



ASSESSMENT OF CLINICAL REASONING IN DENTAL STUDENTS; A CROSS-CURRICULA COMPARATIVE STUDY

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ABSTRACT

Objectives: In response to the gap in the dental literature, the present study aimed at developing a high-quality test to assess clinical reasoning skills in dental students. In addition, it also aimed at understanding the effect of many factors on the level of clinical reasoning development. **Methods:** An online test was created to assess different skills involved in the process of clinical reasoning using a combination of well-known tools. The innovative approach for this quantitative cross-sectional study was used to assess clinical reasoning in final year dental students from three different schools in the United Kingdom and Saudi Arabia. Response rates were different for each school being 50%, 51% and 45%. The study took place in 2013. **Results:** The developed tool was valid, reliable and effectively matched to the sample ability. No statistical difference was found between the samples with regards to their gender or curricula. **Conclusion:** Mixing more than one type of clinical reasoning assessment proved to enhance the effectiveness of assessment. Curriculum effect on clinical reasoning skills found to be minimal for students later in their undergraduate years. Students' gender has minimal effect on clinical reasoning skills. More research is recommended to further understand the development of clinical reasoning process in dental students.

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INTRODUCTION

Clinical reasoning, decision making, clinical thinking, diagnostic reasoning and medical problem solving are different terms used synonymously in the literature to describe how clinicians make decisions (1, 2). Many definitions were formulated to describe this process depending on the different views of their creators (3). The phenomenon of clinical reasoning could be simply defined as the complex process, during which a health professional is working through a clinical case in order to find possible solutions regarding diagnosis and management dealing with many influential factors in order to use knowledge and critically think through possible options (3-5). The process of clinical reasoning involves the use of different skills such as gathering of information, hypotheses generation, proper application of knowledge and decision making. There are many factors affecting the development of clinical reasoning skills in undergraduate students, which can be classified into four major categories: *task attributes*, e.g. degree of risk involved; *patient's attributes* e.g. the nature of the dentist-patient relationship; *the context*

e.g. *organisational factors*; and *attributes related to the decision maker* e.g. gender and the type of undergraduate curriculum (2). With regard to the assessment of clinical reasoning, there are about twenty heterogeneous methods mentioned in the literature. These methods mainly fall into three categories: *non-workplace-based assessment* such as Script Concordance Test (SCT), Multiple choice questions (MCQs), Key Feature (KF) and Patient Management Problem (PMP); *assessment in simulated clinical environment* such as Objective Structured Clinical Examinations (OSCE); and *workplace-based assessment* such as direct observation (6). In this research the discussion will be kept to the first category. Tools in this group can also be categorized based on their purposes as some assess the product of clinical reasoning e.g. (KF), while others are more concerned with the process itself e.g. (SCT), which was developed in response to the fact that there is a need to assess clinical reasoning process itself not only the end product of it (7). These tests also have varying degrees of validity and reliability. In general, there is no single tool or measure that could best assess clinical reasoning process or its end products while being both valid and reliable. Instead, one should carefully consider the aims, objectives and reasons for this assessment in order to choose the test that best meets them (8). The combined use of more than one type of clinical reasoning assessment tools may add to the usefulness of the test. The application of a multi-instrument test for clinical reasoning was used to assess undergraduate medical students with satisfactory reliability levels (9-11).

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Although clinical reasoning is a critical skill of paramount importance in all health professions, little research was devoted to this area in dentistry (12, 13). Similarly, the need to develop an assessment method for clinical reasoning in dentistry was raised as no assessment tool was satisfactory (14). Moreover, calls for the possibilities of integrating more than one type of tools to assess clinical reasoning was raised (15). This gap is still not being addressed in the dental literature. This research discusses a cross sectional quantitative study, in which a new way to test clinical reasoning in undergraduate dental students was developed as a mixture of three different assessment tools for clinical reasoning in a single test. This study aimed to:

-) Evaluate the effectiveness of this innovative method in assessing clinical reasoning in dental students
-) Examine the possible effect of participants' gender on their level of clinical reasoning skills
-) Examine the possible relationship between the type of undergraduate curriculum model and the development of clinical reasoning skills by applying the test to participants who were selected from three different dental schools, two in the United Kingdom (UK) and one in Saudi Arabia (SA)

MATERIALS AND METHODS

This study was approved by the Ethical Committee of the University of Nottingham U09/2010. We developed Clinical Reasoning Test (CRT) using a combination of assessment tools in order to test various elements of clinical reasoning as follows:

-) A modified version of the KF test was used to measure the skill of gathering of important information from the patient history
-) A Patient Management Problem (PMP) was used for the assessment of hypothesis formation and the ability to work through a specific case
-) A SCT was used to measure hypothesis evaluation
-) A small number of questions testing biomedical science knowledge

KF Items: KF items of the test were modified to include only three open-ended questions in contrast to the original test which had a large number of questions that require four hours of testing to reach an acceptable level of validity (16).

