

## AMALGAM SAFETY AND ALTERNATIVE RESTORATIVE MATERIALS: A CROSS SECTIONAL SURVEY AMONG DENTISTS†

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أثارت الحملة الاعلامية الأخيرة في شتى أنحاء العالم مخاوف الكثير من الناس حول سلامة الحشوات السنية الزئبقية الاملغم فقد تعدى هذا الجدل نطاق العاملين في مجال طب الأسنان لتطرح القضية على مستوى الرأي العام أيضاً. الهدف من هذه الدراسة الاستقصائية هو معرفة آراء أطباء الأسنان حول سلامة الأملغم ومدى تقبلهم للحشوات البديلة المقترحة، وموقفهم من المرضى الراغبين في نزع الحشوة لتشككهم في سلامتها. في خريف عام ١٩٤٤م وزع الإستبيان لعينة عشوائية من أطباء الأسنان العاملين في كل من القطاع الخاص والعام بمدينة الرياض وبلغ عدد المشاركين في البحث (١٧٠) طبيب وطبيبة أسنان. اتضح من الدراسة بأن الغالبية من المشاركين في البحث لديهم القناعة بعدم وجود تأثير جانبي من الأملغم على صحة المريض. ولكن الضرر قد يقع على أطباء الأسنان والمساعدين إذا لم تتخذ الوقاية اللازمة إضافة إلى ذلك فقد اختيرت الحشوات الراتنجية والأيونومر الزجاجي بنسبة أكبر من الذهب المصبوب والخزف السني ومع ذلك لم يكن هناك اجماع من قبل المشاركين في البحث على مادة حشوي بديلة ومثالية واتضح أيضاً بأن موقف الغالبية من أطباء الأسنان تجاه المرضى الراغبين في نزع حشوات الاملغم يعد مطمئناً ومتماشياً مع المبادئ الأخلاقية للمهنة. من الفوائد الأساسية لهذه الدراسة هو لفت انتباه العاملين في مهنة طب الأسنان نحو الخلفية العلمية الصحيحة تجاه قضية الأملغم لتكون مشاركتهم وتعاملهم مع الرأي العام ومع المرضى المتشككين في سلامة الأملغم أكثر دقة وإيجابية.

Worldwide publicity of the amalgam controversy has intensified the growing concerns on its utilization and safety. This controversy has grown beyond the confines of the dental profession itself and has become an emotional public health issue. The aim of this study was to solicit information regarding dentists' perception on amalgam safety - their general attitudes on its removal and acceptability of the available alternative materials. A questionnaire was distributed to a random sample of 170 public and private dentists in the city of Riyadh, Saudi Arabia. The study showed that a majority of the respondents do not believe that amalgam poses risks to the patient's health. However, it was felt that occupational hazards from amalgam may exist when it is not properly handled. While composite and glass ionomer restoratives were selected more frequently as an alternative to amalgam, the ideal material was not clearly defined by the respondents. The attitude of most dentists towards amalgam removal upon patient's request, was admirable and consistent with professional and ethical principles. This study serves the dental professionals in assuming a positive and more protective role in the amalgam controversy and in reducing patients' concern.

### Introduction

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During its one-hundred-fifty years history and since the first amalgam war of the 1800's, intermittent controversy has surrounded dentistry's prime restorative material.<sup>12</sup> Contention on the toxicity of amalgam stems from the fact that the restoration is composed of approximately 50% mercury.<sup>3</sup>

In 1988, the National Board of Health and Welfare in Sweden advised dentists not to use amalgam for pregnant women.<sup>4</sup> Further, the amalgam controversy prompted authorities in some countries to formulate strategies and proposals on its phase out and future restrictions on its utilization.<sup>5</sup>

Worldwide publicity of such controversy has given rise to the current concerns regarding the safety of dental amalgam. Discussion has grown beyond the confines of the dental profession itself and has become an emotional public health issue.<sup>6</sup> One particular study revealed that dentists themselves were influenced by such debate in the mass media.<sup>7</sup>

Currently, the more frequent scenario is that more patients are requesting replacement of their amalgam restorations. Such scenario has caused ethical dilemmas related to patients' rights relative to proper health care.<sup>8</sup>

