

Assessment of a Nigerian Dental School Implant Training Programme Using Short-and Long-Term Knowledge Acquisition of Students

*ENABULELE JE, **EHIZELE AO

Department of *Restorative Dentistry,
**Periodontics, School of Dentistry,
University of Benin, Benin City. Nigeria

Correspondence

Dr. J.E. Enabulele
Department of Restorative Dentistry,
School of Dentistry, University of Benin,
Benin City, Edo State
Nigeria.
Email: emien.enabulele@uniben.edu

ABSTRACT

Objective: To assess the effectiveness of a dental implant training programme on dental implant knowledge acquisition and retention among undergraduate dental students

Methods: A cross-sectional study of undergraduate final year students with data collected using a self-administered questionnaire. The questionnaire elicited information on socio-demographic characteristics of the respondents, knowledge of dental implants, satisfaction and adequacy of implant education as well as interest in practicing implant dentistry. On the first day, the participants were given 20 minutes to complete the questionnaire to assess their baseline knowledge (L_0). Then a series of lectures covering various aspects of implant dentistry was delivered to the participants. At the end of the lecture series, the participants were administered the same questionnaire (L_1) to assess their knowledge acquisition. Three months later, the participants were administered the same questionnaire (L_2), to assess their knowledge retention. The data so obtained was analysed using IBM SPSS version 21.0. Chi square test, ANOVA and Student's T- test were performed.

Results: There was statistically significant difference in mean between L_0 (5.53 ± 2.816) and L_1 (9.08 ± 2.614) (3.55 ; $p=0.001$). There was increased satisfaction with the level of implant education received, level of interest and preparedness to practice implant dentistry from L_0 to L_1 with a decrease at L_2 .

Conclusion: The dental implant programme which consisted of only didactic lectures is an effective method of knowledge acquisition in implant dentistry but does not translate to equal knowledge retention. Therefore, more is needed to improve dental implant training at the undergraduate level.

Keywords: Implant dentistry, knowledge acquisition, knowledge retention.

INTRODUCTION

Dental implant as a form of treatment for missing teeth has become desirable (Zarb 1983a; Feine et al., 2002) due to its ability to preserve the alveolar bone and resistance to dental caries (Jivraj and Chee 2006), as well as its high success rate, predictability (Schmitt & Zarb 1993; Zarb & Schmitt 1993), increased awareness among patients (Zarb 1983a; Zarb 1983b) as well as its increased acceptance as a treatment option for

missing tooth/teeth among patients (Zarb 1983a; ADA, 2002)

Citation: Enabulele JE, Ehizele AO (2019). Assessment of a Nigerian dental school implant training programme using short-and long-term knowledge acquisition of students. Nig J Med Dent Educ; 1(1&2):36-44.

Due to this increased awareness, it is essential that future dentists should be able to recognise the indications for implant treatment and provide adequate and probable treatment. Also, with the increase in use of dental implants, dental graduates may encounter more patients with dental implants in the future (Basutkar, 2013) making it imperative that they be properly exposed to this aspect of dentistry. It is very important that dental students be exposed to dental implant treatment modality as they would be providing care for partially and completely edentulous patients throughout their careers (Afshari et al., 2013).

In the United States, dental implant education is now common place within the curriculum and clinical experience of undergraduate dental students (American Association of Dental Schools, 1991). However, same cannot be said for developing countries such as Nigeria. Evidence continues to support the rationale of the advocacy for incorporation of dental implant education into the undergraduate curriculum; as dentists who are exposed to implant therapy as students are more likely to provide implant care for patients who require it (Huebner 2002; Maalhigh-Fard et al., 2002; Enabulele & Omo 2018).

Appropriate didactic lectures and hands on training prior to actual patient experience have been shown to be necessary for students to be comfortable with incorporating implant treatment into their future practices (Kido et al., 2009; Enabulele & Omo 2018). This tends to allow them to see implant treatment as technically attainable and also to consider implant treatment for themselves (Kido et al., 2009; Enabulele & Omo 2018).