PMP Items: The longitudinal nature of the PMP was maintained throughout the entire test, which means that each dental case was presented in a logical order similar to discussing an actual clinical case starting with the patient's history and clinical features and finishing by a management plan. The test was case-based so that the participant went through multiple questions regarding the selection of data, gathering of information, hypothesis generation, interpretation of findings, dealing with new information, hypothesis testing, providing final diagnoses and selection of management options, in addition to a small number of questions testing basic knowledge. The examinees must select among multiple alternatives. Then the results of actions are provided as they proceed through the cases. In contrast to the original PMP test scoring system which concentrated on the ability of data gathering rather than making appropriate decisions (16), decision making was also included as a component to be tested in the developed CRT.

SCT Items: The developed CRT had a total of only ten SCT items related to two of the cases in contrast to the original SCT, which has many questions requiring nearly one-hour of testing time (17).

Knowledge-Based Items: Knowledge is one of the important factors affecting clinical reasoning (18). A decision was made to include two questions to test the biomedical science knowledge of the participants. However, these questions were imbedded in the PMP discussion of

the clinical cases in the CRT and were included in the analysis as part of the PMP because they follow the sequence of discussion related to the clinical cases and were formatted as PMP items.

The CRT Formats: The test was divided into five dental cases in an attempt to refer to multiple dental divisions including restorative dentistry, pedodontics, periodontics, oral pathology and oral medicine. These cases tackle different dental problems that a general dentist may regularly encounter, including improper composite restoration, fluorosis, periodontitis in a diabetic patient, dental trauma in a child and problems with tooth eruption. In addition to the biological problems, a psychosocial component was also a feature of the test. Final CRT items were developed in different formats, see appendix 1. The test had a total of 31 MCQs, yes/no and open-ended questions. The test items were classified according to the known components of clinical reasoning (19), and the classification was then confirmed by inputs from seven expert dentists and experts in medical and dental education. Classification, categories and subcategories of the test items are presented in table 1 and 2.

Scoring the CRT: We scored test results both manually, for the short text answers (looking for key words) and electronically for the MCQs. The total mark of each question varied according to the input required to answer the question. Some questions have a total mark of 1, some have 2 and some have a total mark of 3. All marks were given as a numeral without fractions. Blank and incorrect answers were given a mark of zero. The marks for the short text answers and the MCQs were then added to the marks for the 10 SCT questions. Marking of the SCT items, was followed using the original marking scheme (20). The total mark available for the CRT was calculated as 45 marks, 10 of which came from SC items. For the test marking please refer to Appendix 2.

Phases for CRT Development: Before piloting the CRT, the test was reviewed by a panel of twelve experts in different fields of dentistry and dental and medical education. This convenience sample of experts came from SA, the UK and Canada. The panel include the creator of SCT (21) and the developer of the framework of clinical reasoning in dentistry (22) in addition to other dental educators. Changes were made to some of the test questions in response to experts' reviews. Some of the changes included adding more visual cues as many dental conditions are dealt with by pattern recognition, changing some wording, and adding some questions. We then carried out a pilot study using a convenience sample of thirty final year undergraduate dental students from the participating schools, and a convenience sample of thirteen experts (with more than ten years of experience in dental practice) from the UK and SA. Reliability value was not satisfactory for the pilot phase (Cronbach's alpha was as low as 0.61), and students-item interaction reflected that most of the test items were easy compared to the students' ability. There was a statistically significant difference between the experts' and students' samples, which contributed to the test validity. In response to the analysis of the data obtained from the pilot study, measures to enhance the student-item interaction and to increase the test reliability were taken. The test was amended and problematic items were removed and altered in order to increase their difficulty level. Some redundant items were also excluded to reduce the noise when conducting statistical analysis. The iterative process of the CRT development is illustrated in Figure 1. The final version of the CRT was delivered in an online format using Survey Monkey software®, and the average time to take the test was 20 minutes. Browsing of the test was unidirectional in order to prevent consequential help (the ability to correct earlier answers using information presented later in the test). The link to the test was sent to all final year dental students through the gate keeper in each school. The choice of online survey was made in order to increase the response rate as participants can take the test any time at their convenience, and to take the advantage of including high resolution pictures for the cases without adding extra cost. Site visits to describe the purpose of the study and to recruit participants using a short PowerPoint® presentation were carried out. Participation of students was encouraged by offering entry to a raffle for Amazon® vouchers.

