

Current Awareness of Removable Prosthodontics in Dentists at King Abdulaziz University

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ABSTRACT

Background: Removable prosthodontics is a branch of prosthodontics that requires a high level of knowledge and great skills. This include the basic and advanced understanding of various principles and the practical skills that are crucial to deliver a good quality and satisfactory removable prostheses. To provide a successful prosthodontic treatment in partially dentate patients with removable partial denture (RPD), the awareness of basic RPD principles and design is mandatory.

Therefore, academic education utilizes the good teaching strategies and precise assessment methods for the students to fulfil the required preclinical and clinical skills. In addition, to meet the planned level of competencies, the basic learning domains are required to be fulfilled. In removable prosthodontics, fulfilment of the required knowledge and skills are very crucial to deliver a high-quality prosthesis. In academic study, students are exposed to different learning experiences throughout their years of study to prepare them becoming competent graduates. Some students may face difficulties in understanding and applying the mechanobiological principles of removable partial denture. Therefore, the assessment of their knowledge and cognitive skills, as well as, the current teaching strategies is crucial to reflect upon those strategies and to plan for implementation of future teaching improvements. In this study, students and general dentists were assessed regarding their awareness and understanding of RPD principles and design which is the initial step in performing this prosthodontic treatment option. Also, pre-lecture and post-lecture assessment was planned to reflect upon the teaching strategy in removable prosthodontics among undergraduate students.

Materials and methods: A well-structured online questionnaire in removable partial denture design and principles was formulated to assess the knowledge and cognitive skills of undergraduate, postgraduate students and general dentists at KAU. Also, a pre-lecture and post-lecture assessments were carried out for fifth-year undergraduate students.

Results: The proportion of correct answers were higher in female than male students among postgraduates and undergraduates ($P < 0.05$). Also, Postgraduate students showed the highest level of proportion compared to the undergraduates ($P < 0.05$). In addition, a significant higher proportion and scores of correct answers were reported in the after-lecture response among fifth-year students ($P < 0.05$). **Conclusion:** The level of awareness of removable partial denture increases with the level of experience and lectures are considered as the corner stone in teaching of his branch of prosthodontics

1. Introduction

Edentulism is considered as disability by WHO, so prosthetic rehabilitation is indispensable.(1) Several studies have analyzed the treatment modalities of partial edentulism in various populations. These include

removable partial denture (RPD), fixed partial prostheses and dental implants which are accepted as proper treatment options for such cases. Due to the fact that removable partial denture is a reversible treatment to restore function and esthetic and is economic, makes this treatment option enduring prosthodontic treatment until now. In addition, the proper construction of RPD necessitate clinical and laboratory steps which, briefly, include proper diagnosis and treatment planning, primary impression, surveying of diagnostic casts for initial designing of the prostheses, abutment preparation, final impression and secondary surveying for partial denture followed by try-in and insertion of the final prostheses. However, Following the fundamental guidelines for prostheses fabrication is crucial for the production of a good quality prostheses that affects its survival. (2) This is contributed to the fact that poor RPD design may lead to food and plaque accumulation and undesirable mechanical forces that, consequently, may lead to damage to the existing oral structures. Therefore, RPD design is the dentist responsibility either undergraduate, postgraduate, interns or general practitioner. (3)

Removable partial denture is introduced in dentistry as one of the most successful treatment options for partially edentulous patients at any age. However, understanding removable prosthodontics in undergraduate students may exhibit some difficulties. These may include certain factors that are related to the fact that they have limited clinical exposure to removable prosthodontics during their undergraduate years of study. Also, the basic design principles of removable partial denture may be considered as a major obstacle for undergraduate students in removable partial denture treatment. (4) In addition, their limited knowledge in occlusion principles is accentuating this problem. Therefore, the academic courses incorporate theoretical and practical methods of teaching strategies to meet the students' competencies requirements. Also, multiple assessment methods should be incorporated in the academic curriculum to assess their level of competencies. (5)