Utilization of amalgam is expected to diminish as a result of public pressure and concerns over the potential risk of amalgam. It may also be due to government's concern over its environmental hazards and the successive emphasis on the use of alternative restorative materials advocated by anti-amalgamist and dental manufacturers.<sup>5</sup> Preventive dentistry has dramatically dropped the use of dental amalgam.<sup>9</sup>

Lately, the local media in Saudi Arabia has focused the public attention to the amalgam controversy. According to Meskin,<sup>10</sup> the amalgam debate has caused various dental professionals to react defensively which can only lead to dwindle public confidence in the profession. What position do practicing dentists in Saudi Arabia take with regard to the amalgam issue? How do they respond to patients' concerns? In 1994, a cross-sectional survey of dentists, working in both public and private sectors in Riyadh, was conducted to determine their opinions and attitudes on the safety of amalgam.

The purpose of this study was to obtain information on dentists' perception concerning amalgam safety, their general attitudes towards amalgam removal, and their acceptance of the available alternative restorative materials. Overall, the goal was to call the attention of dental professionals to assume a positive and more protective role in the amalgam controversy and of the concerned patients.

## Materials and Methods

A questionnaire, written in both English and Arabic, was prepared and pretested. Questionnaires were distributed and then collected personally by the research members to ensure having a 100% useable response rate within the scheduled time-frame period.

A total sample of 170 dentists participated in this study and were randomly selected from the official register of authorized dentists working in both the public and private dental health care sectors of the City of Riyadh. Among the total sample, 103 dentists work in the private sector and 67 were in the public sector. The sample size was designed in such a way that 15% of the total number of dentists in each of the two sectors was included in the study. Distribution of dentists in the public sector was as follows: 27 from the Ministry of Health, 10 from the Dental College at King Saud University, 11 from the Military Hospital, 8 from the Security Forces Hospital, 7 from the National Guard Hospital, and 4 from King Faisal Specialists Hospital.

Final data was gathered from the 170 dentists where both open ended and structured questions were used. The main questions that formed the basis of this report were 58 and concerned respondents: (1) assessment of their awareness, personal beliefs and background knowledge of amalgam toxicity; (2) their attitudes and ethical behavior towards amalgam removal upon the request of the patients; and (3) their opinions on the available amalgam alternative materials.

Chi-square test was used for the statistical analyses of data in comparing the differences in distribution among the groups. The significance level was set at 5%.

## Results

A broad demographic characterization of the respondents working in public and private sectors is shown in Table 1.

Virtually, all respondents (98%) were aware of the controversy concerning amalgam safety, of which 50% became aware of it since 1990 and 1991; 27% was within the last three years; and the remaining 23% was aware of the controversy before 1990. The sources of knowledge about amalgam safety, as cited by respondents, are illustrated in Table 2.

Table 1. Demographic Characteristic of Respondents.

Characteristic	RESPONDENTS*	
	Public n = 67 (39%)	Private n = 103 (61%)
Males	51%	52%
Experience > 10 years	36%	52%
Saudi nationals	72%	4%
General practitioners	60%	60%
Specialists	31%	36%
Consultants	9%	4%

n = 17

Table 2. Percentage of respondents knowledge about amalgam safety issue per source of information.

Sources	Percentage*
Journals	57%
Patients inquiries	47%
During undergraduate education	45%
Dental conferences	43%
Newspapers or magazines	40%
Television and radio	22%
Colleagues	20%
Saudi Dental Society lectures	9%

\* The sum of the total exceeded 100% because some respondents indicated more than one choice.

*Safety of Amalgam for the Patients*

The majority of respondents (85%) believed that amalgam is safe and poses no harm to patients. About 8% of the respondents expressed their uncertainty regarding the safety of amalgam. Significantly, a greater proportion of private dentists (10%) than public dentists (6%) ( $p < 0.05$ ) was of this opinion. Those who believed it to be unsafe were 7%. In the latter group, a greater proportion was public dentists (11 %) and a lesser proportion of the private dentists (4%). The difference was statistically insignificant, however. In addition, the percentage among general practitioners was high (8%) relative to that among specialists (5%) and the difference was also significant ( $p < 0.05$ ).

