

Comparative Evaluation of Stability and Gingival Health with three different types of Retainers: A Prospective Study

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ABSTRACT

Aim: Purpose of this study is to evaluate the Comparative evaluation of Stability and Gingival Health with three different types of retainers.

Materials & Methods: Sample size involved 90 participants, who have undergone fixed orthodontic treatment. (Age between 12-25 years). Participants were assessed at an interval of 3 months. T0 indicate stability and gingival health just after debonding, T1-3 months after debonding and T2 -6 months after debonding. Participants were randomly allotted with removable Hawley's (Group1), fixed (Group 2) and vacuum formed retainer (Group 3). Brushing technique were explained to the patient and were asked to brush twice a day. Plaque index, Gingival Index, Oral Hygiene Index and Irregularity Index were measured using caliper and curved probe at To, T1 and T2. Data was analyzed using SPSS software version 20 and p value<-0.05 was taken to be statistically significant.

Results: This prospective study indicates that there is significant difference in plaque index, gingival index, Oral hygiene index level and Irregularity Index at T2 with respect to T1, T0. Plaque index, oral hygiene index and gingival index is higher in group 2 patients (Fixed retainer) (p=0.003 and 0.001) However, patients with fixed Retainers have low irregularity index than removable Hawley's and vacuum formed. (p=0.001)

Conclusion: Through this prospective study, it can be concluded that the plaque index, oral hygiene index and gingival index were significantly different between Hawley's, fixed and vacuum formed retainer. Fixed retainer showed increase in plaque deposition, calculus deposition and gingival inflammation as compared to other two retainers. Irregularity Index for three retainers showed that Hawley's retainer had higher probability of relapse as compared to vacuum formed retainer and Fixed retainers. Also, by the end of 6 months all the periodontal parameters and Irregularity Index showed an increase in the value.

Keywords: Vacuum formed retainer, Hawley's Retainer, Fixed Retainer, Plaque Index ,Gingival Index, Oral Hygiene index, irregularity index.

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INTRODUCTION

Prolonged and indeed an indefinite retention is routinely prescribed following an orthodontic treatment so as to mitigate post treatment changes especially malocclusions with rotated and/or imbricated incisors. It is profoundly related to an unstable positioning of teeth, physiological recovery and age related changes.¹ There are lack of high quality evidences concerning the relative effectiveness of fixed and removable retainers.² Also, their long term impact of fixed or removable retention on periodontal tissue has been the subject of little perspective analysis, compliance level with prolonged removable retention is also unclear.³ Hawley's removable retainer was introduced in Europe a hundred years ago and is still considered as the most prevalent appliance of removable retention.⁴ The Retainer helps in maintaining oral hygiene, and thus gingival and periodontal health. However, the stability of well aligned teeth is largely compromised due to its dependence on patient's discipline and compliance usage. The patient might find these retainers esthetically inconvenient due to its labial wire components which lead to the discovery of fixed lingual retainer.⁵ In 1973, Knierim introduced fixed retainer containing round wire which was later replaced by multi strand round wire. The proposed benefit of such a retainer was to allow physiological tooth movement while maintaining the tooth alignment⁶. Bonded lingual retainer can be left in place for years and are often referred to as "permanent" retainer. Fixed retainer has its own disadvantage which includes excess plaque and calculus deposition (due to roughness of multistrand wire) leading to gingivitis and periodontal breakdown, also placing such a retainer has always been technique sensitive and a time-consuming process.

With the advent of Essix or vacuum formed retainer (Sheridane and colleagues, 1993), an attempt was made to overcome the demerits of Hawley and Knierim's discovery. Essix being an aesthetic removable alternative proved to be more comfortable for the patient. In addition to this, it is comparatively feasible than the traditional bonded retainers and removable retainers. Patient compliance is acceptable with these retainers but its strength is an issue.

