Original Article

EVALUATION OF USPHS CRITERIA FOR MARGINAL ADAPTATION IN FIXED DENTAL PROSTHESIS- A RETROSPECTIVE STUDY

[1]Aman Merchant, [2]Subhabrata Maiti*, **[3]Dr. Ashok V**

[1]Saveetha dental college and hospital Saveetha institute of medical and technical science, Saveetha university Chennai, India

[2]*Senior Lecturer Department of Prosthodontics Saveetha dental college and hospital Saveetha institute of medical and technical science, Saveetha university Chennai, India

[3]Professor and Head, Department of Prosthodontics, Saveetha dental college and hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai-600077,TamilNadu ,India.

Abstract

Aim: This study aims to evaluate the prevalence of the scores of USPHS guidelines for marginal adaptation and check its association with the qualification of the dental students.

Materials and Methods: This retrospective study was carried out from the data obtained from the patients' case sheet. A total of 730 subjects were selected, undergoing treatment for fixed dental prosthesis. The prevalence of three different scores was checked. Group 1- Score of 0, Group 2- Score of 1, Group 3-Score of 2. The frequency of each score was checked and a Chi square test was done to evaluate the correlation between the scores and qualification of the dental student.

Results: It was observed that maximum students achieved a score of 0, followed by a score of 1 and very few people achieved a score of 2. Within the groups, it was seen that the prevalence of the score 0 was seen more in undergraduate students as compared to the post graduate students.

Conclusion: It can be concluded that the overall results achieved by the students were good. Further studies need to be done to verify the results.

Clinical Significance: Marginal fit of the prosthesis is one of the major factors influencing the strength and longevity of the prosthesis. Marginal discrepancies can lead to a lot of endodontic and periodontal problems. Hence, the clinician should try and achieve a good marginal adaptation.

Keywords: Accuracy; Discrepancy; Marginal fit; USPHS criteria.

DOI: 10.47750/pnr.2022.13.S04.149

INTRODUCTION

A dental practitioner mainly aims to restore the form, function and esthetics of the tooth without jeopardizing the remaining soft and hard tissues(Rosenstiel, Land and Fujimoto, 2006; Ariga *et al.*, 2018). A successful fixed dental prosthesis is largely dependent upon the adequate fit of the prosthesis(Basha, Ganapathy and Venugopalan, 2018; Duraisamy *et al.*, 2019). Marginal integrity and adaptation have been reported to be the most important factors affecting restoration longevity(Conrad, Seong and Pesun, 2007; Peumans *et al.*, 2013). The prosthesis should have a good marginal fit(Ganapathy *et al.*, 2016; Ganapathy, Kannan and Venugopalan, 2017). An ill fitting restoration will not only damage the tooth structure, but also the surrounding periodontium(Jyothi *et al.*, 2017). It provides a medium for the bacteria to adhere on, which can cause secondary caries and gingival inflammation(Bader *et al.*, 1991; Knoernschild and Campbell, 2000; Subasree, Murthykumar and Dhanraj, 2016). The toxins released by the bacteria can percolate the dentinal tubules and cause endodontic problems(Felton *et al.*, 1991; Goodacre *et al.*, 2003; Selvan and Ganapathy, 2016; Vijayalakshmi and Ganapathy, 2016). Loss of marginal integrity can cause stress concentration that will reduce the strength and longevity of the prosthesis(Tuntiprawon and Wilson, 1995; Jain, Ranganathan and Ganapathy, 2017).

Since marginal adaptation plays such an important role, certain guidelines should be present to evaluate the marginal fit of the prosthesis(Ashok and Suvitha, 2016). One such important guideline is the USPHS guidelines to evaluate the marginal fit of the prosthesis.

The USPHS guidelines have certain scores according to the fit of the prosthesis. The scoring is as follows:

Alpha- Explorer does not catch

Beta- Explorer catches, no visible crevice is visible into which the explorer cannot penetrate.

