ORIGINAL ARTICLE

Knowledge, attitude, and awareness of biocompatibility of orthodontic materials among dental students

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ABSTRACT

The aim of this study is to find the knowledge, attitude and awareness of biocompatibility of orthodontic materials among dental students.A survey of 13 questions was created using Google Forms. The questions on the survey cover a wide range of topics including the awareness of cytotoxicity of orthodontic materials, their corrosive potential, ways of preventing corrosion and release of subsequent substances, and various means by which these physiological actions occur. This survey was circulated among dental undergraduate students and the responses recorded were then transferred to SPSS software. Here we conducted descriptive analysis to produce a pie chart and Chi square test to determine the association and statistical significance.The results were noted and examined in the form of bar graphs. The p value for this study was found to be 0.01, which makes this study statistically significant. The awareness about the biocompatibility of orthodontic materials among dental students was found to be low. Continuing dental education programs can be conducted to constantly improve the knowledge regarding the judicious and ecofriendly use of all newly available dental materials.

Key words: Adverse reactions, biocompatibility, cytotoxicity, patients, students

INTRODUCTION

Biocompatibility refers to the ability of the material to elicit an appropriate biological response upon application. It also implies that when there is an interaction between the host and the material, a certain function is expected from the material. For an item to be considered biocompatible, all the factors mentioned must be in harmony. To dentists, the necessity of biocompatibility relates to four key areas, namely safety of dental staff, safety of patients, issues relating to regulatory compliance, and legal liability.[1,2] Since the intended response is achieved by physical properties, the term "appropriate host response" indicates that no adverse reactions took place because of the presence of said dental material and hence can be considered biocompatible.[3] Several cases have been reported, wherein such adverse reactions have taken place, but although rare, there are millions of treatments provided every year and hence this means that there is a high potential that several individuals are at risk of developing these reactions.[4-6]

In regular orthodontic practice, metallic materials are the most commonly used.[7,8] This includes noble metals, pure metals and alloys. These derive biocompatibility from the formation of passive film, which generally is an oxide

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of one of the metals in the alloys. These films, which are formed from a reaction, which essentially prevent the wire from corroding further by reducing the corrosion rate significantly.[9] While the metal most commonly used is Nickel, it also has a tendency to cause allergic reactions.[10] While nickel is present in several alloys namely stainless steel, cobalt/chromium alloys, nickel/titanium alloys and nickel/chromium alloys, if the patient shows any sort of allergic reaction, we have no choice but to replace the wire with some other wires.[11–13] Beyond this adverse reactions can occur due to the metals releasing their constituent substances, such as ions from alloys, degradation byproducts and additive products. While there is also a use of ceramics and polymeric compounds in orthodontics, these are considered to be non-cytotoxic, but under certain conditions can lose these properties.[14–18] Our research and knowledge have resulted in high-quality publications from our team.[19–35] The aim of this study is to find the knowledge, attitude and awareness of biocompatibility of orthodontic materials among dental students.

MATERIALS AND METHODS

A survey of 13 questions was created using Google Forms. The questions on the survey cover a wide range of topics including the awareness of cytotoxicity of orthodontic materials, their corrosive potential, ways of preventing corrosion and release of subsequent substances, and various means by which these physiological actions occur. The link to this survey was circulated to 120 students studying in Saveetha Dental College, equally from the 2nd year to Interns, with an equal number of males and females from each year giving responses and then these responses were further transferred to SPSS software version 23.0 . Here we conducted descriptive analysis to produce Chi square test which gave us correlation graphs with the remaining data represented in the form of tables.

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RESULTS

The results of this study have been depicted in the form of bar graphs and pie charts below and the remaining results have been tabulated in Table 1. In pie charts, we show the general distribution of answers obtained for each of the options, while in bar charts, we show the answers given by students of various years. Only 46% of those polled were aware that orthodontic equipment could be cytotoxic [Figure 1]. We then looked at what the respondents meant by austenitic qualities; 35% believed it meant noncorrosive, while 43% claimed it meant unbreakable [Figure 2]. Following this, we discovered that 43% understood copper is not an austenitizing element, whereas the remaining 57% chose manganese and nickel, both of which are austenitizing elements [Figure 3].

