Planning oral rehabilitation: case-based computer assisted learning in clinical dentistry

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The partially edentulous adult offers a unique and problem-rich resource as a basis for a case-based learning scenario in clinical dentistry in the field of planning oral rehabilitation. However, there is little resource material available to help students negotiate the territory between diagnosis and treatment options of discrete conditions and treatment sequencing once decisions have been made. To address the educational void surrounding the teaching and learning of oral rehabilitation strategies, the authors have developed a CD-ROM '*Interactive Learning in Dentistry: Decision making in the oral rehabilitation of the partially edentulous adult*'. The disc emphasises the distinction between 'doing' and 'planning to do' in the decision-making process. After using the disc the students should be able to apply a generic framework to formulate a custom oral rehabilitation plan for their own patient. The disc was evaluated by final-year students from the Faculty of Dentistry, University of Sydney. Response to the program was essentially positive and comments from students have impacted on further development.

The partially edentulous adult offers a unique and problem-rich resource as a basis for a case assisted learning (CAL) scenario in clinical dentistry. The decisions that must be made when planning long-term rehabilitation of such a patient are multifactorial and cover almost all the clinical disciplines, as well as questions of ethics and patient management. For example, the presence of one or more edentulous spaces may have implications in the fields of occlusion, prosthodontics, tooth conservation, endodontics, periodontics, exodontia and/or oral surgery. Since treatment will be largely elective, there are usually several options available to the patient and consequently the possibility of ethical and legal ramifications may be included.

However, while it is patently possible to build scenarios from the partially edentulous adult which span any or all aspects of clinical dentistry, there is little in the dental literature to act as a resource to provide students with strategies to unravel the problems generated. Dental educational material abounds in tactics for diagnosis of various clinical conditions and also in planning treatment sequences once these diagnoses have been made. This still leaves a grey area between diagnosis and treatment sequencing which is largely ignored, or dismissed with the words 'formulate a treatment plan'. The process of formulating a treatment plan from such a wealth of data is second nature to the dental expert who teaches in the clinical setting. It is usually the culmination of years of clinical experience with little or no conscious thought as to the mental steps taken to arrive at the plan. In addition, there is usually no single 'correct' rehabilitation plan. Several experts can, and routinely do, arrive at several different plans for any particular patient. Beginners are often confused by the variation in philosophies conveyed by different experts in the field. As a result students, who have a limited clinical background, find learning how to plan frustrating and difficult.

To address the educational void surrounding the teaching and learning of oral rehabilitation strategies, the authors have developed a CD-ROM (*Interactive Learning in Dentistry: Decision making in the oral rehabilitation of the partially edentulous adult*) (http://www.dentistry.usyd.edu.au/introduction.htm). It was produced to help dental students learn how to negotiate the territory between diagnosis and treatment sequencing in a logical manner and without losing any of the important detail.

Aims

The aim of this paper was to evaluate the CAL program (CD-ROM) that was intended to guide students in a generic framework of clinical decision making. After using the CD-ROM, the students should be able to apply this framework to formulate a custom oral rehabilitation plan for their own patient and to justify it with confidence. A secondary objective is to update discipline-related knowledge.

Challenges

Planning oral rehabilitation consists of making many interrelated decisions which all impact on each other. Helping students to find a reliable protocol which will allow them to do this in a productive manner encompasses three main problem areas.

Firstly, the term 'treatment plan' itself is poorly defined and may mean any of a number of things from diagnosis and decisions regarding treatment needs of isolated conditions, to making decisions regarding treatment of the whole oral cavity or to sequencing treatment once decisions have been made. The authors have therefore avoided use of this terminology and designated the area between diagnosis and procedural treatment sequencing as 'decision making in oral rehabilitation'. The phrase covers decisions about all the options and permutations possible for the treatment of

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each tooth, any area of soft tissues, each periodontium and each edentulous space. Only some decisions are based on purely dental knowledge. Others deal with the recognition of the needs and wants of the patient as a person and the realistic limitations of treatment imposed by time, skill, equipment and finances. All these factors are interrelated and all impact on each other.