Throughout the course of undergraduate training at the University of Benin, students take a variety of courses where dental implants are introduced and minimally discussed. However, the students are exposed to a course that focuses solely on implant dentistry in the final year. This program includes only didactic lectures and competencies on anatomy of the edentulous patients, Biology and histology of osseointegration, Biomaterials of osseointegration, Diagnosis and treatment planning for fixed/removable implants, Selection of patients for implant dentistry, Surgical procedures for implant dentistry, Prosthodontics procedures in implant Dentistry and Periodontal aspects of implant dentistry, Implant retained over dentures and Implant complications and maintenance. There was no Hands-on simulation training, phatom head component of implant dentistry or clinical experience in the restoration of implant cases and no clinical competencies assigned.

Students' perceptions of dental implant learning experiences have been thought to affect how well they learn and incorporate implant treatment options into their daily clinical practice (Yuan et al., 2010; Enabulele & Omo, 2018). Studies have shown a positive correlation between graduating dental students' intention to provide implant therapy in their future practice and their undergraduate implant education (Huebner, 2002; Maalhigh-Fard et al., 2002; Yuan et al., 2010; Kroeplin & Strub, 2011; Enabulele & Omo 2018).

A Nigerian study has shown that there is a low dental implant awareness among health workers (Mgbeokwere et al., 2011). The study further revealed that the option of restoring a lost tooth with dental implants is not included in the treatment protocols and is not frequently discussed. This emphasizes the importance of improving awareness and upgrading information about dental implant and also increases the call for a revision of the undergraduate dental curriculum in Nigeria to include dental implantology (Chaudhary et al., 2013). Furthermore, dental implant training in Nigeria is still mainly didactic competency (Enabulele & Omo, 2018). This study was designed to assess the effectiveness of a dental implant training program on dental implant knowledge acquisition and retention among undergraduate dental students.

MATERIALS AND METHODS

This longitudinal study was carried out using 2 consecutive classes of final year undergraduate dental students of the University of Benin, Benin City, Nigeria. Study participation was voluntary and confidential and the participants' responses were not graded for course assessment. Ethical clearance was obtained from the College ethics and Research committee of the University of Benin.

Data collection was done using a pre-tested self-administered questionnaire. The questionnaire was developed from previous studies (Maalhigh-Fard et al., 2002; Al-Johany et al., 2010; Basutkar, 2013; Afshari et al., 2013). The questionnaire elicited information on socio-demographic characteristics of the respondents, general knowledge of dental implants, familiarity with different implant systems, designs, sizes and loading, satisfaction and adequacy of implant education as well as interest in practicing implant dentistry. Twenty questions were used to assess participants' knowledge of dental implants. All correct answers were awarded a score of 1 and zero was awarded for incorrect answers and where no answers were indicated. A pre-test of the

questionnaire was carried out among newly graduated dental students, to ascertain comprehensibility, validity, reliability and sensitivity of the data tool.

On the first day, the participants were given 20 minutes to complete the questionnaire and this was used to assess their baseline knowledge (L₀). Then a series of lectures covering: anatomy of the edentulous patients, biology and histology of osseointegration, biomaterials of osseointegration, Types of implant systems, sizes, designs and loading, diagnosis and treatment planning for fixed/removable implant supported prostheses, selection of patients for implant dentistry, Single –unit implant restorations, treatment options for edentulous patients, Implant retained over dentures, surgical procedures for implant dentistry, prosthodontic procedures in implant dentistry, periodontal aspects of implant dentistry and implant complications and maintenance was delivered by a consultant restorative dentist with training on dental implants and a Consultant Periodontologist. At the end of the lecture series, the participants were asked to fill the same questionnaire (L₁) in order to assess their

knowledge acquisition. Three months later, the participants who were now fresh graduates were asked to fill the same questionnaire (L₂), to assess their knowledge retention. For proper collation of data, the participants were assigned codes which they indicated on the questionnaires filled on the 3 different occasions

The data so obtained was analysed using IBM SPSS version 21.0 for windows. A Chi-square test was used to compare proportions among categorical variables. Repeated measure ANOVA and Student's T- test were used to compare differences in knowledge at different times. The level of statistical significance was set at $p < 0.05$.

