Dental
Communication

Biosc.Biotech.Res.Comm. Special Issue Vol 13 No 8 2020 Pp-116-120

BBRC
Bioscience Biotechnology
Research Communications

Evaluation of Plaque Retention in Stainless Steel and Ceramic Brackets – A Qualitative Comparative Study

Reshma Mohan[1] and Navaneethan R[2]

[1]Department of Orthodontics and Dentofacial Orthopaedics Saveetha Dental College and Hospital Saveetha Institute of Medical and Technical Sciences, Saveetha University 162, Poonamallee High Road, Chennai-600077, Tamil Nadu,India

[2]Reader, Department of Orthodontics and Dentofacial Orthopaedics Saveetha Dental College and Hospital Saveetha Institute of Medical and Technical Sciences, Saveetha University 162, Poonamallee High Road ,Chennai-600077, Tamil Nadu, India

ABSTRACT

To evaluate the plaque retention in stainless steel and ceramic brackets using OHI-S Index and Turesky et al Modified Quigley Hein Plaque Index. The study was done on 40 subjects who were scheduled for fixed orthodontic treatment. The plaque index of subjects was recorded according to the OHI-S index and Turesky et al Modified Quigley Hein Plaque Index methods . Descriptive statistics and Independent sample t-test was used to see the difference in plaque index in factors having two variables. Also chi-square test was performed to associate between the frequency of brushing and the plaque indices.The mean of metal brackets with OHI-S index was 1.36 +0.72 and Turesky Index was 1.58+ 0.74 .Mean of ceramic brackets with OHI-S index was 1.68 + 0.38 and Turesky Index was 1.63 + 0.94 . On doing independent -t- tests, t was observed that the ceramic brackets showed higher plaque index scores than metal brackets, but this was not statistically significant. The difference in plaque index between stainless steel and ceramic brackets proved to be statistically insignificant, thereby concluding that in terms of plaque reduction ,any one of the two brackets could be used.

KEY WORDS: CERAMIC BRACKETS, METAL BRACKETS , TURESKY ET AL MODIFIED QUIGLEY HEIN PLAQUE INDEX , OHI-S INDEX.

INTRODUCTION

The placement of orthodontic appliances creates a favorable environment for the accumulation of a microbiota and food residues.(Owen, 1949) Maintenance of good oral hygiene is extremely important during the fixed orthodontic treatment. Despite oral hygiene maintenance instructions, the clinical experience as well as literature(Marsh, 1995)(Marsh and Bradshaw, 1995) has shown the accumulation of dental plaque on the teeth. The dental plaque that accumulates can harbor a diverse microflora which could produce toxic products and acids. As a result, the tooth structure and also the supporting structures are jeopardized. The hazards of microbial films can range from simple gingivitis and white spot lesions to severe interdental bone loss and carious cavitations. It has been estimated that some 60% of dental infections, including gingivitis, white spot lesions, dental caries and periodontal disease are due to microbial biofilms. (Costerton, Stewart and Greenberg, 1999).

Adhesion of microorganisms to surfaces is a result of electrostatic interactions and van der Waals forces. (Christersson et al., 1989) Although it is clear that initial attachment is an important factor governing further

ARTICLE INFORMATION

*Corresponding Author: navaneethan@saveetha.com
Received 3rd Aug 2020 Accepted after revision 22nd Sep 2020
Print ISSN: 0974-6455 Online ISSN: 2321-4007 CODEN: BBRCBA

Thomson Reuters ISI Web of Science Clarivate Analytics USA and Crossref Indexed Journal

NAAS Journal Score 2020 (4.31) SJIF: 2020 (7.728)
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*Online Contents Available at: http//www.bbrc.in/
Doi: http://dx.doi.org/10.21786/bbrc/13.8/122*

colonization, the mechanism of attachment and those of subsequent adhesion may differ significantly.(Gibbons, 1989) Decreased wettability may inhibit direct adhesion and colonization of bacteria on to the appliances. (AlMulla, 2014). Clinical studies have shown an increase in biofilm formation combined with an ecological change of the microbial profile after bracket insertion. (Lee et al., 2005),(Paolantonio et al., 1997),(Zachrisson and Zachrisson, 1972)The shift in amount, composition, metabolic activity, and pathogenicity of the oral microflora can lead to generalized gingival inflammation and incipient carious lesions.(Atack, Sandy and Addy, 1996)(van Gastel et al., 2008)(Chapman et al., 2010) (Øgaard et al., 1988)

