Original Article

KNOWLEDGE OF DENTISTS IN TERTIARY INSTITUTIONS ON THE USE OF CLEAR ALIGNERS AS A MEANS OF ORTHODONTIC TREATMENT

Authors: Hillary Smith Ojebor1, Nonso Emmanuel Onyia2, Nneka Chukwumah3, Ikenna Nwafor3, Tolulope Olubamiwa4

1. Department of Child Dental Health, Faculty of Dentistry, College of Medical Sciences, University of Calabar, Calabar, Nigeria.
2. Department of Oral Pathology, Medicine and Pathology, University of Calabar, Calabar.
3. Department of Preventive Dentistry, School of Dentistry, College of Medical Sciences, University of Benin, Benin-City, Nigeria.
4. Tolulope Olubamiwa (BDS, MWACS), Department of Preventive Dentistry, University of Benin Teaching Hospital, Benin-City, Nigeria

Corresponding author: Nonso Emmanuel Onyia, Oral Pathology, Medicine and Diagnosis Department, University of Calabar, Cross River State, Nigeria. Email: onyianonso.e@unical.edu.ng; onyianonso_e@yahoo.com. Telephone: +234-803-7521-206,

ABSTRACT

Context: Clear aligner therapy (CAT) is an increasingly popular and patient-friendly orthodontic option but remains largely inaccessible in Nigeria due to high costs compared with traditional fixed appliances.

Aims: To evaluate Nigerian dentists' knowledge of CAT and its orthodontic applications.

Settings and Design: A cross-sectional analytical study involving dentists of various specialties and cadres practicing across all regions of Nigeria.

Materials and Method: Data were collected using a pretested, self-administered Google Form questionnaire containing dichotomous and Likert-scale items.

Statistical Analysis: Data were analyzed using SPSS 21. Descriptive statistics summarized variables, group differences used Kruskal–Wallis, associations used Spearman's correlation, and predictors

were identified with logistic regression ($p < 0.05$).

Results: A total of 161 dentists participated (mean age 33.12 ± 4.89 years). Most were aged 31–40 years (62.7%) and male (70%). Registrars constituted 54.0% of respondents, while dental officers were fewest (9.9%). Oral surgeons (23.6%) and general practitioners (14.3%) formed the largest specialty groups. Half of respondents practiced in the midwestern region. Only 21.1% demonstrated good knowledge of CAT based on a baseline score of 24.67 from orthodontic senior registrars. Knowledge differed significantly by age, rank, specialty, and years of experience. Specialty was the only significant predictor, with orthodontic residents scoring higher than others.

Conclusion: Knowledge and utilization of CAT among Nigerian dentists are low. Incorporating CAT into curricula, training, and research is vital for improving awareness and aligning national practice with global trends.

Keywords: Clear Aligner Therapy, knowledge, Nigerian dentist, Orthodontic treatment.

INTRODUCTION

Aesthetics and comfort are important features sought by adults on orthodontic treatment and the combination is rarely offered by most fixed conventional orthodontic treatments.[1] The term Clear Aligner therapy (CAT) just like fixed orthodontic appliance systems, encompasses a wide range of appliances with diverse modes of action, construction, and applicability to various malocclusion treatments.[2] All CATs share the use of clear thermoformed plastic aligners that cover some or all the teeth, with significant differences in their ability to correct different forms of malocclusion.[2] It involves the use of a series of clear aligners to gradually move teeth into their desirable positions.[3] CAT use with adjuncts like temporary anchorage devices (TAD) further improves its effectiveness as a treatment option.[4]

For decades, fixed appliances managed diverse malocclusions effectively, raising concerns about CAT, which has evolved from treating minor irregularities to

managing complex cases.[2] and is fast becoming a treatment option for adult patients seeking orthodontic care.[3]