The second problem is the difficulty many students have in the concept of 'planning to do', ie 'making' decisions, as opposed to 'doing'. The sequencing of these two processes is usually best done in reverse order. For example, when dealing with a building, the 'doing' is the laying of the foundations before the building is constructed and then used. The 'planning to do' needs knowledge of what the building is to be used for before the type and method of construction is decided on. The size and type of construction will then impact on decisions as to the type of foundations to be laid. The sequences in 'planning to do' and in 'doing' are reversed. Similarly in dentistry, the 'doing' should be in the following order.*

- Urgent treatment
- Control of disease
- Conservation of oral tissues
- Reconstruction
- Maintenance

This sequence of treatment procedures is based on sound dental principles of patient management. However, as in the example of the building, when 'planning to do', the order is essentially reversed. While 'urgent treatment' must stay first, the order of the remainder of 'planning to do' must begin with maintenance. What kind of work can the patient maintain? This will impact on the kind of reconstructive work envisaged, which will, in turn, dictate which structures should be conserved and thus allow a decision to be reached as to an appropriate disease control strategy (Fig. 1).

The third issue is the educational one of promoting higher learning, which is the construction of meaning from experience.[1] Undergraduate students have very little experience in completing cross-disciplinary rehabilitation plans in a logical manner, but usually have at least some experience in choosing options for discrete conditions. Observation has shown that senior students, who have some clinical background, are willing and able to discuss possibilities and options in planning rehabilitation, but that these discussions tend to be formless, repetitive and rarely progress to a definitive plan of exactly what treatment the patient will receive.

The main intent of the disc, therefore, is to provide a framework that follows specific guidelines in the decision-making processes used to arrive at a rehabilitation plan and treatment sequence for each patient. Creating an environment of supplying very little information in a direct fashion, while at the same time eliciting this information from the students themselves and keeping a complex set of ideas on track, constituted the biggest of the three challenges faced in creating the disc.

The upper left third molar has little crown structure remaining and is periodontally compromised. The strategic value, and consequent treatment, of this tooth will vary depending on decisions regarding restoration of the abutting edentulous space. Will the upper left missing teeth be replaced at all? If not, then the upper left third molar has little value as there is no opposing occlusion and it does not impact on aesthetics. If a conventional fixed or a removable prosthesis is envisaged it has a very high strategic value indeed, and is worth considerable effort to restore and bring to periodontal health. If implants are contemplated, the value of the upper left third molar once again decreases and the best option may well be extraction.

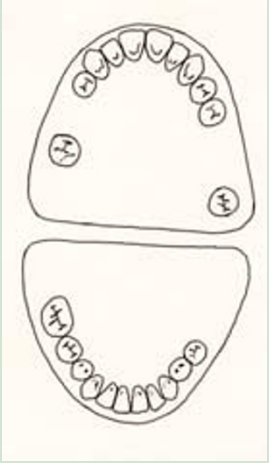

Fig. 1 Odontogram of a hypothetical patient.

The program

The program exploits the full educational potential of computers by the use of graphic movement and three-dimensional images which allow the rotation of diagnostic casts to show any angle required, quickly and easily. It was developed with subject input from all adult clinical disciplines in the Faculty of Dentistry at the University of Sydney. It consists of four main main menus, comprising three cases and a library (Fig 2).

