decision-making and enhance patient satisfaction.

Keywords: Amalgam, Tooth-colored restoration, Patients' attitude, Restorative dentistry outcomes, Patient satisfaction, Regional dental health research.

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Introduction

Dental caries, also known as tooth decay or tooth cavity, is the most common chronic disease among people around the world. It is an infectious disease that causes the calcified tissue of the teeth to dissolve and be destroyed locally^{1,2}.

Removing the carious lesions and restoring them with biocompatible materials in a timely manner is of great importance to protecting oral health and the overall well-being of the patient. Dentists and oral health givers have been in continuous efforts to develop the optimum materials for this purpose³. Dentistry has evolved to become a well-established and highly respected profession. It is built on a foundation of solid scientific knowledge, a genuine dedication to serving the public, and an ethical responsibility to prioritize the health and well-being of patients seeking dental care. When dentists restore a tooth with a direct restoration, they must account for numerous factors influencing the restoration's durability and longevity. These factors can be based on scientific evidence or the personal preferences of the patient or dentist⁴. Clinical decision-making is at the core of dental practice, influencing treatment choices that impact long-term patient outcomes. In restorative dentistry, these decisions require a balance between scientific evidence, clinical expertise, and patient preferences⁵.

The most popular materials for repairing and restoring teeth are amalgam and tooth-colored restorations. Dental amalgam is a metal alloy composed primarily of mercury, silver, and tin. It has been widely utilized in dental treatment for over 170 years. Amalgam is regarded as the optimal dental restorative material, particularly for posterior teeth that endure significant occlusal forces⁶. It is cost-effective, long-lasting, and durable, making it easy to place in prepared teeth. Amalgam exhibits high compressive strength, excellent wear resistance, and minimal dimensional change over time. Notably, amalgams are recognized for their superior marginal sealing capacity, attributed to the formation of corrosion products at the interface between the amalgam and tooth structure. However, its use is limited due to aesthetic concerns and the need for extensive tooth structure removal during placement. Additionally, the potential toxicity of mercury in amalgam has raised concerns^{4,7}.

Resin composites offer a high level of aesthetic value. These materials develop a micro-mechanical bond with the tooth structure and require minimal cavity preparation. However, these materials are highly technique-sensitive. It is crucial to ensure proper isolation during their application and setting, as these materials need a dry field. Saliva or blood contamination

could interfere with the bond between the composite and the tooth, potentially leading to the debonding of the resin composite later on⁸. Resin composite undergoes polymerization shrinkage during light curing, leading to gap formation at the composite-tooth interface, compromising the quality of the restoration and exposing the tooth to the potential development of secondary caries⁴.

Longitudinal clinical trials show that amalgam restorations last about as long as, or slightly longer than, composite resin restorations. In contrast, cross-sectional retrospective studies of restorations done in general practice reveal that amalgam restorations last more than twice as long as composite resin restoration⁹.

According to a previous study, "Pathway to mercury-free dentistry: an insight into past, present, and future",¹⁰ awareness of the toxicity of mercury in dental amalgam was somewhat low among the patients seeking dental treatment. Most patients still accept amalgam, but the majority prefer tooth-colored fillings for a more natural appearance. Overall, the acceptance of amalgam seems to be influenced by economic factors, dental education, and the aesthetic preferences of the community¹¹.

This study aimed to determine patients' perceptions of amalgam and tooth-colored restoration materials and to fill the gap in our understanding of people's preferences regarding different kinds of restorative materials. Estimate patients' knowledge and attitudes towards amalgam and composite restorations, and correlate the findings with participants' age, sex, and education level in Iraqi subpopulation.

Patients and methods

After obtaining ethical approval from the College of Dentistry, University of Sulaimani, a questionnaire survey (Appendix A) was conducted with 476 participants in Sulaimani City from November 2023 to February 2024. Close-ended questions were included in the study.

Inclusion:

Individuals aged 18 and above and Patients who possessed knowledge about different dental filling materials^{12,13}.

