

# The use of light-cured acrylic resin for custom trays by undergraduate dental students: a survey

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**Prof SB KHAN:** BChD, PDD, Lecturer Department of Restorative Dentistry University of the Western Cape, Tel. (021) 937 3006, Fax. (021) 931 2287, Private Bag X01, Tygerberg 7505, E-mail: skhan@uwc.ac.za

**Prof GAVM GEERTS:** BChD, PDD, MChD, Associate Professor, Department of Restorative Dentistry, University of the Western Cape, Tel. (021) 937 3133, Fax. (021) 931 2287, Private Bag XI, Tygerberg 7505, e-mail: ggeerts@uwc.ac.za

## Corresponding Author:

**Prof SB KHAN:** BChD, PDD, Lecturer Department of Restorative Dentistry University of the Western Cape, Tel. (021) 937 3006, Fax. (021) 931 2287, Private Bag X01, Tygerberg 7505, E-mail: skhan@uwc.ac.za

## SUMMARY

**Introduction:** It is unknown how the use of a light-cured acrylic resin is appreciated over the traditional chemically cured resins for the construction of custom trays in a teaching environment.

**Objective:** To evaluate the acceptance of light-cured acrylic resin for custom trays by dental students.

**Method:** A questionnaire addressing the use and handling properties of both light-cured (Megatray, Megadent, Germany) and chemically-cured (Excel, Wright Health Group, UK) custom tray materials was distributed amongst undergraduate dental students of the University of the Western Cape.

**Results:** Of a total of 196 dental students, 38 were absent on the day of the survey. Of the 158 questionnaires that were distributed and returned, 18 did not meet the inclusion criteria and 1 person chose not to participate. Of the 139 participating students, 98 were in 4th year, 41 in 5th year. With regards to the light-cured acrylic custom tray material, 77% used it most often, 64% said it saved time and 62% said that it was easier to handle. Fifty two percent indicated that both types of materials should be taught in undergraduate training, 26% preferred the light-cured acrylic resin custom tray material, 20% suggested that only the light-cured resin be used and no one suggested the chemically-cured resin exclusively.

**Conclusions:** Most undergraduate students positively accepted the light-cured resin, but training in the use of both materials was recommended.

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## INTRODUCTION

Research with regards to the properties of dental materials started centuries ago and is an ongoing phenomenon as new or improved materials appear on the market. New materials should be scrutinised to evaluate their physical and chemical properties, their handling properties, user-friendliness and most importantly their potential toxicity<sup>1</sup>.

Successful treatment outcomes with complete removable prostheses depend largely on the correct clinical and laboratory techniques and the dental materials used for these procedures which are taught as part of the dental curriculum. The use of custom trays to take accurate secondary impressions is one important step in the complete denture making process which could influence the final outcome<sup>2-6</sup>.

Different materials are available for the construction of custom trays but those with the most suitable chemical and physical properties, best user-friendliness and biocompatibility should be used<sup>1,2,6</sup>.

## LITERATURE REVIEW

The ideal requirements of a custom tray material have been summed up as follows<sup>6,7</sup>:

- stability in air and in a moist environment,
- volume stability over time,
- moisture resistance,
- rigidity (high modulus of elasticity),
- adhesion of the impression material in the tray and f) thickness of impression material layer control.

The questionnaire used in this study, however, only makes reference to the user-friendliness, handling properties (including thickness of the light-cured acrylic) and the clinical use of both light- and chemically-cured materials.

The chemically-cured (CC) acrylic resin custom tray materials have negative properties that may affect the outcome of treatment with complete removable prostheses. Polymerisation shrinkage and stress relaxation can cause distortion of the final impression leading to inaccuracies of the final prosthesis<sup>8,9</sup>. Consequently, reports recommend that a time interval be allowed between the fabrication and the use of these custom trays<sup>5,6</sup>. This recommendation suggests that the CC resin material does not fit the requirements of the "ideal" custom tray material and thus negatively influences its "user-friendliness". In addition, the hazardous effects caused by the monomer (methyl methacrylate) of the CC resin material include dermatologic reactions such as type IV contact