In a recent study that was conducted to evaluate the knowledge of undergraduate students in complete denture found that they have adequate knowledge about treatment planning and diagnosis. (6) However, understanding of removable partial denture is one of the most difficult topics for undergraduate students to understand specifically RPD design and surveying. (4) This may be contributed to their self-consciousness and perceived insecurities regarding their clinical competencies.(7) Furthermore, several factors may magnify the effect of this problem such as, limited cases that need cobalt-chromium denture, limited access to surveyors and limited teaching time. (8) This has led to the problem of incompetent students in RPD design. (9)

In the fourth year of undergraduate study at, students start their preclinical study of removable prosthodontics but the first exposure to clinical part of removable partial denture is designed in fifth-year undergraduate at King Abdulaziz University (KAU). This includes theoretical, clinical and laboratory teaching. In general, the undergraduate and postgraduate courses incorporate the use of traditional multi-methods strategies such as theory teaching, hands-on practical, clinical teaching, seminars, case-based learning and presentations. Also, more advanced teaching strategies are adopted, such as, 3-D printed models that can stimulate excellent learning experience. (10)

Therefore, the aim of this study is to assess the awareness and understanding of removable partial denture basic principles and design in dentists of different levels of study at KAU. Also, to assess lectures as a teaching strategy in fifth-year undergraduate students.

Axial traction can manage confirmed cervical fractures in AS. Traction must align with pre-existing kyphosis, using minimal weight. Neck extension risks neurological complications. Even with proper traction, deterioration is possible due to residual rotational movement. Close monitoring for neurological changes, including altered consciousness, is essential. Traction provides temporary stabilization before surgery or can be transitioned to a halo brace for non-operative management.

Materials and methods:

After obtaining ethical approval for the study from the ethical committee at King Abdulaziz University (KAU), a cross sectional survey was done in King Abdul Aziz university (KAU) by an online electronic generated questionnaire (google forms). The questionnaire was formulated to assess the general knowledge and the cognitive skills of dentists in RPD and was reviewed by senior staff in prosthodontic department at KAU. This survey was sent via emails to the participants. These participants included fifth-year undergraduate, 6th year undergraduate and postgraduate students (master's), interns and general practitioners in Faculty of Dentistry at KAU.

For the undergraduate students, this survey was sent twice to the same batch (fifth-year undergraduate students) one before their exposure to the learning activities (lectures) within the course of removable prosthodontics and the second time was after these teaching sessions.

A total of 113 responses were recorded from the participants for a total of 23 questions that were assessing their knowledge in surveying and designing of removable partial dentures. The responses were collected using online electronic forms and the correct answers were recorded.

A knowledge score was computed by summing up the correct responses to relevant questions (n=23). Therefore, the score ranged between 0 and 23, where higher scores indicated better knowledge.

Statistical Analysis

Statistical analysis was carried out using RStudio (R version 4.2.2). Categorical data was expressed as frequencies and percentages, whereas numerical variables were presented as median and interquartile ranges (IQRs). Statistical differences in the proportions of correct answers across different participants' groups were assessed using a Fisher's exact test or a Pearson's Chi-squared test. Additionally, differences in knowledge scores were explored using a Wilcoxon rank sum test or Kruskal Wallis test whenever applicable. The p value of < 0.05 indicated statistical significance.

Results:

Table (1) showed the characteristics of the respondents. A total of 113 responses were collected on the online platform, 65 responses (57.5%) were retrieved before lectures and 48 responses after the lectures (42.5%). More than two thirds of the respondents were females (69.0%), while approximately three-quarters of respondents were studying in the fifth year. All the responses obtained after lectures were collected from the fifth-year students.

Table 1: Characteristics of the respondents.

