International Journal of Infection Control
www.ijic.info ISSN 1996-9783

ORIGINAL ARTICLE

Dental students' knowledge and practices regarding disinfection and sterilisation of extracted human teeth

Ola Moustafa Omar[1,2], Nadia Mostafa Farrag[1,3]
1.College of Dentistry, Taibah University, Saudia Arabia
2.Faculty of Oral and Dental Medicine, Cairo University, Egypt
3.Faculty of Dentistry, Mansoura University, Egypt

doi: 10.3396/IJIC.v12i2.011.16

Abstract

Extracted human teeth are used by dental students in preclinical courses to practice on them different dental procedures, however they can be a source of infection. According to Center for Disease Control, extracted teeth should be disinfected or sterilised before use. The current study aimed to assess knowledge and practices regarding disinfection and sterilisation of extracted human teeth in a group of dental students.

This descriptive cross-sectional study was carried out on third, fourth and fifth- year dental students at College of Dentistry, Taibah University, Saudi Arabia. A self-administered questionnaire was prepared based on previous studies that test the knowledge and practice of students regarding disinfection and sterilisation of extracted human teeth.

Results of this study showed that most of the students in all grades agreed that it is necessary to disinfect and/or sterilise extracted teeth before working on them. They reported also that it is mandatory to use specific precautions while working on these teeth since they can be a source of infection and there is a chance of disease transmission through them. The year of education affected the response. Most (92.5%) of the fourth grade students agreed that there is a necessity to disinfect and/or sterilise extracted teeth before working on them. In comparison third grade students recorded the lowest level (70.4%). This difference was found to be statistically significant. Hydrogen peroxide, sodium hypochlorite and autoclaving got the highest scores for teeth sterilisation and/or disinfection among the three different grades with insignificant statistical difference. Regarding the practices of students, no statistical significant difference was found between the three grades regarding the sterilisation methods for extracted teeth and their use of protective barriers during handling. Most of the students reported that their source of knowledge was taught in dental courses or from instructions

Corresponding author
Ola Moustafa Omar,
Faculty of Oral and Dental Medicine, Cairo University, Egypt
Email: omaromo@yahoo.com

from dental staff members with no statistical significant differences between the grades or gender. The results of the present study concluded that knowledge and practices of dental students at Taibah University in relation to disinfection/sterilisation methods of extracted human teeth was satisfactory.

Key words: dental extraction, dental students, sterilisation, teeth.

Introduction

Use of extracted human teeth in preclinical years in dental colleges is a routine practice to train students about various clinical procedures before they apply them on patients.[1,2] Many of the dental procedures are best learnt on extracted human teeth, as they best simulate clinical situations. However this practice might expose dental students to the risk of cross infection from pathogens harboured with the extracted human teeth, if they do not follow appropriate infection control measures.

The Center for Disease Control and Prevention (CDC) has adopted guidelines for infection control before use of extracted teeth in research and/or teaching. They consider extracted teeth as a potential source of blood-borne pathogens. Prior to handling they should be thoroughly cleaned of visible blood and debris and stored hydrated. Sterilisation of extracted teeth before use is mandated to minimize the risk of transmission of blood borne pathogens.[3,4,5] Infection control concerns regarding the handling of teeth for research purposes have prompted investigators to evaluate the effects of disinfection/sterilisation on extracted teeth.[6]

Difficulties exist in the use of extracted human teeth because they are grossly contaminated, difficult to sterilise because of their structure, and may be damaged or altered by the sterilisation procedures.[7] Several chemical agents have been tried for disinfection/sterilisation of extracted teeth and proved to be successful with different levels.[2] Chemical heat, microwave radiation and autoclave sterilisation methods have been shown to prevent cross-contamination during in vitro dentin bonding research.[7,8,9]

Immersion of teeth in 10% Formalin for 7 days may be the most effective disinfectant used in disinfection of extracted teeth, however it possess potential carcinogenicity and is considered a hazardous material.[10,11] Alternative disinfectants that proved to be effective in a laboratory model were 5% Virkon and Gigasept PA. Gigasept PA was the only disinfectant that sterilised 100% of tooth samples. However this product, though effective, is a high level hospital disinfectant that is used on medical instruments.[11]