Few Randomized controlled trials were done to compare the effectiveness of fixed and vacuum formed retainers.^{7,8} Little difference in terms of their stability, with the mean mandibular anterior irregularity scores less than 2.0mm was examined. It is intuitive to expect that irregularity would increase over time, with important differences between these interventions conceivably only emerging over a more prolonged period.¹

Gingival health in patients using fixed retainers hinders its oral hygiene measure. However, it is not affirmative that the same leads to worsening of periodontal outcomes, particularly in its long run. Periodontal integrity during retention phase has been assessed through number of observational studies.^{9,10,11} The retrospective nature of these studies risks selection bias, and those with poor hygiene may not be considered suitable for fixed retainers. Consequently, prospective analysis with random allocation to retainer type is always preferable. Therefore, the present study was done to undertake a more comprehensive assessment, to evaluate the effects of different retainers in terms of Stability, Oral hygiene, gingival and periodontal health over a span of 6 months.

MATERIALS AND METHODS

Ninety Orthodontic patients, 12 to 25 years of age with optimal occlusion, No missing teeth in the lower anterior segment with irregularity index zero (after debonding) were included in this Prospective study. The participants with poor compliance towards orthodontic treatment were excluded from the study because it is a fact that the prognosis of stability of teeth with removable type of retainers after orthodontic treatment depends upon the patient compliance.

The teeth were thoroughly scaled, roots planed by the same clinician before the study. The appliance were deboned and an impression of the lower arch was taken using Alginate. The impression was then cast in hard type III gypsum stone. Orthodontic Stability was measured from the study models, using digital caliper (Irregularity Index). The lingual surfaces of the mandibular labial segment were obscured on the study models using prosthetic dental wax to ensure assessor blindness.

Participants were randomly allotted into three different groups with three different types of retainers i.e., Hawley's Retainer (Group 1), Fixed retainer (Group 2), Vacuum formed Retainer (Group 3). Periodontal Measurements were recorded for the labial and lingual surfaces of the mandibular canines, central and lateral incisors (oral hygiene index, Plaque index, Gingival index).



Indices were measured at an interval of three months, 1st was taken just after debonding and oral prophylaxis (T0), 3 months after Debonding (T1) and 6 months after debonding (T2) of retention appliance wear. Oral hygiene instructions and brushing technique were demonstrated. Patients was asked to brush twice day. A single examiner performed all the examinations in the study. The investigator was trained and the observations were recorded in the pre designed Performa.

To determine Plaque Index, the distal, lingual, buccal (labial) and mesial surfaces of mandibular six anterior teeth were scored from 0-3, according to the amount of plaque in each surface. The score of each tooth were summed up and divided by 4 to give PI for the tooth. The score of lower anterior teeth were averaged to give PI score for the lower anterior segment. Oral Hygiene Index (OHI) records the amount of debris or calculus on the buccal and lingual surfaces of teeth in anterior dental arch. The debris score was summed with calculus score. Lower anterior teeth (33, 32, 31, 41, 42 & 43) were examined with the help of explorer.

The Gingival Index as studied by Silness and Loe (1963) was recorded for six anterior teeth using periodontal probe. The labial and lingual surfaces of the lower anterior teeth were given a score from 0-3; those scores were averaged to give the GI for each tooth. The GI scores of the lower anterior teeth were summed and averaged to give GI score for the anterior segment



Measurement of irregularity index.

STATISTICAL ANALYSIS:

The data was recorded and subjected to statistical analysis. A master table was prepared to record the values at each interval and the total data was subdivided and distributed as individual tables and graphs. Statistical analysis was done using Statistical Package of Social Science (SPSS Version 20; Chicago Inc., USA). Data comparison was done by applying specific statistical tests to find out the statistical significance of the comparisons. Quantitative variables were compared using mean values and qualitative variables using proportions. Significance level was fixed at $P < 0.05$.

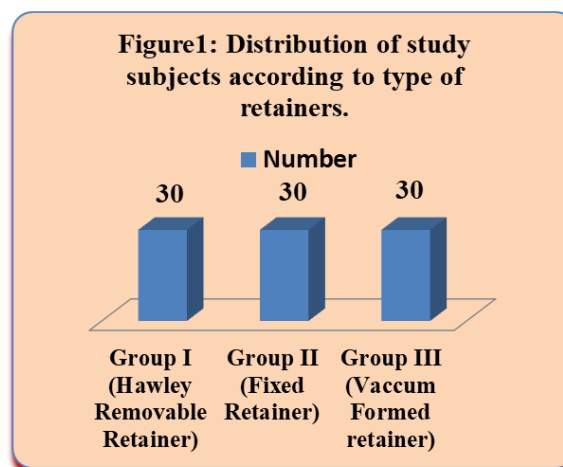


Fig 1: Distribution of study subjects according to type of retainers.