Parameter	Category	Overall, N = 113	Pre lectures, N = 65	Post lectures, N = 48
Year of study	5th year	84 (74.3%)	36 (55.4%)	48 (100.0%)
	6th year to interns and GP	12 (10.6%)	12 (18.5%)	0 (0.0%)
	Master	17 (15.0%)	17 (26.2%)	0 (0.0%)
Gender	Male	35 (31.0%)	21 (32.3%)	14 (29.2%)
	Female	78 (69.0%)	44 (67.7%)	34 (70.8%)

Analysis of participants' knowledge before lectures:

Out of 23 questions showed the proportions of correct responses before lectures by gender (table 2). Generally, the recorded correct answers varied between the two genders of students among all questions. A significant higher proportions of females provided correct responses about three questions (Q) before lectures, including the recommended sequence for designing a removable partial denture(Q8) (70.5% females vs 42.9% among males, $p = 0.032$), the recommended location and number of rests for a unilateral distal extension removable partial denture (Q12) (56.8% females vs 23.8% among males, $p = 0.013$) and the recommended clasp to be used for sound and periodontally strong posterior abutment (Q15) (86.4% females vs 61.9% among males, $p = 0.049$).

Table 2: The proportions of correct responses before lectures by gender.

Question	Male, N = 21	Female, N = 44	p-value
1-The use(s) of a surveyor	16 (76.2%)	40 (90.9%)	0.135
2-Definition of surveying	19 (90.5%)	41 (93.2%)	0.655
3-The main objective of surveying	15 (71.4%)	30 (68.2%)	0.791
4-On the surveyor, the occlusal plane of the cast should be first placed parallel to the ...	12 (57.1%)	23 (52.3%)	0.713
5-Oral tissues to be surveyed	7 (33.3%)	22 (50.0%)	0.206
6-Resistance against tissue away force (Pull) is called ...	13 (61.9%)	30 (68.2%)	0.617
7-Support in removable partial denture is ...	16 (76.2%)	37 (84.1%)	0.503
8-The recommended sequence for designing a removable partial denture	9 (42.9%)	31 (70.5%)	0.032
9-Clinical situations in which the choice of mesial rest on abutment instead of distal rest is advantageous	14 (66.7%)	27 (61.4%)	0.679
10-Direct retention is provided by	17 (81.0%)	36 (81.8%)	>0.999

11-The recommended number and location of the rest on the abutments for single bounded edentulous area should be	11 (52.4%)	25 (56.8%)	0.736
12- recommended location and number of rests for a unilateral distal extension removable partial denture?	5 (23.8%)	25 (56.8%)	0.013
13-The flexible clasps (stress breaking action) include all the following clasps	7 (33.3%)	12 (27.3%)	0.615
14-clinical situations in which flexible clasps are indicated	15 (71.4%)	26 (59.1%)	0.335
15-For sound and periodontally strong posterior abutment, it is recommended to use ... clasp	13 (61.9%)	38 (86.4%)	0.049
16-Indirect retention is provided by	11 (52.4%)	22 (50.0%)	0.857
17-The clasps of choice for a patient who has Kennedy class I edentulous area of the lower arch and the abutments are	12 (57.1%)	24 (54.5%)	0.844
18-In the case in question 17, the rest seats should be	13 (61.9%)	28 (63.6%)	0.892
19-The indirect retainer for the above case should be	10 (47.6%)	20 (45.5%)	0.87
20-For the case in question 17, the amount of lingual vestibular depth that is needed for a lingual bar	15 (71.4%)	35 (79.5%)	0.535
21-For Kennedy class III with no modification, the recommended number of clasps is	14 (66.7%)	32 (72.7%)	0.615
22-For the above case, the recommended number of rest seats is	10 (47.6%)	27 (61.4%)	0.295
23-In a removable partial denture, the main function of minor connector is	16 (76.2%)	38 (86.4%)	0.314