Table 1						
1	When constructing a special tray for complete dentures, which material did you use most often?	light-cured special tray material		chemically-cured special tray material		
2	Light-cured material is quicker to work with than the chemically-cured material.	definitely no	no	yes	definitely yes	
3	Light-cured material is easier to handle than chemically-cured material.	definitely no	no	yes	definitely yes	
4	It is easier to repair the light-cured tray than the chemically-cured tray.	definitely no	no	yes	definitely yes	
5	It is easier to add impression compound / Greenstick for border moulding to the light-cured than the chemically-cured tray.	definitely no	no	yes	definitely yes	
6	S-S white impression material bonds/adheres better to the light-cured than the chemically-cured trays.	definitely no	no	yes	definitely yes	
7	Did you use anything to wipe or clean the light-cured special tray with?	yes	no			
8	If so, what did you use? ( You can mark more than one option)	water	monomer	Megaclean	soap	other
9	What negative effects would deter you from using chemically-cured resin for special tray construction? (you can mark more than one option)	odour	finish	Time	handling properties	
10	What negative effects would deter you from using light-cured resin for special tray construction? (you can mark more than one option)	odour	finish	Time	handling properties	

dermatitis<sup>1,9,10</sup>. It is also a potent sensitiser<sup>11</sup>. Non-dermatologic reactions have also been reported in the literature when using CC acrylic resin (custom tray and denture materials), including eye and respiratory effects and general symptoms (nausea, headaches) among the dental technicians, dentists and patients<sup>1,10</sup>. Hence the need for alternatives.

Alternatives for the fabrication of custom trays include Shellac,<sup>12</sup> Thermoform<sup>6</sup> and Polycaprolaitone<sup>13</sup> material. However, the modulus of elasticity of shellac, even if it is produced by vacuum forming adaptation, is low compared to the acrylic resin trays<sup>6</sup>. According to Breeding *et al* (1994), the strength of thermoform trays is much lower than that of the acrylic resin trays<sup>14</sup>. Although it recovers completely, polycaprolaitone deforms under a low load<sup>13</sup>.

Since the 1990's, light-cured (LC) acrylic resin tray material has been used in the curriculum of dental schools worldwide<sup>2</sup> as an alternative to the CC acrylic resin material. According to a survey done at dental schools in the US, 98% use custom trays for final impression procedures and 70% are using the visible LC resin material<sup>15</sup>.

Manufacturers of LC acrylic resin claim that its use will improve working conditions by being less hazardous, reducing preparation time, being easy to use and having good handling properties.<sup>1,6</sup> Pre-market biocompatibility tests have been performed, but absolute safety or accuracy cannot be guaranteed, and long-term studies still need to be conducted<sup>1</sup>.

The literature does not indicate which features of CC or LC acrylic resin contribute to its user-friendliness and whether these features have an influence on the eventual selection of a material in an academic environment.

**AIM AND OBJECTIVES:**

The aim of this study was to identify the acceptance of LC acrylic resin for custom trays used by undergraduate dental students when doing their own laboratory work during their 3rd and part of their 4th year in training.

The objectives of this study were:

1. To identify which of the available materials (CC or LC acrylic resin) was used most often for custom trays amongst dental students.
2. To determine the ease of use by dental students of both types of acrylic resin as custom tray materials.
3. To select the aspects of either material that is most acceptable or not by dental students.
4. To ascertain the recommendations by 4th and 5th year dental students on which material from those used in the Faculty be used in the undergraduate training programme.

**METHOD AND MATERIALS**

A questionnaire (Table 1) was drawn up to compare the use and handling properties of the CC and LC acrylic resin used in the undergraduate training program of the University of the Western Cape. The instructions, inclusion and exclusion criteria for participation in this study were stipulated on the front page of the questionnaire. The participants included in this study had to be undergraduate dental students; they had to have both laboratory and clinical experience with both types of custom tray materials (LC and CC resin) and the custom trays constructed had to be used for the secondary impression stage of a complete denture.

The format of the questionnaire entailed a set of closed questions and statements with several options following the guidelines according to the Likert scale<sup>16</sup>. The options included a range of positive and negative responses for each question, and emphatic negative and positive responses were also accommodated for. No neutral or "don't know" options were given.

Two drafts of the questionnaire were piloted amongst the dental students and the dental staff (dentists and dental technicians) to ensure clarity of the questions and to eliminate any ambiguities of the questions before the questionnaire was finalised and ready for distribution amongst the dental students.

The questionnaire was also translated into Afrikaans to ensure understanding of questions among students whose first language is Afrikaans.

