Evaluating the Impact and Feasibility of Case-Based Learning in Enhancing Histopathology Education among Dental Students

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ABSTRACT

Background

Oral pathology specialty focuses on the diagnosis and management of oral and maxillofacial pathologies with an extensive study on histopathology. Teaching and learning histopathology have always been a challenge both for the students and the teachers. The students usually get deviated when they face difficulty to integrate clinical and histopathological findings.

Objective

A need for an intervention to bridge the gap was realized and a study to assess the impact and feasibility of case-based learning among dental students was planned.

Method

A cross-sectional study was conducted introducing case-based learning in practical classes of oral pathology among 58 undergraduate dental students. Thirty students were randomly selected for case-based learning group and the remaining as control group. Multiple paper-based cases of oral cancer were designed. A self-designed pre and post-test along with a post-intervention assessment using modified essay questions were designed and applied.

Result

Significant differences in the scores between pre- and post-intervention questionnaires were observed within the case-based learning group ($p < 0.0001$), however not among the control. Similarly, a significant difference in the modified essay question scores was also observed between the study groups. Most of the study participants agreed that it benefitted their personal, professional as well as communication skills. The students expressed strong enthusiasm for learning with case-based learning.

Conclusion

Case-based learning is an effective method and practiced in a multidisciplinary context. Regular practice of case-based learning can create an interactive learning environment, wherein active participation of the students is promoted. Moreover, this approach can help students to integrate clinical with pathological findings for proper management of the patients.

KEY WORDS

Case-based learning, Learning environment, Oral pathology

INTRODUCTION

Oral pathology is a branch of dentistry involved in the diagnosis and management of the diseases and conditions of the oral and maxillofacial region. Learning oral pathology is a blend of clinical and extensive histopathology. The practical experience of understanding pathology is equally important where background theoretical knowledge becomes imperative. The practical exposures provide students the opportunity to understand the pathologic basis of disease by observing the histopathology slides directly under the microscope and able to establish a clinico-pathological correlation.[1]

However, the conceptual difficulty and lack of interest, due to its supposed irrelevance to their future clinical or professional activities, have lowered the motivation among the students. The routine practice of observing the histopathology slides makes it drearier and more tedious and disconnects students from the subject. This led to a need for intervention of an effective approach wherein the clinico-pathological correlations were possible which could link histopathology slides with the patients. These experiences steered us to design a framework to integrate Case-Based Learning (CBL) in the practical sessions.

CBL has been found effective in many aspects of medical education as it is a student-centered teaching method that exposes students to real-world scenarios that need to be solved using their reasoning skills with existing theoretical knowledge.[2] The cases in CBL situates the information in real-world contexts. Contextualization enhances learning by providing association that facilitates memory storage, retention, and retrieval, thereby promoting motivation toward learning.[3] Students can acquire adequate knowledge about patient care by accessing cases and improving understanding, which is useful for developing the mindset for cooperation, as well as continuous knowledge development.[4] The present study was conducted to understand the feasibility and impact of CBL and generate evidence to establish its effectiveness in routine practical sessions.

METHODS

A cross-sectional study was conducted among 59 third-year undergraduate dental students of which 58 students participated and gave consent. The students were divided into a case-based learning group (Group I) and a control group (Group II). The study was conducted after obtaining ethical clearance from the Institutional Review Committee.

The teaching approaches

Two days CBL module of three hours each was designed on 'Oral squamous cell carcinoma' (OSCC). The theory class on OSCC was conducted a week before the module (Fig. 1).

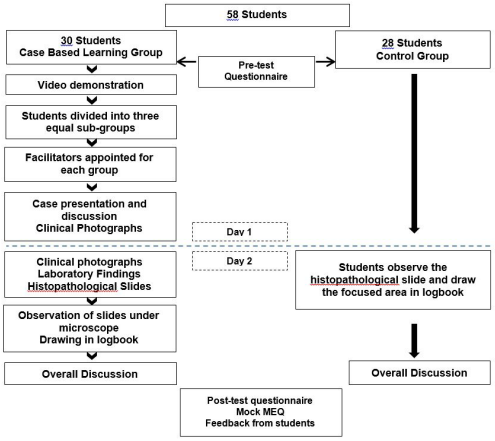

Figure 1. Schematic outline of the study

The students were randomly divided into the CBL group (30 students) and the control group (28 students). The CBL groups were further divided into three equal sub-groups, and each was assigned a facilitator. All the facilitators were oriented about the module and provided with a facilitator's guide. After the completion of the study, students of the control group underwent the same CBL session; however, the results were not used for statistical evaluation.