RESULTS

A total of 40 students agreed to participate in the study however 38 completed all the aspects of the study (L₀, L₁ and L₂). The age of the participants ranged from 22 to 33 years with a mean age of 26.34 ± 2.51 years. There was a male preponderance with male participants accounting for 71.1% of the study population (Figure 1). reported (Figure 3).

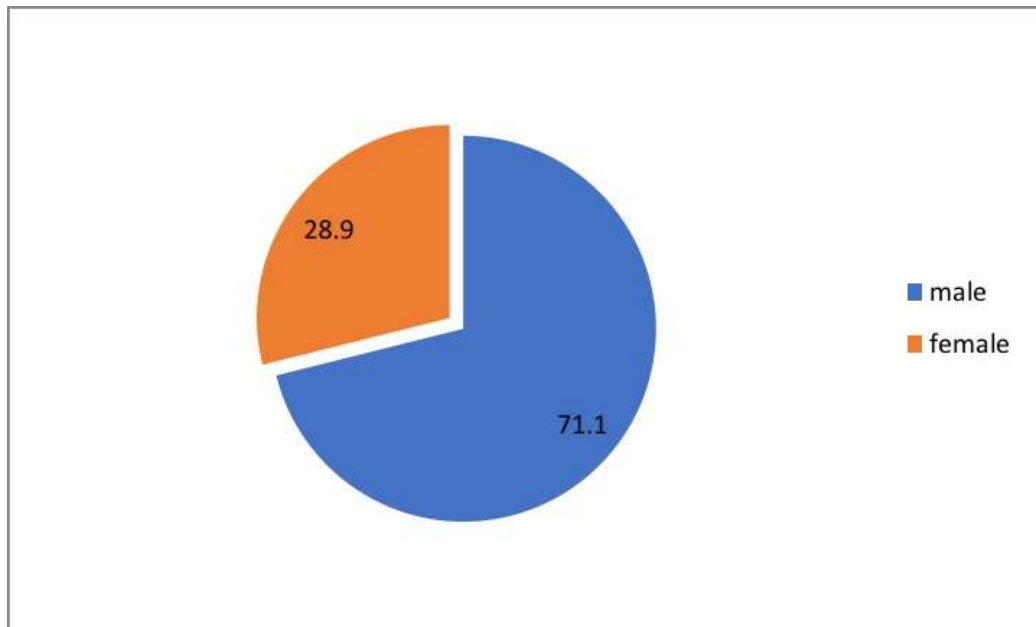


Figure 1: Gender distribution of the participants

Most (86.8%) of the participants had previous exposure to implant dentistry prior to commencement of the study, with undergraduate lecture accounting for the most (76.3%) source of information regarding implant dentistry (Figure 2).

Four dental specialties were reported by the participants to be their source of implant dentistry knowledge prior to the commencement of the study with periodontics being the most frequent (65.8%) specialty