Historically, Dr Harold Kesling in 1946 employed CAT technology in the fabrication of a Tooth Positioner.[1] Further revolution in this technology happened with other researchers[5–8] advances in thermoplastics and CAD-CAM technology transformed CAT, enabling effective malocclusion treatment with improved aesthetics, comfort, and periodontal health.[1, 9] for patients leading to a growing success in CAT use in the management of complex orthodontic cases.[10, 11] Despite the above advances in CAT, it only recently gained approval from the Food and Drug Administration (FDA) in 1998 allowing Align technology use of Invisalign in the orthodontic management of malocclusion.[2]

CAT use in the management of complex orthodontic cases requiring tooth movements such as leveling and aligning, intrusion, and upper molars distalization of no more than 1.5 mm have been demonstrated,[1] but there is an ongoing debate about the predictability of results when required for other forms of tooth movement like derotations, extrusion, and torque movements.[12–14] The diversity within CAT in terms of manufacturers, materials used, varying thicknesses,[12] aligner margins (Some aligner systems involve tooth and gingival coverage while others are entirely tooth-borne),[15] production process etc. have made generalization of the success of CAT very challenging. Most studies on its success are based on just a particular product which is Invisalign.[14, 16] This has been further complicated by various aligners with varied material properties and thickness, production process, and model precision with all of the listed characteristics affecting the final performance of the appliance.[14, 16–18] It is, therefore, not unexpected to have varying results with the various CAT systems.[5,19] Also, the 22 hours of aligner wear per day have

adversely affected compliance leading to poor patient compliance.[1]

Patients' treatment duration is affected by the total number of aligner trays and the rate of progression from one tray to the next which average happens every 2 weeks.[20] Non-tracking occurs when patients progress aligners faster than recommended.[21] Variations in treatment duration are largely due to variations in tooth movement from computer prediction, suboptimal force delivery by clear aligners and poor patient compliance with clear aligners use with all these factors being capable of hampering the success of treatment.[20, 21]

Aligner biomechanics depend on material thickness, fit, and coverage; attachments improve retention and enable complex tooth movements across different aligner systems. CAT as a treatment option is primarily gaining acceptance mainly on aesthetic grounds[22] as the pain and discomfort associated with its use in the first week of treatment is similar to that of conventional fixed orthodontic treatment.[23] It also offers superior psychosocial effects, overall pain reduction, more periodontally friendly, and better oral health index outcomes when compared to conventional fixed orthodontic appliance therapy.[23–25]With this great revolution in orthodontic treatment with CAT, a literature review shows a dearth of knowledge about this revolutionary treatment option in Nigeria.

The aim of this study therefore, is to assess the knowledge of CAT among dentists in tertiary health institutions in Nigeria, raise awareness and stimulate interest in using CAT as an orthodontic therapy choice.

MATERIALS AND METHODS

Study Design and Area

This was a cross-sectional analytical study that was carried out among dentists of different specialties and cadres, practicing in all regions of the country.

Sample Size Estimation

The minimum sample size for a survey as given by Jaykaran & Tamoghna (2013) was used.[26] Prevalence of knowledge of CAT from a previous study[26] = 96.9% and with 10% attrition gave 46 as the minimum sample size. A total number of 100 participants took part in the survey and 91 completed the survey form properly.

Statement of Ethics:

Approval for this study was obtained from the Ethics and Research Committee of the University of Benin Teaching Hospital before it commenced (protocol number ADM/E22/A/VOL. VII/14830984).

Data collection

Data was collected using an online Google form which was a self-administered questionnaire equipped with “yes” or “no” questions and Likert scale questions with a cover page informed consent form which was distributed among Dentists of various specialties on the Edo State’s and National Nigeria Dental Association’s WhatsApp groups. To ensure the quality of the questionnaire, a pilot test was conducted with 10 respondents to evaluate the adequacy of the questionnaire and the effectiveness of the recruitment strategy. Necessary adjustments were made based on participants’ feedback. These pilot participants were excluded from the final analysis

The questionnaire elicited information on participants' demographics (age and gender) and areas of specialisation. Other parameters assessed include their level of awareness of CAT, use, advantages, cost, and availability.

