

# Teaching Approaches in South African Dental Schools: Direct Restorative Procedures

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## SUMMARY

**Introduction:** Worldwide the use of amalgam has declined and mercury-containing products are banned in several countries. National and international opinions on amalgam were recently discussed in journals. According to surveys, significant time is spent on the teaching of amalgam in American, Canadian, Irish and United Kingdom Dental Schools.

**Aims and objectives:** To i) investigate the teaching approaches on direct restorative techniques and materials in South African Dental Schools; ii) compare the teaching approaches of the dental schools in South Africa with each other as well as with the American, Canadian, Irish and United Kingdom schools; iii) use the information of this study as baseline data for future studies on teaching approaches.

**Methods:** A questionnaire regarding the teaching and training of direct restorations was e-mailed to the heads of Restorative Dentistry departments in four South African Dental Schools in 2007.

**Results:** Significant time is spent on teaching and training of amalgam as a restorative material. Teaching and training on direct restorations are very similar in all South African Dental Schools.

**Conclusion:** Although there is a decline in the use of amalgam worldwide, significant time is spent on teaching of amalgam restorations in South African Dental Schools and this corresponds to the curriculums of American, Canadian, Ireland and United Kingdom Dental Schools.

## INTRODUCTION

The use of dental amalgam as a restorative material, especially for posterior teeth, is still a relevant and controversial topic. The South African Dental Association (SADA) received letters of complaints from dental practitioners after media reports on the toxicity of amalgam. SADA responded via an editorial on the amalgam debate.<sup>1</sup> Dr. JT Barnard, executive director of FDI, (World Dental Federation) wrote a letter to the Swedish government to strongly reconsider the plans of banning dental amalgam in Sweden from 1 January 2007.<sup>2</sup> Clinical studies, research and opinions on amalgam, as a restorative material, were recently published.<sup>3-5</sup> A clinical

study on neurobehavioral assessment, which was performed on Portuguese children from 1997 to 2005, found that there was no significant difference in neurobehavioral assessment (memory, concentration and motor/visuomotor domain) and conduction velocity between children who received amalgam and children who received composite restorations. There was a higher treatment need later among children who received composite restorations and the authors<sup>3</sup> suggested that amalgam should remain a viable dental restorative option for children. A clinical study to compare the neuropsychological and renal function of American children, aged between six to ten years, whose cavities were restored using amalgam or mercury-free materials, found no significant difference in adverse neuropsychological or renal effects over a period of five years. Thus, the authors<sup>4</sup> suggested that the health effects of amalgam restorations in children should not be the basis of treatment decisions when choosing restorative dental materials. Osborne<sup>5</sup> (2006) concluded that amalgam is still a viable restorative material.

In a survey regarding the use of dental materials by dentists in South Africa during 1999, Du Preez *et al*<sup>6</sup> (2003) found that 85.8% of respondents were still using amalgam as a direct restorative material. The use of amalgam has declined significantly in the last few years.<sup>7,8</sup> Reasons for this may be the improvement in the properties of bonding agents and resin composites, aesthetic demands of patients and the health concerns regarding the mercury in amalgam.<sup>9,10,11</sup> Composite restorations usually have a shorter clinical lifespan than amalgam restorations.<sup>7,8,12,13</sup> Furthermore, the need for endodontic treatment is usually more frequent for composite restorations than for amalgam restorations.<sup>12,14</sup> In a clinical study, Prof. Paul Abbott, an endodontist, found that teeth restored with amalgam will take longer to present with a pulp disease (68.7% > 10 years and 10.7% between six to 10 years) compared to those restored with composite (91% < three years, remainder by seven years). However, cracks were more common in teeth restored with amalgam than those restored with composite.<sup>14</sup> Brandt and De Wet<sup>10</sup> (2006), stated in their article on the sensitivity of composite restorations that practitioners who do not feel comfortable with the difficult composite placement technique, should rather do a good amalgam restoration, which

will ensure a far more predictable outcome and a longer life for the tooth.