Exclusion criteria:

1. Patients below 18 years old.
2. Patients who didn't have any information regarding dental filling materials.

3. Patients who failed to answer the opening question were omitted from participating in the survey¹⁴.

The participants were asked five knowledge- and opinion-based questions, starting with (1) "Which restoration material do you know?" to assess their level of understanding of basic dental information. If one of the presented choices was selected, they were elicited to move on to the following two questions which are "Yes and No" questions concerned with the respondents' opinions on the two types of tooth filling materials presented. The questions are as follows: (2) "Do you think amalgam can be used to restore the carious tooth?" and (3) "Do you think tooth-colored material can be used to restore carious tooth?". The fourth question is a preference-based question to inquire about the participants' desired choice of restorative material: (4) "Which material will you prefer for tooth filling?" Lastly, the final question in this category is: (5) "Have you taken any knowledge regarding the restorative material for tooth filling from the internet", which serves the purpose of authenticating the status of the respondents' answers as either purely anecdotal and/or experience-based or fact-based¹³.

The second group of questions serves to assess the patients' decision-making or approach process for selection between amalgam and tooth-colored restoration. The first of these questions is: (1) "To whom will you give the choice of selection of restorative material for tooth filling?", with the answers being either "choose by yourself" or "according to doctor" to determine the principal basis of their decision-making. This is followed by a series of basic inquiry questions:

- (2) "According to you, which material is cheaper?" (3) "According to you, which material has more strength?" (4) "According to you, which material will you choose for restoring anterior teeth?" and (5) "According to you, which material will you choose for restoring posterior teeth?" These aim to find out whether the choice of material selected by the participant is related to financial factors, physical property of the material, or location of the tooth to be filled, respectively¹⁵.

Another common misconception among the general population concerns the adverse effects of mercury toxicity associated with amalgam fillings, so the second-to-last question addresses this concern: (1) "Have you heard of mercury toxicity due to amalgam restoration?" Lastly, the final question is (2) "What do you think your preference should be based on?", to find out the patients' most preferred qualities in a dental filling in terms of "Cost", "Appearance", "Life of filling material," and "post-operative pain", with participants allowed to select more than one option¹⁶.

Statistical Analysis

Pearson's Chi-Square Test was performed to examine the association between variables in the questionnaire and gender, age, socioeconomic status, and education among 476 individuals using IBM SPSS (version 25), with $P \leq 0.05$ considered statistically significant.

Results

A total of 476 participants, comprising 232 males (48.7%) and 244 females (51.3%), were included in the study. The age ranged from 18 to 67 years, with a mean age of 32.6 years.

As shown in Table 1, participants' responses to the questionnaire questions show no significant differences across any questions ($p > 0.05$), except for selection and cost of materials ($p < 0.05$). Regarding material selection, there were more responses to amalgam and tooth-colored restoration among females than males, whereas more males than females responded to amalgam, tooth-colored, and other. Regarding the question asking which restoration is cheaper, more females than males responded to amalgam,

According to the responses of participants to the questionnaire, there are no statistically significant differences across age groups for any of the questions ($p > 0.05$).

Table 3 demonstrates significant differences among different socioeconomic statuses in response to these questions: (material knowledge, amalgam for posterior teeth, choice of material, anterior tooth restoration material choice, and toxicity) with a p -value < 0.05

Table 4: The responses of the participants to the questions above show significant differences ($p < 0.05$) in relation to all the categories except their knowledge source, their opinion on the strength of the material, and the toxicity of amalgam restoration ($p > 0.05$), based on their education level.

Discussion

Two primary materials are important in restorative procedures: dental amalgam and composite resin. Both materials are widely used to fill cavities and restore the structural integrity of teeth affected by decay or damage. Despite serving similar purposes, they possess distinct characteristics, applications, and considerations that dentists and patients must understand^{18,19}.

According to the current study, 66% of total participants preferred tooth-colored material over amalgam (14.4%), contrary to other studies^{20,21} which found that amalgam is more popular than composite. Among female participants, 67.6% chose tooth-colored restoration, while 12.2% preferred amalgam; among male participants, 65.9% also chose tooth-colored, while 16.8% preferred amalgam. This finding is similar to that recorded by Mahmood et al.²² Most people preferred tooth-colored restorations, commonly referred to as white fillings, over traditional silver-colored ones.