Gamma- Obvious crevice at margins, enamel, dentine or base exposed.
Delta- Restoration mobile, fractured or missing

According to this score, clinical decisions can be taken regarding the prosthesis(Ashok *et al.*, 2014; Venugopalan *et al.*, 2014). Our team has extensive knowledge and research experience that has translate into high quality publications (Kumar *et al.*, 2006; Devi and Gnanavel, 2014; Varghese *et al.*, 2015; Sivamurthy and Sundari, 2016; Chen *et al.*, 2019) (Rao and Kumar, no date; Nair, Jeevanandan and Vignesh, 2018; Anbu *et al.*, 2019; Sekar *et al.*, 2019; Johnson *et al.*, 2020).Now the growing trend in this area motivated us to pursue this project This study aims to evaluate the prevalence of different scores of USPHS guidelines for marginal adaptation and check its correlation with the qualification of the operator.

Materials and Methods

Study Design

This retrospective cross sectional study was carried out in the Department of Prosthodontics, Saveetha Dental College, Chennai, India. The present study was approved by the Ethics Committee of Saveetha Dental College, Chennai, India. The data was obtained from the case records of the patients coming to the outpatient department of the college.

Ethical approval number- SDC /SIHEC/2020/DIASDATA/0619-0320

Sample selection

From June 2019 to May 2020, the subject selection of this study was done in Saveetha Dental College, Chennai, India based on the inclusion and exclusion criteria.

Inclusion Criteria

1) At least 18 years old.
2) Healthy subjects with no history of systemic diseases.
3) Both genders.
4) Patients undergoing a fixed partial denture treatment.
5) Signed informed consent

Exclusion criteria

1) Patients with systemic disease
2) Alcoholic patients
3) Patients indicated for removable prosthesis
4) Patients indicated for implant placement
5) Patient not willing for the treatment.

After the inclusion and exclusion criteria, the number of subjects were shortlisted from 86000 to 730.

Groups

For convenience, the scoring was modified a little
Group 1: Score 0 (Smooth margins)
Group 2: Score 1(All margins closed)
Group 3: Score 2 (Obvious crevice at the margins)

Statistical Analysis

All analyses were conducted using SPSS 21 (SPSS Inc., Chicago, IL). Descriptive statistics such as frequency was carried out for each model. A Chi square test was done to determine the correlation between the score of the guidelines and the qualification of the operator.

Statistical Variables

The independent variables in this study are the study groups.
The dependent variables in this study are the scores of the USPHS guidelines.

RESULTS

In this study, it is observed that maximum students achieved a score of 0 (62.5%), which indicated a smooth margin, followed by a score of 1 (34.1%), which indicated that all the margins are closed. Few students achieved a score of 2 (3.4%), which indicated obvious crevices at the margins (Table 1) (Figure 1).

It is also observed that the prevalence of score zero was maximum in undergraduate students (64.2%) as compared to postgraduate students (55.6%) (Table 2) (Figure 2).

DISCUSSION

A good marginal fit is mandatory to prevent the longevity of the restoration. Since, it is impossible to achieve a 100% fit every time, a certain amount of marginal discrepancy is acceptable. A fixed value for marginal discrepancy of fixed restoration is difficult to identify in the literature. American Dental Association (ADA) specification No. 8 has reported that the thickness of the luting cement used for cementation of a prosthesis should not be beyond 25µm for a Type I luting agent and 40µm for Type II luting agent. Christenson was in consensus with the ADA specification(Christensen, 1971). Fransson et al(Fransson, Øilo and Gjeitanger, 1985) and Mc Lean and Fraunhofer et al(McLean and Von, 1971) reported that the clinically acceptable marginal gap should be less than 150µm and 120µm respectively. Mc Lean reported in his study that marginal discrepancy of less than 120µm is clinically acceptable(McLean and Von, 1971). Additionally, McLean and von Fraunhofer examined the marginal fit of 1000 fixed restorations over a period of 5 years and deduced that a marginal gap less than 80 µm is difficult to detect under clinical conditions.