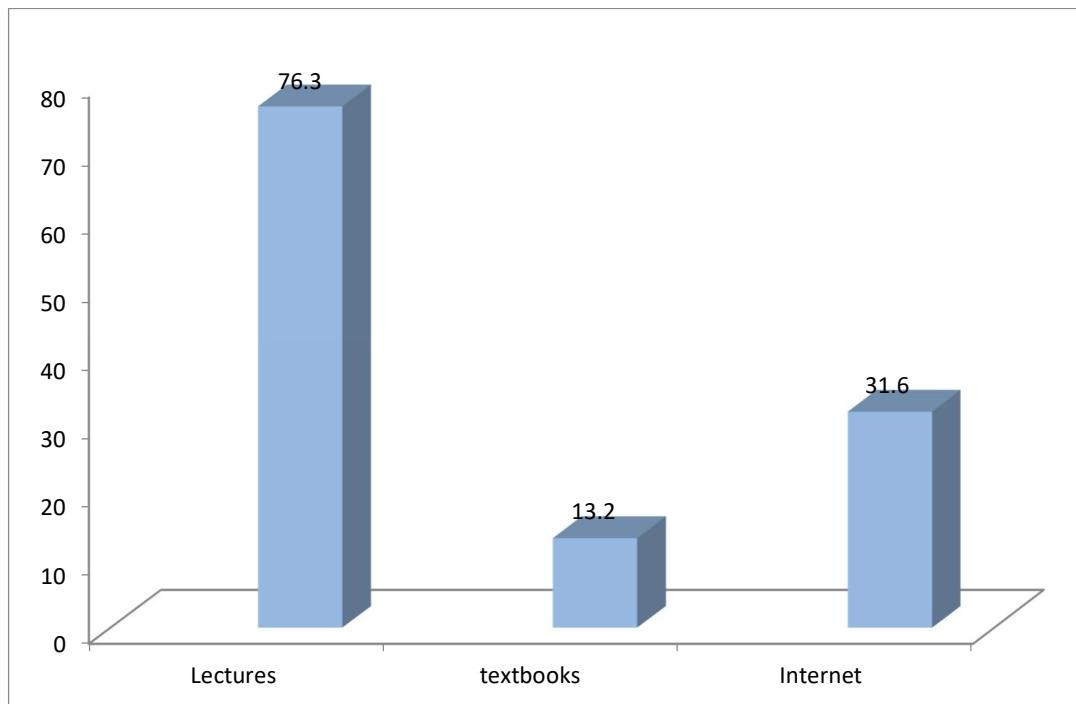


Figure 2: Sources of previous exposure to implant dentistry

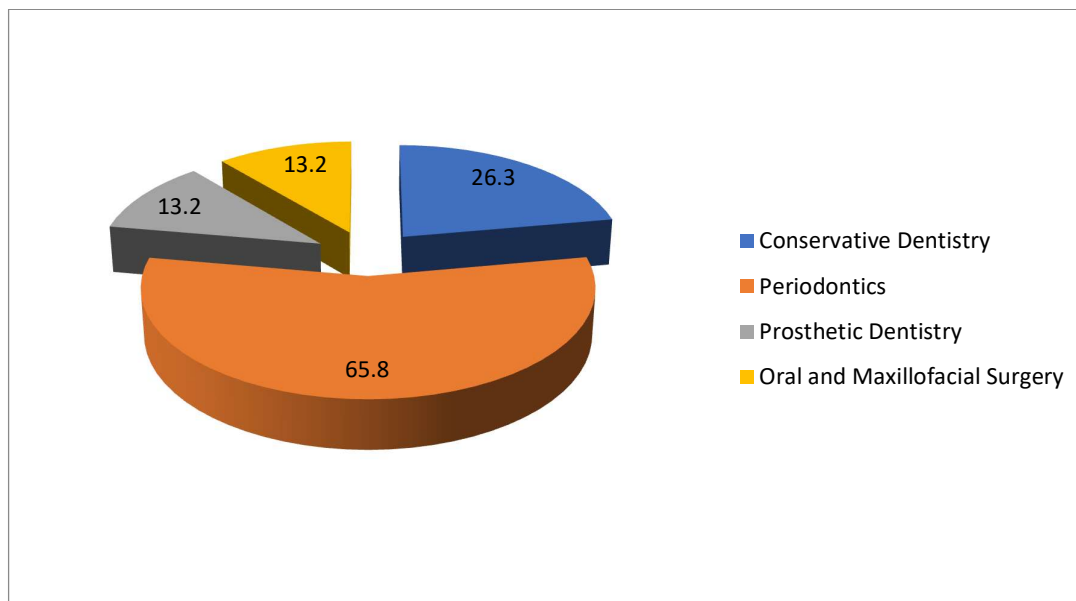


Figure 3: Specialties from which the participants were exposed to implant dentistry

The mean score \pm SD for students' general knowledge on implant was 5.53 ± 2.82 at L_0 , 9.08 ± 2.61 at L_1 and 8.68 ± 3.01 at L_2 (Table 1). There was statistically significant difference between the mean general knowledge score at L_0 and L_1 (3.55 ; $p=0.001$) and between L_0 and L_2 (3.16 ; $p=0.001$) The mean difference between L_1 and L_2 was 0.4 but it

was not statistically significant ($p=0.814$) (Table 2). There was a no correlation between the general knowledge scores at L_0 and L_1 [$r = 0.163$, $n = 38$, $p = 0.328$] but there was a correlation between the general knowledge scores at L_1 and L_2 [$r = 0.688$, $n = 38$, $p = <0.001$].