For students to disinfect extracted teeth in educational settings, a solution that can be used to immerse the samples for disinfection would be more practical. Although several studies on the effectiveness of disinfectants are available,[2,6-10] assessment of the knowledge and practice on handling of extracted teeth among dental students is rare.[1,12,13]

Materials and Methods

This descriptive cross-sectional study was carried out on third, fourth and fifth- year dental students at the College of Dentistry, Taibah University, Saudi Arabia. A self-administered questionnaire was prepared based on previous studies,[1,2,5,12,13] which tests knowledge and practices of students regarding disinfection/sterilisation of extracted human teeth. The questionnaire consisted of five sections, with the first three sections testing the knowledge, the fourth section testing the students' practices, while the last section checking the source of students' knowledge. In addition, the questionnaire included gender and year of study. The first section assessed knowledge related to disinfection/sterilisation of extracted teeth and responses were categorized as 'agree', 'disagree' or 'not sure'. The second section asked students to select the best method for disinfection/sterilisation of extracted teeth based on their knowledge and more than one method could have been selected. The third section included knowledge regarding necessity of using different personal protective equipment where answers were categorized as 'high necessity', 'low necessity' or 'not sure'. The fourth section tested practices performed by

students in the laboratory settings through selection of one or more of disinfection/sterilisation method and one or more of personal protective equipment. The last section asked about the source of information and one or more options could be selected. Questionnaires were anonymous and filling the questionnaire was voluntary. The questionnaire was distributed and collected by a staff member other than the investigators. The goal of the study was explained and students were left alone to fill the questionnaire.

This questionnaire was previously validated in other studies.[12,13] Ethical approval was obtained from the Research Ethical Committee (REC) in the College of Dentistry, Taibah University before conduction of the study.

Data were collected and tabulated with frequencies and percentages of each question and statistically analyzed using SPSS version 22 for windows. Mann-Whitney test was used to compare between males and females in each grade. Kruskal Wallis-U test was used to compare between the three different grades with 5% level of significance.

Results

A total of 100 dental students equally distributed between males and females from the third, fourth and fifth grades, College of Dentistry, Taibah University, participated in the current study. Originally 116 questionnaires were distributed but 100 were returned with a total response rate of 86.2%. The response rate was higher among higher grade students 67.5%, 100% and 91.6% for third, fourth and fifth grades respectively.

The research sample was equally distributed between males and females with 50 each. Distribution among different grades was: 27 third grade students, 40 fourth grade students, while 33 students represented the fifth grade.

Table I shows the frequencies and percentages of answers for section one. Most of the students (70.4%, 92.5% and 87.9% in grades 3, 4 and 5 respectively) agreed that it is necessary to disinfect and/or sterilise extracted human teeth before working on them. They reported also that it is necessary to use specific precautions while working on these teeth. The year of education affected the response. Where 92.5% of fourth grade students agreed that there is a necessity to disinfect and/or sterilise extracted teeth before working on them, only 70.4% of the third grade students agree it is necessary. This difference was statistically significant. On the other hand an unexpectedly low percentage of students considered extracted teeth as a source of infection (65%) or that they can cause disease transmission (45%).

When we compare between males and females regarding the answers of section one, a non-significant difference was noted in most of the questions, except in the answer to question "Is there a chance of disease transmission through these teeth" where 66.7% of males in third grade agreed to this question versus 18.2% of females (P=0.02).

Regarding the question about the best method used to disinfect/sterilise extracted teeth, Hydrogen peroxide, sodium hypochlorite and autoclaving got the highest scores among the three different grades with insignificant statistical difference as shown in table II. Hydrogen peroxide was reported as the best method of disinfection/sterilisation by females more than males in third and fourth grades with statistical significant difference as shown in table III.

The students highlighted the necessity to wear personal protective barriers when working on extracted teeth with no difference regarding the use of all types of barriers between all grades. Gloves and masks both were considered as high necessity among the majority of students.

On the other hand, a contradictory significant difference was recorded between males and females in fourth and fifth grades for only the use of safety glasses. While 95.0% of females in their fourth grade highly rated the importance of safety glasses, only 22.2% of fifth grade females rated it as important (table IV).