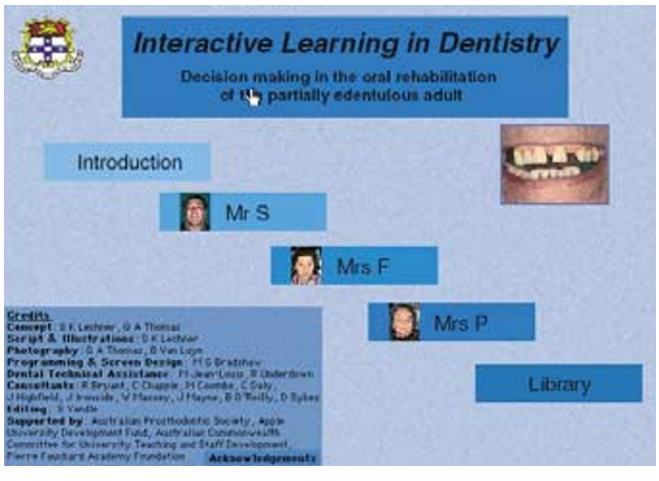

Fig. 2 The main menu of the CAL disc *'Interactive Learning in Dentistry: Decision making in the oral rehabilitation of the partially edentulous adult'*. Students work through oral rehabilitation plans for three very different cases, using a generic framework as a guide. The library deals with referrals, informed consent and history taking.

*Faculty of Dentistry (Sydney). Treatment planning protocol for general dental practice. Publication: Faculty handout, 2000.

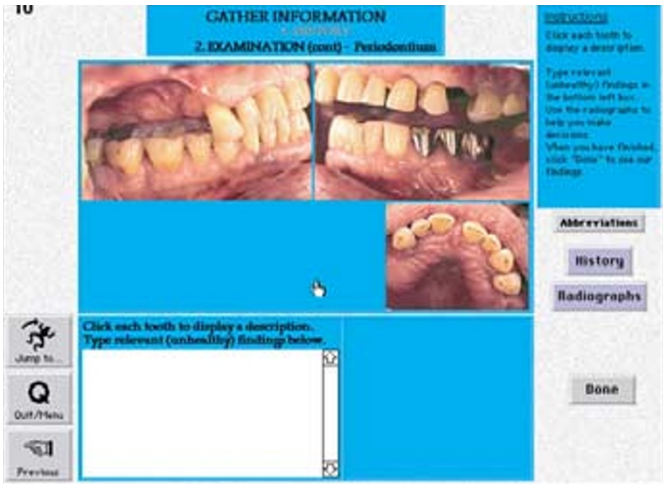

Fig. 3 The main image is in the centre of the screen and the question and answer texts are above and below respectively. Other peripheral areas give additional options available to the user at any stage of the sequence.

While all cases encompass all aspects of clinical dentistry, the emphasis of each case is different. Case 1 has a prosthodontic dilemma, Case 2 has many periodontal problems and Case 3 deals principally with tooth conservation and endodontics. However, all progress within the same framework, with each decision reached impacting on the next one. Each case begins with the patient's history and proceeds briefly through gathering of data (history and examination). Urgent treatment is addressed, the data is summarised and the student is then guided through the various stages of planning. The patient's main concern(s) appears at the top of each screen as a constant reminder. Each treatment decision is made from a choice of options and is rated as urgent, essential, high priority or low priority.

Some conditions require the patient to be referred to a specialist. Details of how and when to refer are covered in the library. The library also addresses the legal aspects of practice, such as gaining informed consent. It is envisaged that further details pertaining to decision making within individual disciplines can be added to the library at a later stage.

Screen design

The layout of the screen follows a concept found to be successful in a previous educational disc.[2] It consists of the main image being in the centre of the screen and the question and answer texts above and below the image respectively (Fig 3). This keeps the focus of attention on that image rather than having it as supplementary material to a text based presentation. The areas to the left and right of the image are used for additional options available to the user at any stage of the sequence. These options include allowing for easy navigation to other parts of the program, referring back to decisions already made, rechecking examination data and to 'learning more about' various points of interest. It was assumed that users would not be computer literate, and a text summary indicating how to complete the current stage of the sequence appears on the right of each screen.