The proportions of correct responses before lectures by the academic year was shown in table (3). The master's students provided significantly higher proportions of correct answers to three questions in comparison to 6th year students, interns, GP and 5th year students, which include the uses of a surveyor (**Q1**) (100.0% vs 66.7% among 6th year students to interns and 86.1% among 5th year students, $p = 0.027$), the occlusal plane of the cast should be first placed parallel to the horizontal plane (**Q4**) (88.2% vs 66.7% among 6th year students to interns and 33.3% among 5th year students, $p < 0.001$), and the recommended number and location of the rest on the abutments for single bounded edentulous area (**Q11**) (82.4% vs 41.7% among 6th year students to interns and 47.2% among 5th year students, $p = 0.032$). However, students of the Master's provided significantly lower proportions of correct answers to the recommended sequence for designing a removable partial denture (**Q8**) (29.4% vs 50.0% among 6th year students to interns and 80.6% among 5th year students, $p < 0.001$).

Table 3: The proportions of correct responses before lectures by the academic year.

Question	5th year, N = 36	6th year, interns, GP N = 12	Master, N = 17	p-value
1-The use(s) of a surveyor	31 (86.1%)	8 (66.7%)	17 (100.0%)	0.027
2-Definition of surveying	33 (91.7%)	10 (83.3%)	17 (100.0%)	0.289
3-The main objective of surveying	24 (66.7%)	6 (50.0%)	15 (88.2%)	0.072
4-On the surveyor, the occlusal plane of the cast should be first placed parallel to the ...	12 (33.3%)	8 (66.7%)	15 (88.2%)	<0.001
5-Oral tissues to be surveyed	20 (55.6%)	2 (16.7%)	7 (41.2%)	0.06
6-Resistance against tissue away force (Pull) is called ...	24 (66.7%)	8 (66.7%)	11 (64.7%)	>0.999
7-Support in removable partial denture is ...	30 (83.3%)	7 (58.3%)	16 (94.1%)	0.063
8-The recommended sequence for designing a removable partial denture	29 (80.6%)	6 (50.0%)	5 (29.4%)	<0.001
9-initial situations in which the choice of mesial rest on abutment instead of distal rest is advantageous	21 (58.3%)	11 (91.7%)	9 (52.9%)	0.069
10-Direct retention is provided by	29 (80.6%)	8 (66.7%)	16 (94.1%)	0.191
11-The recommended number and location of the rest on the abutments for single bounded edentulous area should be	17 (47.2%)	5 (41.7%)	14 (82.4%)	0.032
12-The recommended location and number of rests for a unilateral distal extension removable partial denture?	20 (55.6%)	5 (41.7%)	5 (29.4%)	0.193
13-The flexible clasps (stress breaking action) include all the following clasps	10 (27.8%)	5 (41.7%)	4 (23.5%)	0.576
14-clinical situations in which flexible clasps are indicated	19 (52.8%)	8 (66.7%)	14 (82.4%)	0.113
15-For sound and periodontally strong posterior abutment, it is recommended to use ... clasp	31 (86.1%)	8 (66.7%)	12 (70.6%)	0.246
16-Indirect retention is provided by	21 (58.3%)	3 (25.0%)	9 (52.9%)	0.132
17-The clasps of choice for a patient who has Kennedy class I edentulous area of the lower arch and the abutments are	19 (52.8%)	5 (41.7%)	12 (70.6%)	0.272

18-In the case in question 17, the rest seats should be	22 (61.1%)	7 (58.3%)	12 (70.6%)	0.780
19-The indirect retainer for the above case should be	14 (38.9%)	5 (41.7%)	11 (64.7%)	0.200
20-For the case in question 17, the amount of lingual vestibular depth that is needed for a lingual bar	27 (75.0%)	9 (75.0%)	14 (82.4%)	0.852
21-For Kennedy class III with no modification, the recommended number of clasps is	24 (66.7%)	7 (58.3%)	15 (88.2%)	0.138
22-For the above case, the recommended number of rest seats is	18 (50.0%)	7 (58.3%)	12 (70.6%)	0.366
23-In a removable partial denture, the main function of minor connector is	30 (83.3%)	8 (66.7%)	16 (94.1%)	0.148