In addition to the inefficient brushing practices, there are a lot of factors that can affect plaque accumulation. Some of these factors are related to the clinical practices such as the type of brackets, type of ligation, duration of orthodontic treatment and frequency of patient appointments.(Gastel et al., 2009)(Alves de Souza et al., 2008)(Türkkahraman et al., 2005)(Lobb, 2006) The others are related to the patient socio-demographic factors like eating habits, age, gender and Socio-economic Status. (Islam, Shaikh and Fida, 2014) There are a number of factors that can influence the plaque accumulation around orthodontic brackets. Hence, it is important to know all those factors that can help in reducing plaque and those which are associated with increase in plaque retention. The incorporation of these factors in normal orthodontic clinical practice and in patient education will help to avoid most of the hazards related to dental plaque.

In most cases, fixed orthodontic treatment consists of brackets made of stainless steel.Because of the increase in needs for more esthetic treatment options among young individuals, the usage of tooth colored brackets made of ceramics is highly preferred. After their introduction in 1986, various types of ceramic brackets are currently available by all major orthodontic manufacturers. (Birnie, 1990)(Fox and McCabe, 1992) Since then it has gained widespread popularity in clinical practise. Therefore, the objective of this study was to compare the plaque accumulated with ceramic and metal orthodontic brackets in order to clarify which bracket type had a higher plaque retaining capacity.

MATERIAL AND METHODS

This was a cross-sectional analytical study carried out at the Orthodontics Department at Private Dental institute. A total of 40 subjects were selected who were further divided into two groups– Group A and Group B. Group A consisted of 20 ceramic bracket patients and Group B consisted of 20 metal bracket patients. Both the groups were tested by the following Plaque Indices- OHI-S Index and Turesky et al Modified Quigley Hein Plaque Index. Their records were collected and maintained in Google Sheets.

Dental Indices used: In (Cugini, Thompson and Warren, 2006)Turesky et al Modified Quigley Hein Plaque Index (TQH) , the mesial, distal, and mid surfaces of facial and lingual aspects were scored. After disclosing with Two-Tone dye, the scores were recorded

Scoring was as follows: 0 is no plaque/debris, 1 is separate flecks of plaque at the cervical margin of the tooth; 2 is a thin continuous band of plaque (up to 1 mm) at the cervical margin of the tooth; 3 is a band of plaque wider than 1 mm but covering less than one third of the crown of the tooth; 4 is plaque covering at least one third but less than two thirds of the crown of the tooth and 5 is plaque covering two thirds or more of the crown of the tooth.

In OHI-S Index , the surfaces that were measured were labial/buccal surfaces of upper and lower first molars (16,26,36,46); followed by one upper central incisor (11) and lower central incisor (31). It consists of debris index (DI-S) and calculus index (CI-S).

The following is the criteria for classifying: The score for debris-index represents 0 for No debris or stain present; 1 for Soft debris covering not more than one third of the tooth surface being examined or the presence of extrinsic stains without debris regardless of surface area covered; 2 for Soft debris covering more than one third but not more than two thirds of the exposed tooth surface and 3 for Soft debris covering more than two thirds of the exposed tooth surface.

The score for calculus -index represents 0 for No calculus present; 1 for Supragingival calculus covering not more than one third of the exposed tooth surface being examined; 2 for Supragingival calculus covering more than one third but not more than two thirds of the exposed tooth surface, or the presence of individual flecks of subgingival calculus around the cervical portion of the tooth and 3 for Supragingival calculus covering more than two thirds of the exposed tooth surface or a continuous heavy band of subgingival calculus around the cervical portion of the tooth.

The average of both the DI-S and CI-S are combined to obtain the OHI-S. The C I-S and D I-S values may range from 0 to 3 ; the O H I-S values, from 0 to 6. Inclusion criteria included subjects with intact set of teeth and treatment with orthodontic fixed appliance for at least one month of wear, subjects of 15 years of age and above, and subjects using manual toothbrushes. Exclusion criteria included any physical limitations that might compromise normal toothbrushing technique, any evidence of neglected oral hygiene or major hard or soft tissue lesions or trauma, a medical condition with a requirement of antibiotic therapy or anti-inflammatory medications. Descriptive statistics along with independent t-test was performed between the two groups . Also chi-square test was performed to associate between the frequency of brushing and the plaque indices. The statistical analysis was performed with the help of SPSS software 23.00.