*Safety of Amalgam for Dentists*

While majority of dentists (85%) believed that amalgam is safe for patients, 88% of the respondents indicated that it is hazardous to the dentist if not properly handled. In contrast, 12% indicated

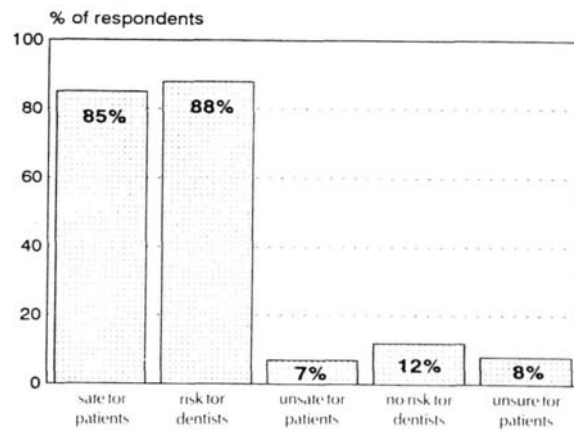


Figure 1. Dentists' opinions on the safety of amalgam for both dentists and patients.

that amalgam is completely safe and presents no harm for the dentists. A greater proportion of private dentists (15%) than public dentists (9%) was of this opinion and the difference was significant ( $p < 0.05$ ). Opinions of the respondents regarding safety of the amalgam are illustrated in Figure 1.

*Signs and Symptoms of Amalgam Toxicity*

Respondents were asked about the signs and symptoms of mercury poisoning, whereby 41% indicated all signs and symptoms, i.e. fatigue, headache, CNS disturbances, and psychological disorders. A greater proportion of private dentists (43%) than public dentists (40%  $p < 0.05$ ) answered correctly. Approximately, 25% of the respondents indicated some of the signs and symptoms while 20% indicated only one sign and symptom; the remaining 15% indicated no knowledge.

*Mercury Route of Absorption*

The respondents were asked about mercury's highest risk absorption path to the bloodstream of the dentists. A majority of the respondents (62%) knew that mercury vapor is more toxic than any form and is absorbed more easily into the bloodstream by way of the lungs; 17% indicated the skin; 13% indicated the mouth; and the remaining 8% stated lack of this information. A significantly greater proportion of public dentists (73 percent) than private dentists (54 percent) ( $p < 0.05$ ) answered correctly.

### Phasing Out Amalgam Use

Participants were also requested to give their opinion regarding banning of amalgam use in Saudi Arabia and other countries. Among the respondents, 83% opposed the ban while 17% encouraged the ban. A greater proportion of public dentists (22%) than private dentists (15%) were of the latter opinion, yet their opinions were statistically similar.

### Attitude Toward Amalgam Removal

We wanted to know how the participants would respond to a patient concerned with the possible risk of amalgam and requested that his or her amalgam be removed. Majority of the respondents (63%) said they would explain to the patient their beliefs before amalgam removal; 21% said they will remove it upon the patient's request; 14% said they will not comply with the patient's request and refuse the request. Whereas, 6% of the respondents said they will encourage the patient and replace the filling with an alternative of choice. As expected only 1.2% of them said they will refer the patient to another dentist if he or she insisted on amalgam removal. Attitudes of the respondents are summarized in Figure 2.

Dentist attitudes toward amalgam removal upon the request of the patient was not influenced by their sex, specialty or years of experience but rather by service sector i.e. private or public. Whereas 21% of all the respondents indicated that they will remove the amalgam filling upon the patient's

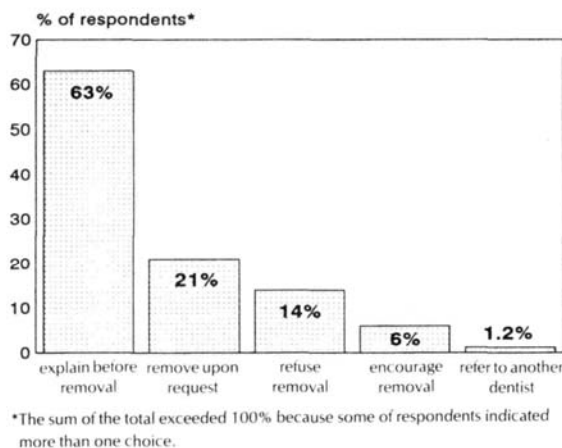


Figure 2. Dentists attitude toward amalgam removal initiated by patients.

request, a greater proportion of private dentists (27%) than public dentists (12%,  $p < 0.05$ ) were of this opinion. Out of the 6% of the respondents indicated that they will encourage the patient's desire to remove their amalgam fillings, a greater proportion were private dentists (8%) than public dentists (3%). No statistically significant difference was present, however.