Contra-indications for placing composite restorations include the inability to properly isolate the operating area and occlusal factors such as heavy occlusion, bruxism and restoration that occupy all of a tooth's occlusal surface.<sup>15</sup> Advantages of composite restorations include good aesthetics, conservative cavity preparation, low thermal conductivity, bonding to tooth structure and reparability. Disadvantages include gap formation because of polymerization shrinkage, more time consuming and costly placement techniques, more technique sensitive, greater occlusal wear and higher linear coefficient of thermal expansion resulting in marginal percolation.<sup>15</sup> According to Coltene Oralloy Magicap S instructions for use,<sup>16</sup> contra-indications for placing amalgam restorations include allergic reactions to any of the components of amalgam, people with severe kidney disease, retrograde root canal fillings, extensive amalgam therapy during pregnancy and in small children. Advantages of amalgam include: ease of use, high compressive strength, wear resistance, good long term clinical results, less expensive than composite, self sealing ability of the cavity with corrosion products and bonding of amalgam (less microleakage, increased strength of the remaining tooth structure, decreased post-operative sensitivity, some retention benefits). Disadvantages of dental amalgam restorations include: not tooth coloured, mercury content, less conservative cavity preparation, weakens tooth structure and initial marginal leakage.<sup>15</sup>

A survey of teaching programmes for direct composite restorations in North American dental schools in 1997,<sup>17</sup> revealed an increase in the time devoted to the teaching of posterior composites, but graduates have minimal clinical experience with composite restorations. It was further determined that 37% of schools spent less than 5% and none of the schools spent more than 50 % of teaching time on the teaching of posterior composites. Seventy five percent of the schools replied that it is contra-indicated to replace large amalgam restorations with composite.<sup>17</sup> In a 2003 survey in Canadian dental schools on teaching approaches related to the use of amalgam and composite for posterior restorations in adults and children, it was found that in their Operative Programmes for adults the curriculum time devoted to amalgam is either more or equal to that of composite. Five of the eight schools also reported greater emphasis on the teaching of silver amalgam. For the Paedodontic Programmes five of the schools reported a greater emphasis on amalgam, three an equal emphasis on amalgam and composite and two a greater emphasis on composite.<sup>18</sup> With a follow-up study in 2004 on 15 dental schools in Ireland and the United Kingdom, the authors concluded that the emphasis on the teaching of posterior composites has increased but that the amount of teaching of amalgam restorations is still greater than that of composite.<sup>19</sup> In these three studies it can be seen that a significant amount of time is still spent on teaching amalgam restorations in American, Canadian, Irish and United Kingdom Dental Institutions. At the Dental School of the University Medical Centre Nijmegen, in the Netherlands, dental amalgam ceased to be taught in 2001. The use of amalgam was terminated because of the more conservative cavity preparations for composite restorations and the strengthening of the remaining tooth structure and not because of aesthetics or the adverse side effects of dental amalgam.<sup>20</sup>

## OBJECTIVES

The objectives of this study were to investigate the teaching and training approaches towards dental amalgam and amalgam

alternatives as direct restorative materials in South African Dental Schools; to compare the teaching approaches of direct restorative techniques and materials among South African Dental Schools as well as American, Canadian, Irish and United Kingdom Dental Schools; to use the information of the current study as baseline data for future studies of changes in the teaching approaches of South African dental schools in future studies.

## MATERIALS AND METHODS

A questionnaire, a revised version (permission was obtained) of the one used by Prof Dorothy McComb\* for a similar study at Canadian Schools of Dentistry, accompanied by a letter explaining the proposed research project, was e-mailed in June 2007 to the heads of the departments of Operative or Restorative Dentistry of the four South African Dental Schools (Schools of Dentistry: University of Limpopo, University of Pretoria, University of the Western Cape and the University of the Witwatersrand). Information was gathered on the teaching of direct restorative materials and clinical procedures for posterior teeth using dental amalgam and amalgam alternatives as restorative materials.

The questions focussed on the direct restorative materials, duration of the course, years in which the theoretical, pre-clinical and clinical components are presented, time devoted to the teaching of the restorative materials, percentage of pre-clinical time spent on amalgam and composite resin procedures and number of restorations required to successfully complete the course. The questions also focussed on contra-indications for placing amalgam and composite resin, clinical competency test for amalgam and composite restorations, changes regarding the teaching of amalgam and composite as posterior direct restorative materials and bonding of amalgam.