In contemporary culture, individuals prioritize their appearance, recognizing its significant impact on self-esteem and success. This emphasis on aesthetics extends to oral health, with many seeking cosmetic interventions to enhance their smiles. Seeking beauty through dental professionals has thus become synonymous with improving one's overall appearance and self-confidence²³ More females than males preferred tooth-colored restorations, and fewer females preferred amalgam, because females tend to be more sensitive to aesthetics.

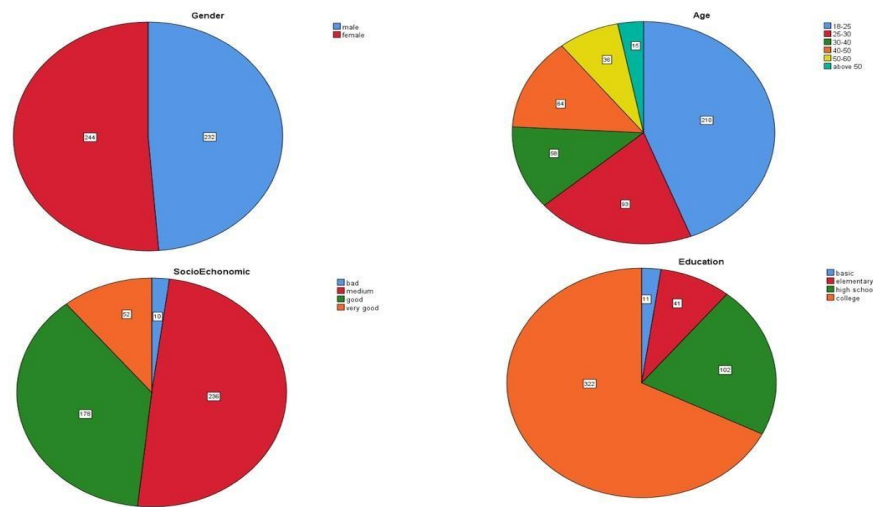


Figure 1: Pie Charts representing the distribution of data according to gender, age, socioeconomic status, and education.

Table 1: Participants' responses to the questionnaires in relation to gender.

		Gender			Chi-square P-value
Questionnaire		Male	Female	Total	
Material	Amalgam	32	25	57	X ² =14.053 P=0.003
	Tooth-colored	109	85	194	
	Other	16	14	30	
	Amalgam & tooth-colored	75	120	195	
Amalgam	Yes	63	71	134	X ² =.253 P=0.881
	No	101	105	206	
	Not sure	68	68	136	
Tooth-colored	Yes	159	182	341	X ² =2.674 P=0.263
	No	23	16	39	
	Not sure	50	46	96	
Choice of material	Amalgam	39	30	69	X ² =3.234 P=0.357
	Tooth-colored	153	165	318	
	Other	13	12	25	
	Both	26	37	63	
Knowledge	Yes	61	71	132	X ² =1.453 P=0.484
	No	145	153	298	
	Not sure	26	20	46	
Choice	Patient	39	43	82	X ² =.055 P=0.814
	Doctor	193	201	394	
Cheaper	Amalgam	94	126	220	X ² =6.372 P=0.041
	Tooth-colored	62	58	120	
	Not sure	76	60	138	
Strength	Amalgam	77	97	174	X ² =2.929 P=0.231
	Tooth-colored	96	84	180	
	Not sure	59	63	122	
Anterior	Amalgam	11	3	14	X ² =5.539 P=0.063
	Tooth-colored	191	213	404	
	Not sure	30	28	58	
Posterior	Amalgam	66	66	132	X ² =1.939 P=0.379
	Tooth-colored	115	111	226	
	Not sure	51	67	118	
Toxicity	Yes	48	56	104	X ² =1.281 P=0.527
	No	153	149	302	
	Not sure	31	39	70	
Total					

Table 2: Participants' responses to the questionnaires in relation to age group.