### Candidate Alternative Materials

The participants were asked if they would prefer to use a restorative material other than amalgam because of their doubts about its safety and/or because of the potential occupational risks associated with amalgam in the workplace. Among the respondents, 71% answered negatively while 29% answered affirmatively. It is worthwhile to mention that out of the 29% who answered "yes", 11% commented with "when a better alternative is available". Figure 3 represents the frequency of alternative filling materials selected by the participants.

Dentist's selections of alternative restorative materials were not found to be influenced by sex, or degree of education but rather by years of experience and service sector. It was found that a greater proportion of public dentists preferred cast gold (28%) and porcelain (22%) more frequently than private dentist (25% and 9%,  $p < 0.05$ , respectively). The percentage of private dentists who have selected composite and glass ionomer, 56% and 39% respectively, was significantly

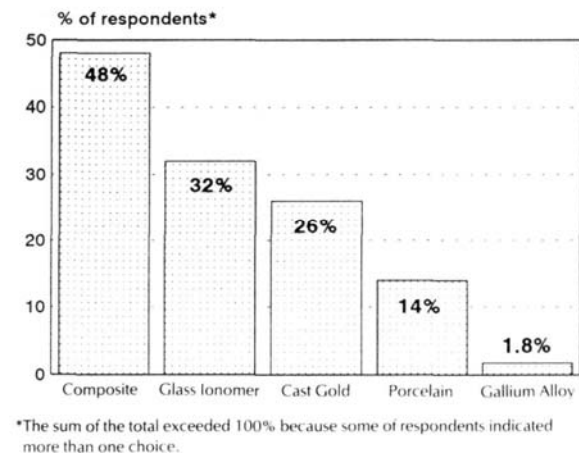


Figure 3. Selected amalgam alternatives.

higher than that among public dentists (35% and 22%,  $p < 0.05$ , respectively). Furthermore, dentists with more than 10 years of experience (33%) preferred cast gold more frequently than dentists with less than 10 years of experience (16%  $p < 0.05$ ).

### Discussion

There has been a substantial increase in magnitude and precision of information on mercury release from amalgam. Rates of mercury release from amalgam fall to very low levels ( $5 \mu\text{g}/\text{m}^3$ ) that are well within the acceptable threshold limit values (TLV of  $50 \mu\text{g}/\text{L}$ ). In fact, mercury release rates are much less than the environmental contribution from breathing, drinking water and eating food.<sup>11</sup> Population studies have not shown any association between amalgam fillings and symptoms of diseases.<sup>12,13</sup>

In September 1990, the CBS-TV channel in the USA aired a program known as "Sixty Minutes". The topic was an expose on the safety of amalgam fillings. Dentists and patients interviewed claimed overnight cure from chronic illnesses after amalgam removal. The program attracted millions of viewers in the United States and the press coverage of that program ensured that the rest of the world received a similar message.

In this study, about three quarters of the respondents were aware of the controversy concerning amalgam safety after the year 1990. This is an indication that the mass media has a strong impact on the dental profession.

Most dentists in our sample do not believe that there is much risk of mercury toxicity for patients from dental amalgam. However, a small proportion (7%) of dentists believed that the risk is high while 8% of them were unsure about the safety. According to Schuman and Presser,<sup>14</sup> minority opinions can have a great impact on the practise of dentistry. If dentist who believed there are high risks from mercury in dental amalgam are vocal about their strongly held opinions, they may perpetuate public fear. Furthermore, dentists who think risks are high usually inflate their estimates of the proportion of worried patients and replaced dental amalgam fillings. In fact it was previously found that, 83% of the dentists who believed that dental amalgam was a high risk material had replaced amalgams, a position considered negative by experts.<sup>15</sup>

The results indicated that 47% of the respondents faced patients who expressed worry about the possible adverse effects of their amalgam fillings. Though this percentage was lower than what has been reported in other countries,<sup>16</sup> it is still considered a popular concern. Since most dentists believed that amalgam is safe to the patient's health, discrepancies may exist between dentists and patients beliefs posing a challenge to the practicing dentist who must communicate with patients about the risk. Slovic in 1986<sup>17</sup> found communicating information about risks to patients is difficult. Patient concerns, although probably initiated by media reports, may be maintained by hard-to-change psychological processes. To help dentists communicate with their patients to reduce their concern, educational brochures on amalgam safety were suggested to be made available to the patients through dental associations and societies.<sup>18</sup>

As the results show, 29% of the respondents wanted to see filling material other than amalgam in the future. This trend is in agreement with recent studies<sup>69</sup> showing that amalgam use is on a progressive decline during the years to come. The decline is mainly because new restorative materials and new caries treatment methods with tooth saving cavity designs have been introduced. In addition to that, some dentists prefer not to take any chances of exposing themselves to the possible potential risks of amalgam hazards at the workplace. However, the great majority of the respondents (71%) in this study were not ready to stop using amalgam in a few years time.