The sample included the 4th and 5th year undergraduate dental students at the University of the Western Cape (n=196) who have made these custom trays (a requirement of their training in 3rd and part of 4th year) using these available tray materials. The questionnaire was distributed by the researcher among the dental students. The researcher emphasised the inclusion /exclusion criteria and instructions to the student group at the time of distribution. It was also re-iterated that participation was voluntarily and that anonymity would be ensured. The purpose of the study was explained: to analyse the acceptance of the LC acrylic (the newer material) over the CC acrylic resin (the norm in undergraduate training) and to assess the recommendations of the 4th and 5th year dental students. The questionnaires were collected immediately on completion.

The data was identified and entered into MSExcel before it was analysed by means of frequency tables and Chi-square tests. Cross-tabulation configurations were conducted to analyse and interpret the responses of the students and the significance of differences in preference amongst the different classes was determined by McNemer tests. A p-value of  $p < 0.01$  was considered to be significant.

## RESULTS

Of a total of 196 students (4th and 5th year students), 38 were absent on the day of the survey. Of the 158 questionnaires that were distributed to the students and returned,

18 of the students did not meet the inclusion criteria and 1 person chose not to participate. Of the 139 participating students (n=139), 98 were in the 4th year and 41 in the 5th year class.

With regards to the use of the LC acrylic resin, 77% of dental students used it most often. (Figure 1)

Ninety seven percent (response: yes and definitely yes) said that it was quicker to work with, 93 % (response: yes and definitely yes) it was easier to handle, and 75% it was easier to repair.

Seventy five percent had no time problem with the LC resin. (Figure 2a) There were significantly less handling problems with the LC resin, but students had problems with the CC resin. (Figure 2b) Twenty six percent had problems with the finish (texture) of the LC acrylic tray material, yet 47% had no problems with the finish of either material. (Figure 2c) Problems with odour of the CC were recorded by 40,7% and 3.6% found that no problems were experienced with the CC resin, but did so with the LC resin. Fifty five percent said none of the materials were problematic with regards to odour. (Figure 2d)

Table 11 demonstrates that students had more problems, which included negative effects such as odour and construction time, with the CC than with the LC acrylic resin. Three

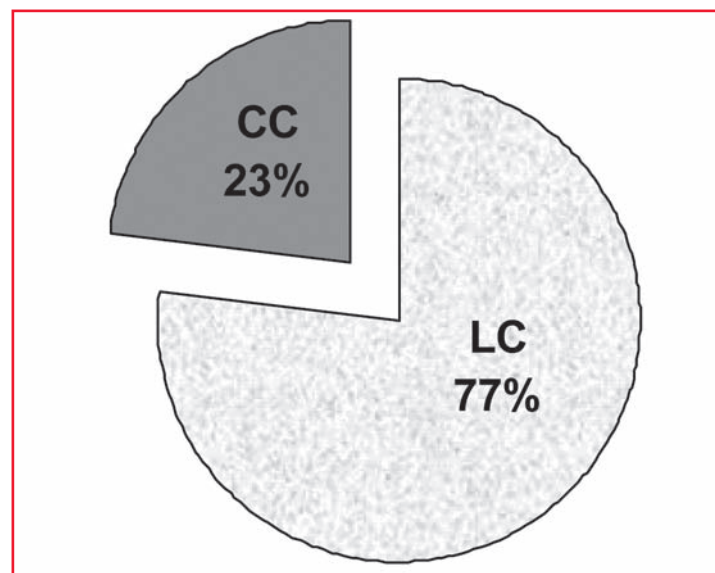


Figure 1: Material used most often

Table 2						
Number of problems with LC	Number of problems with CC					Total
	0 (No Problems)	1	2	3	4	
0	3	21	40	4	14	82
1		17	26	3	3	49
2		4	4			8
3	1					1
4						0
<b>Total</b>	<b>4</b>	<b>42</b>	<b>70</b>	<b>7</b>	<b>17</b>	<b>140</b>

Figure 2: Response in percentages of some of the problems. Prob LC, prob CC = problems experienced with both materials, no prob LC, no prob CC = no problems with either material, prob LC, no prob CC = prob with LC material but not with the CC material, no prob LC, prob CC = no problem with the LC but problem with the CC.  $p < 0.01$  is statistically significant.

