Improvising student teaching during pandemic via the platform of publishing to convey specific case based learning outcomes for undergraduate dental students – Part 2 (Applied basic sciences)

Fuad Al Sanabani ¹⁶, Khurshid Mattoo ²*, Bandar M.A. Al Makramani ³⁶, Armin D Ramos⁴, Verginita Abbas⁴, Undergraduate Students (5th year)⁵

¹ Course Coordinator, Clinical Fixed Prosthodontics, Department of Prosthetic Dental Sciences, College Of Dentistry, Jazan University, Jazan 45142, Saudi Arabia; ² Course Co-coordinator, Clinical Fixed Prosthodontics, Department of Prosthetic Dental Sciences, College Of Dentistry, Jazan University, Jazan 45142, Saudi Arabia; ³ SDS Clinical Staff, Clinical Fixed Prosthodontics, Department of Prosthetic dental sciences, Jazan University, Jazan 45142, Saudi Arabia; ⁴ Production Laboratory Staff, College Of Dentistry, Jazan University, Jazan 45142, Saudi Arabia; ⁵ Undergraduate Students, (5th year), [Class of 2017 (SDS 543/544 20201–20202) (September 2020-21)] ⁶ Assistant Professor, Department of Restorative Dentistry, College Of Dentistry, Sana’a University, Sana’a 1247, Republic of Yemen

* Corresponding author: Khurshid Mattoo, Assistant Professor, Department of Prosthetic Dental Sciences, CODJU, Jazan University (KSA), Mobile – +966595086078, E mail address – drkamattoo@rediffmail.com

ABSTRACT

This article is the second part of an earlier published clinical case series that was aimed to overcome the deficits of clinical teaching suffered due to the restrictions of social distancing and other norms during the pandemic (Covid 19). This article focusses on integrating the theoretical attributes of color (hue, value, chroma) to applied clinical sciences, through patient based learning. Cases presented in this article are collection of complex fixed partial denture designs and treatment plannings along with different cases of shade manipulation to overcome the shortcomings of shade guides. 47 female and 40 male students opted enrollment for Clinical Fixed Prosthodontics (SDS 543 and SDS 544) course, for academic year (2020–2021). Students submitted their clinical cases at the end of the course along with their continuous assessment grades. Case selection was based on case history, accurate diagnosis and complexity in prosthesis design. A split pontic type of non rigid connector was incorporated to overcome the problems of pier abutment. A fluted retainer was used for a three unit fixed partial denture in the complex rehabilitation of a patient who had suffered from a gunshot wound. Multiple cases of non conventional shade matching are presented to demonstrate the clinical success of these restorations. A case of wrong perception of tooth shade in a patient is also presented. Students technician communication and the fallout of poor communication is also presented.

Keywords: shade guide, dental porcelain, metal ceramic, all ceramic, esthetics

Introduction

With the advent of digital technology, medical curriculum has witnessed major changes among which the integration of basic sciences with clinical sciences have received significant push. Simulation technology used in training student doctors has further decreased the gap between basic and applied sciences [1]. Despite such advances, it has been stated that overall conduct of clinical teaching is suboptimal [2]. While to some authors, the future of undergraduate medical students may look uncertain [3], it is also true that over the years, medical schools have regularly been exposed to the pressure of bringing changes in the health care system without affecting excellence in education [4]. The surge of the pandemic (covid 19) has thrown new challenges to already existing ones, thus making organization and studying of practical medical education very difficult and cumbersome for both teacher and students [5]. With so many health care workers succumbing to covid -19 disease [6], many schools/hospitals have lost reputed and skilled
teachers which can be replaced only in due course of times. Among various teaching methodologies however, the patient based learning (PBL) system has been well accepted by the students [7], since it was found to arouse more curiosity and zeal to learn among students [8]. Studies have shown that PBL generate more learning interest with subsequent more retention of the subject [9], [10]. Science of dental materials (SDM) is not only an essential part of dental curriculum, but also one of the least understood and practiced. Its integration is applicable to all clinical branches of dentistry, especially restorative and prosthetic dentistry. It has been one of the subjects whose effective integration into clinical practice of undergraduate curriculum has been posed as a huge challenge [11]. Since both these clinical branches are demanding in terms of procedures being irreversible in patients, effective teaching of such subject, therefore, becomes critical for both student learning and patient safety [12]. Clinical application of the subject of dental materials is difficult unless the results are not evident in the patient’s mouth. In the first part of this article series, student related factors (burnout, stress, lack of attention, overworked, student evaluations etcetera) have been discussed in the light of developing a new teaching approach during and after the pandemic [13]. While the first article mainly focused on psychosocial learning through case based learning, this article is objectively focussed to integrate the science of color restorations through clinical cases. Other general objectives are to reach and educate other students in the group, class who due to covid restrictions, were not able to see student cases during the course, to bring to the notice of undergraduate students about their weaknesses during the course.