Analysis of variance test (ANOVA) was applied to find significant difference. One-way ANOVA was used to compare the mean dft/DMFT, OHI-S and their components between the groups. It tests the significance of difference between the means of more than two groups. It compares group means by

analyzing comparisons of variance estimates. Assumptions in one-way ANOVA are- subjects are sampled randomly, groups are independent, population variances are homogenous, population distribution is normal in shape and null hypothesis. Tukey's Post hoc analysis was applied for intergroup comparison.

RESULT

The mean plaque index score was found highest in group II patients i.e. among patients with fixed retainers (1.062 ± 0.362 and 1.994 ± 0.549 at 3 & 6 months respectively). ANOVA revealed statistically high significant difference between all three groups at 3 & 6 months with respect to plaque index ($p=0.003$ & 0.001). Tukey's Post hoc analysis showed statistically significant difference in plaque index between group I & II and group II & III but the difference found between group I & III was statistically insignificant.

Evaluation of mean Oral Hygiene index score among three retainers was 0.00 for all three groups just after debonding. After 3 and 6 months mean Oral Hygiene index score was found highest in group II patients i.e. among fixed retainer's patients (1.189 ± 0.529 and 2.340 ± 0.824 respectively). At 3 months, there was no statistically significant difference found between the groups ($p=0.093$), but there was statistically significant difference found at 6 months ($p=0.003$). Tukey's Post hoc analysis showed that there was statistically significant difference in Oral Hygiene index between group I & II and group II & III but there was statistically no significant difference found between group I & III at 6 month.

Just after debonding, gingival index score was highest (0.452 ± 0.131). After 3 and 6 months it remained highest in group II patients (1.241 ± 0.360 and 1.968 ± 0.472 respectively). There was statistically high significant difference found between three groups at just after deboning, 3 & 6 month ($p=0.001$). There was statistically significant difference in Gingival index between group I & II and group II & III but there was statistically no significant difference found between group I & III.

Mean Irregularity index score was 0.00 for all three groups just after debonding. It was found highest in group I patients i.e. among Hawley's retainer

wearers (1.640 ± 0.633 and 2.743 ± 0.941 at 3 and 6 months respectively) and lowest in group II patients i.e. fixed retainer patients. There was statistically highly significant difference between all three groups at 3 & 6 months ($p=0.001$). There was statistically significant difference in Irregularity Index between group I & II and group II & III but there was no statistically significant difference found between group I & III at 3 month interval.

DISCUSSION

Bonded lingual retainers are frequently used to retain the lower anterior teeth. These retainers are often fabricated from different types and gauges of wire and may be attached to all anterior teeth or only to the canines. The aims of this study were to compare the gingival health, plaque accumulation and tooth alignment with three different types of retainer been in use for at least 6 months. The underlying intentions were to determine if all the three retainers achieved what they were designed to do, i.e. retain alignment, determine if the gingival health was acceptable at recall or if early signs of periodontal breakdown were present. Based on the finding of the six month follow up, fixed retainer proved to be better in maintaining stability with respect to lower anterior segment. Fixed retainer when compared with Removable Hawley's and vacuum formed showed 1.0- and 0.7-times better stability.

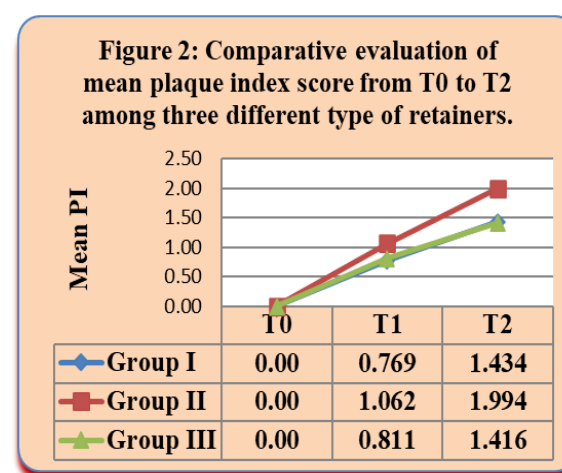


Fig 2: Comparative evaluation of mean plaque index score from T0 to T2 among three different type of retainers.