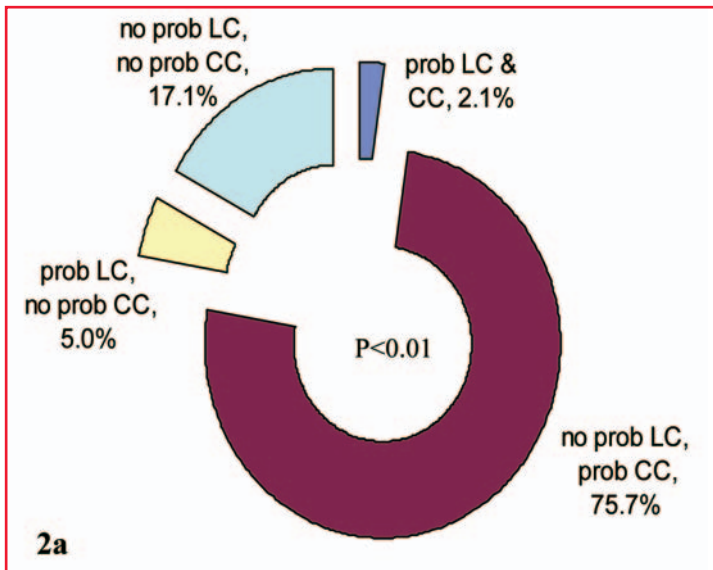


Figure 2a: problem with time

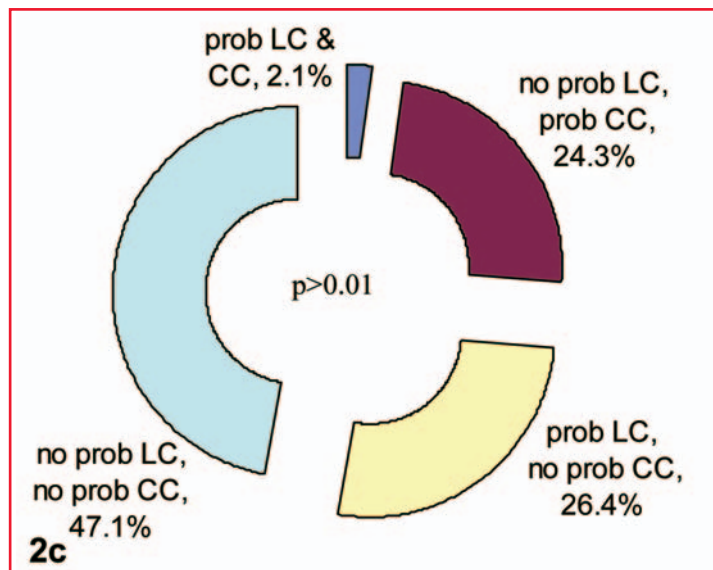


Figure 2c: problem with finishing

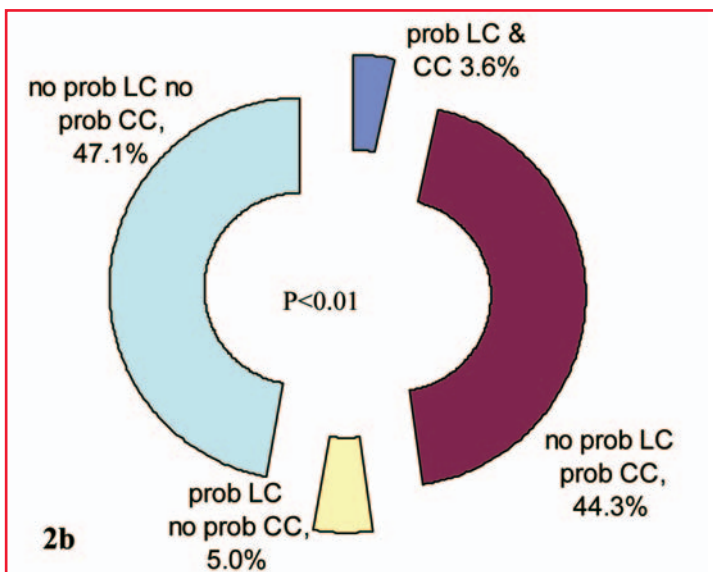


Figure 2b: problem with handling properties

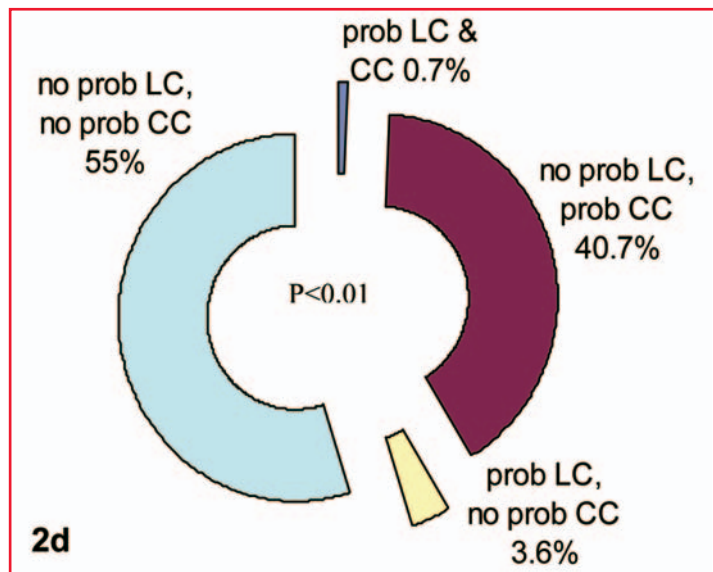


Figure 2d: problem with odour

students had no problem with either material; seventeen students had one problem with both LC and CC resin and 4 students had two problems with both LC and CC resin. Above these common problems, indicated by the shaded area, the table indicates that 111 students had more problems with CC than with the LC acrylic material. Below the shaded area, the table highlights the fact that only 5 students had problems with the LC acrylic material.

Clinical usage of these materials in the form of custom trays by the dental students showed an interesting response. Sixty three percent of respondents said that it was easier to add impression compound to the LC custom trays and 61.6% said zinc oxide eugenol impression material (S-S White) adheres better to the LC trays. An equal number of respondents (36.91% and 36.8%, respectively) disagreed with this.

There was a tendency towards the use of LC resin in both classes, although 48% of the 4th and 68% of the 5th year class (total: 51.6%) inclined towards having both materials being taught and used in undergraduate training. Twenty six percent preferred the LC resin, 20% said "teach and use" only LC resin and no one suggested the use of CC acrylic resin exclusively as part of the curriculum. (Figure. 3)