In this study, it is observed that the prevalence of score zero was maximum in undergraduate students (64.2%) as compared to postgraduate students (55.6%). These results are in contrast to the normal thought process that the postgraduate students will show better results than the undergraduates. Certain authors have reported in their articles that the undergraduate students have shown equally good results as the postgraduate students(Mattheos *et al.*, 2009). One more possibility which cannot be neglected is that the postgraduate students analyse the results very critically, whereas the undergraduate students are not fully well versed analysing minor discrepancies. This can be the reason for the post graduate students having less prevalence of the score 0. The prevalence of the score 1 was seen more with the postgraduates (44.4%) than the undergraduates (31.6%). As mentioned earlier, due to critically analyzing the marginal fit, the prevalence of the score of 1 was higher than the undergraduates. The prevalence of the score of 2 was only seen in the undergraduate students (4.3%), however, it was only a handful of students. The correlation between the scores of USPHS criteria and qualification of the student showed both clinically and statistically significant differences.

Although, this study showed that the prevalence of score 0 was the most, it has certain limitations. Firstly, even after specific guidelines, scoring is subjective from individual to individual. There might be a difference in the thought process between the undergraduates and post graduates(Kannan and Venugopalan, 2018). Secondly, there is a chance of some minute errors clinically(Ajay *et al.*, 2017). Our institution is passionate about high quality evidence based research and has excelled in various fields (Pc, Marimuthu and Devadoss, 2018; Ramesh *et al.*, 2018; Ezhilarasan, Apoorva and Ashok Vardhan, 2019; Ramadurai *et al.*, 2019; Sridharan *et al.*, 2019; Vijayashree Priyadharsini, 2019; Mathew *et al.*, 2020). We hope this study adds to this rich legacy.It should have been verified radiographically for proper validation. Thirdly, the kind of coping framework can create bias in the results. Hence, more studies need to be done under one operator with proper standardization protocols.

CONCLUSION

The present study concludes that most of the dental students had achieved a score of 0, which indicated very good results. The students should be motivated to improve their results. Seminars should be conducted for the students to teach them the importance of marginal accuracy and how to achieve it. More number of invivo studies needs to be done under one operator to avoid bias. Digital impressions can be taken to improve the marginal fit of the prosthesis. With the advancement in technology, it would be more prudent to use a micro CT or CBCT to evaluate the volumetric changes in the marginal gap.

CLINICAL SIGNIFICANCE

Marginal adaptation is one of the key factors determining the strength and longevity of the prosthesis. Inadequate marginal fit can be detrimental to the abutment tooth due to leaching of the luting agent, which can lead to endodontic and periodontal complications. Hence, it is of utmost importance, as clinicians to ensure accurate fit of the prosthesis.

ACKNOWLEDGEMENT

We would like to acknowledge Saveetha dental college and hospital for providing complete patient details required for the study purpose and their constant help and support for this research.

