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Tooth Anatomy in Dental Education: a Better Way to Replicate Dental Morphology

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ABSTRACT

Introduction: teaching dental anatomy encompasses both theoretical and practical methods that aim to accomplish objectives to differentiating between primary and permanent teeth, recognizing anatomical landmarks, and recreating tooth shape. It is a unique learning activity that involves the assimilation or re-memorization of anatomical knowledge and a process of manual skill, which is helpful and essential in clinical dentistry. Therefore, we believe that the crown of the tooth should be carved rather than the root, and computer-assisted instructions can convey information in fresh, creative ways while allowing students learn at their own pace.

Keywords: Tooth; Morphology; Dentist; Clinical Practice, Education.

Introduction

Tooth carving is an important practical preclinical exercise in the curriculum in Indian dental education setup. Tooth carving through wax blocks is a mandatory preclinical exercise for undergraduate and postgraduate students to perform according to the dental curriculum in India[1]. Teaching dental anatomy includes observation and analysis of natural teeth and carving wax models to accurately reproduce the morphology of teeth[2]. This subject is introduced in the first year of BDS course and consists of teaching differences between deciduous and permanent teeth, chronology of tooth eruption, morphology of deciduous and permanent dentition, and root canal anatomy[3].

Understanding primary and permanent teeth, identifying anatomical landmarks, and replicating tooth morphology are just a few of the objectives that are meant to be attained when teaching dental anatomy. It is important to improve the teaching of these concepts, particularly the ability to carve teeth accurately while taking shape, function, and aesthetic into account[4]. The goal of the preclinical dental curriculum is to provide students with well-rounded and balanced preclinical exposure to give them the basic knowledge and skills needed for competence in modern dental practice[2].

The purpose of carving is the reintegration, by means of total or partial recreate in anatomical and morphological landmarks on deciduous and permanent teeth in its form and re-establishing in the physiology of mastication[5]. The main ethos of dental wax carving is to nurture the fine art of waxing teeth by restoring them to their correct morphology and anatomy.[6] Additionally, it is a valuable aid in assimilating or relearning anatomical knowledge and a process of manual ability, both of which are important and useful in professional activities[5].

Strategies in tooth carving:

All students have different learning styles and differing learning needs. Fleming described four sensory modalities: Visual (V), aural (A), reading/writing (R), and kinesthetic (K)[1]. It has been suggested that tooth carving builds the psychomotor skills in dental students. However, it is rather questionable if tooth carving using wax block alone is responsible for the development of psychomotor skills among students. The psychomotor skills that a dental student is expected to learn after completion of dental anatomy is the visual skill to minutely appreciate the normal 3D tooth morphology; the ability to differentiate normal teeth from its deviations; visual efficiency to identify the flaw in the morphology of a tooth and envision the correction required to replicate the closest possible morphology and the motor skill to execute it[7].

A dental student should learn how to evaluate each tooth's shape, volume, and function as well as how to restore the patient's stomatognathic system's physiology and appearance completely[8]. The skills involved in dental wax carving familiarizes dental students with hand instrumentation techniques and allows them to develop skills such as finger dexterity, grip, hand steadiness, aiming and reaction; all of which

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are essential for the high precision needed to practice dentistry[6].

Syllabus associated with tooth carving:

Practical classes consist of carving teeth in natural size (some colleges also require carving of three times bigger than the natural size), from central incisors to second molars with exact crown and root proportion, in wax blocks[3]. Carving of deciduous teeth forms the basic preclinical requirement per the reviewed postgraduate curriculum of Pedodontics[9]. The syllabus should be carefully designed to ensure that students spend their time and energy on subjects and activities that are meaningful and so acquire the skills necessary to become good dental surgeons later in life. A subject such as tooth carving is not only irrelevant but also a waste of valuable time and energy[10]. Computer based learning aids may also be useful to teach other parts of the curriculum such as differences in morphology of primary and permanent dentition, chronology of dentition, stages of dentition, and internal tooth anatomy[1]. Students' understanding and application in other courses where such information is required have been greatly influenced by the training of wax carving in the dental anatomy course by carving of natural tooth dimensions or missing part of teeth placed in a dental articulator.[11] Various authors discuss the importance of tooth wax carving and its advantages/limitations, which are listed in Table -1.