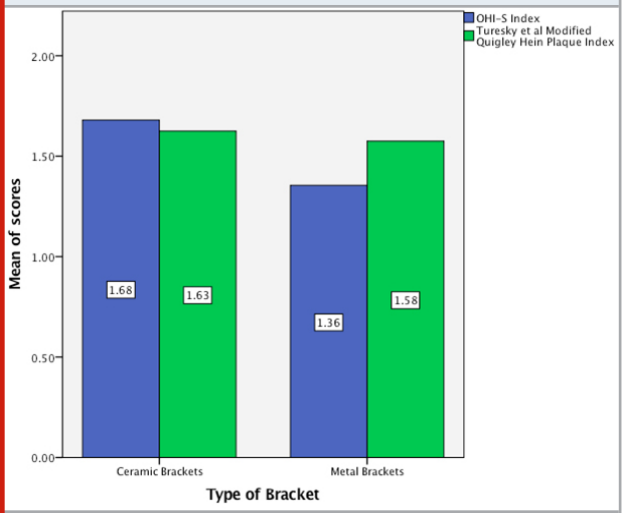
RESULTS AND DISCUSSION

Descriptive statistics along with independent t-test was performed between the two groups . Also chi-square test was performed to associate between the frequency of brushing and the plaque indices. The mean of metal brackets with OHI-S index is 1.36 +0.72 and Turesky Index is 1.58+ 0.74. Mean of ceramic brackets with OHI-S index is 1.68 + 0.38 and Turesky Index is 1.63 + 0.94 [Table. 1] It was observed that subjects with ceramic brackets had higher plaque index scores than those with metal brackets ; however this was not statistically significant (p>0.05) [Figure.2] It was inferred that the subjects who brushed twice a day showed lower plaque index score as compared to subjects who brushed once a day; however this was not statistically significant (p>0.05)[Figure. 3].

Table 1. Descriptive statistics to find mean and standard deviation of the index scores obtained from both groups

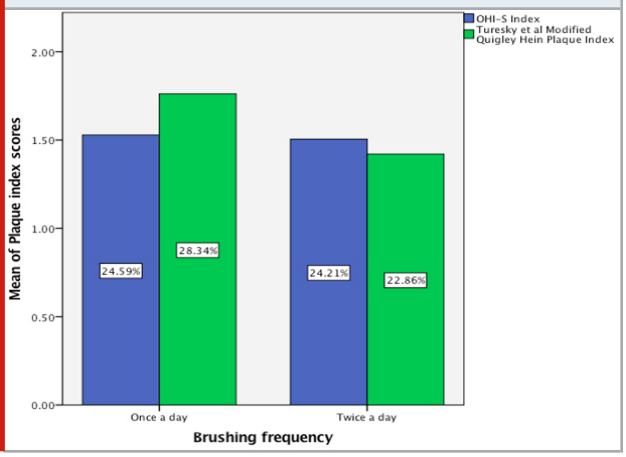
	Mean	Std Dv	Mean Diff	Sig (2-tailed)
Group A - Ceramic brackets				
OHI-S score	1.68	0.368	0.325	0.081
TQH score	1.63	0.935	0.050	0.852
Group B - Metal brackets				
OHI-S score	1.36	0.723	0.325	0.084
TQH score	1.58	0.743	0.050	0.852

Figure 1: Bar chart representing independent t-test performed between ceramic and metal bracket groups. The X-axis represents the type of bracket and the Y-axis represents the mean of plaque indices scores. Independent t-test was performed and was found to be statistically not significant (P value >0.05). It was observed that subjects with ceramic brackets had higher plaque index scores than those with metal brackets ; however this was not statistically significant (p>0.05)



Our extensive research expertise ranged from epidemiological studies to randomised clinical trials that have been published in reputed journals(Felicita, 2017a, 2017b, 2018; Felicita, Thirumurthi and Jain, 2017; Korath, Padmanabhan and Parameswaran, 2017; Krishnan, Pandian and Rajagopal, 2017; Charles et al., 2018; Pandian, Krishnan and Kumar, 2018; Reddy et al., 2018; Chinnasamy et al., 2019). This knowledge was instrumental for us to compare the plaque retention in ceramic and metal brackets. In the present study, it was attempted to address the factors which can affect the plaque around the two types of fixed appliances - metal and ceramic brackets. On doing independent 't' tests , the values show that the difference in plaque accumulation in ceramic and metal brackets were insignificant.