REFERENCES

1. Ajay, R. *et al*. (2017) 'Effect of surface modifications on the retention of cement-retained implant crowns under fatigue loads: An In vitro study', *Journal of Pharmacy And Bioallied Sciences*, p. 154. doi:10.4103/jpbs.jpbs_146_17.
2. Anbu, R.T. *et al.* (2019) 'Comparison of the Efficacy of Three Different Bone Regeneration Materials: An Animal Study', *European journal of dentistry*, 13(1), pp. 22–28.
3. Ariga, P. *et al.* (2018) 'Determination of Correlation of Width of Maxillary Anterior Teeth using Extraoral and Intraoral Factors in Indian Population: A Systematic Review', *World Journal of Dentistry*, pp. 68–75. doi:10.5005/jp-journals-10015-1509.
4. Ashok, V. *et al.* (2014) 'Lip Bumper Prosthesis for an Acromegaly Patient: A Clinical Report', *The Journal of Indian Prosthodontic Society*, pp. 279–282. doi:10.1007/s13191-013-0339-6.
5. Ashok, V. and Suvitha, S. (2016) 'Awareness of all ceramic restoration in rural population', *Research Journal of Pharmacy and Technology*, p. 1691. doi:10.5958/0974-360x.2016.00340.1.
6. Bader, J.D. *et al.* (1991) 'Effect of crown margins on periodontal conditions in regularly attending patients', *The Journal of Prosthetic Dentistry*, pp. 75–79. doi:10.1016/0022-3913(91)90053-y.
7. Basha, F.Y.S., Ganapathy, D. and Venugopalan, S. (2018) 'Oral Hygiene Status among Pregnant Women', *Research Journal of Pharmacy and Technology*, p. 3099. doi:10.5958/0974-360x.2018.00569.3.
8. Chen, F. *et al.* (2019) '6-shogaol, a active constiuents of ginger prevents UVB radiation mediated inflammation and oxidative stress through modulating NrF2 signaling in human epidermal keratinocytes (HaCaT cells)', *Journal of photochemistry and photobiology. B, Biology*, 197, p. 111518.
9. Christensen, G.J. (1971) 'Clinical and research advancements in cast-gold restorations', *The Journal of prosthetic dentistry*, 25(1), pp. 62–68.
10. Conrad, H.J., Seong, W.-J. and Pesun, I.J. (2007) 'Current ceramic materials and systems with clinical recommendations: a systematic review', *The Journal of prosthetic dentistry*, 98(5), pp. 389–404.
11. Devi, V.S. and Gnanavel, B.K. (2014) 'Properties of Concrete Manufactured Using Steel Slag', *Procedia Engineering*, 97, pp. 95–104.
12. Duraisamy, R. *et al.* (2019) 'Compatibility of Nonoriginal Abutments With Implants: Evaluation of Microgap at the Implant-Abutment Interface, With Original and Nonoriginal Abutments', *Implant dentistry*, 28(3), pp. 289–295.
13. Ezhilarasan, D., Apoorva, V.S. and Ashok Vardhan, N. (2019) 'Syzygium cumini extract induced reactive oxygen species-mediated apoptosis in human oral squamous carcinoma cells', *Journal of oral pathology & medicine: official publication of the International Association of Oral Pathologists and the American Academy of Oral Pathology*, 48(2), pp. 115–121.
14. Felton, D.A. *et al.* (1991) 'Effect of in vivo crown margin discrepancies on periodontal health', *The Journal of Prosthetic Dentistry*, pp. 357–364. doi:10.1016/0022-3913(91)90225-l.
15. Fransson, B., Øilo, G. and Gjeitanger, R. (1985) 'The fit of metal-ceramic crowns, a clinical study', *Dental Materials*, pp. 197–199. doi:10.1016/s0109-5641(85)80019-1.
16. Ganapathy, D. *et al.* (2016) 'Effect of Resin Bonded Luting Agents Influencing Marginal Discrepancy in All Ceramic Complete Veneer Crowns', *Journal of clinical and diagnostic research: JCDR*, 10(12), pp. ZC67–ZC70.
17. Ganapathy, D.M., Kannan, A. and Venugopalan, S. (2017) 'Effect of Coated Surfaces influencing Screw Loosening in Implants: A Systematic Review and Meta-analysis', *World Journal of Dentistry*, pp. 496–502. doi:10.5005/jp-journals-10015-1493.
