AMJ Australasian Medical Journal [AMJ 2018;11(5):316-321]

Effect of self-assessment training in preclinical endodontic courses on the clinical performance of undergraduate dental students

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RESEARCH

Please cite this paper as: Abiad RS. Effect of self-assessment training in preclinical endodontic courses on the clinical performance of undergraduate dental students. AMJ 2018;11(5):316–321.
https://doi.org/10.21767/AMJ.2018.3458

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ABSTRACT

Background
Root canal treatment (RCT) of molar teeth is very challenging to undergraduate dental students. Well-structured self-assessment was shown to be the key for improving quality of dental education so that graduates could be properly prepared to act independently in dental practice.

Aims
To observe the effect of rubric self-assessment teaching during the preclinical stage on the performance of undergraduate students in treating patients' molars.

Methods
An improved rubric was introduced to the endodontic preclinical stage through which 128 students were trained on self-assessing their practical work over an entire year (Group A). While 149 students (Group B) were taught without self-assessment. The following year, during the clinical stage, both groups were asked to treat single rooted teeth only, after they finish at least ten teeth, students who feel confident enough were allowed to do simple molar cases. The effect of new system on the ability of undergraduate students to perform root canal treatment on patients' molars was studied.

Results
All students taught on self-assessment where able to perform RCT on patients' on molars before graduation (100 per cent) in comparison to 73.83 per cent for the students of the previous groups. There was statistically significant difference for the average number of molars treated per student: 6.06 for Group A in comparison to 3.00 for Group B. All analysis was performed with 0.05 level of set significance using the statistical software SPSS 16.0 for Windows.

Conclusion
When cases are properly selected, ttechnical part of root canal treatment must not be time consuming if the student is properly trained on how to assess his own work.

Key Words
Dental education, endodontology, self-assessment, rubrics, molars

What this study adds:

1. What is known about this subject?
It is important to define, instruct, and evaluate competencies so that graduates could be properly prepared to act independently in dental practice.

2. What new information is offered in this study?
Rubrics can be particularly helpful in enhancing students' skills rapidly, and the more independent this student is, the better and faster his performance would be.

3. What are the implications for research, policy, or practice?
Proper application of the self-assessment criteria is key to developing proper understanding of the subject.

Background

Root canal treatment (RCT) of molar teeth is very challenging to the general dental practioners as well as dental schools. Allowing undergraduate dental students to do it without complications has always been a challenge.[1] Self-assessment has been shown to enhance active learning and improve practical skills.[2] Assessments in the applied fields such as dentistry represent an ongoing challenge due to the subjective nature of practical work. In fact, it is important to define, instruct, and evaluate competencies so that graduates could be properly prepared to act independently in dental practice. Many health educators assess practical work in varying ways with equally varying degrees of success.[3] Well-structured assessment was shown to be the key for improving quality of dental education.[4]

Competency assumes that all behaviors are performed with a degree of quality consistent with patient well-being and that the general dentist can self-evaluate treatment effectiveness.[2] In this scope, rubrics can be particularly helpful in enhancing students' skills rapidly, and the more independent this student is, the faster his performance would be. O'Donnell et al.[5] proposed rubrics as a method to objectify the assessment process. Rubrics are "scaled tools with levels of achievement and clearly defined criteria placed in a grid". They establish clear rules for evaluation and define the criteria for performance. Such clear rules provide faculty members with guidelines standardizing the grading process and helping students understand the rationale behind their mark. Consequently, students can identify the level at which they stand according to the provided rubric and hence can tackle points of weakness. Rubrics can also be utilized by students to self-assess their work. It is evident that accurate self-acknowledgment of flaws can lead to high dexterity in any subject area especially those requiring high level of practical skills, going about such flaws will only be a matter of time and practice for the student.

Method

An improved rubric[6] (Figures 1 & 2) was introduced to the endodontic preclinical stage through which students were trained on self-assessing their practical work over an entire year: Instructors were familiarized with this system before the commencement of the semester over five training sessions. After the instructors' induction period and with launching of the course, students were taught how to assess their work according to the distributed rubrics through a live demo. Later with the beginning of each practical session, a relevant short video demo was used according to the type of lab activity scheduled after which the students were given the green light to start their work. The work could only be delivered after the self-assessment has been completed. Subsequently, the instructors would assess the work using the same rubric system to give immediate feedback to the student. After comparison of the self-assessment grade and the one awarded by the assigned instructor, students who had successfully matched marks were allocated bonus points for motivation. Students who were trained via this method (Group A, n=128) were compared to the ones from previous years (Group B, n=149) who were taught without self-assessment. When moved to the clinical stage, both groups were asked to treat single rooted teeth only, after they finish at least ten teeth, students who felt confident enough were allowed to do simple molar cases. Data was retrieved form the patient record software (DenTrooper, SOLT, Lebanon) for the properly completed cases only, and the effect of the new system on the ability of undergraduate students to perform root canal treatment on patients' molars was studied. Supernumerary molars were excluded from this study as there are different opinions about keeping those teeth however it was mainly suggested that whenever supernumerary teeth are symptomatic surgical removal is recommended.[7]

Statistical Analysis

Descriptive statistics of the collected data were expressed as means and standard deviation for the quantitative data, while the qualitative data was expressed as percentages. Intergrouping comparison was performed using paired T-test. All analysis was performed with 0.05 level of set significance using the statistical software SPSS 16.0 for Windows (SPSS Inc, Chicago, IL).