The results of this study revealed that, the most commonly suggested amalgam alternative restorative material was composite resin. A slightly greater proportion of private dentists than public dentists selected composites and glass ionomer. Whereas, more dentists in public service than private practice selected porcelain and cast gold. The possible reason for the lower frequency of nominating porcelain and cast gold restoration by the private practitioners might be the higher cost and longer time needed to fabricate and place such proven restorations. Further, choosing cast gold restorations were more influenced by the years of experience. This preference was attributed to the fact that respondents with more than ten years of experience may had more exposure and training in fab-

ricating cast gold inlays and onlays during their undergraduate education than the more recently graduated dentists.

Despite the fact that the initial laboratory studies of the mercury-free alloys, such as gallium alloy, are rather deficient. The alloy was intentionally listed on this study's questionnaire among the preferred alternatives for amalgam to see if the participants recognize and consider such newly developed alloy. Unexpectedly, only three respondents selected gallium alloy as an alternative since the mercury free-alloy has just been recently introduced. Apparently, most dentists did not consider gallium alloy as an amalgam alternative.

According to Christensen<sup>19</sup> there are several alternatives to amalgam. Apparently, none of them are economically available at the present as compared to amalgam. Mjor<sup>20</sup> conducted cost estimates for amalgam, composites and cast gold with estimates of material longevity and relative costs of placement. The performance cost of amalgam was calculated with composite and cast gold restorations. It was found that composites cost 2 to 2.5 times as much as amalgam and cast gold at least 5 times as much. Participants attitude towards amalgam removal, upon the request of the patient, from the ethical point of view is considered sound. However, a greater proportion of private dentists than public dentists were favoring amalgam's removal. Such finding is in agreement with the previous studies showing that private practitioners seemed to be more market-oriented and pay more attention to patients' wishes than the public practitioners.

What ethical principles provide guidance as the dental profession formulates responses to the questions patients are raising about amalgam removal? Based on the scientific evidence available, there is no justification for a dental practitioner to initiate or encourage amalgam removal. This is true even if the dentist genuinely believe that amalgam is hazardous.<sup>21</sup> According to the ADA, a dentist initiating amalgam removal from the nonallergic patient is acting unethically. Further, a dentist who initiates removal for personal benefit deserves condemnation for profiteering and disregard for the duty to benefit the patient.<sup>22</sup>

Two fundamental ethical principles, nonmaleficence and autonomy,<sup>23</sup> offer guidance for such situations. Nonmaleficence requires the health

care provider to follow the concept "first do not harm." This concept requires an explanation and discussion with the patient about the scientific evidences regarding amalgam safety and the potential risks from amalgam removal such as damaging the integrity of the tooth structure beside the unnecessary exposure to a high degree of concentrated mercury vapor release during removal. Given that the patient has a complete understanding, the dentist can ethically choose either to remove or refuse to remove the amalgam.

The autonomous concept is based on the respect for persons and recognizes the patients right to make decisions regarding his or her own health care. Applying the principle of autonomy means that the practitioner must allow patients to participate in an informed consent process before amalgam removal.

In summary, dentists' opinions regarding the safety of amalgam were relatively similar in both sectors. Nevertheless, minor differences were present. A slightly greater proportion of public dentists than those in the private indicated incorrect information regarding the safety of amalgam towards patient's health as well as the signs and symptoms of mercury intoxication. In contrast, a slightly greater proportion of private dentists indicated incorrect information regarding the safety of amalgam towards dentists' health and the high risk path of mercury absorption to dental personnel than public dentists.