Table 1. List of authors debate on the importance of tooth wax carving

SL. N^{o}.	Year	Authors	Opinion Towards Tooth Carving
1	2004	Selma Siessere, Mathias Vitti, Luiz Gustavo de Sousa, Marisa Semprini and Simone Cecilo Hallak Regalo[5]	Authors opined that the professional (surgeon/dentist) who is committed to the preservation of human teeth should have a clear understanding of the characteristics and fundamentals of dental morphology and must develop enough manual dexterity to reproduce any part of the dental system, maintaining perfect correlation with the whole.
2	2004	Bogacki RE[16]	Authors have shown the utility of software-based learning to teach the anatomy of the adult dentition. The software-based teaching along with interactive class meetings has augmented the traditional teaching based on students' positive feedback.
3	2008	B Sivapathasundharam[3]	Authors recommended that carving of crown can thus have some justification. But carving the root is an absolute waste of time, energy, and of course kilos of wax. I strongly feel root carving may not help the students much, but on the contrary, it may only increase the risk of failing in the practical exams, if the student happens to break the roots during the examination.
4	2009	Bakar PK[10]	Authors reveal that the syllabus should be carefully designed to ensure that students spend their time and energy on subjects and activities that are meaningful and so acquire the skills necessary to become good dental surgeons later in life. A subject such as tooth carving is not only irrelevant but also a waste of valuable time and energy.
5	2009	Nance ET[15]	Authors have shown in their study that computer assisted instructions can present material in new and innovative ways while allowing students to learn at their own pace. It has the advantage of allowing the students to review the methodology and technique multiple times as compared to the traditional instructor-directed learning.
6	2010	Irulandy Ponnaih[19]	Author expressed that Firstly, learning tooth morphology can only equip a student to become a good technician rather than a clinician. Secondly, because most of the restorative works are performed by dental technicians, and as surgeons or anatomists are never required to carve the maxilla or mandible to learn the anatomy to perform corrective surgery, dental students can become skilled surgeons (Bachelor of Dental Surgery) even without learning tooth morphology. It is not essential for dental students or practitioners to learn tooth morphology at the curricular level and that too by expending enormous time and effort.
7	2010	Arathi Rao[9]	Author opined that Carving of deciduous teeth forms the basic preclinical requirement per the reviewed postgraduate curriculum of Pedodontics.
8	2014	Meghanand T. Nayak, Priya Sahni, Abhishek Singhvi and Anjali Singh[2]	Authors suggest that tooth carving is unmatched as a means for teaching dental anatomy. Most respondents in this study felt that the total curriculum time allotted to tooth carving they received as students was appropriate, and they think that carving should be continued in undergraduate dental curriculum.

9	2015	Patil S, Sowmya SV, Rao RS and Raj T[12]	Authors expressed that students in the current era are more tech-savvy and exposed to the latest gadgets will have a more efficient and enjoyable E-learning experience. However, the age-old exercise of carving using wax remains the gold standard when compared to E-learning techniques.
10.	2016	Saurabh Juneja and Manjushree Juneja[1]	Authors opined that Tooth carving is an important practical preclinical exercise in the curriculum in Indian dental education setup. It forms the basis of introduction to tooth anatomy, morphology, and occlusion of primary and permanent teeth through practical approach. It requires enormous time and manpower to master the skill. Therefore, there is an imminent necessity to incorporate computer-based learning of the art of tooth carving for effective teaching and efficient student learning.
11	2018	Sergio Varela Kellesarian[13]	Authors prescribed that using oversized wax blocks, has presented low cost, easy handling, and good reproducibility.
12	2018	Renato A. de Azevedo, Marcos B. Correa, Marcos A. Torriani and Rafael G. Lund[8]	Authors proposed that studying the theory of dental anatomy alone is not enough to acquaint students with the anatomy of each tooth in detail. In addition to the study of natural teeth, macro models made of plaster or resin and models of dental arches can help students understand the anatomical aspects they need to know. Sculpting in wax on natural teeth or macro teeth is also an option for learning dental anatomy while developing psychomotor ability.
13	2020	Madiha Anwar, Beenish Fatima Alam and Syed Jaffer Abbas Zaidi[6]	Authors suggested that dental wax carving exercise is a practical exercise to teach tooth morphology that develops psychomotor skills needed to practice clinical dentistry. Dental carving skills develop manual dexterity and psychomotor skills for practicing clinical dentistry and should be an integral component of preclinical dental curriculum so that clinically relevant cognitive & psychomotor skills are incorporated. Based on this study, a live demonstration of dental wax carving skills should be the preferred teaching modality.
14	2021	Daniele B. Conte, Milena Zancanaro, Andre Guollo, Luana R. Schneider, Rafael G. Lund and Sinval A. Rodrigues-Junior[4]	Authors felt that for the psychomotor ability to sculpt a tooth, 2D-drawing and 3D-wax carving practices have been extensively used. The latter, using oversized wax blocks, has presented low cost, easy handling, and good reproducibility.
15	2021	Afnan O. Al-Zain, Adel M. Abdel-Azim and Hisham I. Othman[11]	Authors expressed that Practicing dental carving of teeth is an essential aspect of undergraduate dental education because it helps develop their psychomotor skills. The training of wax carving in dental anatomy course by carving of natural teeth dimensions or missing portions of teeth placed in a dental articulator has played a significant part in the students' knowledge.
16	2021	B Sivapathasundharam and GB Protyusha[7]	Authors suggested that tooth carving builds the psychomotor skills in dental students. Carving of wax teeth, which is bound to vary from the actual tooth measurement and morphology is a debatable teaching practice as the visual skill development is significantly impaired, given that it does not provide the student with an idea of deviations that exist in real life clinical scenarios.
17	2022	Ademar Fonseca, Victoria B. da S. Guimaraes, Sinvak A. Rodrigues-Junior, Alison A.R. Fonseca, Renato A. de Azevedo, Marcos B. Correa and Rafael G. Lund[18]	Authors pointed out that knowledge of dental morphology enables the identification of different dental groups, helps diagnose variations of normality and dental pathologies, and develops functional and aesthetic senses for the reproduction of the tooth using dental materials.