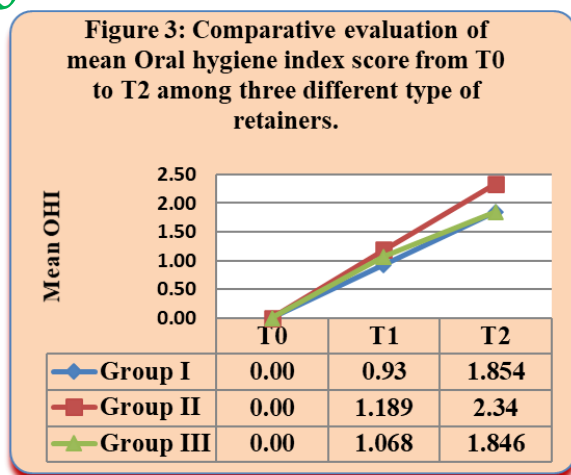


Fig 3: Comparative evaluation of mean Oral hygiene index score from T0 to T2 among three different type of retainers.

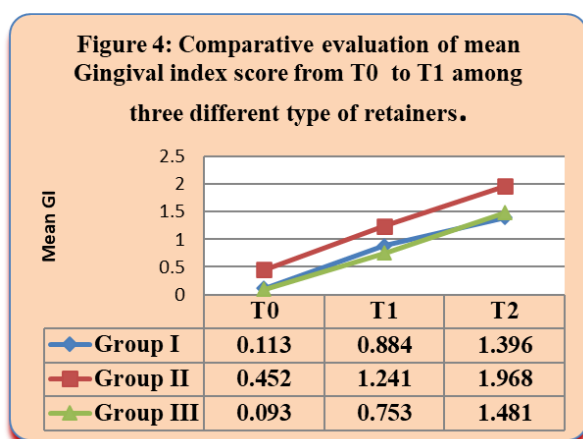


Fig 4: Comparative evaluation of mean Gingival index score from T0 to T1 among three different type of retainers.

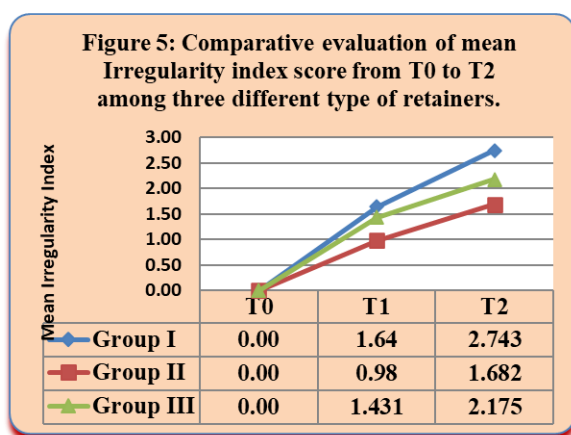
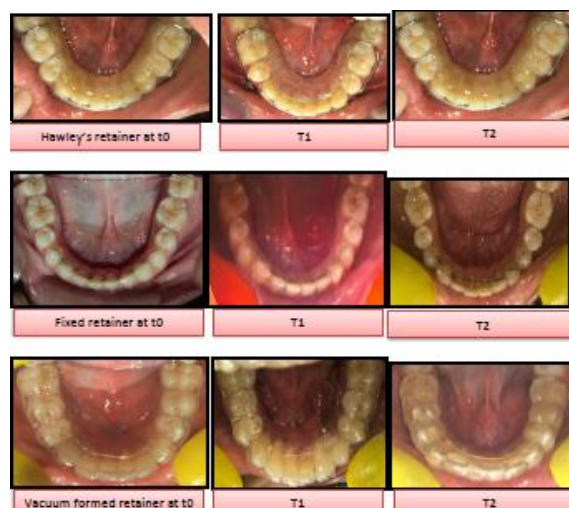


Fig 5: Comparative evaluation of mean Irregularity index score from T0 to T2 among three different type of retainers.