Methodology: This second part of the case series is a continuation of successfully completed clinical cases done at the undergraduate level. The cases were completed in the clinical fixed course which is a part of the curriculum for the fifth year. The cases are those completed for the academic year 2020-21. All cases were supervised under qualified and experienced staff in one of the reputed and recognized academic institution in the Kingdom of Saudi Arabia. Patients presented in this series were thoroughly informed about their respective treatment plans and consent was obtained from each of them. A total of 87 students (47 female, 40 male) enrolled for the course (SDS 543 and SDS 544) for academic year December 2020 – June 2021. Students completed their clinical requirement of a three unit anterior or posterior fixed partial denture along with a case of a post and core restoration. Before concluding the semester, students were asked to submit their completed clinical cases along with respective photographs and staff signatures. Verification of the cases was done on R4 (Carestream, Software). Selection of cases was based on verified records, availability of preoperative and postoperative photographs and fulfilling the criteria for this article. Cases are segregated into different sections which are as follows:

Case presentations:

Case 1: a) Complex fixed partial denture designing
A young male patient, who was an expatriate and was planning to go back to his country permanently, reported with a chief complaint of missing maxillary maxillary right and left molars along with a missing right first premolar (Kennedy class 3 modification 2 partial edentulous situation). Medical, social, drug and family history was insignificant to prosthetic rehabilitation. Extra oral and intra oral examination was within normal limits. The patient was presented with multiple prosthetic treatment options (Implant supported, Fixed Movable Partial Denture (FMPD), fixed - fixed partial denture, cast partial denture) in the order of preference. After an explanation of the advantages and disadvantages of each, the patient consented for a FMPD on the maxillary right side. Treatment was initiated by making of diagnostic impressions using Irreversible
hydrocolloid (CA 37; Cavex, Haarlem, Holland). A diagnostic mounting on a semi adjustable articulator (Whip Mix series 3000; Elite Dental Services, Inc, Orlando, Fla) was done followed by evaluation of dimensions of each abutment crown. The design selected for making the bridge as a fixed movable was a split pontic. The entire FMPD was prepared in two different sections at different times (casting). Clinical and laboratory procedures performed were similar to those done for routine fixed partial denture till the stage of wax pattern fabrication. Different consistencies of pattern waxes (Bego, Wilhelm-Herbst, Germany) were used for fabricating the wax pattern with most rigid and stable wax used for the horizontal bar that would fit under the pontic (Fig 1 A). After doing the casting (Wiron 99; Bego, Bremen, Germany) of the wax pattern, the first component of the FMPD was fitted to the cast (Fig 1 B) and tried in the patient's mouth. Meanwhile the last abutment tooth was prepared, waxed and cast in base metal alloy followed by the fitting of the second component of the FMPD (Fig 1 C). Porcelain (feldspathic) (VMK-95 Metall Keramik; Vita Zahnfabrik, Bad Sackingen, Germany) was fused followed by a porcelain trial. Finishing and polishing of metal (Fig 1 D, E) was later accomplished and the entire assembly of the fixed partial denture was cleaned in ultrasonic cleaner. After occlusal adjustment the first component of fixed partial denture was cemented into final place using zinc phosphate (Harvard, Germany) cement followed by cementation of the second component using the same cement (Fig 2 A, B). After removal of excess cement, the patient was instructed regarding the care and maintenance of the FMPD. The other side fixed fixed partial denture was fabricated at a later date.

Fig 1: (A) Wax pattern for split Pontic (B) Cast framework (C) Assembled split Pontic - FMPD (D) Finished FMPD (E) Disassembled FMPD showing split points

Fig 2: (A) Buccal view of FMPD (B) Frontal view of the FMPD

Case 2: Complex Treatment (Combination of a Fixed and Removable Partial Denture)