Participants: Participating schools implement different curriculum models for their undergraduate BDS (Bachelor of Dental Surgery) courses. These schools are: The University of Birmingham and the University of Manchester in the UK and King Abdulaziz University in SA. Analysis of their curricula was based on the SPICES and the Integrated Ladder models (23, 24) and was described in another research. (2) One participating school implements PBL, which is the Dental School at the University of Manchester, whereas the curricula of the remaining other dental schools preserve the separation between pre-clinical and clinical phases of dental education. The two UK dental schools show elements of student-centered approach being more prominent at Manchester. The level of curriculum integration was different for the three schools being higher for the University of Manchester, followed by the University of Birmingham, and finally King Abdulaziz University with mainly discipline-based education. The Birmingham Dental School had a total of 77 final year dental students, the Dental School at King Abdulaziz University had a total of 96 final year students, and the total number of final year dental students was 81 for the University of Manchester. The response rates were different for each school being 50%, 51% and 45% respectively. 76% of our collective students' sample were female. Data collection was carried out over three months. Participants were targeted approximately in the middle of their final year 2013. Choosing final year students would ensure that almost all students would have gained all the required teaching and training needed to be future dentists, and allow fair comparison of their curricula effects on clinical reasoning skills of their students. This would also deal with the fact that different subjects are taught during different year group of the programs. Another convenient sample of sixteen expert dentists, with more than ten-year experience in dentistry, was also participating in the final study, seven of which were females. They received the same electronic version of the CRT as the student sample with an information letter. Inputs from experts also provided information for the SCT marking (25) (20).

RESULTS

A total number of fifteen experts ensured that the test organization and its contents were matched to its objectives and specifications and thus provided both content and face validity. The construct validity was supported as the expert sample performs significantly better than the students' sample, p value = 0. The reliability value of the CRT items, (indicated by Cronbach's alpha), was 0.51, 0.90 and 0.79 for KF, PMP and SC items respectively. Cronbach's alpha was calculated for the whole CRT as well. It was 0.93 for the combined students' sample from the three different schools indicating that the test was reliable. The person-item map was created to examine the interaction between participants' ability and the final CRT items as measured by Item Response Theory (IRT) (26), see Figure 2. Results of normality tests showed that some of the data were not normally distributed. Therefore, non-parametric tests were used to carry out statistical comparisons.

The Relationship between Students' Gender and their Performance in the CRT: The mean values of the total test scores for both males and females were approximately similar being 25.67 and 26.04 respectively. The P value was equal to 0.56 (>0.05), which indicated that the data did not provide statistically significant evidences of a difference between males and females in their total CRT marks.

Comparison between the Samples from the Different Schools Taking the CRT: The mean values for the total CRT marks from King Abdulaziz University, Birmingham and Manchester participants were 27.44, 25.23 and 24.58, respectively. The spread of scores, as shown by the standard deviation values, was a little higher for Birmingham and Manchester participants than it was for King Abdulaziz group. The non-parametric test Kruskal Wallis was used to analyze our continuous and non-normally distributed data as we intended to compare more than two independent groups.

There was no statistically significant difference between the CRT scores obtained by students from the three different schools ($H(2) = 1.835, P = 0.4$).

Correlation between Knowledge and Clinical Reasoning: In order to understand the effect of knowledge on clinical reasoning we analyzed the correlation of knowledge-based questions in the CRT (Q5 and Q25) and the total test marks obtained for the students' sample. Pearson correlation coefficient values were 0.61 and 0.54 respectively, which indicates a strong positive correlation.