18. Goodacre, C.J. *et al.* (2003) 'Clinical complications in fixed prosthodontics', *The Journal of prosthetic dentistry*, 90(1), pp. 31–41.
19. Jain, A., Ranganathan, H. and Ganapathy, D. (2017) 'Cervical and incisal marginal discrepancy in ceramic laminate veneering materials: A SEM analysis', *Contemporary Clinical Dentistry*, p. 272. doi:10.4103/ccd.ccd_156_17.
20. Johnson, J. *et al.* (2020) 'Computational identification of MiRNA-7110 from pulmonary arterial hypertension (PAH) ESTs: a new microRNA that links diabetes and PAH', *Hypertension research: official journal of the Japanese Society of Hypertension*, 43(4), pp. 360–362.
21. Jyothi, S. *et al.* (2017) 'Periodontal Health Status of Three Different Groups Wearing Temporary Partial Denture', *Research Journal of Pharmacy and Technology*, p. 4339. doi:10.5958/0974-360x.2017.00795.8.
22. Kannan, A. and Venugopalan, S. (2018) 'A systematic review on the effect of use of impregnated retraction cords on gingiva', *Research Journal of Pharmacy and Technology*, p. 2121. doi:10.5958/0974-360x.2018.00393.1.
23. Knoernschild, K.L. and Campbell, S.D. (2000) 'Periodontal tissue responses after insertion of artificial crowns and fixed partial dentures', *The Journal of Prosthetic Dentistry*, pp. 492–498. doi:10.1067/mpr.2000.110262.
24. Kumar, M.S. *et al.* (2006) 'Expression of matrix metalloproteinases (MMP-8 and -9) in chronic periodontitis patients with and without diabetes mellitus', *Journal of periodontology*, 77(11), pp. 1803–1808.
25. Mathew, M.G. *et al.* (2020) 'Evaluation of adhesion of Streptococcus mutans, plaque accumulation on zirconia and stainless steel crowns, and surrounding gingival inflammation in primary …', *Clinical oral investigations* [Preprint]. Available at: https://link.springer.com/article/10.1007/s00784-020-03204-9.
26. Mattheos, N. *et al.* (2009) 'Assessment of knowledge and competencies related to implant dentistry in undergraduate and postgraduate university education', *European journal of dental education: official journal of the Association for Dental Education in Europe*, 13 Suppl 1, pp. 56–65.
27. McLean, J.W. and Von, F. (1971) 'The estimation of cement film thickness by an in vivo technique', *British Dental Journal*, pp. 107–111. doi:10.1038/sj.bdj.4802708.
28. Nair, M., Jeevanandan, G. and Vignesh, R. (2018) 'Comparative evaluation of post-operative pain after pulpectomy with k-files, kedo-s files and mtwo files in deciduous molars-a randomized clinical trial', *Brazilian dental journal* [Preprint]. Available at: https://bds.ict.unesp.br/index.php/cob/article/view/1617.
29. Pc, J., Marimuthu, T. and Devadoss, P. (2018) 'Prevalence and measurement of anterior loop of the mandibular canal using CBCT: A cross sectional study', *Clinical implant dentistry and related research* [Preprint]. Available at: https://europepmc.org/article/med/29624863.
30. Peumans, M. *et al.* (2013) 'Four-year clinical evaluation of a self-adhesive luting agent for ceramic inlays', *Clinical Oral Investigations*, pp. 739–750. doi:10.1007/s00784-012-0762-9.
31. Ramadurai, N. *et al.* (2019) 'Effectiveness of 2% Articaine as an anesthetic agent in children: randomized controlled trial', *Clinical oral investigations*, 23(9), pp. 3543–3550.
32. Ramesh, A. *et al.* (2018) 'Comparative estimation of sulfiredoxin levels between chronic periodontitis and healthy patients - A case-control study', *Journal of periodontology*, 89(10), pp. 1241–1248.
33. Rao and Kumar (no date) 'Analgesic efficacy of paracetamol vs ketorolac after dental extractions', *Journal of advanced pharmaceutical*