Figures 4 and 5 show that 52 percent of respondents were aware that orthodontic wires could corrode intraorally, and that 78 percent were aware that Titanium dioxide had a stronger corrosion resistance than Chromium oxide. Only 47% of the respondents were aware of this information. In Figure 4, a bar graph depicts the relationship between each year's students' awareness of which metal's oxides have the highest corrosion resistance. Finally, in Figure 5, a bar graph depicts the relationship between the understanding of galvanic corrosion among students of various years.

DISCUSSION

The survey results were gathered, and the data were analyzed further. Overall, we discovered that dental students had a high level of awareness in various areas. Only 46% of the respondents were aware that orthodontic material including the wires and brackets could exhibit cytotoxic behavior. Austenitic properties represent the noncorrosive nature of a material. Only 35% of the respondents were aware of this fact. Increased quantities of copper were found to reduce the corrosion resistance of materials. Only 43% were able to identify this property of materials, wherein the remaining chose other materials which supposedly exhibit austenitic behavior.

The possibility of corrosion intraorally can be because of a variety of reasons which includes the variation in properties of material due to any kind of physical stress induced over a long period of time that make it lose the corrosion resistant

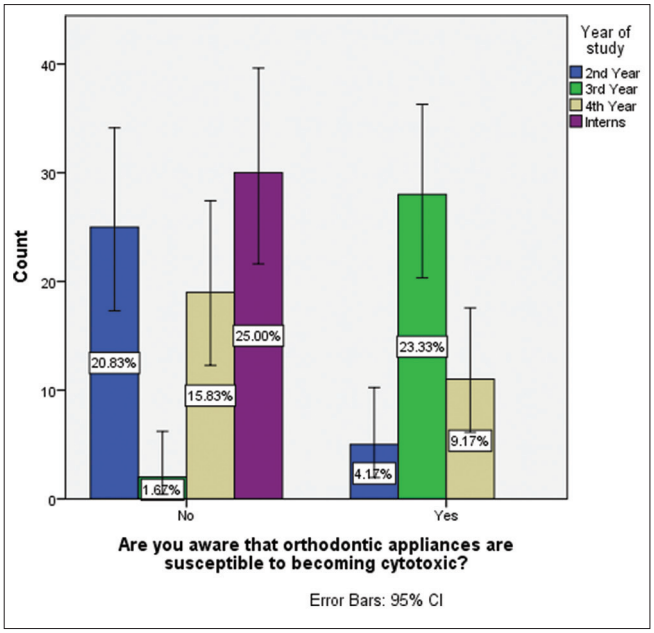

Figure 1: This graph shows the awareness of the students regarding the possible cytotoxicity of the orthodontic materials. Of the respondents, 54% were aware of this and 46% were not aware. The Pearson's Chi-square value was found to be 63.340, df = 3, and *P* value was found to be 0.00 (<0.05, hence it is statistically significant)

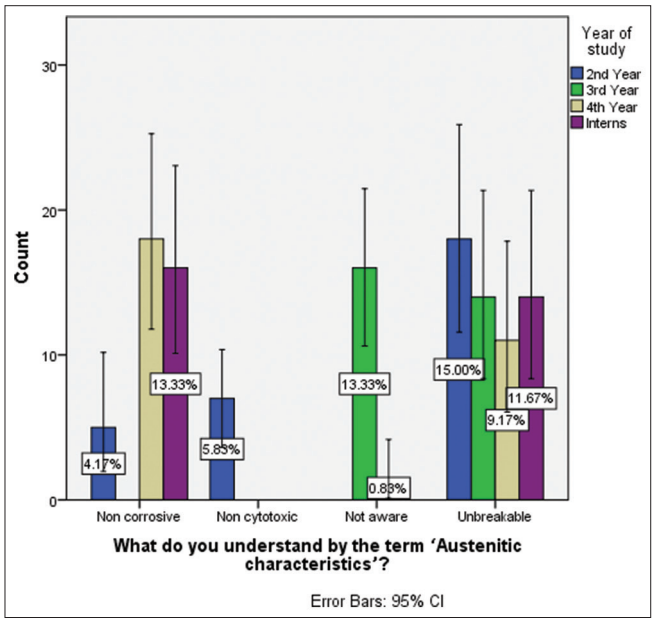

Figure 2: This graph shows whether the respondents were familiar with the term austenitic characteristics, only 32.50% were familiar with the definition of austenitic property of the biocompatible materials. The Pearson's Chi-square value was found to be 83.259, df = 9, and $P = 0.00$ (<0.05, so it is statistically significant)