Questionnaire		Age groups						Total	Chi-square P-value
		18-25	25-30	30-40	40-50	50-60	Above 60		
Material	Amalgam	21	10	5	10	8	3	57	X ² =20.583 P=0.151
	Tooth-colored	79	36	26	25	20	8	194	
	Other	13	7	4	4	0	2	30	
	Amalgam & tooth-colored	97	40	23	25	8	2	195	
Amalgam	Yes	52	29	12	23	12	6	134	X ² =8.957 P=0.536
	No	90	39	27	28	16	6	206	
	Not sure	68	25	19	13	8	3	136	
Tooth-colored	Yes	147	69	47	42	25	11	341	X ² =7.140 P=0.712
	No	20	6	2	7	4	0	39	
	Not sure	43	18	9	15	7	4	96	
Choice of material	Amalgam	25	11	7	13	9	4	69	X ² =12.773 P=0.620
	Tooth-colored	142	66	39	39	23	9	318	
	Other	11	6	2	3	2	1	25	
	Both	32	10	10	8	2	1	63	
Knowledge	Yes	66	29	13	12	8	4	132	X ² =9.627 P=0.474
	No	123	54	41	46	23	11	298	
	Not sure	21	10	4	6	5	0	46	
Choice	Patient	40	15	8	11	5	3	82	
	Doctor	170	78	50	53	31	12	394	
Cheaper	Amalgam	103	41	26	30	15	5	220	X ² =7.369 P=0.690
	Tooth-colored	52	29	14	15	7	3	120	
	Not sure	55	23	18	19	14	7	136	
Strength	Amalgam	85	27	20	25	11	6	174	X ² =3.833
	Tooth-colored	72	41	20	25	17	5	180	
	Not sure	53	25	18	14	8	4	122	
Anterior	Amalgam	5	2	2	2	2	1	14	P=0.955
	Tooth-colored	180	78	47					
	Not sure	25	13	9	6	4	1	58	
Posterior	Amalgam	53	25	11	24	10	9	132	X ² =16.112 P=0.096
	Tooth-colored	101	43	30	27	20	5	226	
	Not sure	56	25	17	13	6	1	118	
Toxicity	Yes	54	21	9	9	9	2	104	X ² =12.612 P=0.246
	No	126	57	43	47	21	8	302	
	Not sure	30	15	6	8	6	5	70	
	Total	210	93	58	64	36	15	476	

Table 3: Participants' responses to the questionnaires in relation to socioeconomic status.

Questionnaire		Bad	Medium	Good	Very good	Total	Chi-square P-value
Material	Amalgam	5	34	14	4	57	$X^2=28.318$ $P=0.001$
	Tooth-colored	2	85	89	18	194	
	Other	0	19	7	4	30	
	Amalgam & tooth-colored	3	98	68	26	195	
Amalgam	Yes	7	69	44	14	134	$X^2=13.039$ $P=0.042$
	No	2	98	87	19	206	
	Not sure	1	69	47	19	136	
Tooth-colored	Yes	8	163	130	40	341	$X^2=8.463$ $P=0.206$
	No	2	24	9	4	39	
	Not sure	0	49	39	8	96	
Choice of material	Amalgam	5	44	19	1	69	$X^2=33.716$ $P=0.000$
	Tooth-colored	2	143	132	41	318	
	Other	0	11	9	5	25	
	Both	3	37	18	5	63	
Knowledge	Yes	3	56	56	17	132	$X^2=6.812$ $P=0.339$
	No	6	161	103	28	298	
	Not sure	1	19	19	7	46	
Choice	Patient	2	45	29	6	82	$X^2=1.904$ $P=0.593$
	Doctor	8	191	149	46	394	
Cheaper	Amalgam	5	108	80	27	220	$X^2=2.698$ $P=0.846$
	Tooth-colored	2	59	44	15	120	
	Not sure	3	69	54	10	136	
Strength	Amalgam	4	97	56	17	174	$X^2=8.906$ $P=0.179$
	Tooth-colored	2	79	80	19	180	
	Not sure	4	60	42	16	122	
Anterior	Amalgam	2	7	3	2	14	$X^2=16.273$ $P=0.012$
	Tooth-colored	5	205	151	33	404	
	Not sure	3	24	24	7	58	
Posterior	Amalgam	3	74	44	11	132	$X^2=10.585$ $P=0.102$
	Tooth-colored	2	103	96	25	226	
	Not sure	5	59	38	16	118	
Toxicity	Yes	1	43	51	9	104	$X^2=13.309$ $P=0.038$
	No	5	156	104	37	302	
	Not sure	4	37	23	6	70	
Total							

Table 4: Participants' responses to the questionnaires in relation to education.