Using the questionnaire, three senior registrars in orthodontics were tested and their answers were averaged to be a standard reference of knowledge. The results for the three senior registrars were analyzed using Cohen’s Kappa statistics. The inter-examiner Kappa score was 0.91, and the intra-examiner values were 0.96, 0.92 and 0.84, respectively. The responses of the three senior registrars were rated as ‘good’ for a score of 60 and above, ‘fair’ for

scores between 45 and 59, and 'poor' for scores below 45.

Data Analysis

The information collected was analyzed using SPSS version 21. Categorical data were summarized as frequencies and percentages while numerical data was summarized using mean and standard deviation. Chi-square statistics and independent t-tests were used to determine the statistical significance of the variables. Where association was significant, logistic regression analysis was carried out to determine predictors of knowledge of CAT. The significant p-value was set at $p < 0.05$.

RESULTS

A total of 161 participants submitted the survey questionnaire. The mean age among these participants was 33.12 ± 4.89 years. Most respondents were of the 31 – 40 age group, 101 (62.7%) while the least was the 41 – 50 age group, 8 (5.0%). A higher proportion of the respondents (70.2%) were males. Concerning the ranking of the respondents, most were registrars 87 (54.0%), followed by Interns 32 (19.9%), senior registrars 26 (16.1%), and dental officers 16 (9.9%). All the specialties were represented in the study with the most being oral surgeons and general practitioners, 38 (23.6%) and 23 (14.3%) respectively. Orthodontic residents made up 13.7% of the respondents while prosthodontics (2.5%) and public health dentistry (3.7%) were the least represented. About half of the respondents (50.9%) practiced in the midwestern region of Nigeria, with knowledge scores averaging 11.04 ± 8.21. The eastern region had the least representation (9.9%), yet its respondents had the highest average knowledge scores (15.44 ± 12.47). Comparatively, knowledge scores in the western (14.42 ± 9.87) and northern (13.60 ± 10.70) regions were moderate. The differences in knowledge scores by region were not statistically significant ($F = 1.724$, $p = 0.164$). Regarding the years of clinical experience, the highest proportion of respondents had

between 5-10 years of working experience (54.7%). Most respondents 134 (83.2%) were aware of CAT. Among these, about 47.0% knew about CAT from the orthodontic seminars they attended. Other demographic characteristics are shown in Table 1. The level of knowledge among dental practitioners regarding CAT is also presented in Table 1 below. A total of 12 questions (which included 4 multiple choice questions) were used to assess the level of knowledge among the respondents. The baseline score (24.67) was the average score of the 3 senior registrars who specialised in orthodontics. The mean (SD) CAT knowledge score was 12.60 ± 9.58, suggesting an overall 51.1% (12.60/24.67 *100) correct rate on this knowledge test. Knowledge test scores differed significantly across the various age groups (p = 0.024), rank (p = 0.036), clinical dental specialties (p = 0.001), and years of clinical experience (P = 0.003) (Table 1). The significant differences (based on post hoc) were between the 23 - 30 and 31 - 40 years age groups (p = 0.025), between the intern dentists and registrars (p = 0.044), and between those with less than 5 years and 5 – 10 years of work experience (p = 0.003). Table 2 shows that most of the respondents (56.5%) possessed a poor level of knowledge regarding CAT, while 22.4% had fair knowledge, and only 21.1% had good knowledge of CAT. Knowledge scores of CAT had a significant positive correlation with age (rs = 0.25, p = 0.009) and with the number of years of clinical practice (r = 0.18, p = 0.020) (Table 3). Binary logistic regression results showed that the only variable, specialty, had a statistically significant difference. The odd ratio between Orthodontic residents vs. other residents was 0.16 (95% CI: 0.04 – 0.53, P = 0.005). This indicated that the odds of having “fair/good” knowledge in other residents were 84% lower than in orthodontic residents. In other words, other residents are much less likely to have fair or good knowledge than orthodontic residents. Regarding the ranks of participants,

registrars appear to have 2.1 times (or twice) more fair/good knowledge relative to senior registrars however this was not statistically significant (p = 0.150). Dental officers appeared to have about 10% less fair/good knowledge than senior registrars, which was also insignificant (p = 1.000). Other socio-demographic variables showed no statistically significant difference (p > 0.05) (Table 4).