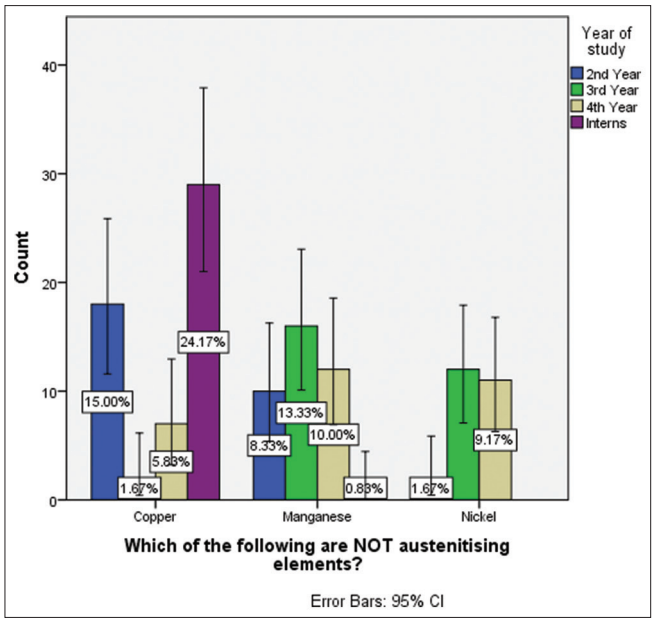

Figure 3: In this graph, we find that 46.67% of the respondents were aware that copper was not an austenitizing material. The interns had the highest awareness. The Pearson's Chi-square value is 61.425, df = 6, and $P = 0.00$ (<0.05, which is statistically significant)

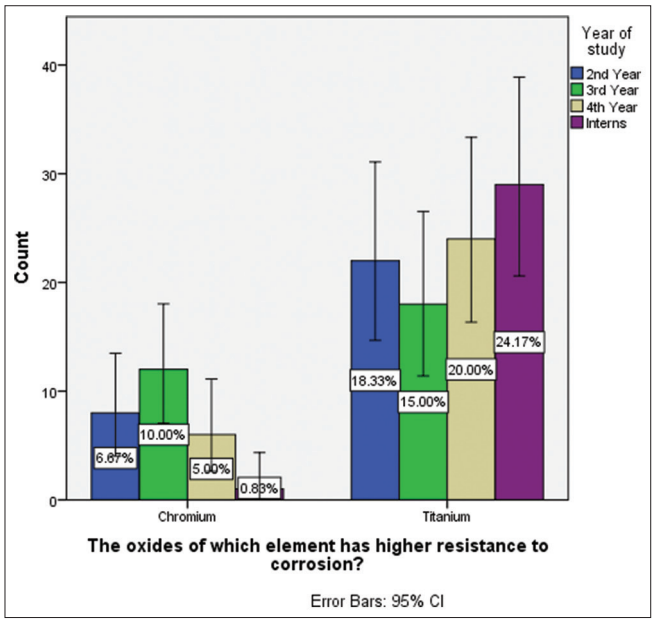

Figure 4: Bar graph shows the association between the students of each year and their awareness of the oxides of which metal has the highest resistance to corrosion. Titanium oxide is more corrosion resistant compared to chromium oxide. Dental students in almost all the years of study were aware about this fact and the difference was found to be statistically significant (Pearson's Chi-square value = 24.600, df = 3, $P = 0.01$ [<0.05])