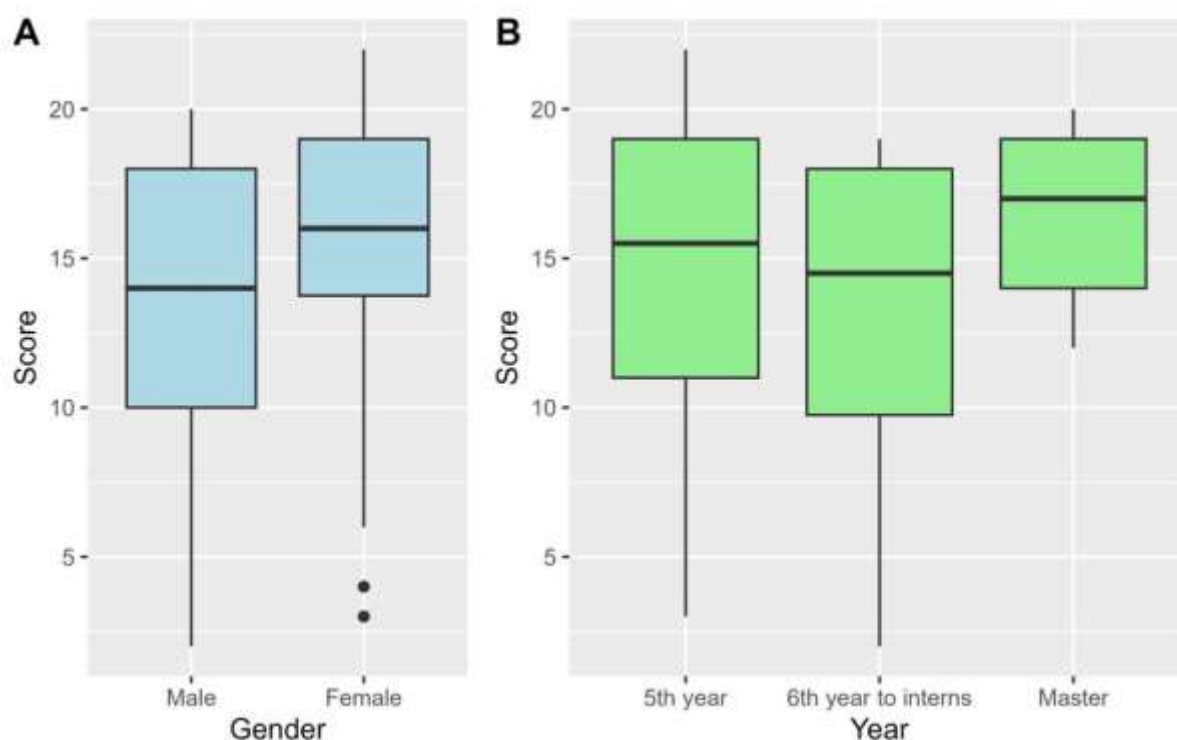


Figure 1: Calculated knowledge score. (A): Calculated knowledge score in male and female. (B): Calculated knowledge score among different years of study.

Regarding the calculated knowledge score, there were no significant differences in the median scores of knowledge between males and females (median = 14.0, IQR = 10.0 to 18.0 and median = 16.0, IQR = 13.8 to 19.0 among males and females, respectively, $p = 0.371$, **Figure 1 (A)** and between different categories of academic years (median = 15.5, IQR = 11.0 to 19.0 among 5th year students, median = 14.5, IQR = 9.8 to 18.0 among 6th year students, GP and interns and median = 17.0, IQR = 14.0 to 19.0 among Master's students, $p = 0.342$, **Figure 1 (B)**).