The Effect of the Time Spent for Taking the Test on the CRT Marks: One of the advantages of the online test is that it is possible to measure the duration that each participant spent during the test. Spent time was calculated for students' and expert dentists. It was found that the female and male student samples nearly had the same time spending behavior when taking the CRT, mean values were 18.61 and 19.11 minutes respectively. It was also found that the experts spent less time to answer the test when compared to the students' sample, mean values were 14.93 and 18.86 minutes respectively. The correlation of time spent by the students' participants during the test and the total marks was calculated and Pearson correlation coefficient, r was 0.18. This value is considered as a statistically weak correlation. It means that time spent by the students during the test was weakly positively correlated to the total test mark.

DISCUSSION

The clinical reasoning test presented in this study aimed to mix more than one type of the well-known assessment tools used in the literature. The intention was to add the advantages of these tools in one high quality test for clinical reasoning. The developed CRT has been shown to have acceptable levels of validity and reliability despite of the shorter overall testing time used compared to what was claimed by the original tools involved to reach acceptable validity. The CRT presented in this study comprises all the important guidelines agreed upon by experts in clinical reasoning which are: the question should be based on a clinical case, the question represents a challenge achievable for the student, the correction scale (i.e., scoring grid) is explicit, and a panel of experts revises the questions (27). Different items of the test examined different components of the clinical reasoning process such as selection of information, hypotheses generation, testing of hypotheses, providing management options as well as a few knowledge-based questions. The test was also able to statistically differentiate between students and expert dentists, which supports what is known in literature (28-30). Furthermore, it was able to evaluate the interaction between subjects and test items following the concepts of IRT (31).

The results of the current study showed that there was no statistically significant gender-related difference in the total test marks. This result was consistent with many other studies which indicated that there is no relationship between gender and the level of clinical reasoning ability (10, 32-34). Beside its passive effect in case of dental and medical students, it was also been found that gender difference does not affect the treatment decisions made by dentists and these decisions are made irrespective of gender. However, male dentists tend to perform complex therapies themselves, whereas female dentists referred more patients to specialist (35). In contrast, the results of Groves *et al* (36) study suggested that female gender was a positive predictor of the clinical reasoning ability. However, this was approved for only one type of clinical reasoning assessment namely *the clinical reasoning problems (CRP)* and not in case of another type of clinical reasoning assessment used in the same study; *Diagnostic Thinking Inventory (DTI)*. The explanation given by the authors was that female students tend to be more careful and thorough in their approach to diagnosis as they can identify all critical features from a case presentation, in the case of a CRP.

Table 1. CRT items categories using inputs from experts and suggestions made by the researcher based on the literature regarding the components of clinical reasoning

Categories	Subcategories	Questions
Selection of information	Key features from the case presentation	Q1, Q6, Q26
Processing of new information	Selection of discriminatory questions	Q8
	Hypotheses generation	Q9
Hypotheses testing, Script Concordance	Generating diagnostic hypotheses	Q2, Q10, Q18, Q19, Q27
	Suggesting causes to the problems	Q17, Q21, Q22
Decision making	Selection of required investigations	Q11, Q12, Q13, Q14, Q15, Q16, Q28, Q 29, Q30, Q31
	Management options	Q3, Q23
Knowledge based questions	Preventive measures	Q4, Q7, Q20, Q24
	Management options	Q5
		Q25

Table 2. Classification of the CRT items according to their type of clinical reasoning assessment tool

Key Features	Patient Management Problems	Script Concordance
Q1, Q6, Q26	Q2, Q3, Q4, Q5, Q7, Q8, Q9, Q10, Q17, Q18, Q19, Q20, Q21, Q22, Q23, Q24, Q25, Q27	Q11, Q12, Q13, Q14, Q15, Q16, Q28, Q 29, Q30, Q31