This comparative study confirms without any bias, that the fixed retainer offers the least score of irregularity index, also provide maximal stability in long run with respect to removable retainer. However, periodontal and gingival condition should not be considered excellent in either of three groups as there is elevated plaque level. Prevention of plaque accumulation even after active treatment is very important. Few previous studies have compared the effectiveness of fixed and vacuum formed retainer like Niamah O'Rauke compared the two retainer for eighteen months and concluded that in six months better stability is obtained using fixed retainer but alluded to a lack of significant between group differences in relation to mandibular anterior segment stability after 18 months.⁸ Xiao in his study compared lingual fixed retainer with Hawley's at night against Vacuum formed retainer for a full time wear in lower anterior teeth. Similar Stability of the mandibular anterior teeth was noted at the 1 year follow up. However this study risked attrition bias due to high level of dropouts with a small sample size. Only night time wear was advised to the subjects. There was greater relapse seen in mandibular arch as compared to the maxillary arch, at its twelve months of follow up ⁷.

Our study after a follow up of six month and a regular checkup at each three month irregularity index was examined using dental cast, concluded that fixed retention provide better stability of lower anterior teeth and prevent from its relapse as compared to both the type of removable retainers (vacuum formed and Hawley retainer) from the study it was seen that subjects with vacuum formed

retainer showed 0.052 and 0.001 for Hawley retainer, chances of relapse.

However, Rowland (2007)¹² did a clinical study for evaluating the effectiveness between Hawley and vacuum formed retainer. He concluded that significant changes in irregularity of the incisors was more in the Hawley's group than VFR group at 6 months, suggesting the vacuum formed retainer are more effective than Hawley's retainer. This study also specifies that result largely depends upon patient's compliance.

Compliance with Hawley and VFR during Orthodontic treatment is limited with patients routinely failing to reach stipulated levels of wear. The expectation that patient might wear removable retainers after treatment may be somewhat optimistic, particularly when much of this period is often not routinely monitored by clinician. Therefore, it appears that narrative means of increasing amenability with retainers, including various outlooks not directly rely on patient-clinician contact, require further crowning. It may include various electronic method or web series such as providing rich quality and easily reaching information promoting various methods which aid in positive behavior/attitude on social media platform.

Regular reminding patient regarding wear the retainers using email messages or whatsapp is helpful. V.F.R have gained popularity in recent years due to transparent thermoplastic sheet used in making only three RCT has involved periodontal and gingival assessment of patients wearing them.

In a twelve month follow up higher calculus index score were associated with fixed retainers compared with V.F.Rs. Although periodontal assessment in the later was confined to calculus score in isolation. Furthermore, patients in fixed retainer. Retainer group were instructed to wear removable retainers at night making it difficult to distinguish between two types of retainers.

Our comparative study used single retainer at a particular time, being fixed retainer, Hawley's retainer or vacuum formed retainer so that the effect of a particular retainer maybe examined without results being in a biased case.

90 participants of our study were randomly divided into three groups of thirty after ensuring that all the participants were likely to have periodontal and gingival conditions, including plaque index, gingival index and oral hygiene index were calculated and all were at suboptimal level.

Plaque index, gingival index and oral hygiene index were calculated and all were at suboptimal level. This has been continued in our randomized trial. We took special consideration, in distribution of retainers as randomization is likely to reduce the selection bias, also fixed retainers have ability to affect gingival condition.

Observer bias was reduced, for the assessment of irregularity in mandibular anterior teeth by masking the lingual surface of teeth however binding was not practical in assessing oral hygiene index, as it had to measure clinically.

Stability was assessed in the mandibular arch especially as its instability tends to be more salient in mandibular anterior region due to tooth treatment induced and physiologic changes and so noteworthy differences between the three groups may be apparent in lower arch be that as it may be associated for maxillary fixed retainer with better stability.