Table 1 – Demographic characteristics of participants and knowledge score of CAT

Characteristics	Level	N (%)	Knowledge Score	Test Statistic[1]	p-value[2]
Age	23 - 30	52 (32.3)	9.69 ± 9.46	3.809	**0.024**
	31 - 40	101 (62.7)	13.99 ± 9.07		
	41 - 50	8 (5)	14.88 ± 13.23		
Sex	Female	48 (29.8)	12.31 ± 8.98	-0.298	0.766
	Male	113 (70.2)	12.79 ± 9.86		
Specialty***	Conservative Dentistry	13 (8.1)	11.15 ± 8.39	3.715	**0.001**
	Family Dentistry	10 (6.2)	10.4 ± 5.97		
	General Practitioner	23 (14.3)	10.87 ± 7.23		
	Oral Medicine	12 (7.5)	9.75 ± 9.23		
	Oral Pathology	8 (5.0)	15.38 ± 7.8		
	Oral and Maxillofacial Surgery	38 (23.6)	12 ± 7.31		
	Orthodontics	22 (13.7)	22.05 ± 13.38		
	Paedodontics	17 (10.6)	10.59 ± 10.57		
	Periodontics	8 (5.0)	6.62 ± 7.15		
	Prosthodontics	4 (2.5)	16.75 ± 7.18		
	Public Health Dentistry	6 (3.7)	9.33 ± 6.53		
Rank	Dental officer	16 (9.9)	11.12 ± 9.55	2.926	**0.036**
	Intern Dentist	32 (19.9)	8.59 ± 9.93		
	Registrar	87 (54.0)	13.89 ± 9.29		

Characteristics	Level	N (%)	Knowledge Score	Test Statistic[1]	p-value[2]
	Senior Registrar	26 (16.1)	14.42 ± 9.1		
Years	Less than 5 years	52 (32.3)	9.4 ± 9.61	6.075	**0.003**
	5 – 10 years	88 (54.7)	14.92 ± 9.24		
	Greater than 10 years	21 (13.0)	11.14 ± 8.69		
Region	Eastern Region	16 (9.9)	15.44 ± 12.47	1.724	0.164
	Midwestern Region	82 (50.9)	11.04 ± 8.21		
	Northern Region	30 (18.6)	13.6 ± 10.7		
	Western Region	33 (20.5)	14.42 ± 9.87		

[1]F statistic (T statistic for gender and specialty)

[2]One-way ANOVA (and T-test for gender)

[***]The T-test compared two broad specialty groups (orthodontics vs others).

Table 2: Categorization of knowledge scores of clear aligner therapy among the participants

Category	**N**	**%**
Poor knowledge of CAT	91	56.5
Fair knowledge of CAT	36	22.4
Good knowledge of CAT	34	21.1
Total	**161**	**100.0**

Table 3: Correlation of knowledge of clear aligner therapy with age and clinical experience of the participants

Variables	**Rho**	**P value**
Age	0.25*	**0.002**
Number of years of practice	0.18*	**0.020**

*Correlation is significant at the 0.05 level (2-tailed)

Table 4: Binary logistic regression analysis on sociodemographic factors associated with knowledge of clear aligner therapy

Characteristic	OR[1]	95% CI[1]	p-value
Age (41 – 50 years vs.)			
31 - 40	1.22	0.21, 8.04	0.825
23 – 30	0.58	0.08, 4.41	0.578
Specialty (Orthodontics vs. Others)	0.16	0.04, 0.53	0.005
Rank (Senior Registrar vs.)			
Registrar	2.09	0.78, 5.83	0.148
Intern Dentist	0.90	0.16, 5.47	0.911
Number of years in practice (Less than 5 years vs.)			
5 – 10 years	1.81	0.41, 8.51	0.433
Greater than 10 years	0.69	0.12, 4.13	0.678