Tools for content and process validation

a. Case selection and design

A session on 'oral squamous cell carcinoma' was finalized comprising five case scenarios. Each case scenario had different clinical presentations and different histopathological grades. Detailed clinical information, habit history, description of the lesion, radiographs, and laboratory investigations, along with histopathological diagnosis were included. Colored photographs of the lesions, histopathological features and printed images of the radiographs were also prepared. Prior consent was obtained from the patients.

b. Audio-visual teaching aid

An educational video (6.51 minutes) with information regarding oral cancer, biopsy, tissue processing, and histopathology slide was prepared. The video also included interviews with the oral cancer patients. This video was prepared with an objective to sensitize the students to realize a direct connection between the pathology and the histopathology glass slides.

c. Facilitator's guide

A guide was prepared along with the suggestions from the faculties of the Department of Health Professions Education of the Institute for the facilitators. Structured instructions regarding the process, learning objectives, and possible outcomes of each session, time frame, feedback of students, etc. were included.

Table 1. Students perceived professional benefits during case-based learning

Students perceived professional benefits	Strongly Agree	Moderately Agree	Neutral
Stimulated the desire to learn	15	15	-
Confident to apply basic sciences and oral pathology concepts to solve clinical cases	14	13	3
A good method to practice integration of knowledge and skill	24	6	-
Improved the clinical reasoning ability	14	16	-
Motivated to learn oral pathology by CBL	6	22	2
The emphasis on clinical concept was detrimental to learn oral pathology	8	20	2
The method helped to reinforce concepts taught in class	17	13	-
Promoted self-directed learning skills	14	16	-
Increased self-confidence and attitude towards learning	13	13	4
Better than traditional teaching method	24	6	-

d. Pre-test and post-test questions

Self-designed multiple-choice questions (MCQ) including relevant information on oral cancer were prepared by the faculties of the department. The MCQ consisted of 19 items and was validated. The reliability of the instrument was assessed using Cronbach's alpha which showed better results with a coefficient of 0.723 after excluding three items. The intra-correlation coefficient was estimated to be 0.723 (95% CI; 0.508 - 0.872). The final scale included only 16 items and was used for the comparison of pre and post-intervention scores. Each MCQ had one best answer with three distractors and one mark was allocated for each correct response.

e. Modified Essay Questions (MEQ)

A mock MEQ comprising eight questions (20 marks) was designed and validated. Subsequent questions were given to the students only after the previous question was answered. Adequate time was allocated to answer each question.

f. Student's feedback forms

An evaluation form was adapted and modified to assess the personal (ten questions), professional (four questions), and communicative (three questions) benefits of the case-based learning method.[5,6]

The data were entered in Microsoft Excel spreadsheets and transferred to SPSS version 11.5 for further statistical analysis. The quantitative data were analyzed using the appropriate statistical tool. The statistical analyses were considered as significant at p-value less than 0.05.

RESULTS

Fifty-eight students gave consent to participate in the study of which there were six females and 24 males in the CBL group and 17 females and 11 males in the control: all within an age range of 19 to 23 years.

The pretest scores between the CBL and control group ($p = 0.10$) and between the pre-test and post-test scores of the control group ($p = 0.44$) showed no statistically significant difference. However, a highly significant difference was observed comparing the pretest and posttest among the CBL group ($p < 0.0001$) and between CBL and control groups ($p = 0.0001$). The pretest score ranged from 8-14 for CBL and 3-12 for the control group. Fourteen of the control group had a score below eight. A significant difference in the mean scores of MEQ was observed between the two groups ($p = 0.001$). The maximum score among the CBL group was 18.5 and a minimum of 13 however, the maximum was 14 and a minimum of four among the control group. The majority of the students agreed that learning by CBL was interesting and helpful and benefited professionally and personally along with improvement in their communication skills (Fig. 2). Almost 80% of the students strongly agreed that CBL was better than routine practical sessions (Fig. 1). At the end of the session, the CBL group students were asked to share their experiences as open feedback which were subsequently categorized (Table 2).