The program follows the interactive format used by Davenport and Pollard[3]. There are almost no didactic screens. Instead, almost every screen asks a question. Questions and answer scenarios vary. They include simple yes/no, multiple choice, put things in the right order or sort into the right category (Fig 4). One of the difficulties encountered in teaching this subject is that there is usually a diverse range of useable options in each stage of planning. For this reason, many of the screens ask the student to type in their own answer rather than respond to a multiple choice question. When they have finished they can proceed to see an expert answer and the question is asked: 'Was your decision as good as, or better than, ours?' (Fig 5). This keeps the program on track while allowing students the freedom to have their own opinions.

Since learning from one's mistakes forms part of the learning process for some students, the program does not keep track of 'mistakes' and students are not penalised for a different or incorrect choice. The program thus encourages them to explore and to feel that they can purposely choose a wrong answer just to see what happens. For example, one inappropriate choice in the program results in the patient suing for a squillion Widgets.

Minimum requirements for using the program are 486DX or Pentium processor with Windows 95/98, QuickTime 3.0 (included), 16MB memory, 16-bit (High Colour) video, Sound card, 4x CD-ROM drive or Macintosh, PowerPC processor, System 7.1 or later, QuickTime 3.0 (included), 16MB memory,16-bit (Thousands) capable video, 2x CD-ROM drive.

Evaluation

The authors were particularly anxious not to assume that the evaluation would determine actual learning outcomes, for two reasons. Firstly, it is not always possible to say objectively that one rehabilitation plan is better than another. Secondly, current educational thinking is leaning away from quantitative research in the evaluation of learning programs, since true learning outcomes cannot be quantitatively defined[5,6]. Thus, the focus of the evaluation was to determine whether the program was helpful and easy to use.

The disc was evaluated by 32 final-year students from the Faculty of Dentistry, University of Sydney. Students were asked to use the CD-ROM and then given an anonymous questionnaire based on a similar one found to be useful in a previous study. It contained four structured questions and four open questions (Table 1).

Previous computer experience varied from little or no computer experience (70%) to having used computers 'hundreds of times!' (30%). It was interesting to note that limited computer expertise did not seem to impact on feeling '…. comfortable using the computer for this learning experience'. Eighty-seven per cent of students felt 'very' or 'quite' comfortable using the program. In a related question 87 % also agreed that, 'finding my way through the program was easy'.

Overall response was positive. All students felt that the program increased their confidence in planning oral rehabilitation. Sixty-three per cent said it increased their confidence 'a little', 37% said it increased it 'a lot' and none said that it did not help at all. In a related question, 'I felt that the program increased my understanding of the subject matter', 81% agreed, 12% neither agreed nor disagreed and 6% disagreed. Students also felt that the subject matter was relevant. Eighty