Descriptive statistical analysis using frequency counts of responses for the different questions of the four dental schools were calculated.

## RESULTS

There was a 100% response rate to the questionnaires sent to the dental schools. The questionnaires were completed by the Head of Department and/or staff members involved in the teaching and training of the direct restorative procedures at the four dental schools.

In view of the respondents concerning the inclusion of the direct restorative materials (amalgam, conventional composite resins, flowable composite, condensable/packable composite, conventional glass ionomers, resin modified glass ionomers and compomers) in the Restorative Dentistry curriculum, three of the schools were in favour that all these materials be included while one of the schools indicated that packable composite and compomers should not be included. To complete the dental course, all four dental schools require a minimum of five years.

The pre-clinical component of the direct restorative module is presented in two of the schools in the 3<sup>rd</sup> year, one of the schools in the 2<sup>nd</sup> year and one of the schools in the 1<sup>st</sup> and 2<sup>nd</sup> years. The theory of the direct restorative module is presented in one of the schools in the 2<sup>nd</sup> and 3<sup>rd</sup> year, one of the schools in the 3<sup>rd</sup> and 4<sup>th</sup> year, one of the schools in the 3<sup>rd</sup> year and one of the schools from the 1<sup>st</sup> to the 5<sup>th</sup> year. The clinical component of the direct restorative module is presented at two of the schools in the 3<sup>rd</sup> and 4<sup>th</sup> year, one of the schools in the 4<sup>th</sup> and 5<sup>th</sup> and one of the schools in the 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> year.

still spent on teaching amalgam in American, Canadian, Irish and United Kingdom Dental Institutions.<sup>17,18,19</sup> A dental school at Nijmegen, Netherlands, ceased to teach dental amalgam in 2001.

The current study was undertaken to get information from the different South African Dental Schools to determine whether the teaching of amalgam as a restorative material is still relevant and to compare the teaching approaches at South African Dental Schools with those of international dental schools.

All the respondents of the four South African Dental Schools believe that amalgam must be included as a direct restorative material. This is in agreement with the international studies done at dental schools in Canada, Ireland and the United Kingdom.<sup>18,19</sup> Because of different teaching approaches, the pre-clinical and clinical components of the direct restorative module are presented in different years at the different South African Dental Schools. On the teaching of the theory of direct restorative materials, reasons were not given as to why flowable and condensable composites are not taught and why most of the time is spent on teaching resin modified glass ionomers in one of the dental schools. This may lead to a void in the teaching and training of students in this school because of the development of a new posterior composite resin (silorane technology) and the many applications of flowable and packable composites. The four schools devote equal amounts of time on the pre-clinical teaching of amalgam and composite (50% on amalgam and 50% on composite). In contrast, five of the eight Canadian dental schools placed a greater emphasis on silver amalgam.<sup>18</sup>

Clinical procedures including amalgam and composite restorations is a requirement of all the South African Dental Schools. In three of the schools the clinical requirement for composite is higher than that for amalgam. In the 4<sup>th</sup> school the clinical requirement is the same for amalgam and composite. The reason for the higher requirement for composite may be the small cavities that are restored with composite (minimal invasive procedure). In Canada, five of the eight schools require specific numbers of surfaces or restorations. However, two abolished requirements and one school required a minimum of restorations in either type of restoration.<sup>18</sup> In the Irish and United Kingdom schools the posterior amalgam restorations to be placed by undergraduate students represent 65 – 70% and composite 30% of the requirement.<sup>19</sup>