[1]OR = Odds Ratio, CI = Confidence Interval

DISCUSSION

CAT as a treatment option in recent years has greatly increased in relevance and use.[27] This is because of better esthetics and comfort with the use of CAT.[28, 29] With the ongoing advances in aligner material chemistry and consequent reports of better oral health-related quality-of-life ratings, the potential to bring about radical transformations through the therapeutic applications of CAT is evident.[30, 31] Although there are still doubts about CAT performance in complex orthodontic cases, CAT has shown the ability to perform a wide range of orthodontic tooth movements including intricate tasks such as derotation and impacted canine management.[32, 33] These improvements and effectiveness of CAT over the years could be attributed to the fact that it has undergone evolution with

advances in technology across three generations since its formal use in 1998.[34]

The present study assessed the knowledge of dentists in tertiary health institutions on this fast-rising innovative treatment option in orthodontics. The knowledge of this treatment option is still very low among dentists as shown in our study where a majority of the respondents (62.6%) possessed a poor level of knowledge regarding CAT. This may not be unconnected to CAT not being taught in most Dental Schools as an item in the undergraduate curriculum, coupled with the non-availability of this treatment option in many Dental Health Facilities in Nigeria.

Respondents from this study further agreed strongly that cost, non-availability as a treatment option and patients not being offered CAT by dentists and even orthodontists as a treatment option contributed to the poor knowledge among Dentists. This may also be extrapolated to other institutions in the country as they offer the same orthodontic courses and similar lecture modules. Predictably, orthodontic residents had the highest knowledge score, this is not surprising as the Nigerian Association of Orthodontists, a body of Orthodontists and orthodontic residents in Nigeria has been championing the advocacy for the introduction and acceptance of this treatment option into the orthodontic space in Nigeria. Besides, the dentists who are likely to respond to patients, colleagues, and the general public on issues concerning CAT are the orthodontists. This finding is in consonant with previous studies that reported better knowledge, training, and use of CAT among orthodontists compared to general dental practitioners.[28, 35] In contrast, another study with similar survey methods to this present study reported no difference in the knowledge and use of CAT between orthodontists and general dentists, this finding was attributed to the marketing influence of different aligner companies on other dental specialties in the use of

CAT.[29] This may imply that whereas there is a high incidence of malpractice in the field of orthodontics, especially in a resource-poor nation like Nigeria, there is less potential of malpractices in the application of CAT, given that orthodontic treatments including CAT should be done under supervision of an orthodontics.[36] Another study reported good knowledge of CAT among medical and dental students.[37] Although with feather margins, registrars demonstrated more knowledge of CAT than their senior registrar counterparts. This may be attributed to the fact that overall; the knowledge of CAT is not expected to be more among higher ranks in other specialties (except orthodontics), and registrars are more likely to be exposed to innovative trends in dentistry in their update (continuing education) courses compared to the senior registrars who are polarized to narrower clinical interests. Although there was a non-uniform spread of the respondents to the online questionnaire in terms of location of practice in Nigeria, there was a reasonable distribution across the regions. This pattern of spread follows closely the spread of Nigerian dentists across the country. However, there could be a need for more studies that will adopt alternate recruitment strategies to ascertain the applications of the knowledge of CAT among Nigerian dentists, and specifically, amongst orthodontists. Also, future studies could include an analysis of non-responders to reduce uncertainty regarding potential differences in characteristics between responders and non-responders, which may limit the generalizability of the study findings to all Nigerian dentists.

CONCLUSION

Despite the revolutionary impact of CAT in the orthodontic management of adult patients, this study highlights a significant gap in knowledge and use of CAT among dentists in tertiary institutions in Nigeria. Addressing this issue requires incorporating CAT into undergraduate and

postgraduate dental curricula, establishing mandatory continuing professional development (CPD) programs to enhance awareness and practical skills, and increasing access to CAT-related resources such as hands-on training materials and clinical case demonstrations. Partnerships with aligner manufacturers and professional organizations can facilitate these initiatives. Encouraging multi-center research on CAT to evaluate its feasibility, cost-effectiveness, and clinical outcomes in Nigeria is also crucial. Implementing these strategies will align Nigeria's orthodontic protocols with global standards, improve access to modern orthodontic care, and increase the number of adults seeking treatment.