When we checked the practice of students (section 4 of the questionnaire) during working on extracted human teeth, we found no statistical significant difference between the three grades regarding their disinfection/sterilisation methods for extracted teeth and their use

Table I. Frequency and Percentage of student's answers regarding their knowledge about disinfection/sterilisation of extracted teeth

Question		Third year		Fourth year		Fifth year		p-value
		N	%	N	%	N	%	
Is there a necessity to disinfect and/or sterilise extracted teeth before working on them	Agree	19	70.4%	37	92.5%	29	87.9%	0.035*
	Disagree	2	7.4%	1	2.5%	2	6.1%	
	Not Sure	6	22.2%	2	5.0%	2	6.1%	
	Total	27	100.0%	40	100.0%	33	100.0%	
Can disinfection and/or sterilisation damage those teeth	Agree	8	29.6%	17	42.5%	8	24.2%	0.358 NS
	Disagree	7	25.9%	8	20.0%	9	27.3%	
	Not Sure	12	44.4%	15	37.5%	16	48.5%	
	Total	27	100.0%	40	100.0%	33	100.0%	
Is there a necessity to use specific precautions while working on these teeth	Agree	22	84.6%	35	89.7%	28	84.8%	0.804 NS
	Disagree	1	3.8%	0	0.0%	1	3.0%	
	Not Sure	3	11.5%	4	10.3%	4	12.1%	
	Total	26	100.0%	39	100.0%	33	100.0%	
Can extracted teeth be a resource for infection	Agree	15	55.6%	27	67.5%	23	71.9%	0.442 NS
	Disagree	5	18.5%	3	7.5%	4	12.5%	
	Not Sure	7	25.9%	10	25.0%	5	15.6%	
	Total	27	100.0%	40	100.0%	32	100.0%	
Is there a chance of disease transmission through these teeth	Agree	12	46.2%	20	50.0%	13	39.4%	0.0601 NS
	Disagree	1	3.8%	5	12.5%	4	12.1%	
	Not Sure	13	50.0%	15	37.5%	16	48.5%	
	Total	26	100.0%	40	100.0%	33	100.0%	

Table II. Frequency and Percentage of students' answers regarding their knowledge about the best sterilisation method

Question		Third year		Fourth year		Fifth year	
		N	%	N	%	N	%
Which of the following method/methods is considered the best for disinfection/sterilisation of extracted teeth? You can choose more than one if necessary.	Hydrogen peroxide	12	18.8%	27	21.1%	22	19.8%
	Formalin	4	6.3%	10	7.8%	16	14.4%
	Alcohol	6	9.4%	14	10.9%	15	13.5%
	Chlorhexidine	7	10.9%	5	3.9%	12	10.8%
	Boiling water	0	0.0%	6	4.7%	2	1.8%
	Sodium hypochlorite	12	18.8%	22	17.2%	19	17.1%
	Saline	7	10.9%	6	4.7%	4	3.6%
	Vinegar	1	1.6%	0	0.0%	1	0.9%
	Glutaraldehyde	0	0.0%	4	3.1%	3	2.7%
	Autoclave	12	18.8%	24	18.8%	12	10.8%
	Hot air Oven	3	4.7%	10	7.8%	5	4.5%
	Total	64	100.0%	128	100.0%	111	100.0%

of protective barriers during handling of them. On the other hand, the use of hydrogen peroxide was significantly higher among females in fourth grade than males (table V). The most commonly used methods were sodium hypochlorite (70 responses), followed by hydrogen peroxide (52 responses) then autoclave (34 responses).

Regarding the source of their knowledge, most of the students reported that it was taught in dental courses or from dental course staff instructions, with no statistical significant differences between the grades and gender. Reading articles and research papers was the method least used to obtain their knowledge (table VI).

Discussion

Extracted human teeth used for the education of dental students in laboratory settings should be considered infective and classified as clinical specimens because they contain blood.[9] Center of Disease Control (CDC) has recommended that all persons who handle these teeth in dental education settings should be vaccinated against hepatitis B virus.[14-16] The College of Dentistry, Taibah University adopts the CDC guidelines where all dental students should be vaccinated before being enrolled in pre-clinical courses and handling extracted teeth in laboratory sessions. After thorough cleaning of teeth they should be autoclaved at 121°C, while teeth with amalgam restorations should be immersed in 10% formalin for 7 days.