Figure 2: The bar chart represents the association between brushing frequency among the subjects and the plaque index scores. The X-axis represents the brushing frequency and the Y-axis represents the mean of the plaque indices scores. Chi-square association was done and it was found not to be statistically significant, [Chi-square value for OHI-S =12.27 , p value = 0.51; Chi-square value for TQH= 13.07 , p value= 0.67] ; It was inferred that the subjects who brushed twice a day showed lower plaque index score as compared to subjects who brushed once a day; however this was not statistically significant (p>0.05).



A number of researchers have worked on various sociodemographic and clinical factors to search out their relevance to plaque accumulation. Some studies have found.that adolescents exhibit higher levels of plaque as compared to the adults(Boyd and Baumrind, 1992) (Boyd et al., 1989). But in some studies, the difference in plaque accumulation among different age groups was compared and found to be statistically insignificant although all the three groups had moderate levels of plaque (Islam, Shaikh and Fida, 2014) .

The subjects, after putting the fixed appliances, are instructed about the type of brush, timing and frequency of brushing in order to maintain optimal oral hygiene. Usually, the given instructions are to brush the teeth at least twice daily before going to bed and after breakfast. The use of interdental brush to clean between the brackets

is also prescribed. In study by Islam ZU et al, a significant decrease of plaque levels was found in subjects who brush the teeth twice or more than twice daily as compared to those who brush once per day. Furthermore, the subjects who used the interdental brush in addition to the normal brush have shown reduced plaque levels when compared to the subjects who only used the normal brushing for cleaning their teeth (Islam, Shaikh and Fida, 2014).

They also showed that the subjects who brushed their teeth after breakfast have significantly reduced levels of plaque than the subjects who exercised brushing before breakfast. Some studies show that the use of mouthwash has been shown to reduce the level of plaque and gingivitis (Lindel et al., 2011). Generally, the ceramic brackets have been shown in studies to accumulate more plaque as compared to the metallic brackets (Gastel et al., 2009) (Anhoury et al., 2002). This was similar to our present study results ; however it was found not to be statistically significant. On the contrary, a more recent and controlled study has shown a significantly lower amount of biofilm on ceramic brackets than on stainless steel brackets(Lindel et al., 2011). This may be due to the fact that the subject with ceramic brackets are more conscious about the esthetics and oral hygiene than subjects with metal brackets .

Our study showed that subjects who maintained good oral hygiene and brushed twice daily showed lesser incidence of plaque; although this was not statistically significant. In clinical practice, the decision of bracket selection is more dependent on the basis of oral hygiene maintenance. The clinician would suggest the bracket system most suited for the patient according to their hygiene(Islam, Shaikh and Fida, 2014). This means that the amount of plaque may be kept at minimum if the brushing practices are exercised precisely and frequently, irrespective of how long the duration of treatment extends and which type of bracket was used on the patient. From the discussion above, it seems that the maintenance of really good oral hygiene during fixed orthodontic treatment is more dependent on the brushing practices and fewer on the clinical practices.

The subjects who comply with the use of normal and interdental brushing, the timing of brushing and frequency of brushing is less prone to plaque accumulation. (Islam, Shaikh and Fida, 2014) The elastomeric module accumulates more plaque, must be used with caution in patients with poor oral hygiene as shown in this and other studies.(Alves de Souza et al., 2008)(Lobb, 2006) Therefore, patients' education on oral hygiene maintenance must be a part of the orthodontic treatment. For these reasons, proper methods of instructions by means of verbal, brochures and video tapes must be devised and incorporated in clinical practice. The limitations of this study was small sample size and sampling technique.

CONCLUSION

Within the limitations of the study , the following conclusions can be made :

- The difference in plaque index between stainless steel and ceramic brackets proved to be statistically insignificant, thereby concluding that in terms of plaque reduction ,any one of the two brackets could be used.
- Patients with metal brackets seem to have lesser plaque accumulation as compared to ceramic brackets , even though it is not statistically insignificant. This could be attributable to differences in surface characteristics in ceramic and metal brackets.
- Patients who brushed twice a day showed lesser retention of plaque compared to patients who only brush once a day. However this was not statistically significant.