Questionnaire		Education					Chi-square P-value
		Basic	Elementary	High school	College	Total	
Material	Amalgam	5	8	19	25	57	X ² =26.645 P=0.002
	Tooth-colored	1	15	42	136	194	
	Other	1	3	7	19	30	
	Amalgam & tooth-colored	4	15	34	142	195	
Amalgam	Yes	7	17	36	74	134	X ² =20.273 P=0.002
	No	2	11	37	156	206	
	Not sure	2	13	29	92	136	
Tooth-colored	Yes	8	23	69	241	341	X ² =18.825 P=0.004
	No	2	9	5	23	39	
	Not sure	1	9	28	58	96	
Choice of material	Amalgam	4	11	23	31	69	X ² =32.156 P=0.000
	Tooth-colored	4	18	62	234	318	
	Other	0	5	6	14	25	
	Both	3	7	11	42	63	
Knowledge	Yes	2	8	18	104	132	X ² =10.809 P=0.094
	No	8	29	74	187	298	
	Not sure	1	4	10	31	46	
Choice	Patient	4	4	9	65	82	X ² =11.459 P=0.009
	Doctor	7	37	93	257	394	
Cheaper	Amalgam	4	22	31	163	220	X ² =15.414 P=0.017
	Tooth-colored	4	9	30	77	120	
	Not sure	3	10	41	82	136	
Strength	Amalgam	4	16	40	114	174	X ² =8.205 P=0.223
	Tooth-colored	1	18	36	125	180	
	Not sure	6	7	26	83	122	
Anterior	Amalgam	3	1	3	7	14	X ² =23.552 P=0.001
	Tooth-colored	7	35	86	276	404	
	Not sure	1	5	13	39	58	
Posterior	Amalgam	6	17	32	77	132	X ² =15.22 P=0.019
	Tooth-colored	2	15	40	169	226	
	Not sure	3	9	30	76	118	
Toxicity	Yes	1	5	15	83	104	X ² =11.635 P=0.071
	No	8	26	72	196	302	
	Not sure	2	10	15	43	70	
Total							

The present study also shows that among the participants aged between 18 and 25 years, 67.6% preferred tooth-colored restorations over amalgam restoration, while only 11.9% chose amalgam as their preferred material. Among the other age groups, the 25-30 group also preferred tooth-colored restorations (70.9%), while only 11.8% chose amalgam. Among the age group 50-60 years tooth-colored restorations were still the majority choice, but a significant portion chose amalgam restoration (25%), which is a significant increase compared to the previous age group. Moreover, there was an even higher percentage among participants aged above 60 (26.6%), as was also recorded by another study²⁴.

As is obvious from the aforementioned results, the older the age of participants, the higher the percentage preferring amalgam restoration, (this could be linked to tradition and culture and even more to older patients' familiarity with amalgam and their good impressions of it). However, the present study had a lot more participants in the 18-25 age group, which will have skewed the results¹¹.

Another factor that influenced the choice of material was the participants' education level. It can be seen from the results that 22% of high school students chose amalgam as their preferred material, while only 0.96% of participants with college-level education chose amalgam. It is obvious that college students will have more knowledge and information about amalgam, and maybe its toxicity, which would explain why such a small percentage chose it as their preferred material.

The results of this study show that only 21.8% of participants had knowledge of the toxicity of amalgam, while 63.4% of participants had no knowledge of its toxicity and 14.7% of participants were not sure whether they had knowledge about it or not, and these findings are similar to those recorded in some studies^{11,20,25,26}, while they are significantly different from other studies^{25,27,28} which reported a much higher percentage of patients knowing the harmful effects of amalgam. The concern about amalgam restoration arises from the fact that this material contains about 50% mercury by weight¹⁹ and during chewing, dental amalgam restorations can emit elemental mercury vapor in amounts that are lower than half of what is typically encountered in natural daily exposure¹⁹. This result reflects the lack of dental education among the people in Sulaymaniyah city regarding their knowledge about the materials used for tooth restoration, whereas the dental profession is one of the largest end-users of mercury²⁹. The Kurdistan Dental Association should take a leading role in awareness raising and promoting clinical and epidemiological research, to support the cause of getting economical alternatives to amalgam imported into the

country. Amalgam is a material of choice due to its low cost, and dental professionals need to be trained to adopt the best practices for amalgam waste management in the dental setting²⁷ and to find alternatives to amalgam containing mercury³⁰.