### DISCUSSION

The literature mostly discusses the use of CC custom trays and the properties of tray materials such as, the dimensional stability and hazardous effects, aspects which are currently being investigated further. Several of the more recent articles focussed on the properties of the LC acrylic resin custom trays and a few comparisons were made to the older CC acrylic

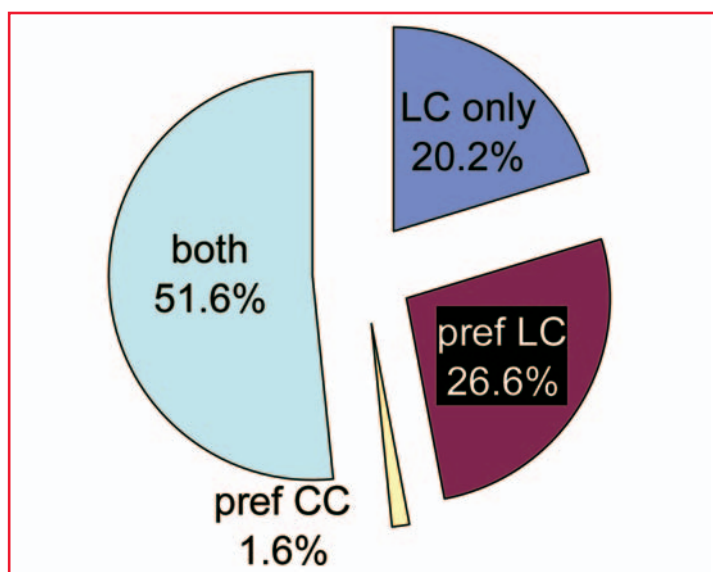


Figure 3: Material to be recommended. Pref = preferably.

material. No studies, however, have been found comparing the use of LC and CC acrylic resin for custom trays among undergraduate dental students.

The use of a questionnaire as a research tool is guided by certain principles. Questions must be focused on outcomes, be unbiased and be properly sequenced. Closed questions, and questions using yes/no or definitely yes/no answers on a scale, focus the respondents and contain the answers, thus limiting the choices to respondents. This simplifies recoding and analysing of data, but it can be viewed as a limitation when using a questionnaire to obtain information<sup>16</sup>.

A weakness of these types of questions is that no provision is made for recording individual opinions and differences. Methods such as piloting should be instituted to eliminate bias and ambiguity, especially among students where language may be a hindrance.