ACKNOWLEDGMENTS

I would like to record my deep sense of gratitude to my research supervisor Dr Navaneethan R, Reader, Department of Orthodontics, Saveetha Dental College and Hospitals, Chennai for his guidance and encouragement with my work during all stages. There was an equal contribution from all the authors.

Conflict of Interest: No conflict of interest.

REFERENCES

AlMulla, A. (2014) 'Solving the puzzle of caries risk and prevention in orthodontic patients', Oral Health and Dental Management. doi: 10.4172/2247-2452.s1.002.

Alves de Souza, R. et al. (2008) 'Periodontal and microbiologic evaluation of 2 methods of archwire ligation: ligature wires and elastomeric rings', American journal of orthodontics and dentofacial orthopedics: official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics, 134(4), pp. 506–512.

Anhoury, P. et al. (2002) 'Microbial profile on metallic and ceramic bracket materials', The Angle orthodontist, 72(4), pp. 338–343.

Atack, N. E., Sandy, J. R. and Addy, M. (1996) 'Periodontal and Microbiological Changes Associated With the Placement of Orthodontic Appliances. A Review', Journal of Periodontology, pp. 78–85. doi: 10.1902/jop.1996.67.2.78.

Birnie, D. (1990) 'Ceramic Brackets', British Journal of Orthodontics, pp. 71–75. doi: 10.1179/bjo.17.1.71.

Boyd, R. L. et al. (1989) 'Periodontal implications of orthodontic treatment in adults with reduced or normal periodontal tissues versus those of adolescents', American Journal of Orthodontics and Dentofacial Orthopedics, pp. 191–198. doi: 10.1016/0889-5406(89)90455-1.

Boyd, R. L. and Baumrind, S. (1992) 'Periodontal considerations in the use of bonds or bands on molars in adolescents and adults', The Angle orthodontist, 62(2), pp. 117–126.

Chapman, J. A. et al. (2010) 'Risk factors for incidence and severity of white spot lesions during treatment with fixed orthodontic appliances', American Journal of

