

# Comparative Evaluation of Variable Thicknesses of Vacuum-formed Retainers

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## Abstract

*Since the commencement of orthodontic specialty, it is a grueling and portentous task to maintain the orthodontically treated teeth in their corrected and desired position. Retention of what has been achieved is the goal and the most clamant phase of any orthodontic treatment as well as the orthodontist. To maintain the stomatognathic system's esthetics, function, and stability, orthodontic retainers play a vital role in precluding post-treatment tooth movement. The predetermination of retention goals is critical to that achieved while accomplishing the biomechanical objectives of dentoskeletal movements. The overall success of orthodontic treatment is contributed by the compliance of the patient, diurnal oral hygiene maintenance, durability and effectiveness of the appliance that has been worn, and routine follow-up visits and generalized oral health of the patient. As a trend of suggesting lifetime usage of retainers is important, imperceptible and visually beautiful vacuum-formed retainers have gained significant popularity. In this rising period of an individual being more confident, aesthetically pleasant appliances are a treatment of choice.*

**Keywords:** Orthodontics, retention, retainers, vacuum-formed retainers, thickness, Essix retainer

## INTRODUCTION

In Orthodontics, the treatment phase relies on the most integral part which is, retention and stability. Maintenance of what has been achieved by the end of the treatment is of the greatest importance to the orthodontist [1]. The patient's compliance, daily oral hygiene maintenance, longevity and efficiency of the appliance worn, routine follow-up appointments, and the patient's overall oral health all play a part in the ultimate success of orthodontic treatment [2]. When the appliances are removed, the patient may feel that treatment is complete, but still an important stage lies ahead of it, that's retention and stability

[3]. Retention after completion of orthodontic treatment is defined by Moyers as "the holding of teeth together, for the sufficient period of time, which is necessary to preserve the results that have been achieved at the end of the orthodontic treatment". Riedel defined it as "the holding of teeth maintaining its functional position and ideal aesthetics" [4]. Patients treated should be viewed as constantly changing and dynamic, especially through the third and fourth decades of life and maybe throughout life. The time needed for bone reconstruction and for the muscles and soft tissues to adapt around the dentition after orthodontic treatment to reach a stable state is longer as compared to the time needed for tooth alignment. Thus, use of retainers is critical to carry long-lasting and stable results. After the completion of orthodontic treatment, the time of retainer wear

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should be at least a minimum of 2 years, and for adults, it may be recommended to wear for their whole life [5]. Daily wear of retainers causes plaque accumulation, which is not favourable and causes deleterious effects on periodontal health which cannot be ignored.

In recent years, vacuum-formed retainers (VFRs) have been greatly favoured by orthodontists as well as patients. VFRs are removable, thermoplastic clear retainers. Ponitz first described their use in 1971 for the purpose of orthodontic retention. A vacuum machine adapts the heat-softened plastic creating a negative pressure and vacuum, which pulls the plastic onto a working study cast. The two most commonly used materials for the fabrication of VFRs are polyethylene polymers and polypropylene polymers [6]. Their demand is increasing precipitously because of their simple production, low cost of manufacturing, and good aesthetics. With the main advantage of being aesthetic, vacuum-formed retainers are durable also and attempts are made to further increase their durability and effectiveness by increasing the thickness of the thermoplastic sheets which are used to make these retainers. They are available in variable thicknesses, such as 0.75 mm, 1 mm, 1.5 mm, and 2 mm [7]. The VFRs are unnoticeable and usually no adjustments are required when fitted. In today's world, most of the people prefer VFRs over any other retainer.

Different thicknesses of VFRs differ in their effectiveness, durability, functional stability and compliance. An ideal thickness having all the properties, necessary to maintain overall health of the patient and the orthognathic system should be made as standard.

The findings of the present study are beneficial as:

- To the best of our knowledge, there are no published data available regarding the aggregate of VFRs thickness.
- This review provides information on the ideal VFRs thickness that is suitable in all respects for a person's overall health.
- Also provides information on the patient's and the appliance's compliance parameters.

### **VACUUM FORMED RETAINERS**

An invisible thermoplastic retainer introduced in 1971 by Ponitz to maintain the teeth in their corrected position has gained prevalence in recent times. It can be manufactured by two types of machines that are:

1. Pressure machines such as Biostar™, that drive the heat-softened plastic over the plaster end-mould with positive pressure, making them superior.
2. Vacuum machines, which use negative pressure to form the heat-softened plastic.

Two examples of the material types utilized in its production are Essix type 'A' co-polyester, which is allegedly more aesthetically pleasing but more prone to cracking and breaking, and Essix type 'C+' polypropylene or ethylene co-polymer, which is allegedly more durable but less retentive.