The literature has been lacking the assessment of knowledge and practice regarding handling of these teeth among the students of dental colleges.[1,12,13] This study attempted to assess the students' knowledge and practices regarding disinfection and sterilisation

Table III. Comparison between males and females regarding frequency and percentage of answers regarding their knowledge about best method for sterilisation

Question: Which of the following method/methods is considered the best for disinfection/sterilisation of extracted teeth? You can choose more than one if necessary.

Question	Third year				Fourth year				Fifth year			
	Male		Female		Male		Female		Male		Female	
	N	%	N	%	N	%	N	%	N	%	N	%
Hydrogen peroxide	2	5.6%	10	35.7%	9	15.8%	18	25.4%	8	17.0%	14	21.9%
Formalin	3	8.3%	1	3.6%	2	3.5%	8	11.3%	10	21.3%	6	9.4%
Alcohol	4	11.1%	2	7.1%	5	8.8%	9	12.7%	7	14.9%	8	12.5%
Chlorhexidine	3	8.3%	4	14.3%	3	5.3%	2	2.8%	5	10.6%	7	10.9%
Boiling water	0	0.0%	0	0.0%	1	1.8%	5	7.0%	1	2.1%	1	1.6%
Sodium hypo-chlorite	8	22.2%	4	14.3%	8	14.0%	14	19.7%	3	6.4%	16	25.0%
Saline	2	5.6%	5	17.9%	3	5.3%	3	4.2%	3	6.4%	1	1.6%
Vinegar	1	2.8%	0	0.0%	0	0.0%	0	0.0%	1	2.1%	0	0.0%
Glutaraldehyde	0	0.0%	0	0.0%	3	5.3%	1	1.4%	2	4.3%	1	1.6%
Autoclave	11	30.6%	1	3.6%	15	26.3%	9	12.7%	5	10.6%	7	10.9%
Hot air Oven	2	5.6%	1	3.6%	8	14.0%	2	2.8%	2	4.3%	3	4.7%
Total	36	100%	28	100%	57	100%	71	100%	47	100%	64	100%

of extracted human teeth in preclinical educational settings at the College of Dentistry, Taibah University, and their compliance to the college guidelines in order to implement any necessary precautions.

Consistent with the findings of previous studies,[1,12,13] dental students in the present study had moderate knowledge regarding the necessity to disinfect and/or sterilise extracted human teeth before working on them. They reported also that it is necessary to use specific precautions while working in these teeth. Surprisingly a lower percentage of students (65%) agreed that extracted teeth can be a source for infection and there is a chance of disease transmission through them and 22% were not sure about possibility of disease transmission. Students might consider thoroughly cleaned extracted teeth not liable to harbour blood borne pathogens.

Meanwhile, contrary to one study,[12] the year of education and gender affected the response. The majority (92.5%) of fourth grade students agreed that there is a necessity to disinfect and/or sterilise extracted teeth before working on them in comparison to third grade students who recorded the lowest score (70.4%). This may be explained by the more experience of fourth grade students as the preclinical exercises on extracted teeth are first taught during third grade of the dental curriculum.

As extracted teeth serve as an invaluable educational tool in dental institutions for various pre-clinical courses, sterilising them is mandatory.[17] Since hydrogen peroxide, 5.25% sodium hypochlorite and autoclaving are easily available in dental clinics, they have become the obvious choice as the best option to sterilise/disinfect extracted teeth by the students of

Table IV. Frequency and percentage of students' answers regarding their knowledge concerning necessity of use of protective items when working on extracted teeth