Note withstanding this, the failure rate for maxillary retainer tended to be slightly higher in the view of occlusal and masticatory forces, potentially diluting any associated advantage. Stability was assessed directly from study models using Little's irregularity index, this the most acceptable approach for assessing the alignment of lower anterior teeth, stability. However this approach is not useful for assessing the vertical movements, rotation and also inclination angulation changes.

Based on lay and professional opinions, however, horizontal displacement is consistently scored as the most salient features, and this is reflected in Little's score. We are also mindful of inadvertent complication such as localized changes in torque, which is particularly prone to arise with fixed retainer in long term. Although complications stated here were not seen in our study.

In relation to the assessment plaque, gingival and oral hygiene index, total evaluation and analysis of only two surfaces that is buccal and lingual surface

were included .This helped us to ensure that overall evaluation and clinical assessment of plaque accumulation adjacent to fixed lingual retainer surfaces would not be diluted.

Heier EE in 1997¹³, discussed about Hawley retainer's follow up to six month when gingival index scores were increased on buccal surfaces of maxillary and mandibular anterior teeth, minor changes were also observed with vacuum formed retainer in this study. The plaque scores in both groups were relatively high with median plaque index score of 3 to 3.5, approximately 0.5 units higher than the mean plaque scores for the lingual surfaces of the mandibular incisors fixed and Hawley retainers over a six month period.

RCT done by Storey M. (2017)¹⁴ involved comparison between fixed and vacuum formed retainers in the mandibular anterior segment with no significant difference in gingival and plaque indexes, however fixed retainers were associated with significantly higher plaque score.

Muslem Zadeh SH¹⁵ in 2018 compared of gingival health between Hawley and vacuum formed retainer and concluded that no significant difference were seen in gingival health.

A number of gingival outcomes were assessed in this study, potentially risking false-positive outcomes in view of various analysis ; however these were ill numerated and statistically significant findings were not observed .This multitude of outcome suggest that refinement of outcome in that periodontology and general dental research would be done timely.

This Prospective study had 90 participants that is less of a sample size and thus it is helpful in preventing from false-positive result bias. However significant findings were observed for the main outcome.

In our study, we didn't experience any dropouts between three groups of thirty each. Notwithstanding this , the challenge of recruiting and retaining a sufficiently large sample for an orthodontic retention. Future research evaluating the effectiveness of long term approaches to orthodontic retention should mindful of this issue.

Furthermore, this comparison study was conducted at one university based center; these findings are only applicable to patients who have undergone orthodontic treatment and after debonding have similar characteristics and these subjects may not be generalized to other patients group and settings. A baseline examination of plaque and gingival condition have helped us to a gain a clearer understanding of adverse changes during six month of the retention period ; however , patients with a history of periodontal disease were excluded at baseline .

The control group, which were not treated would have helped to make sure that periodontal change beyond that characteristics of maturation was associated with six month retention period. However, choosing of an age-matched , untreated control group with occlusal characteristic over a period of six month could not be justified for an ethical standard point , also attachment loss was small, indicating that the minimal effect could be seen on any of three retention regimen.

CONCLUSION

- 1) The present study indicates that fixed retainers provide better stability to the teeth after active orthodontic treatment, as compared to vacuum formed and Hawley's Retainer.
- 2) The Plaque index was found to increase after debonding up to 3 months, but fixed retainers showed maximum increase in the index.
- 3) Oral hygiene index, gingival index was also seen maximum with respect to fixed retainer followed by vacuum formed and Hawley retainer at 6 months.
- 4) Irregularity index was seen maximum with respect to Hawley suggesting that there are maximum chances of relapse when only Hawley's retainers are used followed by vacuum formed retainers and fixed retainers.
- 5) No significant difference was seen between Hawley and Vacuum formed Retainer in terms of Plaque index, Oral hygiene index, Gingival index and irregularity index.

The results of this study definitely advocate the use of fixed lingual retainers after the active orthodontic treatment for better stability of orthodontic ally moved teeth. These retainers do attract plaque but this can be taken care of with the use of proper oral hygiene measures and regular visits to the dental clinic for check-ups. Removable retainers on the other hand are dependent on patients' compliance and do not retain teeth in their desired positions when used independently.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

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