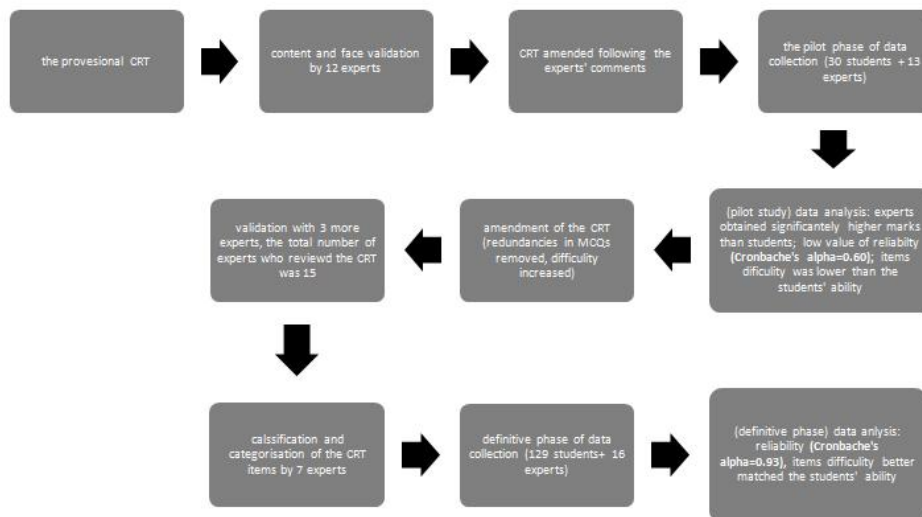


Figure 1 Phases for the Clinical Reasoning Test development

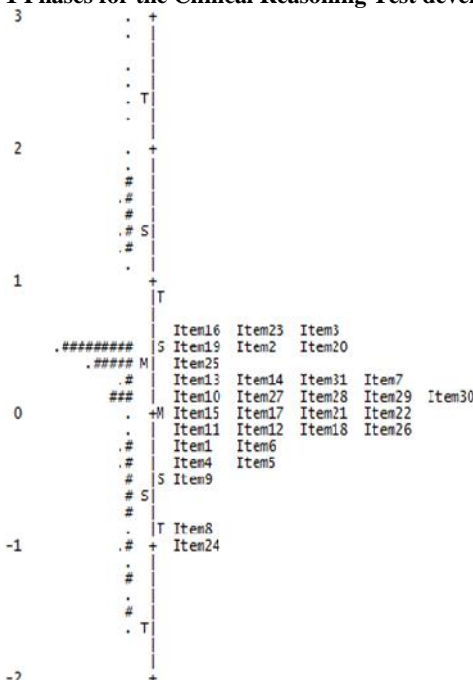


Figure 2 Item-student map for the final phase of the study. Each # represents four students. The values on the left of the scale are logits. Items of the test are presented with their number of order in the CRT, M =mean, S = 1 standard deviation from the mean, T = 2 standard deviations from the mean. Most of the test items match students' ability.

The type of undergraduate curriculum appeared to play a role in the development of dental and medical students' clinical reasoning skills especially during their early years of undergraduate education (36, 37). However, curriculum impact on the level of clinical reasoning is argued to diminish when students approach their final years (2, 10). Although the mean value of the total test mark was slightly higher for the King Abdulaziz sample than that of the other two cohorts, statistical comparison between the three samples supported the null hypothesis in that there was no significant difference between the different cohorts. This finding also showed that there was no statistical difference between the samples despite the cultural and geographical differences. This result agrees with what is argued about the effect of the different curricula on the development of clinical reasoning skills in medical students in the literature. It was suggested that although there are significant differences in the clinical reasoning ability of medical students in favor of the PBL program over the students from traditional curriculum, this difference diminishes when students proceed to the last years of their study, suggesting that towards graduation there is no differences in reasoning ability based on the type of undergraduate curriculum (10, 36, 38).

In order to explain our results, we suggest that this is a reflection of the fact that our study targeted the students when they were in their final year of undergraduate dental course. It is not unusual for the students at this stage to perform similarly, as they have already acquired all the basics to become dentists. However, they were still lacking the element of experience as reflected in the statistical difference of the performance between the students and experts' dentists. Many studies showed that expert dentists perform better than dental students (28-30). The results of the current study showed that experts performed better and spent less time answering the CRT compared to the students' samples. This finding was consistent with what is published in the literature as experts usually spend less time to reason through clinical cases than novices (39, 40). The results also showed that despite the small number of the knowledge-based questions, there was a strong positive correlation of results obtained for these questions with the total test marks obtained by the students' sample. This finding supports what was argued in the literature about the importance of knowledge in clinical reasoning skills development (41-43). The presented study has limitations in that comparing single test results from different cohorts of students at different schools may not be sufficiently reliable because of the psychometric sources of errors generated by group and cohort effects which could limit the generalizability of findings (44). Differences in students' admission strategies, the hidden effect of the different curricula, and cultural effects are matters which further complicate the problem. Longitudinal benchmarking might provide better comparison than a cross-sectional study.

CONCLUSION

An innovative test was developed to assess clinical reasoning which is claimed to add the advantages of well-known tests. The level of clinical reasoning was not affected by the gender or the types of undergraduate curriculum.