technology & research [Preprint]. Available at: https://www.indianjournals.com/ijor.aspx?target=ijor:rjpt&volume=11&issue=8&article=026.
34. Rosenstiel, S.F., Land, M.F. and Fujimoto, J. (2006) *Contemporary Fixed Prosthodontics*. Elsevier Health Sciences.
35. Sekar, D. *et al.* (2019) 'Methylation-dependent circulating microRNA 510 in preeclampsia patients', *Hypertension research: official journal of the Japanese Society of Hypertension*, 42(10), pp. 1647–1648.
36. Selvan, S.R. and Ganapathy, D. (2016) 'Efficacy of fifth generation cephalosporins against methicillin-resistant Staphylococcus aureus-A review', *Research Journal of Pharmacy and Technology*, p. 1815. doi:10.5958/0974-360x.2016.00369.3.
37. Sivamurthy, G. and Sundari, S. (2016) 'Stress distribution patterns at mini-implant site during retraction and intrusion—a three-dimensional finite element study', *Progress in orthodontics*, 17(1), pp. 1–11.
38. Sridharan, G. *et al.* (2019) 'Evaluation of salivary metabolomics in oral leukoplakia and oral squamous cell carcinoma', *Journal of oral pathology & medicine: official publication of the International Association of Oral Pathologists and the American Academy of Oral Pathology*, 48(4), pp. 299–306.
39. Subasree, S., Murthykumar, K. and Dhanraj (2016) 'Effect of Aloe Vera in Oral Health-A Review', *Research Journal of Pharmacy and Technology*, p. 609. doi:10.5958/0974-360x.2016.00116.5.
40. Tuntiprawon, M. and Wilson, P.R. (1995) 'The effect of cement thickness on the fracture strength of all-ceramic crowns', *Australian Dental Journal*, pp. 17–21. doi:10.1111/j.1834-7819.1995.tb05607.x.
41. Varghese, S.S. *et al.* (2015) 'Estimation of salivary tumor necrosis factor-alpha in chronic and aggressive periodontitis patients', *Contemporary clinical dentistry*, 6(Suppl 1), pp. S152–6.
42. Venugopalan, S. *et al.* (2014) 'Magnetically retained silicone facial prosthesis', *Nigerian journal of clinical practice*, 17(2), pp. 260–264.
43. Vijayalakshmi, B. and Ganapathy, D. (2016) 'Medical management of cellulitis', *Research Journal of Pharmacy and Technology*, p. 2067. doi:10.5958/0974-360x.2016.00422.4.
44. Vijayashree Priyadharsini, J. (2019) 'In silico validation of the non-antibiotic drugs acetaminophen and ibuprofen as antibacterial agents against red complex pathogens', *Journal of periodontology*, 90(12), pp. 1441–1448.