Orthodontics and Dentofacial Orthopedics, pp. 188–194. doi: 10.1016/j.ajodo.2008.10.019.
Charles, A. et al. (2018) 'Evaluation of dermatoglyphic patterns using digital scanner technique in skeletal malocclusion: A descriptive study', Indian journal of dental research: official publication of Indian Society for Dental Research, 29(6), pp. 711–715.
Chinnasamy, A. et al. (2019) 'Chronic nail biting, orthodontic treatment and Enterobacteriaceae in the oral cavity', Journal of clinical and experimental dentistry, 11(12), pp. e1157–e1162.
Christersson, C. E. et al. (1989) 'Effect of critical surface tension on retention of oral microorganisms', European Journal of Oral Sciences, pp. 247–256. doi: 10.1111/j.1600-0722.1989.tb01609.x.
Costerton, J. W., Stewart, P. S. and Greenberg, E. P. (1999) 'Bacterial biofilms: a common cause of persistent infections', Science, 284(5418), pp. 1318–1322.
Cugini, M., Thompson, M. and Warren, P. R. (2006) 'Correlations between two plaque indices in assessment of toothbrush effectiveness', The journal of contemporary dental practice, 7(5), pp. 1–9.
Felicita, A. S. (2017a) 'Orthodontic management of a dilacerated central incisor and partially impacted canine with unilateral extraction - A case report', The Saudi dental journal, 29(4), pp. 185–193.
Felicita, A. S. (2017b) 'Quantification of intrusive/retraction force and moment generated during en-masse retraction of maxillary anterior teeth using mini-implants: A conceptual approach', Dental press journal of orthodontics, 22(5), pp. 47–55.
Felicita, A. S. (2018) 'Orthodontic extrusion of Ellis Class VIII fracture of maxillary lateral incisor - The sling shot method', The Saudi dental journal, 30(3), pp. 265–269.
Felicita, A. S., Thirumurthi, A. S. and Jain, R. K. (2017) 'Patient's Psychological Response to Twin-block Therapy', World Journal of Dentistry, 8(4), pp. 327–330.
Fox, N. A. and McCabe, J. F. (1992) 'An Easily Removable Ceramic Bracket?', British Journal of Orthodontics, pp. 305–309. doi: 10.1179/bjo.19.4.305.
Gastel, J. et al. (2009) 'Microbial Adhesion on Different Bracket Types in vitro', The Angle Orthodontist, pp. 915–921. doi: 10.2319/092908-507.1.
van Gastel, J. et al. (2008) 'Longitudinal Changes in Microbiology and Clinical Periodontal Variables After Placement of Fixed Orthodontic Appliances', Journal of Periodontology, pp. 2078–2086. doi: 10.1902/jop.2008.080153.
Gibbons, R. J. (1989) 'Bacterial Adhesion to Oral Tissues: A Model for Infectious Diseases', Journal of Dental Research, pp. 750–760. doi: 10.1177/00220345890680050101.
Islam, Z. U., Shaikh, A. and Fida, M. (2014) 'Plaque index in multi-bracket fixed appliances', Journal of the College of Physicians and Surgeons--Pakistan: JCPSP, 24(11), pp. 791–795.
Korath, A. V., Padmanabhan, R. and Parameswaran, A. (2017) 'The Cortical Boundary Line as a Guide for Incisor Re-positioning with Anterior Segmental Osteotomies', Journal of maxillofacial and oral surgery, 16(2), pp. 248–252.
Krishnan, S., Pandian, S. and Rajagopal, R. (2017) 'Six-month bracket failure rate with a flowable composite: A split-mouth randomized controlled trial', Dental press journal of orthodontics, 22(2), pp. 69–76.
Lee, S. M. et al. (2005) 'Prevalence of putative periodontopathogens in subgingival dental plaques from gingivitis lesions in Korean orthodontic patients', Journal of microbiology , 43(3), pp. 260–265.
Lindel, I. D. et al. (2011) 'Comparative analysis of long-term biofilm formation on metal and ceramic brackets', The Angle Orthodontist, pp. 907–914. doi: 10.2319/102210-616.1.
Lobb, W. K. (2006) 'Archwire Ligation Techniques, Microbial Colonization, and Periodontal Status in Orthodontically Treated Patients', Yearbook of Dentistry, pp. 256–257. doi: 10.1016/s0084-3717(08)70201-0.
Marsh, P. D. (1995) 'The Role of Microbiology in Models of Dental Caries', Advances in Dental Research, pp. 244–254. doi: 10.1177/08959374950090030901.
Marsh, P. D. and Bradshaw, D. J. (1995) 'Dental plaque as a biofilm', Journal of Industrial Microbiology, pp. 169–175. doi: 10.1007/bf01569822.
Øgaard, B. et al. (1988) 'Orthodontic appliances and enamel demineralization Part 2. Prevention and treatment of lesions', American Journal of Orthodontics and Dentofacial Orthopedics, pp. 123–128. doi: 10.1016/0889-5406(88)90360-5.
Owen, O. W. (1949) 'A study of bacterial counts (lactobacilli) in saliva related to orthodontic appliances', American Journal of Orthodontics, pp. 672–678. doi: 10.1016/0002-9416(49)90123-2.
Pandian, K. S., Krishnan, S. and Kumar, S. A. (2018) 'Angular photogrammetric analysis of the soft-tissue facial profile of Indian adults', Indian journal of dental research: official publication of Indian Society for Dental Research, 29(2), pp. 137–143.
Paolantonio, M. et al. (1997) 'Clinical significance of Actinobacillus actinomycetemcomitans in young individuals during orthodontic treatment. A 3-year longitudinal study', Journal of clinical periodontology, 24(9 Pt 1), pp. 610–617.
Reddy, A. K. et al. (2018) 'Comparative Evaluation of Antimicrobial Efficacy of Silver, Titanium Dioxide and Zinc Oxide Nanoparticles against Streptococcus mutans', Pesquisa brasileira em odontopediatria e clinical integrada, 18(1), p. e4150.
Türkkahraman, H. et al. (2005) 'Archwire ligation techniques, microbial colonization, and periodontal status in orthodontically treated patients', The Angle orthodontist, 75(2), pp. 231–236.
Zachrisson, B. U. and Zachrisson, S. (1972) 'Gingival Condition Associated with Partial Orthodontic Treatment', Acta Odontologica Scandinavica, pp. 127–136. doi: 10.3109/00016357209004597.