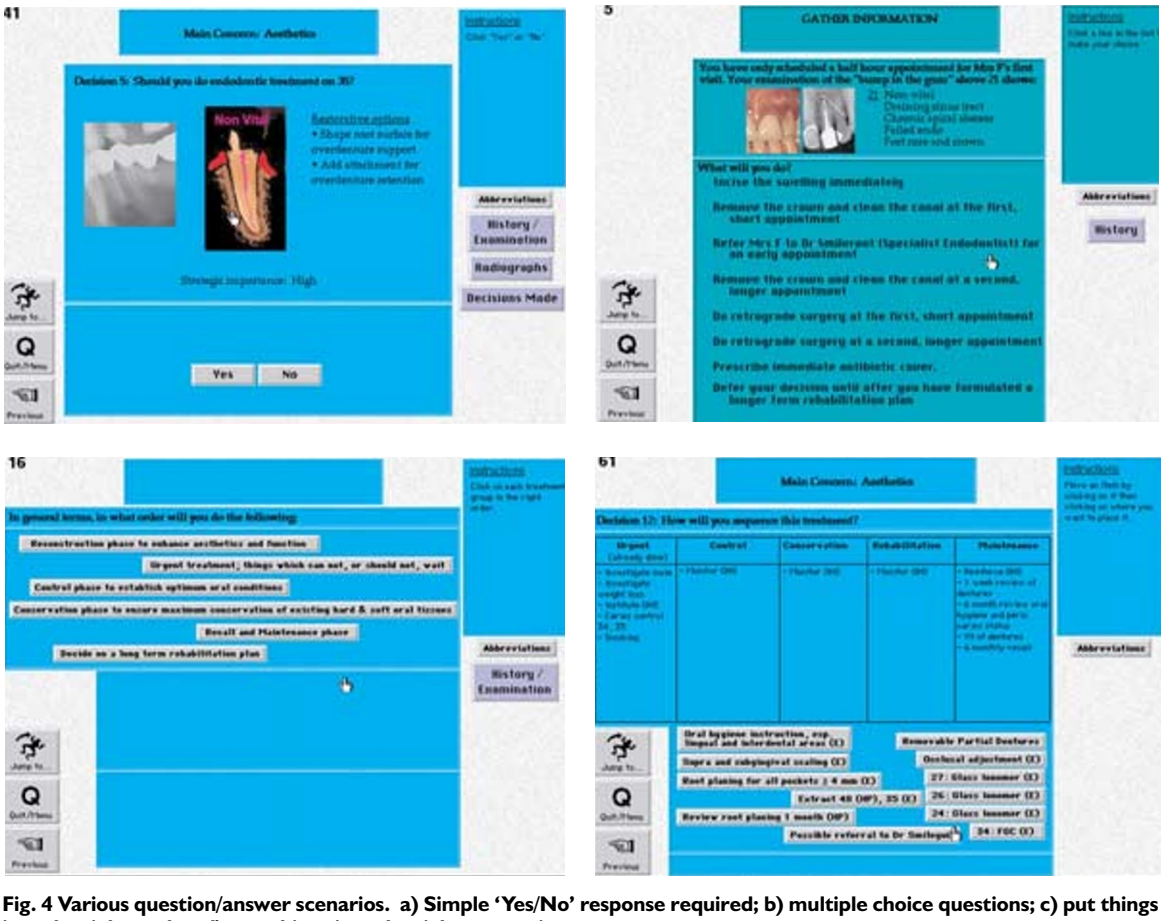

Fig. 4 Various question/answer scenarios. a) Simple 'Yes/No' response required; b) multiple choice questions; c) put things into the right; order; d) sort things into the right categories.

per cent answered the question 'How important is it to learn how to plan oral rehabilitation? Why?' by positive phrases such as 'Very, very important. It is a major part of being a dentist', 'Crucial', '…basis of good practice', etc.

When asked to associate positive and negative words with their experience of the program, 84% checked only positive words (mostly 'useful', 'enjoyable' and 'informative'), 16% checked both positive and negative words ('frustrating', 'difficult'). None checked only negative words. Some students added explanations to the negative words; 'frustrating' was due to lack of time or computer access. This issue regarding lack of time was repeated several times in the open question about 'the worst thing about the program'. Other recurrent complaints related to the typing required throughout the program and the perception that it was too long but needed more cases.

The 'best things about the program' were perceived to be the interactive and self-paced nature of the learning process, as well as the graphics and the screen design and layout. Students also described the program in their own words as 'interesting', 'comprehensive' and 'relevant'.

In response to the open question 'What was the main thing you learnt?' most answers referred to the logical progression of planning, the insight into decision making and the need for flexibility in planning treatment. Typical answers were, 'Planning is complex and requires time and a lot of thinking in a multidisciplinary approach' and, 'Treatment varies a lot depending on the patient'. One student replied, 'How to stay out of legal trouble!'

As has been found in other studies[4] some students did not want to forgo human tuition entirely. In response to the question 'Would learning about oral rehabilitation be better in lectures?', 44% answered 'no', 34% wanted a combination of both, but 22% felt that lectures would be better.