Analysis of the effects of lectures on participants' knowledge:

Table (4) showed the proportions of correct answers before and after lectures among 5th year students. A cross the 23 questions, the percentage of correct responses increased significantly for four questions, including those related to the recommended number and location of the rest on the abutments for single bounded edentulous area (**Q11**) (47.2% vs.79.2% , $p = 0.002$), indirect retention is provided by (**Q16**) (58.3% vs 81,2% , $p = 0.021$), the indirect retainer should be (**Q19**) (38.9% vs 70.8% , $p = 0.003$) and For Kennedy class III with no modification, the recommended number of clasps (Q21) (66.7% vs 89.6% with P value 0.010)

Table 4: The proportions of correct answers before and after lectures among 5th year students.

Question	Pre lectures, N = 36	Post lectures, N = 48	p-value
1-The use(s) of a surveyor	31 (86.1%)	43 (89.6%)	0.738
2-Definition of surveying	33 (91.7%)	45 (93.8%)	>0.999
3-The main objective of surveying	24 (66.7%)	35 (72.9%)	0.535
4-On the surveyor, the occlusal plane of the cast should be first placed parallel to the ...	12 (33.3%)	24 (50.0%)	0.127
5-Oral tissues to be surveyed	20 (55.6%)	22 (45.8%)	0.378
6-Resistance against tissue away force (Pull) is called ...	24 (66.7%)	39 (81.2%)	0.127
7-Support in removable partial denture is ...	30 (83.3%)	40 (83.3%)	>0.999
8-The recommended sequence for designing a removable partial denture	29 (80.6%)	45 (93.8%)	0.091
9-Clinical situations in which the choice of mesial rest on abutment instead of distal rest is advantageous	21 (58.3%)	31 (64.6%)	0.559
10-Direct retention is provided by	29 (80.6%)	43 (89.6%)	0.242
11-The recommended number and location of the rest on the abutments for single bounded edentulous area should be	17 (47.2%)	38 (79.2%)	0.002
12-The recommended location and number of rests for a unilateral distal extension removable partial denture?	20 (55.6%)	36 (75.0%)	0.061
13-The flexible clasps (stress breaking action) include all the following clasps	10 (27.8%)	18 (37.5%)	0.350
14-clinical situations in which flexible clasps are indicated	19 (52.8%)	28 (58.3%)	0.612
15-For sound and periodontally strong posterior abutment, it is recommended to use ... clasp	31 (86.1%)	41 (85.4%)	0.928

16-Indirect retention is provided by	21 (58.3%)	39 (81.2%)	0.021
17-The clasps of choice for a patient who has Kennedy class I edentulous area of the lower arch and the abutments are	19 (52.8%)	32 (66.7%)	0.197
18-In the case in question 17, the rest seats should be	22 (61.1%)	33 (68.8%)	0.466
19-The indirect retainer for the above case should be	14 (38.9%)	34 (70.8%)	0.003
20-For the case in question 17, the amount of lingual vestibular depth that is needed for a lingual bar	27 (75.0%)	43 (89.6%)	0.076
21-For Kennedy class III with no modification, the recommended number of clasps is	24 (66.7%)	43 (89.6%)	0.010
22-For the above case, the recommended number of rest seats is	18 (50.0%)	26 (54.2%)	0.705
23-In a removable partial denture, the main function of minor connector is	30 (83.3%)	46 (95.8%)	0.069

Concerning the difference in scores, there was a significant difference in the overall knowledge score of participants' responses before lectures (median = 15.5, IQR = 11.0 to 19.0) to the after lectures (median = 19.0, IQR = 15.8 to 20.0, $p = 0.009$, **Figure 2**).