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Appendices

Appendix A: Screenshots for Clinical Reasoning Test

Clinical Reasoning Test

Dear Fifth Year Dental Student:

My name is Ebtihaj Nafea. I am a dental and PhD student at the University of Nottingham. For my PhD research, I am assessing clinical reasoning among undergraduate dental students at four universities; Birmingham, Manchester, KAUU, and Tabuk. Because you are a fifth year dental student I am inviting you to participate in this research study by completing the following form.

This study will provide important information and guidelines to dental educators and course planners to improve clinical reasoning skills within the undergraduate dental curriculum.

I would be very pleased if you could spare some time to take part in my research. The following questionnaire will require approximately 10-15 minutes to complete. Please note that for the purposes of my research, it is not always possible to see the previous screen once you have completed it.

Please be assured that all information collected during this research will be kept strictly anonymous and confidential. A summary of the findings of the study will be forwarded to you. In addition, participation is strictly voluntary and you may refuse to participate at any time. Thank you for taking time to assist my educational endeavours. If you have any questions or concerns, or if I may be of assistance in any way, please do not hesitate to contact me at en22@nottingham.ac.uk.

Note: you will have the opportunity to enter a raffle to win Amazon gift vouchers as a thank you for your effort. The first winner will receive £100. The second winners each will receive £50. Three third place winners each will receive £25.

Best wishes:

Ebtihaj Nafea
PhD student
Medical Education Unit
Medical School
University of Nottingham, UK
NG7 2UH

1. What is your gender?

Female

Male

2. The place of your school

Qadiriya (dentist)

King Abdul Aziz University

Tabuk University

University of Birmingham

University of Manchester

Page 1

Clinical Reasoning Test

CASE 1

A 30-year-old lady came to your dental office complaining of pain related to her lower left molars, especially when biting. She reported the pain as moderate.

Past medical and dental history:
The patient is medically fit and is not on any medication. She reported that she is used to having regular visits to the dentist. Her last visit to the dentist was about 3 weeks ago.

Observation examination:
No abnormality observed.

Intraoral examination:
Fitting green case upper and lower with healthy gingival tissue. She has class I occlusion with cross bite in her canines on both sides. Class I occlusal composite restorations to her teeth: U7C, U6L, U6R and U7C. The U7C has a class I amalgam filling. She also has fissure sealant for her premolars. The LL7, with an adequate occlusal class I composite, was sensitive to vertical percussion. Cervical/abutment abutment to occlusal surfaces was observed. By asking the patient, she confirmed that she often clenches her teeth especially when stressed.

Radiographic examination:
No radiographic lesion was noticed in the area of concern.

3. List the features from the case description above that could help you in making a diagnosis for her complaint. (List at least three)

1

2

3

4. At this stage, what is your most likely diagnosis for the LL7?

5. What further investigations will help you to diagnose this problem, or confirm your diagnosis?

Clinical Reasoning Test

6. If you suppose that this lady has a high composite filling for LL7, and by reviewing her dental record, it was found that her dentist had used composite for anterior teeth. How can you manage her problem? Choose the best answer.

- Slightly reduce the filling by 0.5mm
- Replace the filling by a new one with composite for posterior teeth
- Do a night guard (splint)
- Ignore the problem as it will go away with time, it will undergo attrition by clenching.
- Identify high points and reduce the filling
- Replace the filling with amalgam

7. How could this problem be avoided in the first place?

Clinical Reasoning Test

CASE 2

A 16 year old male came to your clinic complaining of brownish discolouration and irregular teeth related to his anterior teeth as seen in the picture. He is shy and does not want to show his teeth. He also stated that he's had bad teeth since he was a child but he's now started to take care of them and they are improving. His nationality is Indian and he came to live in the UK 8 years ago.



8. What clinical features would you focus on in making your diagnosis for this patient?

List up to 3

1	<input type="text"/>
2	<input type="text"/>
3	<input type="text"/>

9. If you could choose the course of action to follow, what would you like to do immediately? (choose one)

- I don't know
- Ask the patient more questions
- Conduct intraoral examination
- Give him oral hygiene instructions and do scaling.
- Take an x-ray
- Refer the patient to an oral pathology specialist

Clinical Reasoning Test

10. From the list below select the (THREE) most important questions that you would like to ask the patient.

- Do you have other siblings affected?
- How frequently do you brush your teeth?
- Do you use fluoridated tooth paste?
- Do you have any pain or sensitivity?
- Have you experienced trauma to your teeth?
- Do you drink lots of coffee or tea?
- What type of water did you used to drink when you were younger?
- Did you have any serious illness when you were a baby?
- Do you use Chlorhexidine mouth wash?