These retainers can be worn part-time or full-time, depending upon the stability required post-orthodontic treatment. The optimal design, effectiveness, wear protocol, dental and periodontal effects, and their effect on the quality of life of the patient need to be assessed before using them as a retainer for stabilization of the achieved orthodontic results.

### **COMPARATIVE EVALUATION OF VARIABLE THICKNESSES OF VFR**

Aesthetics is a critical component of the dental field, particularly that of orthodontics. Excellent esthetic characteristics and formability have given a boon to the invisible thermoplastic retainers. In today's world, a VFR is one of the most commonly used retainers in orthodontic practice. Hichens et al. [8] concluded in their study that, using VFRs caused less embarrassment as compared to any other retainer, to the patients in terms of appearance and speech. A similar result was declared by Pratt et al. [9] of VFRs being more compliant as compared to Hawley retainer after the debonding of the fixed

appliances. This can be accredited to the transparent appearance of the thermoplastic VFRs. Lesser the thickness of VFR's more transparent will be the appearance. Hence, in terms of appearance, a 0.75–1 mm thickness is preferred over a thicker VFR.

VFRs have a major disadvantage in the longer term, which includes the occlusal wear of the appliance with its subsequent cracking. In a study by Sun J et al. [10], 0.75 mm-thick thermoplastic sheets were used for the manufacturing of retainers and it was found that they broke at the midline. However, in this study bruxism was not investigated. Bruxism could be the cause of breakage of the retainer because VFRs cover occlusal surfaces, and the stresses from functional and parafunctional activities can cause the breakage of these retainers. Maintaining the results of orthodontic treatment and keeping the teeth in the corrected position is a great challenge for orthodontists, for which survival of the retainers is a must, preventing their perforations and making them more durable and compliant. Aiming to evaluate this, Moslemzadeh et al. [11], compared the survival time of three types of retainers including Hawley, and two different thicknesses of VFR that is, 1 mm and 1.5 mm. By the end of treatment and 6 months after the use of retainers To evaluate the stability of the results achieved, the American Board of Orthodontics objective grading system (ABO-OGS) index was also used. The gingival index (GI) was also used to evaluate gingival health. By the end of the comparative study, it was seen that ABO-OGS and GI scores with the 1.5 mm VFR were found to be higher than those of the other two groups. However, when two different thicknesses of VFRs were compared with each other, in terms of perforations, then the thicker ones proved to be a retainer of choice.

VFRs are also seen to have an effect on reducing vertical settling. VFR acts as a bite raiser that increases the vertical dimension of the patient which, in turn, affects the temporomandibular joint (TMJ). During the retention period, some changes in the disc position and muscle tension have also been observed. To have a glance at it, Mohammed et al. [12] conducted a study to assess the disc position during the retention phase by the use of three different thicknesses of VRF (Essix retainer) that is, 1 mm, 1.5 mm, and 2 mm. Various techniques were employed for the imaging of the TMJ which included, cephalograms, arthroscopy, orthopantomograms, arthrography, and computed tomography (CT) scanning. It was observed at the end of the study that, the 1.5 mm and 2 mm thickness of the Essix retainer showed a comparatively greater anterior disc displacement with reduction as compared to the VFR of a thickness of 1 mm.

Meade [6] conducted a study among specialist orthodontists, to evaluate retention protocols and the use of VFRs in which, Vacuum-formed retainer sheets with a thickness of 1.0 mm and 0.75 mm were most commonly recommended by orthodontists. It was also observed that the VFR design prescribed by the majority was the full occlusal coverage having a thickness of 1.0 mm.

Until now, for the thickness of VFRs, no uniform standard has been established. Also, there is no published evidence to indicate whether the differences in the thicknesses influence the effectiveness of these thermoplastic retainers or not.

## CONCLUSION

Even though numerous studies have shown that clear retainers still offer many benefits, there are many things to consider before deciding on the best type and thickness of retainer.

Relapse risk reduction is an important factor, and most participants preferred 1 mm. In terms of aesthetics, VFRs with a thickness of 0.7 mm and 1 mm were chosen over those with 1.5 mm and 2 mm. A thickness of 1 mm was recommended to have the least negative impact on the TMJ. Every orthodontist and patient want their retainers to last as long as possible, and 1 mm demonstrated a longer survival duration than 0.7 mm. When gingival and periodontal health was assessed, thicker retainers—those measuring 1.5 and 2 mm—showed greater plaque accumulation than those measuring 0.7 and 1 mm. To assess the superiority in effectiveness of various thicknesses, more research is still needed.

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According to a comparative analysis of the data presented above, we can conclude that a thickness of 1 mm is optimal for the fabrication of VFR in terms of decreased relapse, superior aesthetics, improved survival and longevity, minimal effects on the temporomandibular joint, and maintenance of gingival and periodontal health.

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