Table 1: The mean score for respondents' general knowledge on implant at L₀, L₁ and L₂

Time	N	Mean score ± Standard deviation
L ₀	38	5.53±2.82
L ₁	38	9.08±2.61
L ₂	38	8.68±3.01

Table 2: The difference in mean score for respondents' general knowledge on implant

I score	J score	Mean difference (I-J)	Standard Error of Mean	Sig	95% confidence interval	
					Lower bound	Upper bound
L ₀	L ₁	-3.55	0.57	<0.001	-4.71	-2.40
	L ₂	-3.16	0.62	<0.001	-4.42	-1.90
L ₁	L ₀	3.55	0.57	<0.001	2.40	4.71
	L ₂	0.40	0.37	0.286	-0.34	1.13
L ₂	L ₀	3.16	0.62	<0.001	1.90	4.42
	L ₁	-0.40	0.37	0.286	-1.13	0.34

There was an increase in the proportion of participants who claimed to be familiar with different implant systems from L₀ (15.8%) to L₁ (57.8%) but there was a slight reduction at L₂ (50%). For familiarity with implant design, the proportion increased from 13.2% at L₀ to 50% at L₁ and 57.9% at L₂, for familiarity with implant sizes, the proportion increased from 13.2% at L₀ to 50% at L₁ and L₂. And for familiarity with implant loading, the proportion increased from 13.1% at L₀ to 55.3% at L₁ and 57.9% at L₂ (P<0.001) (Table 3).

The proportion of respondents who were not at all satisfied with the level of implant education received decreased from 31.6% at L₀ to 13.2% at L₁ but slightly increased to 18.4% at L₂ (p<0.001). Only a few respondents (5.3%) were not at all interested in implant dentistry at L₀ and this proportion further reduced to 2.6% at L₁ and L₂ (p<0.001). Concerning their level of preparedness to practice implant dentistry, 39.5%, 10.5% and 15.8% felt not at all adequate at L₀, L₁ and L₂ respectively (p<0.001) (Table 4)

Table 3: Respondents' familiarity with implant systems, designs, size and loading

Familiarity	L ₀ n (%)	L ₁ n (%)	L ₂ n (%)	P-value
Implant systems				<0.0001
Familiar	6 (15.8)	22 (57.9)	19 (50.0)	
Undecided	6 (15.8)	12 (31.6)	15 (39.5)	
Unfamiliar	26 (68.4)	4 (10.5)	4 (10.5)	
Implant designs				<0.0001
Familiar	5 (13.2)	19 (50.0)	22 (57.9)	
Undecided	5 (13.2)	10 (26.3)	9 (23.7)	
Unfamiliar	28 (73.6)	9 (23.7)	7 (18.4)	
Implant sizes				<0.0001
Familiar	6 (15.8)	19 (50.0)	19 (50.0)	
Undecided	4 (10.5)	10 (26.3)	7 (18.4)	
Unfamiliar	28 (73.7)	9 (23.7)	12 (31.6)	
Implant loading				<0.001
Familiar	5 (13.1)	23 (55.3)	22 (57.9)	
Undecided	6 (15.8)	10 (31.6)	9 (23.7)	
Unfamiliar	27 (71.1)	5 (13.1)	7 (18.4)	

Table 4: Respondents' level of satisfaction with dental education, interest in implant dentistry and preparedness to practice implant dentistry