REFERENCES

1. Rossini G, Parrinia S, Castroflorio T, Deregibus A, Debernardi CL. Efficacy of clear aligners in controlling orthodontic tooth movement: A systematic review. Angle Orthod 2015; 85: 881–889.

2. Weir T. Clear aligners in orthodontic treatment. Australian Dental Journal. 2017; 62: 58–62.

3. Uribe F, Padala S, Allareddy V, Nanda R. Patients', parents', and orthodontists' perceptions of the need for and costs of additional procedures to reduce treatment time. Am J Orthod Dentofacial Orthop 2014; 145(4): 65-73.

4. Zheng M, Liu R, Ni Z, Yu Z. Efficiency, effectiveness and treatment stability of clear aligners: a systematic review and meta-analysis. Orthod Craniofac Res. 2017; 20: 127–133.

5. Ponitz RJ. Invisible retainers. Am J Orthod 1971; 59: 266–272.

6. McNamara JA, Kramer KL, Juenker JP. Invisible retainers. J Clin Orthod. 1985; 19(8): 570-578.

7. Sheridan JJ, LeDoux W, McMinn R. Essix retainers: fabrication and supervision for permanent retention. J Clin Orthod 1993; 27: 37–45.

8. Lin F, Yao L, Bhikoo C, Guo J. Impact of fixed orthodontic appliance or clear-aligner on daily performance, in adult patients with moderate need for treatment. Patient Prefer Adherence. 2016; 10: 1639–1645.

9. Kaduskar A. Kanade A. Evolution of the efficiency and predictability of clear aligner therapy. Int J Curr Res. 2020; 12: 13074 – 13079

10. Lagravère MO, Flores-Mir C. The treatment effects of Invisalign orthodontic aligners: a systematic review. J Am Dent Assoc. 2005; 136: 1724–1729.

11. Baldwin DK, King G, Ramsay DS, Huang G, Bollen A. Activation time and material stiffness of sequential removable orthodontic appliances. Part 3: premolar extraction patients. Am J Orthod Dentofac Orthop. 2008; 133: 837–845.

12. Cowley DP, Mah J, O'Toole B. The Effect of Gingival-Margin Design on the Retention of Thermoformed Aligners. J Clin Orthod.2012; 46: 697–702.

13. Hahn W, Zapf A, Dathe H, Fialka-Fricke J, Fricke-Zech S, Gruber R, et al. Torquing an upper central incisor with aligners—acting forces and biomechanical principles. Eur J Orthod. 2010; 32: 607–613

14. Simon M, Keilig L, Schwarze J, Jung BA, Bourauel C. Forces and moments generated by removable thermoplastic aligners: incisor torque, premolar derotation, and

molar distalization. Am J Orthod Dentofac Orthop. 2014; 145: 728–736.

15. Dasy H, Dasy A, Asatrian G, Ròzsa N, Lee H-F, Kwak JH. Effects of variable attachment shapes and aligner material on aligner retention. Angle Orthod. 2015; 85: 934–940.

16. Lombardo L, Martines E, Mazzanti V, Arreghini A, Mollica F. Stress relaxation properties of four orthodontic aligner materials: a 24-hour in vitro study. Angle Orthod. 2017; 87(1): 11–18.

17. Martorelli M, Gerbino S, Giudice M, Ausiello P. A comparison between customized clear and removable orthodontic appliances manufactured using RP and CNC techniques. Dent Mater. 2013; 29: 1–10.

18. Lombardo L, Arreghini A, Ramina F, Huanca Ghislanzoni LT, Siciliani G. Predictability of orthodontic movement with orthodontic aligners: a retrospective study. Prog Orthod. 2017; 18: 35.

19. Alikhani M, Alansari S, Hamidaddin MA, Sangsuwon C, Alyami B, Soumya N et al. Vibration paradox in orthodontics: anabolic and catabolic effects. PloS One 2018; 13(5): 1-18.