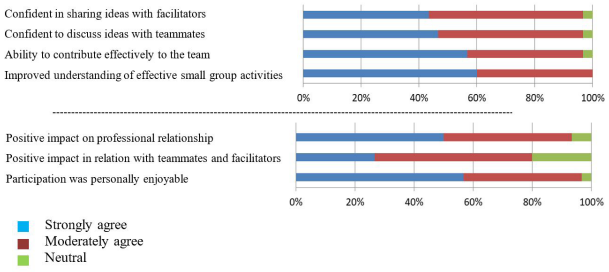

Figure 2. Students perceived communication and personal benefit

Pre-intervention analysis to evaluate the background information showed no statistical differences between the study groups and hence a better comparison of the results. The post-intervention score was statistically better among the CBL group ($p < 0.001$) compared to their pre-intervention scores. However, the control group showed only marginal improvement.

DISCUSSIONS

Case-based learning was introduced in medical education back in 1912 and it still lack an internationally understandable consensus definition.[7] The introduction of the CBL varies from author to author based on their personal experience acquired during the CBL projects. The study designed for the course in laboratory medicine summarized CBL to be a method structured for the trainee to explore clinically

Table 2. Thematic analysis of responses from the students

Category	Student's responses	Contribution of the theme
Learning environment	-Interactive, fun learning, easy understanding in small group -Gave everyone 'equal chance' to open with their opinion -Innovative learning, helped to brainstorm -One-to-one interaction with mentor helped to put the views properly	-The interactive session requires active listening and participation with self- preparedness which increases the retentiveness of the knowledge.
Organization and design	-Real case video was very effective, with feeling like a real scenario -CBL gave real situations of diseases, taught the way for clinical approach -The topic was strategically divided to facilitate the discussion	-Real case scenarios make the student realize the actual scenario, and the importance to emphasize individual cases.
Acquisition of skill and knowledge	-Help to gain idea about the clinical approach to the case and to know about various screening tests done in clinical practice -The best method of learning that improved the clinical reasoning ability -More retentive and helpful	-Acquisition of skill and knowledge develops preparedness among individuals to independently handle real patients.
Way forward	-Suggested to conduct more often to cover multiple topics	-The explanation helps to evaluate the motivational factors that can be implemented while incorporating CBL in the curriculum

relevant topics.[8] Similarly, a study on dental education explored its advantage in promoting self-directed learning, clinical reasoning, clinical problem solving, and decision making through repeated experiences.[9] A physiology-based CBL project emphasizes it as a method that establishes a self-evaluation of a student in understanding their concept using high order cognition.[10] Similarly, CBL conducted among medical students with pharmacological backgrounds suggested it to be a continuum between structured and guided learning.[11] The study summarized, with the background of the present research and literature review, that the CBL is "a structured, focused small group discussion moderated by a facilitator on a clinically relevant topic, promoting self-directed, inquiry-based problem solving ability with emphasis on critical analysis and deep learning pertinent to longer duration."

In the present study, case-based learning on 'oral squamous cell carcinoma' was designed for third-year undergraduate dental students. OSCC was chosen not just because it has significant importance in the dental curriculum but also being one of the most common neoplasms of global concern.[12] The presentation of OSCC varies remarkably, which is why diagnosis is delayed in many instances.[13,14] In addition to medical and dental students, it is also very important to highlight the entire handling and managing protocols for the cases of OSCC to the health care providers at primary healthcare centers where a module of CBL could be a major contributor. CBL project based on training primary care providers focusing on increasing treatment to hepatitis C virus-infected patients, in the rural and underserved areas conducted as Extension for Community Healthcare Outcome (ECHO) in two states of USA was one of the best examples of the impact of CBL on rural medical care.[15,16] This project also motivated the authors to select OSCC which is often diagnosed late because of underserved areas in our part of the world primarily due to limited diagnostic facilities, low socio-economic status, and limited knowledge.[14]

The CBL group showed better performance with an improvement in the score which was relevant to the study conducted by Du et al., Omprakash et al. and Liu et al. in oral medicine, physiology, and implant dentistry, respectively.[17-19] The improvement in the scores might be attributed to the dynamic activities compared to the routine methods, which mostly relied on existing theoretical knowledge and memorization of histopathological images. Most of the time students need an inherent self-directed active learning for better performance, and the students end up with an average performance. However, CBL promoted active discussion and participation.[20] Students are engaged in problem-solving activities, seeking support and feedback from colleagues and experts, which would make the learning interactive.[21]