Results

By the end of their clinical training, all students taught on self-assessment where able to perform RCT on patients' on molars before graduation (100 per cent) in comparison to 73.83 per cent for the students of the previous groups (Table 1). Paired T-Test showed statistically significant difference (P<0.0001) for the average number of molars treated per student: 6.06 for Group A in comparison to 3.00 for the students who managed to do molars in Group B, 26.17 per cent of this group students graduated without completing any molars (Table 2).

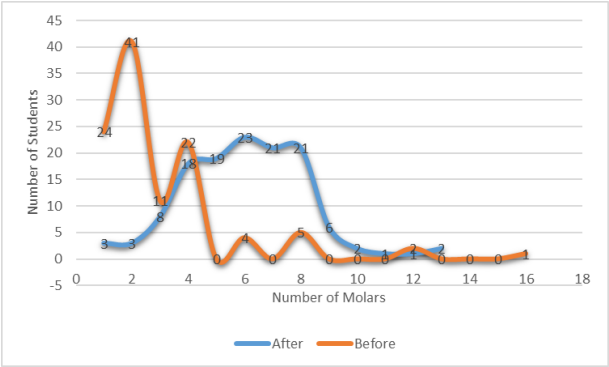
Table 1: Showing percentage of students who managed to do RCT on patients' molars during their clinical training

Group	Number of Students/ Group	Number of students treating Molars at the time of graduation	Percentage of students treating molars at the time of graduation
Group A	128	128	100%
Group B	149	110	73.83%

Table 2: Group Statistics Summary

	Group	N	Mean	Std. Deviation
Molars treated throughout the clinical courses	A	128	6.06	2.23
	B	110	3	2.44
Paired -t	9.99			
P	<0.0001			

Figure 3: Comparision between numbers of molars treted by students showing normal distribution among the group A student and Abnormal distribution among group B



Discussion

In this Retrospective comparison, only completed cases without complications were included. Data showed that 128 students of group A, who were taught on self-assessing their work, had finished 761 molar root canal treatments during two years of clinical practice in comparison to 331 molars treated by 110 students among the 149 students for the other group who where not taught on self-assessment.

There was normal curve distribution (Figure 3, blue) for group A where most of the students were within the same range which reflects the efficiency of the teaching mehodology while that was not the case with the previoious group (Figure 3, orange) as teaching and assessment was subjective and did not deliver clear info and proper feedback to the student.

Not much data was found in the literature doing such comparison however, the results reached in this study are not be surprising; as the students of group B had moved from novice stage in the levels of competence.[8] It was stated that when clinical skills were practiced without feedback or evaluation, errors are usually reinforced rather than corrected, and this feedback should be provided immediately.[9,10] This could properly explains what was happening previously with group B. This immediate feedback gave the students more experience in a shorter time helping them to have higher stress management ability[11] in comparision to the previous group although they both are within the same age range, thus they were able to deal with more complex cases such as RCT for molars which are usually stressful to a graduated dentist not only a student.

Proper case selection was a key factor in this study, as only simple cases were referred to undergraduate student while more complex cases were referred to the postgraduates and specialty program.

The innovation of the curricula and introduction of the critical thinking, where graduates must be competent to apply quality assurance, assessment, and improvement concepts might have helped the rubric to give such a good influence.[8]

Cooperation of the instructos and the efforts made during the preclinical sessions, in addition to the awarness made to the students about the importance of the self-assessment play a major role in having such results.

Decision making was one of the main advantages achieved as the student is being taught how to assess his own work which gave him more confidence, this was reflected on the speed of work as he was confident from what he was doing and not afraid from making mishaps.

As this was a retrospective study, there was several limitations in sample selection that need to be overcome when designing similar future research. As the effect of other collateral factors such as smoking habits[12] or bacterial infections[13] were not included in the difficulty assessment form and thus their effect on retarding student's work was not assessed.

The top priorities for future curriculum modification are to involove new techniques for assessing competences[14] that

might improve students performance and the educational process as a whole.

Conclusion

For an effective educational experience, students should be allowed enough time to thoroughly apply the self-assessment criteria to their own work.