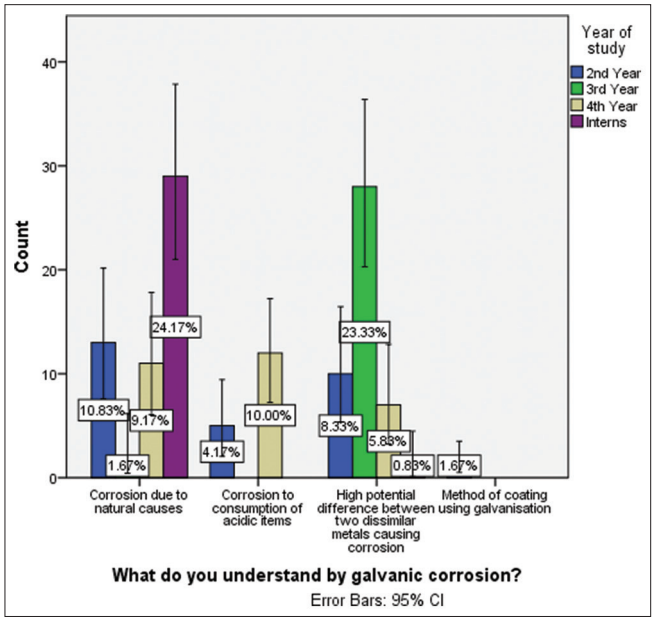

Figure 5: Bar graph shows the relationship between the students of different years and their understanding of galvanic corrosion. The differences in the response were found to be statistically significant (Pearson's Chi-square value = 46.990, df = 9, $P = 0.00$ [$P < 0.05$])

layer and become more susceptible to corrosion. One-half of the respondents were aware about the possibility of losing the property intraorally resulting in corrosion of materials. Titanium and chromium oxides are few such which induce properties of resistance to corrosion. Three-fourth of the respondents were aware about the fact that titanium dioxide had a stronger corrosion resistance than chromium oxide. Saliva has a strong effect on orthodontic wires, and prolonged exposure might result in the release of chemicals. Only one-half of the respondents were aware of this information. Association

Table 1: Data compilation of the responses for the survey on biocompatibility of orthodontic materials among dental students

Question	Options (%)	Percentage of distribution (%)	*P*
Is the corrosion of orthodontic wires possible intraorally?	Yes – 60.83 No – 39.17	2nd year Yes – 20.83 No – 4.17 3rd year Yes – 1.67 No – 23.33 4th year Yes – 13.33 No – 11.67 Interns Yes – 25 No – 0	0.00, statistically significant
What do you think can be the cause of pitting corrosion?	Damage during procedure – 19.17 Manufacturing defect – 10.00 Highly porous surface – 46.67 None of the above – 24.16	2nd year – 5 4th year – 14.17 2nd year – 5.83 4th year – 4.17 2nd year – 15.83 3rd year – 1.67 4th year – 4.17 Intern – 25 3rd year – 23.33 4th year – 0.83	0.00
What do you understand about corrosion fatigue?	Corrosion due to differences in electrochemical potential – 67.50 Fatigue on wire due to extended time inside oral cavity – 11.66 Formation of craters on wire – 18.33 None of the above – 2.51	2nd year – 12.50 3rd year – 25 4th year – 5.83 Intern – 24.17 2nd year – 5.83 4th year – 5.83 2nd year – 5.00 4th year – 13.33 2nd year – 1.67 Intern – 0.83	
Do you think that saliva can cause release of substances?	Yes – 43.33 No – 56.67	2nd year – 9.17 3rd year – 13.33 4th year – 20.00 Intern – 0.83 2nd year – 15.83 3rd year – 11.67 4th year – 5.00 Intern – 24.17	
Do you think *in vitro* studies can properly stimulate clinical conditions for testing cytotoxic effects of metals?	Yes – 72.50 No – 27.50	2nd year – 16.67 3rd year – 11.67 4th year – 20.00 Intern – 24.17 2nd year – 8.33 3rd year – 13.33 4th year – 5.00 Intern – 0.83	

among the knowledge in the students belonging to the various years was seen to have a statistically significant difference.

CONCLUSION

In this study, the awareness regarding the biocompatibility of orthodontic materials among dental students was found to be low. Knowledge on their basic properties and ill effects due to improper use should be emphasized from the undergraduate level and more dental education programs can be conducted to improve this aspect.

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Conflicts of interest

There are no conflicts of interest.

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