A male patient aged 42 years, was primarily allotted for the clinical removable Prosthodontic course (SDS 541) with the patient’s chief complaint being difficulty in mastication due to loss of maxillary left posterior teeth. Patient had a history of trauma (bullet injury) that had rendered his maxillary left side to be completely removed from maxillary left lateral incisor to the last molar on the same side. Medical, drug and social history were insignificant, while dental history revealed loss of teeth as a result of trauma few years back. Intra oral examination revealed a maxillary class 2 and mandibular class 3 partial edentulous situation. The patients remaining teeth were stained that included rare vertical pigmented lines in the maxillary and mandibular anteriors. Treatment plan presented to the patient included a cast partial denture for the maxillary arch and a three unit porcelain fused to metal, fixed partial denture in relation to mandibular arch.
Other treatment options like implant supported prosthesis were not advised because of occlusal condition and overall financial condition of the patient. To initiate the treatment, the design of the maxillary partial denture was acquired from the supervising staff of other course (SDS 541) so that the occlusal scheme for lower fixed partial denture can be designed. Two features that were challenging in fabricating mandibular FPD were the preparation of mandibular left side molar (lingual) side and the shade matching for buccal facing. Lingually the outline of the furcation had a definite influence on the placement of the margins and the shape of the lingual wall (Fig 3A, B). The lingual wall was designed to be concave in the center, so that the metal in the crown will also replicate the underlying contour (fluted crown). This design does not allow the formation of an overhang in the region and enhances self cleansing ability of the restoration (Fig 3 C). Since remaining natural teeth had generalized stains (intrinsic), the current FPD was modified using light and dark brown stains (VMK-95 Metall Keramik; Vita Zahnfabrik, Bad Sackingen, Germany) on a moderately high value of porcelain shade (Fig 3 D). After cementing (Poly F Plus; Dentsply DeTrey GmbH, Konstanz, Germany) the mandibular FPD, the maxillary cast partial denture was fabricated with a group function occlusion on either side (Fig 3 E).

Fig 3: (A) Fluted tooth preparation on the lingual side (B) Occlusal view showing the convex contour of the lingual preparation (C) Metal framework with lingual fluted retainer on first molar (D) Three unit fixed partial denture in place (E) Overall occlusal rehabilitation after insertion of a maxillary cast partial denture.

Case 3: Significance of systematic patient education and motivation regarding aesthetics
An elderly male patient, being treated by the student, was reluctant about getting a new FPD that looked exactly like a previous one present in the maxillary arch. While medical history revealed his long standing controlled diabetic condition, the patient's mental attitude was not conducive for negotiations in the treatment since he was basically overdemanding. Upon extra oral examination, it was noted that the patient had previously got a five unit maxillary FPD done on the left side about 7 months back and that he wanted a similar FPD on the right side. Existing FPD had a too high value selected for porcelain and in no way was the restoration hidden or would blend with remaining dentition (Fig 4 A). It was in fact absolutely in total contrast to the
remaining shade of the surrounding natural teeth thus making it look absolutely artificial from even far off distance. The shade of the existing tooth was actually demanded by the patient himself during previous treatment. The patient was thoroughly educated and motivated that he should not dictate and demand the shades to the dentist and that since he does not know much about aesthetics, it would be better for professionals to decide the right shade for him. Patient had a fractured right lateral incisor along with missing right maxillary first premolar (Fig 4 A). After much deliberation between the patient and the student supervisor, the patient agreed for an FPD. Routine clinical and laboratory procedures for FPD fabrication were done till the stage of porcelain firing on the casting. A higher value of shade on 3D vita master shade guide (Vita Zahnfabrik, Badsackingen, Germany) was kept as the basic shade since his anterior teeth were more greyish. Even this value did not match his severely greyish natural shade of anteriors. Staining had to be done to entire FPD to achieve the desired results (Fig 4 B). The occlusal surface was kept of metal (Fig 4 C) to achieve the function of mastication and to make the FPD self cleansing. After the final cementation (Poly F Plus; Dentsply DeTrey GmbH, Konstanz, Germany) (Fig 4 D) the patient understood the importance of listening to what the doctor decides for that patient and regretted that he had dictated his own concepts of shade during previous treatment. The results of the Shade combined with staining to match with remaining natural anterior teeth (Fig 4 D).

Fig 4: (A) Previous FPD shows the porcelain with high value resulting in contrasting color against color, of natural teeth (B) New FPD with correct shade matching making the FPD less obvious to the naked eye (C) Occlusal view (D) Shade of entire dentition matching except the FPD in which patient was allowed to make a shade of his own choice

Case 4: Understanding the three different attributes of color perception (hue, value and chroma) based on clinical cases.