Proper application of the self-assessment criteria is key to developing proper understanding of the subject. Immediate feedback must be provided to the student to avoid accentuation of the mistakes.

If the student is properly skilled with the practical part, he will save so much time during the clinics as he will mainly need his instructor to discuss clinical issue or to help with the difficult situation.

Provided that only simple cases are referred to undergraduate students, technical part of root canal treatment must not be time consuming if the student is properly trained on how to assess his own work.

Future assessment of the effect of this rubric on the overall quality as well as time taken by each student to finish the service need to be studied.

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ACKNOWLEDGEMENTS

The statistics of this work was done by Dr. Z. Abdallah, Head of IT department, Central administration of Statistics in Lebanon, to whom I would like to express my deepest gratitude. I also thank Prof A. Abdelrahman, Professor of Biostatistics at Beirut Arab University for his help with the statistical analysis and Prof E. Osman, dean Faculty of Dentistry, for his continuous support that made this work possible.

PEER REVIEW

Not commissioned. Externally peer reviewed.

CONFLICTS OF INTEREST

The author declares that she has no competing interests.

ETHICS COMMITTEE APPROVAL

BAU - Institutional Review Board (Form H-XII), Exemption number: 2017H-0051-D-R-0211

Figure 1: Rubrics for access opening

I. Access cavity preparation Grading: 10 marks

Points				Proper (1)	Partial (1/2)	Improper (0)
SITE	Ant.		+1	Middle Middle third (MM1/3) of the Palatal/ Lingual surface.	Shifted away from the MM1/3	Any surface other than the Palatal/Lingual
	PM			Center of the Occlusal Surface	Occlusal Surface but shifted away from the PROPER	Any surface other than the Occlusal
	Mo	U		Mesial half of the Occlusal Surface, with the oblique ridge left mostly intact.		
		L		Meisal ⅔ of the Occlusal Surface, slightly shifted to the buccal.		
SIZE	Ant. & Post.		+1	Reflects the internal pulp chamber size (recognized by the radiograph)	Undersized: Size 1 mm less than the confines of the pulp chamber Oversized: Size 1 mm more than the confines of the pulp chamber	Undersized: Just Exposure Oversized: Preparation is 2-3mm beyond the pulp chamber size
SHAPE	U	I	+1	TRIANGLAR with the Base Incisally and the Apex towards the Cervical. 	Incomplete shape of the Triangle.	Any deviation of the shape of the Triangle.
		Ca		OVOID in an Inciso-Cervical direction 	Little wide in M-D direction but still ovoid	Any deviation of the I-C ovoid shape
		PM		OVOID in a Bucco-Lingual direction 	Little wide in M-D direction but still ovoid	Any deviation of the B-L ovoid shape
		Mo		TRIANGULAR with the Base to the Buccal, parallel to the outer buccal surface, & the Apex of the triangle towards the Lingual.  	Incomplete shape of the Triangle	Any deviation of the shape of the Triangle
	L	I		Elongated Triangle in Labio-lingual direction 	Incomplete shape of the elongated Triangle.	Any deviation of the shape of the Triangle
		Ca		OVOID in Labio-lingual direction 	Little wide in M-D direction but still ovoid	Any deviation of the L-L ovoid shape
		PM		OVOID in Bucco-lingual direction 	Little wide in M-D direction but still ovoid	Any deviation of the B-L ovoid shape
		Mo		TRAPEZOID, RHOMBOID, or RECTANGULAR in a M-D direction  	Incomplete shape	Any deviation of the shape
EXTENSIONS	Ant		+1	➢ Incisally: Spare the Incisal edge ➢ Proximally: Spare the Marginal ridge ➢ Cervically: Spare the Cingulum	Not reaching the limit of ONE of the extensions Or Going beyond ONE of the extensions	Not reaching ALL the extension limits Or Going beyond ALL the extensions
	PM			➢ B-Li:from the Buccal cusp tip to the base of the lingual cusp ➢ M-D: Spares the M & D Marginal ridges.		
	Mo	L		➢ MB: MB cusp tip. ➢ MLi: at the base of the MLi cusp, online with MB, just lingual to the central developmental groove. ➢ The line joining the MB & MLi is parallel to the MMR (Mesial Marginal Ridge) ➢ D: ≈ 2mm distal to the central pit.		
		U		➢ MB: MB cusp tip ➢ DB:≈ 2mm D & P to MB (up to the B developmental groove) Joining MB & DB line will be parallel to Buccal Surface. ➢ Palatal: Base of the MB cusp (in the center of the tooth), when joining with DB it's perpendicular to the palatal surface. If MB2 is present, it should be M & P to the MB.		
Complete Deroofing			+ 1	Uncovering of ALL pulp horns & connections between them+ Removal of the lingual shoulder in Anterior teeth.	Partial catching of the Probe on one or two of the walls	Deep catching of the Probe on one or more walls
Convenience form			+1	Proper Funneled out preparation	One or more walls are not funneled out	Not all the walls are funneled.
Caries Removal			+1	Complete caries removal with the removal of undermined tooth structure & questionable restoration.	Caries removed but cavity left unadjusted for temporary or permanent restoration.	Presence of caries &/or undermined tooth structure.
Gouging			-1	Canal orifice should be with a straight-line connection with all side walled,without any bur indentations or steps.	Shallow bur indentations on one or two of the side walls.	Shallow bur indentations on more than two side walls. Deep bur indentations on one or more of the side walls.
Perforation			-2	NO perforation.		Reparable perforation.