The survey indicated that the LC acrylic resin was used most often amongst the undergraduate dental students who had experience with both materials. This could be attributed to the fact that: it was considered more user-friendly by the students and/or they experienced and identified the negative effects of the CC acrylic and opted to use the LC material. The time taken to make custom trays with each material is also an important deciding factor; it was quicker with this new LC acrylic material. This could thus have been a deciding factor to use this LC material more often too. It is important to realise that this was a retrospective study and that availability of the two materials was not controlled although stocks should be constant in a teaching environment.

With regards to the ease of use of the LC acrylic resin:

Most respondents said that it was quicker to work with the LC compared to the CC acrylic resin. The focus of the students with regards to the acceptable effects of these materials was on time-saving and handling properties of both materials. It

was interesting to note that time-saving with the LC acrylic was positively mentioned in the survey and this confirms the results in the literature. Handling of the LC material covered aspects such as the material that comes in a wafer of equal thickness and that it can be cut to the required size making it easier to work with. In comparison to the CC acrylic material, there is no mixing of materials which eliminates any errors in production and no heat production is also experienced when working with this LC acrylic material. Ninety three percent (responses: yes and definitely yes) said it was easier to handle; and this was also indicated in the literature<sup>6</sup>. Seventy five percent said that the reparability is a positive factor with this new material.

The results focusing on the clinical responses could be related to following the manufacturer's instructions strictly or not. Reference is made to the wiping off of the sticky oxygen layer that forms on the surface of the LC trays with a solution provided by the manufacturers. This survey showed that only 2.8% used this solution exclusively and 30% used some other agents. This is a clear indication that manufacturer's instructions were not followed closely, with the resultant low response on the clinical use of this material. The reason why manufacturer's instructions are not followed should be investigated further.

Even though many of the articles discussed the effects of the monomer such as emittance of vapour as an important negative factor, only 40,7% of students alluded to this as a problem when working with this material.

The absence of odour of the LC acrylic could have positively influenced the choice of this material amongst students although they did not use this as a deciding factor. These responses could be due to the fact that their exposure to the material is limited.

The finish with the LC material was recorded as a deterrent to its use. It can therefore be concluded that there are some students who do prefer to work with the CC acrylic due to the more acceptable finish. According to the literature, the cost of the LC acrylic resin was high making it a negative factor, although this was not investigated further as it is not a consideration among dental students. The high cost also includes that of the curing-unit used. What is interesting is the fact that the students recorded it as such in this survey, showing a degree of "cost consciousness" among them.

With regards to the CC resin, the cost and clinical use seems to have been the acceptable aspects as no mention was made of either as negative effects exclusively or in combination with other properties. The percentages were negligible.

This survey indicated that both types of acrylic resin were acceptable as custom tray materials and no preference in teaching in this undergraduate training programme was suggested.

It is important to note that with different groups within the profession such as students, dental technicians or dentists, a different set of results may be obtained. It depends largely on the amount of time spent with the materials and the exposure time to the constituents of each material. For example, the hazardous effects will not be as clear with a person who occasionally uses the material (e.g. student) as compared to the one who uses it daily (e.g. dental technician). Therefore, a survey of this nature could be done among general dental practitioners/technicians and the results could be compared in the future.

When teaching a techniques course using these materials, one will obviously have a very different set of focuses and results. Students are assessed according to their handling of the materials, of the instrumentation and equipment involved and the outcome of the final product. When using the LC acrylic resin, which comes in a wafer/ sheet and can be cut to size, none of the dexterity or managing of the material is required to be checked. From a teaching perspective, using the CC acrylic resin would provide one with better criteria to assess the practical and future clinical abilities of dental students.

**CONCLUSION**

Most undergraduate dental students positively accepted the light-cured acrylic resin material, but suggested training in the use of both materials. It is suggested by the author that

dental schools should not expect any difficulties and /or resistance from students or staff when introducing new clinical methods and materials in their curricular. Decisions affecting a change in curriculum should be critically viewed in order to provide future students with the best learning options available to prepare them for the modern practice.

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The rest of this article's references (4-16) will be available on [www.sadanet.co.za](http://www.sadanet.co.za)

CONFLICT OF INTEREST.  
NO CONFLICT OF INTEREST WAS DECLARED

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**Dr A.K Seedat**

BSD(UDW) B.CHD(UWC) MDENT(ORTHO)(WITS)

**Orthodontist**

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