Subcase 1: An elderly female patient presented with a well maintained natural tooth that included the presence of a metal crown on the maxillary right lateral incisor (non noble alloy). With medical history and clinical parameters within normal range, the biggest challenge was replicating of intrinsic stains in the natural teeth that ranged from white to yellow to dark brown. The treatment option of FPD with individual characterization was presented to the patient and consented by her. After porcelain trial, the three unit bridge was stained with white stains (VMK-
95 Metall Keramik; Vita Zahnfabrik, Bad Sackingen, Germany) that were diffusely distributed in the cervical third of the restoration (Fig 5 A, B). After the application of glaze the FPD was cemented using a zinc phosphate cement (Harvard, Germany) (Fig 5 C, D).

**Subcase 2:** An elderly female patient, highly conscious about aesthetics reported with a will to replace the maxillary missing lateral incisor on the left side. Patients medical, social, drug and other related histories were within normal limits. Negative clinical findings included gummy smile, thin maxillary lip, bimaxillary protrusion with protruded anterior teeth, diastema, moderately proclined, incisal wear (notch - seed eating) on right maxillary central incisor and an arrested proximal carious lesion of maxillary left canine (Fig 6 A). The patient was educated about the importance of duplicating diastema within the new restoration and the possibility of difficulty of shade matching in her case. The patient was asked to undergo a thorough oral prophylaxis of natural teeth. Shade of the artificial teeth on the vita shade guide (3D) did not match the shade of remaining natural teeth (Fig 6 B, C). While, the esthetic incorporation of diastema was successful using a loop connector, the shade of artificial teeth was contrasting in oral cavity and was easily detected by the naked eye (Fig 6 C). A multi chromatic staining technique was developed to achieve the final shade that matched natural teeth (Fig 6 D)

**Subcase 3:** A middle aged male adult patient reported with chief complaint of poor facial aesthetics because of loss of mandibular anterior teeth. Adding to the compromised aesthetics was also a single crown restoration of mandibular anterior tooth, which was not matched with remaining natural teeth. The patient gave a history of type 2 diabetes that was under control. The patient had got his lower anterior teeth extracted due to periodontal problems. Extra oral features on examination were within normal limits. Intra orally the patient had a Kennedy class 4 partial edentulous situation in the mandibular arch with two central and left lateral incisor missing (Fig 7 A). The right lateral incisor had an existing crown restoration that was not properly extended at the margins. Remaining natural teeth were mostly multichromatic with stains also being multichromatic and diffuse in nature. Concentrated zones and well distributed zones of different shades were prominent on the cervical third of maxillary anteriors. The patient was provided with various treatment options including that of implant supported single crowns and a cast partial
denture. After explaining the pros and cons of an FPD in such situation, the patient finally consented to an FPD in the same region. Routine clinical and laboratory procedures were carried till the stage of porcelain trial. The value of the shade was kept higher (chroma being lower), so that it can be modified with staining (Fig 7 B). Various shades of corn, brown, khaki and black (VMK-95 Metall Keramik; Vita Zahnfabrik, Bad Sackingen, Germany) in different consistencies were applied in the restoration and fired (Fig 7 C). The fixed partial denture was cemented with a polycarboxylate cement (Poly F Plus; Dentsply DeTrey GmbH, Konstanz, Germany) (Fig 7 D).

**Subcase 4: Inappropriate/Incomplete work authorization forms**

Students failed to comply with proper and complete instructions given to the laboratory technician during the course. An example along with its drastic effect is shown in Fig 8 A, where the laboratory form shows the shade selection written as if it was a crown restoration while in reality it was a three unit bridge (Fig 8 B). Clinically, the shade did not match appropriately (Fig 8 C) because the distribution of the shade was not mentioned.

**Discussion**

This article in the form of the case series was intended to overcome some of the drawbacks that resulted either as a direct or indirect consequence of a pandemic, on medical/dental education. Besides the traditional clinical education, the authors chose to educate their students through the publishing platform. It is expected that when a student sees something written about his course and/or patient, he will take his criticism more seriously rather than when such criticism is done verbally in a clinic. It is also true, that faculty in medical education is already overburdened with administrative and clinical duties [14], whether such a platform will be viable or not will be a matter of future research. The concept of patient based learning has become more popular among students since it helps them understand the basic sciences [15], in this case the subject being the science of dental materials. PBL is especially more beneficial for those students who have to overcome language barriers like knowing of English. PBL, however, does not imply that the student will necessarily acquire knowledge [16], it will only assist in the application of basic science knowledge in him [17]. Medical students understand the importance of basic sciences only when they come to clinical learning. Today's student is not only overstressed but also overburdened and overloaded with information, which may be either appropriate or inappropriate. This makes basic sciences more important, since the knowledge of basic sciences