N.B: Perforation that will affect the treatment plan (Un-reparable) will be considered as fatal mistake.

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Legend: Upper (U), Lower (L), Molars (Mo), Premolar (PM), Canine (Ca), Incisor (I), Middle Middle third (MM 1/3), Mesial (M)., Distal (D), Buccal (B), Lingual (Li), Labial (La), Cervical (C), Reference Point (R P), Working Length (WL), Estimated Working Length (EWL), Initial File (IF), Master Apical File (MAF), Master Cone (MC).

Figure 2: Rubrics for mechanical preparation and obturation

II. Mechanical Preparation: 10 marks

Points		Proper (1)	Partial (1/2)	Improper (0)
Working length (WL)	+2	0.5 – 1 mm short of the radiographic apex.	Short up to 2mm	Short more than 2mm Or Over: beyond the anatomical apex.
Reference Point (RP)	+1	Rubber stopper seated perpendicular to a reliable repeatable point	File must be moved to reach the reliable repeatable point	Reference point Not Identified
Apical Seat	+2	Forceful tapping on the MAF up to the W.L., confirms the resistance form.	Forceful tapping on the MAF pushes it beyond the W.L.	Gentle tapping on the MAF pushes it beyond the W.L.
Smoothness of the preparation	+1	Dragging the file along the circumference of the root canal walls, gives the tactile sense of SMOOTHNESS	Dragging the file along the circumference of the root canal walls, gives the tactile sense of ROUGHNESS on One of the side walls.	Dragging the file along the circumference of the root canal walls, gives the tactile sense of ROUGHNESS on Two or More the side walls.
Taper	+2	The spreader of size not less than 25 or B, must be able to enter 1-2mm short of the working length along the side of the Master cone.	The spreader of size not less than 25 or B, cannot penetrate more than 3mm short of the working length along the side of the Master cone.	Inability to insert any size of spreader along the side of the master cone more than 3 mm short of the W.L.
Maintaining the original shape of the canal & Curvature	+2	Absence of Canal transportation, zipping, stripping, ledges or perforations.	Ledge or zipping	Stripping, Zipped foramen and or any other type of Perforation.

N.B:

- Initial File (IF) is the first file that binds to the apex after coronal flaring.
- Perforations are considered FATAL Mistakes

III. Obturation: 10 marks

Points			Proper	Partial	Improper
Master cone selection:	*Size*	+1	Similar to the MAF	1 size smaller or larger than the MAF	Size is far from the MAF
	Visual	+1	The selected MC is clearly marked at the reference point	The mark of selected MC is 0.5- 1mm ahead of the RP.	The selected MC mark is beyond RP, or more than 1 mm ahead.
	Tactile:	+2	Tug back at the working length	Slight resistance to removal only.	No tug back at all.
	Radiographic:	+1	The MC is 0.5-1mm coronal to the radiographic apex	The MC is at the radiographic apex Or 1.5 - 2 mm coronal	The MC is beyond the radiographic apex Or More than 2mm coronal to the radiographic apex
Condensation:	*Length*:	+1	The filling is at the W.L	The filling is 1-2mm shorter or longer than the WL	The filling is more than 2mm shorter or longer than the WL
	Homogeneity:	+2	No radiolucencies within the filling	Sight radiolucencies but in non-critical areas.	Many radiolucencies within the filling Or Sight radiolucencies but in critical areas. (Like the Apical Foramen)
	Adaptation to the walls	+1	No radiolucencies between the filling and the canal walls & Reflects properly tapered canal preparation.	Slight radiolucencies between the filling and one of the canal walls	Many radiolucencies between the filling and the canal walls Or Does not reflect properly tapered canal preparation.
	Proper cleaning	+1	Proper cleaning of the pulp chamber from gutta-percha and sealer	Gutta-percha removed from the pulp chamber but sealer not properly cleaned.	Gutta-percha and sealer not removed from pulp chamber at all.

N.B: Final Obturation x-ray must be taken without rubber dam AFTER placement of temporary filling.

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