Contra-indications for placing amalgam in patients on which 50% or more of the South African Dental Schools agree include: large intercusp width of the cavity, endodontically treated teeth, core build-up of vital teeth, patient mercury concern, pregnant patient and children younger than six years. An interesting finding was that one of the schools identified large pulps as a contra-indication for placing amalgam which is not assumed to be a contra-indication by the other schools. More than 50% of schools agree on the following as contra-indications for placing composite restorations: poor oral hygiene, gingival margin of the composite on root structure, parafunctional activity, direct/indirect pulp capping and children younger than six years. There is a difference of opinion between South African Dental Schools regarding contra-indications for the placement of amalgam and composite. These differences are also found in schools in Ireland and the United Kingdom.<sup>19</sup> Lynch *et al*<sup>19</sup> reports that at a meeting of the British Association of Teachers of Conservative Dentistry, guidelines concerning composite were agreed upon to encourage consensus

on the use of composite. Considering the contra-indications for placing amalgam or composite, there is not one direct restorative material which can be used to restore all cavity preparations in all clinical situations.

Although clinical test(s) forms part of their module assessment, not all the students in South African Dental Schools are evaluated on Class II composite restorations, either because of student choice or because of the schools' curriculum. In one of the schools where the majority of students prefer to use amalgam, the reasons can be that amalgam is less technique sensitive, easier and faster to place than composite. In five of the eight Canadian schools, there is a Class II clinical competency test for both restorative materials.<sup>18</sup>

Because there was no significant change in the curriculum concerning teaching and training on amalgam and resin composite in three of the schools in the previous five years - and no changes anticipated in the four schools in the near future - schools may consider to give students more exposure to composite when considering that there is a decrease in use of amalgam for posterior restorations. Canadian Dental Schools are not anticipating any major curriculum changes in the next year or two.<sup>18</sup> Irish and United Kingdom Dental Schools anticipate that over the next five years there will be an increase in posterior composite restorations placed by undergraduate students, 50% would be amalgam and the rest composite resin.<sup>19</sup>

## CONCLUSION

Although the use of amalgam has declined significantly in the last few years, amalgam is still a relevant restorative material and significant time is still spent on teaching and training students on amalgam in South African, American, Canadian, Irish and United Kingdom Dental Schools. Teaching and training of students in direct restorative dentistry between the four South African Dental Schools and between dental schools in America, Canada, Ireland and the United Kingdom are similar. International guidelines on teaching and training off all aspects of composite restorations should be discussed and published to ensure uniform consensus on the use of composite. Because of the increased use of composite as a posterior restorative material, dental schools must consider to put greater emphasis on the teaching and training of composite as a direct restorative material for posterior teeth.

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**Declaration:** This research has been approved by the University of Limpopo (Medunsa Campus) Research and Ethics Committee and no conflict of interest was declared.

## REFERENCES

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*Additional references (5-64) are available on [www.sada.co.za](http://www.sada.co.za)*

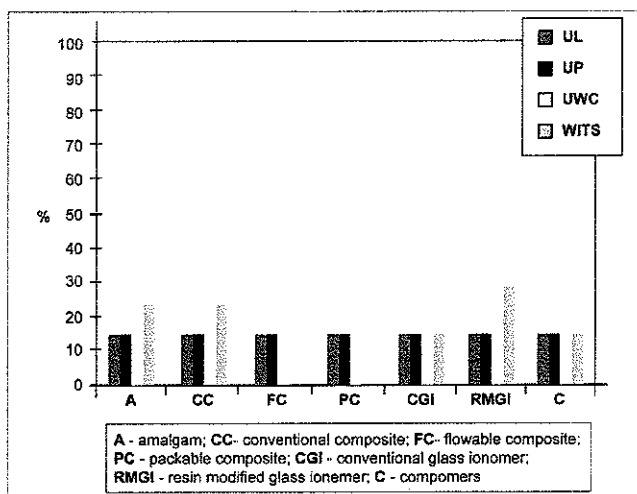


Figure 1: % of time devoted to teaching the theory of direct restorative materials