	L ₀ n (%)	L ₁ n (%)	L ₂ n (%)	P value
Satisfaction with dental education received				0.007
Not at all satisfied	12 (31.6)	5 (13.2)	7 (18.4)	
Slightly satisfied	6 (15.8)	12 (31.6)	10 (26.3)	
Moderately satisfied	7 (18.4)	12 (31.6)	14 (36.8)	
Very satisfied	4 (10.5)	8 (21.1)	4 (10.5)	
Extremely satisfied	3 (7.9)	0 (0.0)	3 (7.9)	
No response	6 (15.8)	1 (2.6)	0 (0.0)	
Level of interest in implant dentistry				0.045
Not at all interested	2 (5.3)	1 (2.6)	1 (2.6)	
Slightly interested	7 (18.4)	2 (5.3)	3 (7.9)	
Moderately interested	7 (18.4)	16 (42.1)	13 (34.2)	
Very interested	9 (23.7)	15 (39.5)	12 (31.6)	
Extremely interested	10 (26.3)	4 (10.5)	9 (23.7)	
No response	3 (7.9)	0 (0.0)	0 (0.0)	
Level of preparedness to practice implant dentistry				0.001
Not at all adequate	15 (39.5)	4 (10.5)	6 (15.8)	
Slightly adequate	9 (23.7)	9 (23.7)	6 (15.8)	
Moderately adequate	4 (10.5)	20 (52.6)	16 (42.1)	
Very adequate	3 (7.9)	5 (13.2)	6 (15.8)	
Extremely adequate	3 (7.9)	0 (0.0)	4 (10.5)	
No response	4 (10.5)	0 (0.0)	0 (0.0)	

Table 5: Respondents' opinion on and recommendation of dental implant as a treatment option to the patients with missing teeth

	Yes n (%)	No n (%)	Total n (%)
Present dental implant as a treatment option			
L ₀	5 (22.7)	17 (77.3)	22 (100.0)
L ₁	17 (53.1)	15 (46.9)	32 (100.0)
L ₂	24 (75.0)	8 (25.0)	32 (100.0)
Dental implant is a more difficult treatment option compared to other treatment options			
L ₀	14 (63.6)	8 (36.4)	22 (100.0)
L ₁	24 (75.0)	8 (25.0)	32 (100.0)
L ₂	20 (62.5)	12 (37.5)	32 (100.0)

Among the respondents who claimed to have managed patients with missing teeth, the proportion who presented dental implants as a treatment option increased from 22.7% at L₀ to 53.1% at L₁ and 75% at L₂. The proportion of the respondents who felt dental implant is a more difficult treatment option when compared to other treatment options, among those who claimed to have managed patients with missing teeth, was 63.6%, 75% and 62.5% at L₀, L₁ and L₂ respectively (Table 5).

DISCUSSION

As implant dentistry gained dominance in developed parts of the world, it became very necessary to harmonize dental education on

implant therapy and to ensure acceptable level of competence among both undergraduate and postgraduate dental students (Sanz & Saphira, 2009). A previous study emphasized the need to enhance undergraduates' knowledge regarding dental implants based on the incorrect and incomplete knowledge the study elicited among the studied dental students (Chandarana et al., 2018). Previous studies reported that majority of the studied undergraduate dental students felt the degree programme did not provide sufficient information about implant treatment procedures and would like more to be provided in the curriculum (Chaudhary et al., 2013; Sheth et al., 2017; Enabulele & Omo, 2018; Sharma et al., 2018). This study revealed incomplete general knowledge

on implant dentistry and not all the dental students were familiar with the various types of implant systems, sizes, designs and loading. These findings support the call for the review of the undergraduate curriculum on implant dentistry. The respondents' predominant source of information of implant dentistry was didactic class lectures. This is different from what was reported in Kuwait (Al-Musawi et al., 2017) where the participants gathered dental implants information through media (33.9%), friends or social gatherings (24%), dental clinics (23.3%) and family (18.8%). It is likely that dental students receive didactic training from more than one relevant area of specialization in dentistry since those who teach or practice implantology must have undergone postgraduate training in form of certificate courses, postgraduate diploma, master's degree or specialist training in oral surgery, periodontics or prosthodontics (Association of Dental Implantology, 2012). Majority of the respondents in this study however claimed to have received lectures on implant dentistry in periodontics.