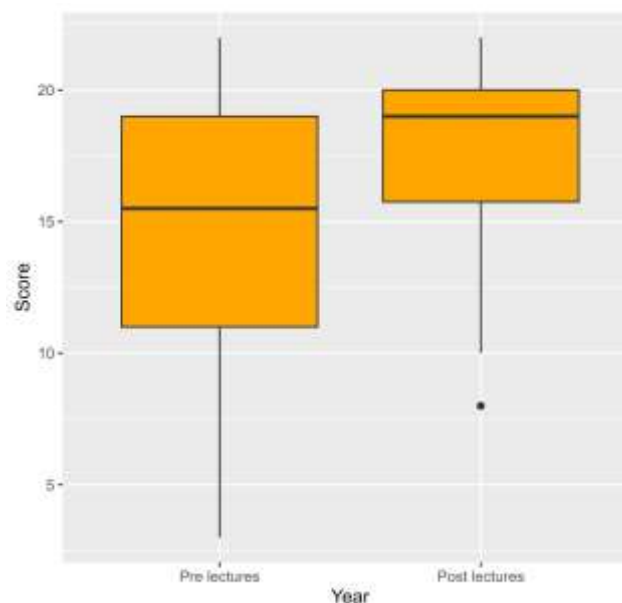


Figure2: Calculated knowledge score before and after lectures

Discussion:

Majorities of the researches have been conducted to assess the knowledge and cognitive skills of the dentists regarding prosthodontics. (11),(12) These researches were carried out to allow the application of proper mechanical and biological principles of partial denture design (13). As a result, this will limit it's possible biological and mechanical consequences. (14)

Our study was conducted to determine the level of knowledge in RPD and whether teaching of RPD design to the undergraduate students has a valuable information for proper designing of RPD.

In this study the female participants recorded a higher percentage of correct answers than the male students.

In the general assessment of the students' knowledge and cognitive skills, the postgraduate students showed a higher level in these learning domains. This was evident by the higher percentage of correct answers in most of the questions (15 questions) among all other participants. However, three specific questions were particularly significant which included surveying and designing of removable partial denture. Nevertheless, their level of knowledge was lower in the question of the recommended sequence for designing RPD. This could be due to the fact that this sequence of RPD designing had been explained to the undergraduate students during their fourth year of pre-clinical study of removable partial denture. This was, also, evident by the higher percentage of this question in fifth-year students than the other participants as emphasis of this design sequence was carried out during this year of study.

The fifth-year students were more confident to answers the questions after the lectures as the teaching activity had prepared them with the certainty that is required to answer these questions. This could be due to the fact that undergraduate students confidence in removable prosthodontics increases as their course is progressing. (15) This was reported by the increase in their participation in the after-lecture assessment.

In addition, the knowledge and cognitive skills in removable partial denture of the undergraduate students were significantly improved after lectures. This was clearly noted by the higher knowledge score and the higher percentage of correct answers among these students in the after-assessment. This improvement included the information of the recommended number and location of the rest on the abutments for single bounded edentulous area, ways to provide indirect retention, indirect retention for a case of lower Kennedy class I and the recommended number of clasps in Kennedy class III.

Therefore, the undergraduate students have shown a good level of knowledge and cognitive skills regarding removable partial denture, however, lectures exert a great influence in improving the students' level of knowledge and skills. This finding is in consistence with a recent study conducted by Lamfon H., which has found that the undergraduate students drew good quality of partial denture design that might reflect the good understanding of partial denture design principles. (16) Also studies have shown that structured clinical training has led to improved skills level in dentists. (17), (18)

Though this is a uni-center based study; this helps in inclusion of unified learning experience which hails in avoiding of any inconsistency in the results. In addition, the retention period of knowledge was not assessed in this study. Therefore, future studies to assess retention period of knowledge is recommended.

Conclusion:

The level of knowledge and awareness in removable partial denture is improved with the level of experience where postgraduates have a higher level of understanding than undergraduates and general dentists. However, lectures have produced a significant improvement in knowledge and cognitive skills among undergraduate students. Therefore, lectures can be considered as the corner

stone in teaching removable prosthodontics and more advanced teaching strategies can be implanted additionally.

Conflict of interest

The author declares no financial interest. Also, I certify that the submission is a self-funded original work and is not under review at any other publication.

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