Technique of teaching:

Traditional Technique:

Traditional teaching techniques for dental anatomy may include lectures, enormous three- dimensional models, dental anatomy books and manuals, samples of preserved teeth, and sectioned natural teeth revealing the inner structure[4]. When compared to E-learning strategies, the traditional practise of carving with wax continues to be the gold standard[12]. The most popular technique for instructing students about tooth morphology in classrooms around the world is wax carving[8]. The majority of dental schools use conventional techniques to teach dental anatomy, with lectures used to impart the theoretical portion while

the practical portion involves carving teeth, sketching teeth in two dimensions, and identifying anatomical features in samples of preserved teeth[13]. Oral anatomy and tooth morphology have been traditionally taught by didactic lectures, books, manuals, artificial tooth models and extracted teeth. Wheeler's[10] was one of the first who introduced tooth carving in wax blocks[6]. Foundational knowledge of tooth morphology was traditionally presented in didactic lectures, textbooks, and study guides while psychomotor skills of students were developed through two-dimensional line drawings of teeth and sketching projects of different views of the teeth in graph books. This traditional model of teaching was instilling only superficial understanding without any clinical significance or integration with clinical sciences[6].

Newer technique:

There have been initiatives worldwide to make dental anatomy education more dynamic and clinically relevant. When using digital resources, factors like time, effort, and cost help to explain accurate judgement of learning impacts[4]. Senior members of the dental faculty have a responsibility to periodically review and modify this syllabus, which was formulated more than 50 years ago.The students express great appreciation for the capacity to obtain visual knowledge outside of the classroom at their earliest convenience[4]. "Which educational tactics enhance dentistry students' ability to carve dental anatomy? "To direct the search, a structured inquiry based on the PICO acronym was created[14]. The following was decided upon as the structured PICO question:

P–Undergraduate dental students
I – Educational interventions involving the teaching of dental anatomy and sculpture C – None

O – The primary outcome was the dental carving ability of dental students.

Nance *et al*. have shown in their study that computer assisted instructions can present material in new and innovative ways while allowing students to learn at their own pace. It has the advantage of allowing the students to review the methodology and technique multiple times as compared to the traditional instructor-directed learning[15].

Bogacki *et al*. have shown the utility of software-based learning to teach the anatomy of the adult dentition[16]. To encourage active learning, critical thinking, and engagement among dental students, the flipped classroom educational model is a potential approach to teaching dental anatomy[13]. The occlusion of permanent teeth can be better visualised and understood with the use of macro models of the dental arches[5].

Application of tooth carving in Clinical dentistry:

Crown carving may help in the practice for crown and bridge and other restorative treatment. Restoring the tooth with silver amalgam or contouring the composite restoration may warrant knowledge of carving[3]. The students in dentistry must carve the tooth directly in a patient's mouth in the form of various direct restorative procedures, which include amalgam restorations, posterior composite restorations, direct filling gold restorations, anterior direct composite restorations, direct composite laminate veneers, and so on. Even for the indirect or castable restorations, (such as posterior metal or porcelain inlays, onlays or crowns, anterior ceramic crowns, or laminates), a dentist must carve the wax pattern, also for the metal ceramic or all ceramic crowns and bridges, the dentist must literally build-up and carve the external tooth form. Although the indirect restorations are fabricated in the laboratory and the dentist may not directly be involved in the carving process of wax patterns or ceramic build-ups, the final adjustments ultimately must be carried out by the dentist himself. Hence the three-dimensional architecture or anatomy of each tooth (at least of crown portion) can only be oriented by learning wax carvings in his initial period of curriculum[17].

Dental carving connects the material from foundational disciplines, like dental anatomy and morphology, to professional clinical disciplines covered in the course's middle and late phases, like restorative dentistry, dental occlusion, and dental prosthetics[18].

Conclusion

It is the need of the hour to incorporate computer-based learning in the preclinical exercise of tooth carving for undergraduate students for effective teaching and efficient student learning. We also recommend the traditional method of exercise on only crown of tooth carving instead of making root carving since its waste of time. We suggest that tooth carving is unmatched as a means for teaching dental anatomy. An essential link between theory and practise is the integration of clinical and basic sciences.

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