GRAPHS AND LEGENDS

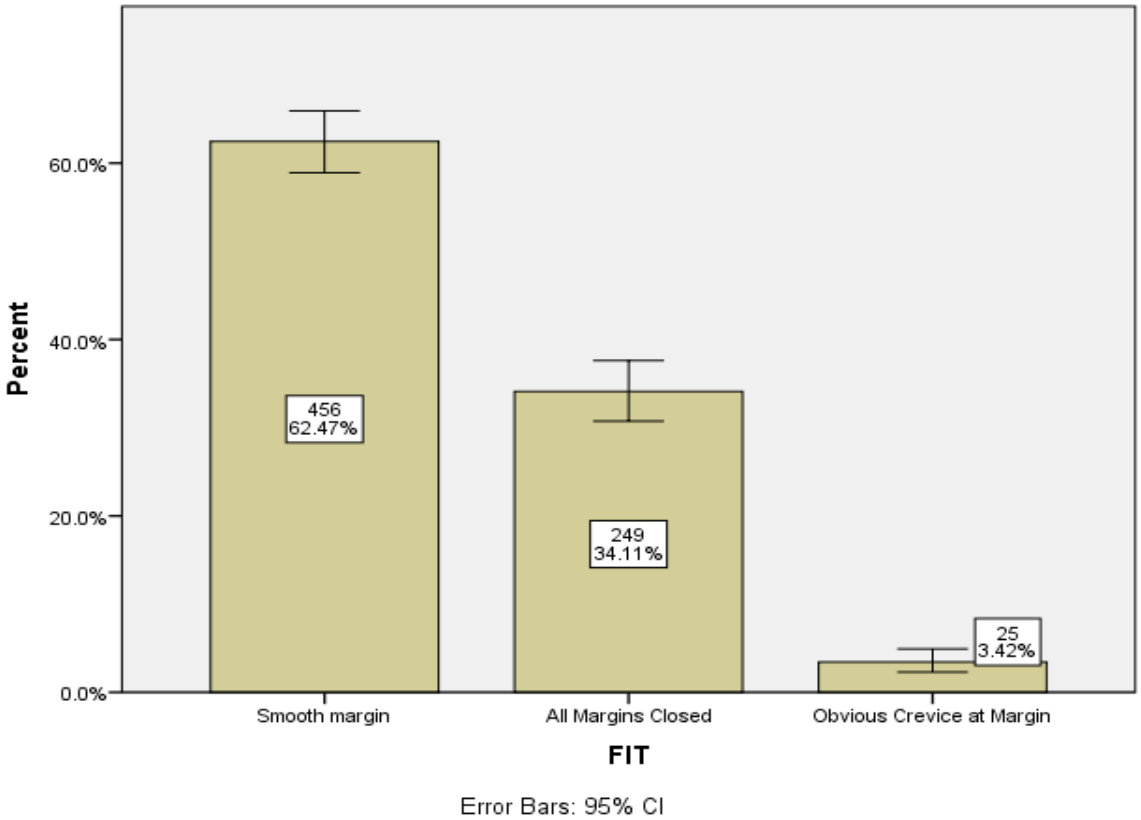

Figure 1: *Bar graph depicting the prevalence of USPHS scores for marginal adaptation. The X- axis represents the various scores for marginal fit according to the USPHS guidelines and Y- axis represents the percentage of cases. The most prevalent of the scores was score 0 (62.5%), followed by score 1 (34.1%) and the least prevalent score was score 2 (3.4%).*

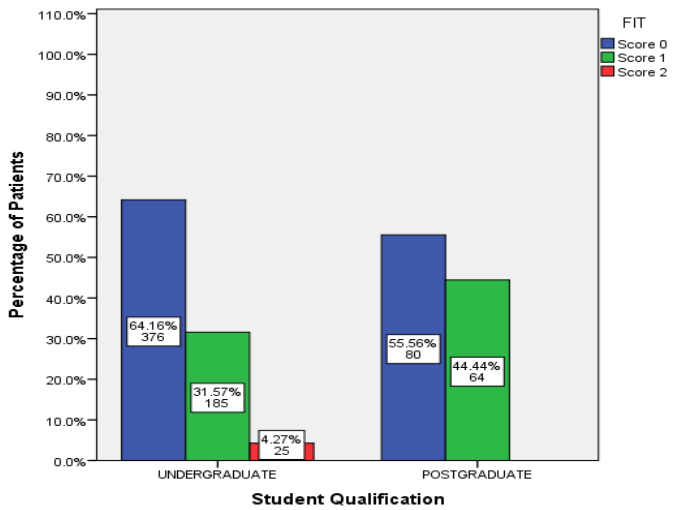

Figure 2: *Bar graph representing the association between scores for marginal adaptation according to the USPHS guidelines and student qualification . X-axis represents the student qualification and Y-axis represents the percentage of patients having the scores with Score 0 (Blue), Score 1 (Green) and Score 2 (Red). There is a statistical significant association between marginal adaptation scores and student qualification [Chi square value- 13.132, p value- 0.001 [p<0.05]. Undergraduates gave a higher marginal adaptation score of 0 as compared to the postgraduates.*

TABLES AND LEGENDS

Table 1: *Table depicting the frequencies of the scores of marginal fit according to the USPHS guidelines. The most prevalent of the scores was score 0 (62.5%), followed by score 1 (34.1%) and the least prevalent score was score 2 (3.4%).*

Groups	Frequency	Percentage
Score 0	456	62.5%
Score 1	249	34.1%
Score 2	25	3.4%

Table 2: *Table depicting the association of the USPHS guidelines for marginal fit score and student qualification. There is a statistical significant association between marginal adaptation scores and student qualification [Chi square value- 13.132, p value- 0.001 [p<0.05]. Undergraduates gave a higher marginal adaptation score of 0 as compared to the postgraduates, whereas, postgraduates gave a higher marginal adaptation score of 1 as compared to the undergraduates.*

			Score 0	Score 1	Score 2	Chi square value	p value
Student Qualification	Undergraduate	Count % within the group	376 (64.2%)	185 (31.6%)	25 (4.3%)	13.132	0.001
	Post graduate	Count % within the group	80 (55.6%)	64 (44.4%)	0 (0.0%)		