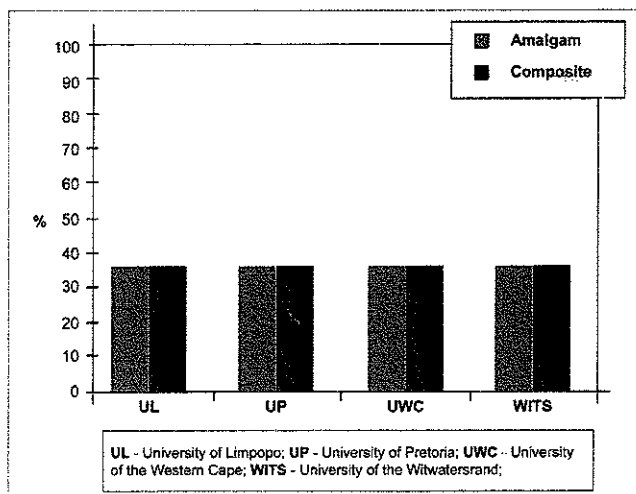


Figure 2: % of time devoted to pre-clinical teaching of amalgam and composite

	Amalgam	Composite
Poor oral hygiene/high caries risk	0	4
Gingival margin on root structure	0	3
Parafunctional activity/heavy occlusion	1	3
Cavity size > 2/3 inter-cuspal width	2	1
Large pulps	1	0
Direct/indirect pulp cap	0	3
Endodontically treated teeth	2	0
Core build up (vital teeth)	2	0
Removeable partial denture abutment	0	1
Patient mercury concerns	3	0
Contact with dissimilar metal	1	0
Pregnant patient	2	0
Age of patient:		
< 6 years	2	2
> 6 years	0	0
Patient health problems (Severe kidney disease)	1	0

In terms of the percentage (number of lecture sessions to total number of lecture sessions) of time devoted to the teaching of the theory of the direct restorative materials, three of the schools dedicated equal amounts of time to all the restorative materials. One school did not teach flowable or condensable/packable composite and spent more time on teaching amalgam and conventional composite resin than on conventional glass ionomer and compomers. Most of the time at this school was spent on teaching resin modified glass ionomers (Figure 1). The percentage (number of practical sessions to total number of practical sessions) of time devoted to pre-clinical teaching of amalgam and conventional composite resins: all four of the schools devoted equal amounts of time to amalgam and conventional composite resin (Figure 2). All of the schools had clinical requirements (number of surfaces to be completed) for amalgam and conventional composite resin

Contra-indications as indicated by the different schools for placing amalgam in Class II cavities include parafunctional activity/heavy occlusion (one school), large cavity size (two schools),

large pulps (one school), endodontically treated teeth (two schools), vital teeth core build up (two schools), patient mercury concerns (three schools), contact with dissimilar metals (one school), pregnant patient (two schools), children younger than six years (two schools), patients with health problems (one school) - kidney disease as the contra-indication (Table 1). Contra-indications for the placement of composite in Class II cavities include poor oral hygiene/high caries risk (four schools), gingival margin on root structure (three schools), parafunctional activity/heavy occlusion (three schools), large cavity size (one school), direct/indirect pulp capping (three schools), removable partial denture abutment (one school), children younger than six years (two schools) (Table 1).

In all four dental schools, clinical tests form part of the module assessment. In one school the students have a choice for their clinical test between Class II amalgam, Class II, III or IV composite. In the 2<sup>nd</sup> school the students have a clinical test for Class II amalgam and Class IV composite. In the 3<sup>rd</sup> school students have a choice of amalgam or composite to restore a Class II cavity. In the 4<sup>th</sup> school the students do a clinical test in all the classes of cavities (Class I and II amalgam, Class I, II, III and IV composite). Of the two dental schools where students have a choice of the restorative material to use for Class II restorations during the clinical test, the students in the one school preferred amalgam and the other school composite.

On the question if there was any change in the focus concerning teaching of amalgam and/or posterior composite during the previous five years for Class II restorations, three of the schools reported no change, while one of the schools indicated an increased focus on posterior composite. All schools did not anticipate any change in the focus concerning teaching of amalgam and/or posterior composite in their curriculum during the next year or two for Class II restorations. All the dental schools teach their students the bonding of amalgam.

**DISCUSSION**

National and international discussion on the use of dental amalgam as a restorative material is still a relevant and controversial topic. This can be seen in the banning of amalgam in certain countries, recently published clinical studies, research and opinions in national and international media.<sup>3-5</sup> Significant time is