Clinical Reasoning Test

The patient's answers to the previous questions are:

1. How frequently do you brush your teeth? I brush my teeth twice a day.
2. Did you have any serious illness when you were a baby? No I don't think so.
3. Do you use Chlorhexidine mouth wash? Yes I usually use it once a day for about three months.
4. What type of water did you used to drink when you were younger? Tap water.
5. Do you have any pain or sensitivity? No
6. Do you drink lots of coffee or tea? I usually take two cups of black coffee daily.
7. Do you use fluoridated tooth paste? Yes
8. Do you have other siblings affected? I have a 4-year old sister and she hasn't got this problem.
9. Have you experienced trauma to your teeth? Can't remember.

11. Select (THREE) results from the list below that you would expect to find during examination!

- Generalised discoloration
- Caries
- Generalised recession
- Localised discoloration
- Open bite
- Small teeth
- Loss of proximal contact
- Abrasion and horizontal bone loss
- Vertical bone loss
- Submandibular gland tenderness
- Family history of a similar condition
- Gingivitis

Clinical Reasoning Test

12. Choose (THREE) differential diagnoses

Generalised enamel abrasion

Dentinogenesis Imperfecta

Extrinsic discolouration

Amelogenesis Imperfecta

Genetic pigmentation

Calculus deposition

Fluorosis

Generalised attrition

Enamel hypoplasia

Enamel opacities

Generalised enamel hypomineralisation

13. The following questions deal with your ability to use the results of investigations to refine your diagnostic hypotheses

Use the Likert scale to indicate how likely this hypothesis becomes

If your diagnostic hypothesis was (Amelogenesis Imperfecta), and you find the result of investigation was (generalised brownish discolouration with white patch and pitting of enamel), this hypothesis becomes:

[]

14. Use the Likert scale to indicate how likely this hypothesis becomes

If your diagnostic hypothesis was (external stain), and then you find the result of investigation was that (staining of all tooth surfaces for incisors and first molars), this hypothesis becomes:

[]

15. Use the Likert scale to indicate how likely this hypothesis becomes

If your diagnostic hypothesis was (tooth fluorosis) and you find the result of investigation was (marked wear), this hypothesis becomes?

[]

Clinical Reasoning Test

16. Use the Likert scale to indicate how likely this hypothesis becomes

If your diagnostic hypothesis was (congenital enamel defect), and then you find the result of investigation was (open bite), this hypothesis becomes?

[]

17. Use the Likert scale to indicate how likely this hypothesis becomes

If your diagnostic hypothesis was (tooth fluorosis), and you find the result of investigation was that (the patient had used to drink ground water when he was in India), this hypothesis becomes:

[]

18. Use the Likert scale to indicate how likely this hypothesis becomes

If your diagnostic hypothesis was (Amelogenesis Imperfecta), and you find the result of investigation was that (both mother and father have similar condition whereas young siblings have not), this hypothesis becomes:

[]

Clinical Reasoning Test

CASE 3

A 53-year-old, non-smoking male came to your clinic complaining of bleeding gums and bad breath. He reported that he visits the dentist only when having toothache. He also reported that he brushes his teeth only once a day and does not use dental floss. He also wanted to replace his missing teeth.

19. At this stage, what do you think are the possible causes for his symptoms (please provide TWO causes)

1

2

Clinical Reasoning Test

(Past medical history)

In the review of symptoms he reported mild fatigue. He also reported that his father died of a heart attack at the age of 66 and his mother was alive and taking medication for diabetes mellitus. He reported recent weight loss, but you notice central obesity.

(Past dental history)

The patient reported that in the past he had required many fillings and had a lot of teeth extracted.

(Intra oral examination)

Examination reveals multiple missing teeth with several amalgam restorations. The gingiva demonstrated moderate to severe inflammation, being more pronounced in the papillae. Periodontal abscesses and moderate plaque accumulations were present. Probing depth ranged from 2 to 8 mm and the remaining molars have furcation involvements and variable degrees of mobility.