In the present study, eighty percent (n=24) of the students strongly agreed that CBL was better and further agreed that there was better integration of knowledge and skill. Majority of the students (n=17) also agreed that CBL helped them reinforce their existing concepts and the small group discussions were effective. They asserted that they felt confident and did not feel inhibited to contribute to the team and enjoyed the learning process. This method was well accepted by the student which might be due to the freedom of expression during small group activities, the competitive nature among peers, or because this was their first exposure to CBL. However, for the persistent outcome and continuing practice of CBL, a standard working protocol along with dedication from facilitators would be crucial. So, it becomes imperative to create a friendly and conducive learning environment and academic practice. The selection and design of cases using simulation, paper-based cases, or real patients can be one of the important factors in the success of case-based learning.[7]

Studies conducted worldwide have given positive feedback for CBL and preferred it over traditional methods, highlighting its impact on medical education.[5,22-24] Research conducted on a CBL-based curriculum in a dental school in Germany involving 404 participants suggested that the students benefited their research competence, interdisciplinary thinking, dental-medical knowledge, practical dental skills, teamwork, and independent learning.[22] Botelho and O'Donnel in their study on fixed prosthodontic simulation laboratory course found that students mostly valued the significance of small group discussion. They were also able to establish a good clinico-pathological correlation as compared to learning through lecture allowing the integration of information from different sources and utilizing broader concepts.[25] Improvement in perceived satisfaction, motivation, and engagement among students in pharmacology course has also been reported.[26] According to Steinhert, the students highlighted the role of group atmosphere, facilitation skills, and clinical relevance of the cases in effective small group learning during CBL.[27]

Oral pathology is best learnt with a good clinico-pathological correlation. During the traditional method of practical exercise, it is challenging to bridge the clinical and pathological findings, due to which the students are not able to effectively understand the pathologic basis of the disease just by observing the hitopathological slides. CBL is an active learning process that stimulates the students in critical thinking of the clinical presentation and helps them understand the nature of the disease before evaluating the histopathology. This approach can also lead to increased retention of information and better performance.[28] According to a study conducted among first-year dental students, the students felt that CBL provoked interest to learn and was effective in linking basic concepts with clinical application. Also, it promoted critical thinking, clinical reasoning, and problem-solving ability and preferred CBL for other topics as well.[9]

Deep learning is one of the purported benefits of CBL. That is learning which is more aligned with either evidence of critical thinking or changes in behavior, as well as the generalizability of learning to other circumstances, rather than simply identifying correct answers.[7]

The introduction of CBL among the study group was very well accepted. Irrespective of the mode of teaching histopathology, either direct viewing under the microscope or digitally; the incorporation of innovative learning and assessment methods has always been interesting and fruitful. Oral pathology is a bridge between the basic sciences and clinical dentistry, and case-based learning could help the students to acclimatize and be prepared, wherein they are directly exposed to the patients.

CBL has been globally established as an innovative and highly efficient methodology of teaching-learning with an excellent outcome in relevance to the trainee and patient management.[7] However, CBL on its own is crucial to implement, as it requires vigorous planning and a generous infrastructure. It is equally important to indulge an optimally trained and motivated tutor to prevent CBL from turning into a lecture.[29] It is also important to realize the difference between case-based learning and problem-based learning where PBL has a problem-solving approach whereas CBL is focused on incorporating knowledge and skills.[7]

Medical education is undergoing rapid transformation. Access to the study materials is just at the fingertips of the students and also have strong ability to understand the statement coded within the literature. The matter of concern is to keep the medical students on track and help them improve the understanding rather than just overloading with the information. Hence, the prime focus should be to prioritize a progressive approach of conditioning the students to understand medical education to bridge the tetrad of basic medical sciences, clinical medical sciences, the patients, and the learning environment to reach the pre-determined objective, which can be well achieved and consolidated by the case-based learning.

This study was limited to a single exposure of CBL, capturing only short-term effects. The modest sample size from a single institution further constrains the external validity. Future research employing a randomized, longitudinal controlled trial with repeated measures would provide more robust evidence on the sustained impact of CBL.

CONCLUSION

Case-based learning is an effective teaching-learning method, especially in professional education courses like dentistry. Regular practice of case-based learning can help create an interactive learning environment; wherein active participation of the students is promoted. The present study suggests the feasibility of CBL in pathology training and encourages its implementation in other aspects of dental education.

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