Didactic teaching is expected to give understanding of the basic concepts and achieve required learning results (Tubbs, 2014; Enabulele & Omo, 2018). The result of this study seems to suggest that although the general knowledge on implant increased after the first didactic teaching, the knowledge was not fully retained after 3 months. It has been suggested that knowledge gained may not be fully retained if the learner is not made to visualise and practicalize the knowledge gained and this may explain the pattern reported by this present study (Goins & Fisher, 2018). It should therefore be recommended that training on a technical area such as implant dentistry must include simulations and the use of audio-visuals. A previous study, which also identified some areas of deficiencies in undergraduate implant training, recommended revision of the undergraduate dental curricula to accommodate the practical aspect of implant dentistry (Chaudhary et al., 2013). The respondents' level of interest and preparedness to practice implant dentistry increased initially with didactic lectures and later decreased few months after. It is possible that more detailed private study on the part of the students revealed some more technicalities that made them become uncertain of their competence.

There was an increase in the proportion of the respondents who provided option of implant therapy, to patients who presented to the dental clinic for replacement of missing teeth, from the initial point to when they received didactic training

and 3 months after. This suggests that the more knowledgeable the dental students became in implant dentistry, the more likely they were to educate their patients and the more the number of persons who will be able to make informed decision about their treatment. This can be assumed because it was previously reported in another study that majority of the studied population could accept their dentist's advice for replacement of missing teeth with implant (Suprakash et al., 2013; Awooda et al., 2014; Kumar & Chauhan, 2015). However, despite the fact that more of the respondents, after didactic training, became more willing to prescribe implant therapy, majority still consider it a more difficult treatment option when compared with other options. This may be because the training they received did not include practical "hands-on" training. It is generally believed that any teaching practicalized becomes easier. Could we then conclude that the dental students in this study considered implant therapy a more difficult option because they had no practice?

CONCLUSION

The findings of this study suggest that the dental implant program which consisted of only didactic lectures is an effective method of knowledge acquisition in implant dentistry but does not translate to equal knowledge retention and students' level of preparedness with regards to plans for providing dental implant care. Therefore, more is needed to improve dental implant training at the undergraduate level. Furthermore, there is need for continuous dental education on implant dentistry, with special emphasis on the practical aspects for dentists in developing countries such as Nigeria.

Financial support and sponsorship

This work received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

Conflict of interest

The authors declare that they have no conflicts of interest.

REFERENCES

- ADA survey reveals increase in dental implants over five-year period. Chicago: American Dental Association, 2002.
- Afshari FS, Yuan JC, Quimy A, Harlow R, Campbell SD, Sukotjo C (2013). Advanced predoctoral implant program at UIC: description and qualitative analysis. *J Dent Educ*; 78(5):770-779.