This is the OPG of the patient



20. Based on the information provided, what is your most probable diagnosis of his periodontal problem?

21. Referring to the picture, please provide a suitable diagnosis to the radiopacity in the left angle of the mandible.

22. You offer endodontic treatment and crowns for multiple teeth, and then do a removable partial denture. However, the patient tells you that he cannot afford the cost of this comprehensive treatment. He suggests that you extract his remaining teeth and do a complete denture. You also need to do a complete denture in order to finish your course requirements. What can you do in this case?

Clinical Reasoning Test

A few weeks after giving oral hygiene instructions, scaling and root planing, and endodontic treatment for UR4 and UR5 you notice the oral hygiene has improved but tissue inflammation remains. You decide to refer the patient to a periodontist. The specialist performs surgical periodontal treatment in the maxillary right quadrant. The healing response is fair with persistence of inflammation of the gingival tissue even in the treated area. A few months later the patient underwent another surgical treatment to the maxillary left quadrant which was similar to the first surgical procedure. Unfortunately, the post surgical course was as before and both surgical treatments were unsuccessful with persistent inflammation.

23. What do you think is the possible cause of the unimproved periodontal condition?

Clinical Reasoning Test

CASE 4

24. A lady rushes into your emergency dental clinic with her 4-year old daughter who is crying and has blood drooling from her mouth.

What are the possible causes for her problem?

1.
2.

25. What investigations will help you to specify the possible causes?

Clinical Reasoning Test

The mother reported that her daughter had accidentally fallen on her face and she took her child straight away to your clinic.

26. You conduct an intraoral examination and find that crowns of both upper primary central incisors are palatally displaced but quite firm in this position.

Your most likely management will include: (CHOOSE TWO)

- Extraction of both upper centrals, since they are deciduous
- Trying to pull them back to their position
- Leave them if not interfering with occlusion
- Refer the patient to a maxillofacial surgeon
- Take an x-ray

27. If these teeth had been intruded apically how would this change your management plan?

Clinical Reasoning Test

CASE 5



This is a picture of a seven-year old boy who came to your dental office with his parents. His dad was concerned with his son's front teeth which had the lesion shown in the photograph.

28. How would you describe this lesion?

29. What are the differential diagnoses of this lesion? (LIST UP TO TWO)

1

2

30. The following questions deal with your ability to use the results of investigations to refine your diagnostic hypotheses. Use the Likert scale to indicate how likely this hypothesis becomes.

If your diagnostic hypothesis was (localised gingival inflammation), and then you find the result of investigation was that (the patient was playing with a pencil in his mouth), this hypothesis becomes:

31. Use the Likert scale to indicate how likely this hypothesis becomes

If your diagnostic hypothesis was (genetic gingival pigmentation), and then you find the result of investigation was that (the mother has got genetic pigmentation), this hypothesis becomes:

Clinical Reasoning Test

32. Use the Likert scale to indicate how likely this hypothesis becomes

If your diagnostic hypothesis was (eruption cyst), and then you find the result of investigation was that (this lesion is slightly painful upon palpation), this hypothesis becomes:

33. Use the Likert scale to indicate how likely this hypothesis becomes

If your diagnostic hypothesis was (eruption haematoma), and you see the periapical film of the patient below, this hypothesis becomes:



34. Please enter your email address to take part in the raffle.

35. We would like to conduct qualitative research about clinical reasoning using interviews. We would like you to volunteer for our qualitative research. If you are a Birmingham dental student and happy to be interviewed (less than 20 minutes), could you please provide your email address below. Compensation for your time will be provided for you

Appendix B: Clinical Reasoning Test Marking

Question Number	Question type	Total mark
Q1	Open-ended	3
Q2	Open-ended	1
Q3	Open-ended	1
Q4	MCQ	1
Q5	Open-ended	1
Q6	Open-ended	3
Q7	MCQ	1
Q8	MCQ	3
Q9	MCQ	3
Q10	MCQ	3
Q11	MCQ	1
Q12	MCQ	1
Q13	MCQ	1
Q14	MCQ	1
Q15	MCQ	1
Q16	MCQ	1
Q17	Open-ended	2
Q18	Open-ended	1
Q19	Open-ended	1
Q20	Open-ended	1
Q21	Open-ended	1
Q22	Open-ended	2
Q23	Open-ended	1
Q24	MCQ	2
Q25	Open-ended	1
Q26	Open-ended	1
Q27	Open-ended	2
Q28	MCQ	1
Q29	MCQ	1
Q30	MCQ	1
Q31	MCQ	1