		Third year males		Third year females		Fourth year males		Fourth year females		Fifth year males		Fifth year females	
		N	%	N	%	N	%	N	%	N	%	N	%
Safety glasses	High	7	46.7%	9	75.0%	4	20.0%	19	95.0%*	10	66.7%	4	22.2%*
	Low	3	20.0%	3	25.0%	12	60.0%	1	5.0%	5	33.3%	7	38.9%
	Not Sure	5	33.3%	0	0.0%	4	20.0%	0	0.0%	0	0.0%	7	38.9%
Face shield	High	5	33.3%	4	33.3%	9	45.0%	11	55.0%	6	40.0%	10	55.6%
	Low	8	53.3%	6	50.0%	7	35.0%	9	45.0%	8	53.3%	7	38.9%
	Not Sure	2	13.3%	2	16.7%	4	20.0%	0	0.0%	1	6.7%	1	5.6%
Mask	High	13	86.7%	10	83.3%	17	85.0%	20	100%	14	93.3%	17	94.4%
	Low	1	6.7%	2	16.7%	3	15.0%	0	0.0%	1	6.7%	0	0.0%
	Not Sure	1	6.7%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	5.6%
Gloves	High	13	86.7%	12	100%	18	90.0%	20	100.0%	12	80.0%	18	100.0%
	Low	2	13.3%	0	0.0%	0	0.0%	0	0.0%	2	13.3%	0	0.0%
	Not Sure	0	0.0%	0	0.0%	2	10.0%	0	0.0%	1	6.7%	0	0.0%
White Coat	High	5	33.3%	9	75.0%	4	20.0%	10	50.0%	1	6.7%	9	50.0%
	Low	7	46.7%	2	16.7%	14	70.0%	7	35.0%	13	86.7%	6	33.3%
	Not Sure	3	20.0%	1	8.3%	2	10.0%	3	15.0%	1	6.7%	3	16.7%
Gown	High	6	40.0%	7	58.3%	14	70.0%	16	80.0%	5	33.3%	14	77.8%
	Low	7	46.7%	4	33.3%	5	25.0%	4	20.0%	10	66.7%	1	5.6%
	Not Sure	2	13.3%	1	8.3%	1	5.0%	0	0.0%	0	0.0%	3	16.7%

the present study (table II). Although 10% formalin is a proven disinfectant of extracted teeth[1,2,13,17,18] it was not widely used by students in the current study. This may be attributed to the hazards of formalin as an irritant and a probable carcinogen.[13,17,18] Most of the students preferred to use hydrogen peroxide and sodium hypochlorite instead as previously reported in another study[1] which may be attributed to their availability and ease of use.

In addition, autoclaving got the third rank among the three different grades although it is the gold standard in our institution. Since teeth containing amalgam cannot be autoclaved thus students prefer to sterilise all teeth collected by them using a single simple method. Sodium hypochlorite have demonstrated effective disinfection in several researches,[8,17,19] furthermore it does not affect the "feel" and cutting characteristics of the teeth.[9,17]

Table V. Frequency and percentage of students' answers regarding their practices in disinfection/ sterilisation method and personal protective equipment use in both males and females

	Third year				Fourth year				Fifth year			
	Male		Female		Male		Female		Male		Female	
	N	%	N	%	N	%	N	%	N	%	N	%
Hydrogen peroxide	4	12.1%	6	25.0%	9	18.8%	16	29.6%*	5	13.2%	12	26.1%
Formalin	2	6.1%	0	0.0%	1	2.1%	2	3.7%	8	21.1%	1	2.2%
Alcohol	1	3.0%	0	0.0%	4	8.3%	5	9.3%	3	7.9%	7	15.2%
Chlorhexidine	5	15.2%	1	4.2%	4	8.3%	0	0.0%	2	5.3%	0	0.0%
Boiling water	0	0.0%	0	0.0%	0	0.0%	1	1.9%	0	0.0%	1	2.2%
Sodium hypochlorite	12	36.4%	8	33.3%	7	14.6%	17	31.5%	8	21.1%	18	39.1%
Saline	1	3.0%	7	29.2%	3	6.3%	2	3.7%	3	7.9%	5	10.9%
Vinegar	1	3.0%	0	0.0%	0	0.0%	0	0.0%	1	2.6%	0	0.0%
Glutaraldehyde	0	0.0%	1	4.2%	1	2.1%	1	1.9%	2	5.3%	0	0.0%
Autoclave	6	18.2%	1	4.2%	14	29.2%	8	14.8%	4	10.5%	1	2.2%
Hot air Oven	1	3.0%	0	0.0%	5	10.4%	2	3.7%	2	5.3%	1	2.2%
Safety glasses	5	11.1%	9	20.0%	0	0.0%	20	22.0%	4	9.5%	10	13.3%
Face shield	6	13.3%	2	4.4%	3	5.7%	5	5.5%	5	11.9%	7	9.3%
Mask	13	28.9%	10	22.2%	20	37.7%	19	20.9%	14	33.3%	17	22.7%
Gloves	14	31.1%	12	26.7%	20	37.7%	20	22.0%	13	31.0%	18	24.0%
White Coat	2	4.4%	8	17.8%	1	1.9%	17	18.7%	1	2.4%	14	18.7%
Gown	5	11.1%	4	8.9%	9	17.0%	10	11.0%	5	11.9%	9	12.0%