A later discussion with some of the students elicited the suggestion that the program be used in the more junior years where they felt it would be even more useful. Other comments reiterated what had been learnt from the questionnaire.

Future directions

To address the problems articulated by the students, several changes are being made:

- The program has been introduced earlier in the course

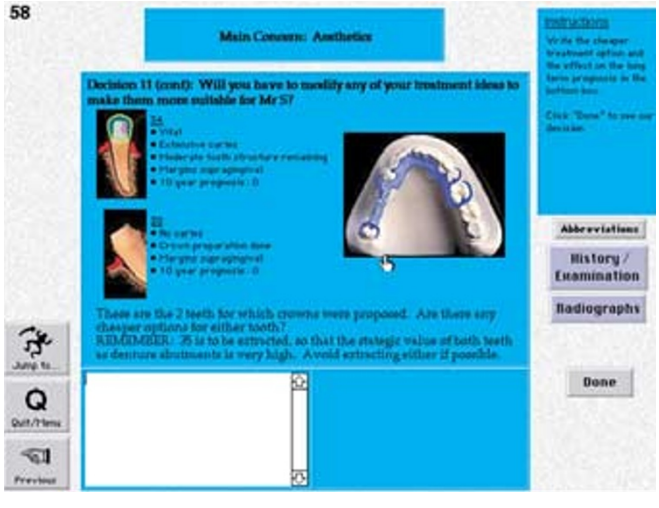

Fig. 5 For questions where a wide range of answers could be acceptable, students are asked to type in their own answers. They can then immediately compare their answer with an expert answer and are asked, 'Was your decision as good as, or better than, ours?'

Table 1 Questionnaire

1. How many times have you used computers? Please tick the appropriate box.
   a) Never ☐ b) 1–10 ☐ c) 11–40 ☐ d) 51–100 ☐ e) Hundreds of times ☐

2. How comfortable did you feel using the program?
   Very ☐ Quite comfortable ☐ Not very ☐ Very uncomfortable ☐

3. The program increased my confidence in planning oral rehabilitation for my own patients
   Yes, a lot ☐ Yes, a little ☐ Not at all ☐

4. Please tick the response which best represents your experience of this computer program.
   (A: Agree, N: Neither agree nor disagree, D: Disagree)

	A	N	D
Finding my way through the program was easy			
I felt that the program increased my comprehension of the subject matter			
I would prefer to have a lecture rather than trying to learn through a computer			

5. How important is it to learn to plan oral Rehabilitation. Why?
   .....

6. Tick as many of the words listed below as describe your experience of this computer program in your first session:
   Fun ☐ Informative ☐ Frustrating ☐
   Boring ☐ Irritating ☐ Enjoyable ☐
   Innovative ☐ Useless ☐ Useful ☐
   Difficult ☐

7. What was the worst thing about the program?
   .....

8. What was the best thing about the program?
   .....

9. What was the main thing you learnt?
   .....

- More time has been dedicated for using the program and better access to computers has been provided. The disc is also available in the library.
- Short quizzes have been included to act as milestones and counteract the perception that the cases are too long.
- More cases will be included as time permits.
- A method has been included to allow students to bypass some of the typing if they wish to.

Conclusion

Planning oral rehabilitation for the partially edentulous adult is a complex activity that must take a multitude of factors into consideration.

Key issues to be considered include state of the art treatment options, the realities of time constraints, limitations of operator skill, patient compliance, financial pressure and legal and ethical dilemmas. This complicated process was simplified and presented to students in a logical sequence in a case-based CAL format. By guiding students in the use of a generic planning template, the program helped them to become more confident in planning oral rehabilitation for their own patients.

Overall student response was positive as to relevance, things learnt and ease of use of the program. However, some students did not want to lose human tuition entirely, seeing the program as an additional, rather than as a stand-alone, resource. The program should thus be envisaged fundamentally as a basis for further discussion with clinically experienced experts.

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