### Conclusions

1. A majority of the respondents were aware of the controversy in regards to amalgam safety. About three quarter of them were aware of it since 1990 when amalgam was discussed by the mass media.
2. Most of the respondents do not believe that amalgam is hazardous to patient's health but asserted on its risk towards dental personnel. This concept is in agreement with the scientific evidence and authorities opinion.
3. Opinions of dentists, both in the public and private sectors, concerning amalgam safety were relatively similar although minor differences existed between them. Public dentists were more knowledgeable about the risk and safety of amalgam towards dentist health. On

the contrary, private dentists were more concerned on the risk of amalgam to patients' health.

4. Most of the dental populace were hesitant to refrain from using amalgam in a few years time. As an alternative, composite resins and glass ionomers were selected more frequently than cast gold and porcelain. Only few respondents recognized gallium alloy as an ideal alternative material in lieu of amalgam although it was not clearly defined.
5. Respondents attitude towards the contention on the use of amalgam were based on scientific evidence and consistent with the professional ethical principles. Only a small minority of private dentists seemed to be more market-oriented and pay more attention to patients wishes than the public service dentists.

### References

1. Langan DC, Fan PL, Hoos AA. The use of mercury in dentistry: a critical review of the current literature. *J Am Dent Assoc* 1987; 115(6):867-80.
2. Mackert JR. Dental amalgam and mercury. *J Am Dent Assoc* 1991;122:54-61.
3. Brown L). Dental amalgam. Designs for research in human population. ) *Am Dent Assoc* 1991 ;122:73-77.
4. The National Board of Health and Welfare Social Styrelsen Redovisar. Kuicksilver/amalgam, hlsorisker: Nr lo, Stockholm, 1987 (English summary).
5. Widstrm E, Forss H. Selection of restorative materials in dental treatment of children and adults in public and private dental care in Finland. *Swed Dent J* 1994;18:1-7.
6. Reinhardt JW. Risk assessment of mercury exposure from dental amalgams. *J Public Health Dent* 1988;48(3):172-77.
7. Widstrm E, Haugejorden O, Sundberg H, Birn H. Nordic dentists' opinions on the safety of amalgam and other dental restorative materials. *Scand J Dent Res* 1993; 101:238-42.
8. Chiodo GT, Tolle SW. Can a patient make an irrational choice? The dental amalgam controversy. *Gen Dent* 1992;40:186-87.
9. Nash KD, Bentley JE. Is restorative dentistry on its way out? *J Am Dent Assoc* 1991 ;122(9):79-80.
10. Meskin LH. A perception of risk. ) *Am Dent Assoc* 1991 ;122:10.
11. Ferracane JL. Amalgam-derived mercury. *Gen Dent* 1992;40(3):223-29.
12. Ahlqwist M, Bengtsson C, Furunes B, Hollender L, Lapidus L. Number of amalgam tooth fillings in relation to subjectively experienced symptoms in a study of Swedish women. *Community Dent Oral Epidemiol* 1988;16(4):277-31.
13. Lavstedt S, Sundberg S. Medical diagnosis and disease as related to amalgam restorations. *Tandlakartidningen* 1989;81(3):81-8.
14. Schuman H, Presser S. Questions and answers in attitude surveys. San Diego: Academic Press;1981:231-50.
15. Gerbert B, Bernzweig J, Bleecker T, Bader J, Miyasaki C. Risks of the "big three". What dentists and patients believe about dental amalgam, fluoride and HIV.) *Am Dent Assoc* 1992;123(3):82-88.
16. Widstrom E, Birn H, Haugejorden O, Sundberg H. Fear of amalgam: dentists' experiences in the Nordic countries. *IntDent*] 1992;42:65-70.
17. Slovic P. Informing and educating the public about risk. *Risk Anal* 1986;6:403-15.
18. American Dental Association Division of Communications. Facts about dental amalgam. Patient education brochures. Chicago: American Dental Association^ 991.
19. Christensen GJ. Are there alternatives to dental amalgam? *J Am Dent Assoc* 1991; 122(3):77.
20. Mjor IA. Longterm cost of restorative therapy using different materials. *Scand J Dent Res* 1992;100(1 ):60-5.
21. Odom JG. Ethics and dental amalgam removal.) *Am Dent Assoc* 1991;122:69-71.
22. ADA Special report. Ethical consideration on removal of dental amalgam. American Dental Association Division of Legal Affairs, December 1990.
23. Odom JG, Morris WO. The autonomy of the practioner. *J DentPractAdm* 1989; 6(1):12-5.