Since the current study showed no statistically significant difference by gender, the choice of restoration material is more likely related to the population's age and education level. Regarding the toxicity of amalgam, among the participants aged between 18 and 25 years, 25.7% knew about the toxicity of amalgam, while among participants aged 25-30, 30-40, and 40-50, only 22.5%, 15.5%, and 14.0%, respectively, knew about this hazard. These findings can be explained by the fact that younger generations in the city are more educated than the older ones because of having a better education environment and more education resources than were available for the older generations.

As for the education level, we can see from the results that 25.7% of participants with a college-level education knew of the toxicity, while only 14.7% of participants with a high school education and 12.1% of participants with elementary school level education knew of it, and these findings coincide with what was recorded by other studies^{24,31}. This further shows that having a good, higher-level education makes people more aware of this information, as is reinforced by the age results. However, the educational results are more skewed towards college-level education, with 67.6% of all participants having this level, which might have affected the current results.

Among the limitations of the current study is the need for inclusion of a larger population. Moreover, all age groups should be included.

Conclusion

Within the constraints of this cross-sectional study, the results indicate a clear preference for tooth-colored restorative materials over dental amalgam among participants, with aesthetics as the primary influencing factor. While some individuals still appreciate amalgam for its durability and affordability, current trends reflect a shift toward appearance-based choices. Differences in material preference were also associated with age and educational background, especially among those with dental training, underscoring the impact of knowledge on attitudes.

Awareness regarding potential mercury-related concerns was relatively limited, emphasizing the need

for improved patient education and communication. Overall, the results support the importance of integrating patient preferences with clinical evidence to ensure informed, patient-centered decision-making in restorative dentistry.

Declarations

Ethics Approval and Informed Consent (Institutional Review Board) Statement: This study was conducted in accordance with the principles of the Declaration of Helsinki. Ethical approval was obtained from the Ethics Committee of the College of Dentistry, University of Sulaimani, with approval number [211\23] dated [05\11\2023]. Written informed consent was obtained from all participants prior to inclusion in the study.

Author Contributions: KMS: Study design, and results. KOA: Discussion section, patient recruitment, and questionnaire development. DSA: Conceptualization, and drafting the initial manuscript. RPK: Literature review and supervision. HMS: Data entry and the result section. SMA: Writing conclusion section and supervision.

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Appendix A

Questionnaire¹⁷

1) Which restoration material do you know?

- a. Amalgam
- b. Tooth-colored restoration
- c. Any other

2) Do you think amalgam can be used to restore the carious tooth?

- a. Yes
- b. No
- c. Not sure

3) Do you think tooth-colored material can be used to restore the carious tooth?

- a. Yes
- b. No
- c. Not sure

4) Which material would you prefer for tooth filling?

- a. Amalgam
- b. Tooth-colored restoration
- c. Any other

5) Have you gained any knowledge regarding the restorative materials for tooth filling from the internet?

- a. Yes
- b. No
- c. Not sure

6) To whom will you give the choice of selection of restorative material for tooth filling?

- a. Choose by yourself
- b. According to the doctor

7) According to you, which material is cheaper?

- a. Amalgam
- b. Tooth-colored restoration
- c. Not sure

8) According to you, which material has more strength?

- a. Amalgam
- b. Tooth-colored restoration
- c. Not sure

9) According to you, which material will you choose for restoring anterior teeth?

- a. Amalgam
- b. Tooth-colored restoration
- c. Not sure

10) According to you, which material will you choose for restoring posterior teeth?

- a. Amalgam
- b. Tooth-colored restoration
- c. Not sure

11) Have you ever heard about mercury toxicity due to amalgam restoration?

- a. Yes
- b. No
- c. Not sure

12) What do you think your preference should be based on?

- a. Cost
- b. Appearance
- c. Life of filling material
- d. Post-operative pain