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**Fig 7:** (A) Intra oral view of previous treatment (B) Ceramic shade with higher value and lower chroma (C) Stains applied cervically (D) FPD with a lip in normal position

**Fig 8:** (A) Incomplete and inappropriate work authorization form (B) The FPD that was made according to the instructions on the form (C) Clinically unmatched restoration

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can only equip a student with ability to whether a particular information should be accepted or rejected. In earlier times, medical students used to study basic sciences even after they used to pass clinical science subjects. However, today's students rely more on information on internet for correcting their concepts. Academically, studies have shown that more attention in the curriculum needs to be devoted to the basic medical sciences and that too regularly at all semester levels [18]. Even students in the Kingdom of Saudi Arabia have expressed that PBL improved their chances of learning abilities and learning outcome domains [15], [19].

Identification of the gap in learning between basic dental sciences and clinical problems in dental education was stressed by institute of medicine about three decades ago [20]. While, didactic lectures are most preferred mode of teaching, they tend to be more of teacher centered and also lack synchronization with applicable clinical science. The science of dental materials covers a vast group of materials (mainly ceramic, resins, alloys and cements). Besides, there are many materials that assist fabrication of restoration and/or a prosthesis. The introduction of such vast subject is therefore essential in the first few years of undergraduation. Most students are either required to mentally visualize the clinical situation which makes subject difficult and uninviting. With case based or problem based learning the student not only is able to understand the application of the material, but it also enhances his interest in a subject which he might not feel reading [21]. One of the issues that is worthwhile investigating or discussing, is the level of complexity of a case which a student may not be able to understand at undergraduate level. The first two cases described in this article are of a complex prosthetic design and a complex treatment plan. Undergraduates have been reported to complete difficult cases [22]. Complex designing may on the contrary attract students' attention and thus promote learning, however, when asked to prepare a treatment plan for a complex case may not achieve same learning responses. Therefore, it is important for undergraduate students to have adequate basic knowledge in order to generate and develop interest in clinical cases. A pier abutment is considered to be a complex fixed partial denture design and traditionally has been successfully restored with the use of a non rigid connector [23]. The design used is termed as a fixed movable bridge which can be achieved by use of different designs [24], [25]. The use of a non rigid connector design used in this case is a split pontic, which consists of a bar under the pontic. The design can be incorporated in two different approaches. These include to prepare entire assembly into hard crown wax followed by their casting. Another method used is to fabricate casting framework in two different sections as used in this case. Among various complex treatment plans, fabricating a removable partial denture and a fixed partial denture simultaneously can be extremely challenging. We present one such case which was completed in two different semesters (total period of 11 months). For the fixed partial denture, incorporating a fluted crown as a retainer was done successfully by doing the tooth preparation on a retracted gingiva. The fixed partial denture matching to existing shade was also a complex process. The three attributes of color, namely hue, value and chroma are very difficult to understand at any level of education. Besides these attributes, there are other properties like translucence, metamerism, and fluorescence that confuse students even more. Although they read about it during lectures in the early years, they tend to understand its relevance only after doing clinical courses [26]. Successful shade matching is not only dependent on thorough knowledge, but it also depends upon one's cognitive ability to accomplish things. Most cases presented in this article are based on proper and correct shade evaluation and estimation. Patients wrong perceptions about shades or tooth color has also been presented. Under no circumstances should a student learn to satisfy the esthetic desires of a patient. Most of the patients do demand white teeth, which may work for complete denture prosthesis, but cannot be applied to fixed partial dentures. Students must also
understand that their social reputation as practitioners can be endangered if meeting such demands [27]. At undergraduate level, inappropriate student technician communication is the main reason for the poor aesthetic output. Students tend to write work authorization form with less seriousness. Shade may be written, but without distribution.

**Conclusion**

Students during training go through various sufferings, in which one of the academic suffering is non availability of overburdened clinical faculty (with patients, student ratio, working long hours, administrative work). Since teaching staff is required to publish, this article provides an innovative way of educating ones students during their respective training. However, it still remains to be proven that students do find such publications effective to further enhance their clinical skills, for which future studies are encouraged.

**Limitations and Future Studies**

This case series is a random collection of students clinical work, that has been presented under specific objectives and in no way can be generalized to other students or other academic courses. Finding answers to such questions, requires studying of individual parameters as mentioned in this article. How students react to this teaching approach will take a major longitudinal study in which the effect is measured at the individual level.

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