Recently, house hold vinegar proved to be an effective disinfectant medium for extracted human teeth.[20] However, only two students from the whole sample chose it as a possible disinfectant (table II). This result reflects the overlooking of students regarding recent articles on disinfection/sterilisation of extracted teeth.

In agreement with previous studies,[12,13] most of the students highlighted the necessity to wear personal protective equipment when working on extracted teeth. On the other hand, a contradictory gender difference was recorded between males and females in fourth and fifth grades for only the importance of use of safety glasses. This may be explained by the fact that as fifth grade students proceed in clinical years they consider the importance of safety glasses in clinical settings but not in laboratory settings.

Also, like what has already been reported,[13] self-reading of articles and research papers was not so popular in this study population as a source of getting new information. This was reflected on their answers and practice of using an appropriate medium or method for sterilising/disinfecting extracted human teeth. In his context, the students need to be acquainted with the latest published literature regarding this aspect. Both males and females of third grade reported the higher grade students as their third source of information. This reflects insufficient information regarding this subject in the dental curriculum which should be discussed in detail.

Conclusion

Although students agreed on the necessity of disinfection/sterilisation, yet their knowledge regarding

Table VI. Frequency and Percentage of student's answers regarding source of information

	Group					
	Third year		Fourth year		Fifth year	
	N	%	N	%	N	%
Taught in one of the dental courses.	16	29.1%	22	25.0%	16	26.7%
Instructions from course staff members	15	27.3%	33	37.5%	21	35.0%
Instructions from lab technician.	6	10.9%	8	9.1%	4	6.7%
Information obtained from Colleagues in higher level	12	21.8%	13	14.8%	6	10.0%
Self-reading of Articles and research paper	6	10.9%	12	13.6%	13	21.7%
Total	**55**	**100%**	**88**	**100%**	**60**	**100%**

possibility of disease transmission from those teeth was poor. The ideal sterilisation methods like autoclaving and 10% formalin were used by only 34% and 14% of the total sample of this study. The most common method used by dental students (70%) for disinfection/ sterilisation of extracted teeth was 5.25% sodium hypochlorite. Self reported use of personal protective equipment showed high compliance.

Recommendations

The possibility of disease transmission through extracted teeth should be highlighted in infection control workshops provided to dental students and continuous monitoring and motivation of students regarding compliance to infection control policies when working on extracted dental teeth should be mandatory.

Acknowledgments

The authors would like to thank Prof. Dr. Tamer El-hifnawy and Dr. Waleed Al-Saadi for their great help in distributing and collecting the questionnaire among students in the College of Dentistry, Taibah University.