20. Liao Z, Elekdag-Turk S, Turk T, Grove J, Dalci O, Chen J et al. Computational and clinical investigation on the role of mechanical vibration on orthodontic tooth movement. J Biotech 2017; 60: 57-64.

21. Rosvall MD, Fields HW, Ziuchkovski J, Rosenstiel SF, Johnston WM. Attractiveness, acceptability, and value of orthodontic appliances. Am J Orthod and Dentofac Orthop. 2009; 135(3): 276–277.

22. Miller KB, McGorray SP, Womack R, Quintero JC, Perelmuter M, Gibson J, et al. A comparison of treatment impacts between Invisalign aligner and fixed appliance therapy during the first week of treatment. Am J Orthod Dentofacial Orthop. 2007; 131(3): 301–309.

23. Karkhanechia M, Chow D, Sipkinc J, Sherman D, Boylan JR,Norman GR et al. Periodontal status of adult patients treated with fixed buccal appliances and removable aligners over one year of active orthodontic therapy. Angle Orthod 2013; 83: 146–151.

24. D'Apuzzo F, Perillo L, Carrico CK, Castroflorio T, Grassia V, Lindauer SJ, et al. Clear aligner treatment: different perspectives between orthodontists and general dentists. Prog orthod. 2019; 20(10): 256-259.

25. Phan X, Ling PH. Clinical limitations of Invisalign. J Can Dent Assoc. 2007; 73(3):263-266.

26. Charan J, Biswas T. How to calculate sample size for different study designs in medical research? Indian J Psychol Med. 2013;35(2):121-126.

27. Best AD, Shroff B, CarricoCK, Lindauer SJ. Treatment management between orthodontists and general practitioners performing clear aligner therapy. Angle Orthod. 2017; 87(3): 432-439.

28. Best AD, Shroff B, Carrico CK, Lindauer SJ. Treatment management between orthodontists and general practitioners performing clear aligner therapy. Angle Orthod. 2017;87(3):432-439.

29. Yanzi G, Xuejun S, Xinyu Y, Ziwei T, Wenli L, Hu L. Orthodontic Practitioners' Knowledge and Education Demand on Clear Aligner

Therapy. Inter Dent J,.2024; 74(1):81-87

30. Bichu YM, Alwafi A, Liu X, Andrews J, Ludwig B, Bichu AY, et al. Advances in orthodontic clear aligner materials. Bioact Mater. 2023; 1: 22:384–403.

31. Gold BP, Siva S, Duraisamy S, Idaayath A, Kannan R. Properties of Orthodontic Clear Aligner Materials - A Review. J Evol Med Dent Sci. 2021; 13: 10(37):3288–94.

32. Greco M, Machoy M. Impacted Canine Management Using Aligners Supported by Orthodontic Temporary Anchorage Devices. Int J Environ Res Public Health. 2023; 1: 20(1).

33. Lione R, Paoloni V, De Razza FC, Pavoni C, Cozza P. Analysis of Maxillary First Molar Derotation with Invisalign Clear Aligners in Permanent Dentition. Life. 2022; 1: 12(10).

34. Hennessy J, Al-Awadhi EA. Clear Aligners Generations and Orthodontic Tooth Movement. J Orthod. 2016; 43(1): 68–76.

35. Vicéns J, Russo A. Comparative Use of Invisalign® by Orthodontists and General Practitioners. Angle Orthod. 2010; 80(3): 425-434.

36. Corte-Real A, Caetano C, Alves S, Pereira AD, Rocha S, Nuno Vieira D. Patient safety in dental practice: lessons to learn about the risks and limits of professional liability. Int Dent J. 2021 Oct 1;71(5):378–383.

37. Sameer KV, Silpa MC, Rethish E, Lily Sofea B, Sharifah SB, Nurul AB, et. al. Awareness and Knowledge Of Clear Aligners- A Malaysian Medical University Study. J Popl Ther Clin Pharmacol 2023;30(17):773-779.