- Al-Johany S, Al-Zoman HA, Al-Juhaine M, Al-Refeai M (2010). Dental patients' awareness and knowledge in using dental implants as an option in replacing missing teeth. A survey in Riyadh, Saudi Arabia. *Saudi Dent J*; 22:183-188.
- Al-Musawi A, Sharma P, Maslamani M, and Dashti M (2017). Public Awareness and Perception of Dental Implants in Randomly Selected Sample in Kuwait. *J Med Implants Surg*; 2:116.
- American Association of Dental Schools (1991). Curriculum guidelines for predoctoral implant dentistry. *J Dent Educ*; 55(11):751-753.
- Association of Dental Implantology (2012). A Dentist's Guide to Implantology. Retrieved from http://www.adi.org.uk/profession/dentist_guide/a-dentists-guide-to-implantology.pdf (Accessed on 06/11/18)
- Awooda EM, Eltayeb AS, Hussein SA, Dayelnaiem SI, Abdelhamied MA, Mohamed LA, Taha SM (2014). Knowledge, Attitude and Acceptance of Dental Implants among Patients Attending Khartoum Dental Teaching Hospital. *IOSR-J Dent Med Sci*; 13 (11):19-23.
- Basutkar NA (2013). Assessment of knowledge related to implant dentistry in dental practitioners of North Karnataka region, India. *Dental Implant*; 3:26-28.
- Chandarana D, Trivedi A, Patel J, Ajmera H, Patel A, Patel B (2018). Knowledge and Level of Awareness about Dental Implants amongst the First- and Second-Year Dental Students. *Nat J Integrat Res Med*; 9(3):34-36.
- Chaudhary S, Gowda TM, Kumar TA, Mehta DS (2013). Knowledge and attitudes of dental interns in Karnataka state, India, regarding implants. *J Dent Educ*; 77(10):1365-1370.
- Enabulele JE, Omo JO (2018). Impact of two pedagogical techniques on knowledge of dental implantology among undergraduate dental students. *Nig Health J*; 18:97-104.
- Feine JS, Carlsson GE, Awad MA, Chehade A, Duncan WJ, Gizani S, et al. (2002). The McGill consensus statement on overdentures, Montreal, Quebec, Canada, May 24-25, 2002. *Int J Prosthodont*; 15(4):413-414.
- Goins T, Fisher J. Knowledge retention tactics for more effective learning. retrieved from <https://trainingindustry.com/articles/content-development/knowledge-retention-tactics-for-more-effective-learning/> (accessed on 06/11/18)
- Huebner GR (2002). Evaluation of a predoctoral implant curriculum: does such a program influence graduates' practice pattern? *Int J Oral Maxillofac Implants* 17(4):543-549.
- Jivraj S, Chee W (2006). Rationale for dental implants. *Br Dent J*; 200(12):661-665.
- Kido H, Yanamoto K, Kakura K, Morinaya K, Matsuura T, Matsunaya T et al. (2009). Students' opinion of a predoctoral implant program. *J Dental Educ*; 73(11):1279-1285.
- Kroeplin BS, Strub JR (2011). Implant dentistry curriculum in undergraduate education: part 1—a literature review. *Int J Prosthodont*; 24(3):221-34.
- Kumar S, Chauhan A. 2015. Knowledge and Awareness of Dental Implants in India: An Exploratory Study. *Int J Oral Health Med Res*; 2(4):29-33.
- Maalhagh-Fard A, Nimmo A, Lepczyk JW, Pink FE (2002). Implant dentistry in predoctoral education: the elective approach. *J Prosthodont*; 11(3):202-207.
- Mgbeokwere U, Okoye L, Ekwueme O. 2011. A survey of the knowledge of dental implants as a choice in treatment of edentulous jaws among health workers in government dental clinics in Enugu. *Ann Med Health Sci Res*; 1:91-95.
- Sanz M, Saphira L (2009). Competencies in implant therapy for the dental graduate: appropriate educational methods. *Eur J Dent Educ*; 13(Suppl 1):37-43.
- Schmitt A, Zarb GA. (1993). The longitudinal clinical effectiveness of osseointegrated dental implants for single-tooth replacement. *Int J Prosthodont*; 6(2):197-202.
- Sharma A, Shrestha B, Chaudhari BK, Suwal P, Singh RK, Niraula SR et al (2018). Preferred source and perceived need of more information about dental implants by the undergraduate dental students of Nepal: All Nepal Survey. *Int J Dent* <https://doi.org/10.1155/2018/6794682>.
- Sheth TS, Shah SS, Thakore DS, Shah MN. 2017. Contemporary dental implant knowledge and attitude: A perspective of budding dentists. *Journal of Dental Implant* 7:54-8
- Suprakash B, Ahammed ARY, Thareja A, Kandaswamy R, Kumar N, Bhondwe S (2013). Knowledge and Attitude of Patients toward Dental Implants as an Option for Replacement of Missing Teeth. *J Contemp Dent Pract*; 14(1):115-118.
- Tubbs N (2014). *The New Teacher: An Introduction to Teaching in Comprehensive Education*. Routledge. pp. 35-. ISBN 978-1-134-09074-7.
- Yuan JC, Kaste LM, Lee DJ, Harlow RF, Knoernschild KL, Campbell SD et al (2010). Dental students' perception of predoctoral implant education and plans for providing implant treatment. *J Dent Educ*; 75 (6):750-760.

Zarb GA (1983a). Introduction to osseointegration in clinical dentistry. *J Prosthet Dent*; 49(6):824.
Zarb GA (1983b). The edentulous milieu. *J Prosthet Dent*; 49(6):825-831.

Zarb GA, Schmitt A (1993). The longitudinal clinical effectiveness of osseointegrated dental implants in posterior partially edentulous patients. *Int J Prosthodont*; 6(2):189-196