References

1. Kumar M, Sequeira PS, Peter S, Bhat GK. Sterilisation of extracted human teeth for educational use. *Indian J Med Microbiol* 2005; **23:** 256–258.
2. Lolayekar NV, Bahat VS, Bahat SS. Disinfection methods of extracted human teeth. *J Oral Health Comm Dent* 2007; **1:** 27–29.
3. CDC. Guidelines for infection control in dental health-care settings e 2003. MMWR 2003; **52:** 1-61. http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5217a1.htm.
4. Handling Extracted Teeth. American Dental Association. 2003. Available from: http://www.ada.org/en/search-results#q=Handling%20Extracted%20Teeth&t=all&sort=relevancy. [Last cited on 2014 Feb 14].
5. Lee JJ, Nettey-Marbell A, Cook A Jr, Pimenta LA, Leonard R, Ritter AV. Using extracted teeth for research: The effect of storage medium and sterilisation on dentin bond strengths. *J Am Dent Assoc* 2007; **138:** 1599–1603. http://dx.doi.org/10.14219/jada.archive.2007.0110
6. DeWald JP. The use of extracted teeth for *in vitro* bonding studies: Areview of infection control considerations. *Dent Mater* 1997; **13:** 74–81. http://dx.doi.org/10.1016/S0109-5641(97)80015-2
7. Pantera EA Jr, Schuster GS. Sterilisation of extracted human teeth. *J Dent Educ* 1990; **54:** 283-285.
8. Viana PS, Machado AL, Giampaolo ET, Pavarina AC, Vergani CE. Disinfection of bovine enamel by microwave irradiation: Effect on the surface microhardness and demineralization/ remineralization processes. *Caries Res* 2010; **44:** 349–357. http://dx.doi.org/10.1159/000318528
9. Chandki R, Maru R, Gunwal M, Garg A, Mishra A. A comparison of different methods for disinfection or sterilisation of extracted human teeth to be used for dental education purposes. *World J Dent* 2013; **4:** 29–31. http://dx.doi.org/10.5005/jp-journals-10015-1198
10. Cuny E, Carpenter WM. Extracted teeth: Decontamination, disposal and use. *J Calif Dent Assoc* 1997; **25:** 801–804.
11. Hope CK, Griffiths DA, Prior DM. Finding an alternative to formalin for sterilisation of extracted teeth for teaching purposes. *J Dent Educ* 2013; **77:** 68–71.

12. Hashemipour MA, Mozafarinia R, Mirzadeh A, Aramon M, Nassab SAH. Knowledge, attitudes, and performance of dental students in relation to sterilisation/disinfection methods of extracted human teeth. *Dent Res J (Isfahan)* 2013; **10(4):** 482–488.
13. Smitha D, Tijare MS, Amith HV, Gujjar KR, Sharma R. Knowledge, attitude and practice regarding handling of extracted human teeth among students of a dental college in Bhopal. *J Indian Assoc of Public Health Dent*, 2014; **12(4):** 276-282. http://dx.doi.org/10.4103/2319-5932.147661
14. CDC. Guidelines for prevention of transmission of human immunodeficiency virus and hepatitis B virus to health care and public safety workers. *MMWR* 1989; **38(suppl 6):** 1-37. http://www.cdc.gov/mmwr/preview/mmwrhtml/00001450.htm
15. CDC. Protection against viral hepatitis: Recommendations of the immunization practices Advisory committee (ACIP). *MMWR* 1990; **39(RR-2):** 1-26. http://www.cdc.gov/mmwr/preview/mmwrhtml/00041917.htm
16. CDC. Hepatitis B virus: A comprehensive strategy for eliminating transmission in the united states through universal childhood vaccination. Recommendations of the Immunization Practices Advisory Committee (ACIP). *MMWR* 1991; **40(RR-13):** 1-19. http://www.cdc.gov/mmwr/preview/mmwrhtml/00033405.htm
17. Sandhua SV, Tiwari R, Bhullar RK, *et al*. Sterilisation of extracted human teeth: A comparative analysis. *J Oral Biol Craniofac Res* 2012; **2:** 170-175. http://dx.doi.org/10.1016/j.jobcr.2012.09.002
18. Dominici JT, Eleazer PD, Clark SJ, Staat RH, Scheetz JP. Disinfection/sterilisation of extracted teeth for dental student use. *J Dent Educ* 2001; **65:** 1278-1280.
19. Ghosh A, Chowdhury S. Sterilisation and disinfection of extracted human teeth for institutional use. *Int J Clin Dent Sci* 2013; **4:** 9-12.
20. Tijare M, Smitha D, Kasetty S, Kallianpur S, Gupta S, Amith H. Vinegar as a disinfectant of extracted human teeth for dental educational use. *J Oral Maxillofac Pathol* 2014; **18:** 14-18. http://dx.doi.org/10.4103/0973-029X.131883