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Cleaning Removable Orthodontic Appliances

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Abstract

Objective: Removable appliances are fabricated by different types of material like auto polymerizing acrylic resin, heat polymerizing acrylic resin, and light polymerizing acrylic resins. These materials have some built in characteristic that make them prone to bacterial aggregation and biofilm formation. Denture hygiene methods have been suggested to keep these appliances clean during the time of treatment, like toothbrushes, toothpaste, commercial mouthwash, denture cleansers and others. The primary aim of cleaning removable orthodontic appliances is to maintain oral hygiene, prevent plaque buildup, and protect the health of both the appliance and the teeth. **Material and Methods**: 45 samples were taken from different people wearing removable orthodontic appliances. Swabs were taken from the appliances before and after using the disinfectant for two weeks to determine its effect on the microorganisms present in the orthodontic appliance. This was done by passing these swabs in bacterial culture media and performing a bacterial count of the sample before and after the disinfection process. On this basis, a comparison was made, and the effect of the disinfectant materials was determined. **Results**: Mouthwash was the most effective agent against all types of bacteria, especially Klebsiella pneumonia and Escherichia Coli. Normal saline was the least effective, with minimal reduction rates against all types of bacteria. Water and salt (tap water) was moderately effective, with reasonable reduction rates against most types of bacteria. **Conclusion**: Mouthwash was the most effective disinfectant for cleaning removable orthodontic appliances, significantly reducing bacterial growth. Salted tap water offers moderate efficacy, while normal saline is the least effective.

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Introduction

Modern removable appliances generally use acrylic baseplates and stainless-steel wires [1-5]. The development by Adams of the modified arrowhead clasp (1950) the scope and efficiency of these appliances was greatly increased. Unfortunately, they often represented the only available method of treatment and, as a result, were commonly used to treat a wide range of malocclusions for which they were inadequate and unsuited [6,7]. In recent years fixed appliance techniques have been transformed, particularly with the introduction of preformed bands and components, direct bonding techniques, preadjusted brackets and, more recently, by the advent of preformed arch wires in stainless steel as well as nonferrous alloys. They often represented the only available method of treatment [8-12].

Removable appliances are, by definition, orthodontic appliances that can be inserted and removed by the patient [13-15]. They comprise several components. Removable appliances can also have a role in combination with fixed appliances and can be particularly useful in carrying out local, interceptive tooth movements in the mixed dentition [16-18]. They are effective space maintainers and are used almost universally as retention appliances after the completion of active tooth movements for cases treated with fixed appliances [19].

Removable appliances began to be used routinely in the 19th century, but these were relatively crude devices, constructed from vulcanite, with precious metal wires and sometimes depending for their action on the expansion of hickory wood pegs when soaked by saliva. Complex removable appliances, often relying upon the action of expansion screws, evolved in the early part of the 20th century [20].

In some areas of clinical activity, removable appliances have significant advantages over fixed appliances. A well-constructed maxillary removable appliance can be highly conservative of anchorage [6,9]. Intraoral anchorage is not only provided by the teeth themselves but also supplemented by the contact of the acrylic baseplate with the palatal vault. This is particularly useful where it is necessary to achieve occlusal movement of misplaced or impacted teeth, for example in

the correction of unerupted incisors and canines. Traction can be applied to these teeth to bring them down to the occlusal level using the palate as anchorage [16,19].
A fixed appliance is, by contrast, much more likely to intrude and tip the adjacent teeth. Inexperienced practitioners often assume that removable appliances demand little skill and that their design can safely be left to the laboratory. Considerable skill is required. If an appliance is to be exploited to its full potential it must be thoughtfully designed, well-constructed and carefully supervised. The general practitioner can, with suitable training [21,22].

Material and Methods

Study design

A total of 45 patients attended the Department of Orthodontics at the College of Dentistry, Tikrit University. Their ages ranged from 6 to 15 years, and all were in good general health.
These patients were divided into three groups, each consisting of 15 participants, based on the disinfectant used for cleaning their removable orthodontic appliances:

- Group 1: Used normal saline for cleaning.
- Group 2: Used tap water with salt for cleaning.
- Group 3: Used mouthwash for cleaning.

Sample Collection and Microbiological Analysis

Samples were collected from the surface of each appliance using sterile swabs ,Forst sample took when the patient come to clinic and wear the appliance for the first time and final sample took after 2 weeks after 12h immerse in disinfectant solution, these samples were then cultured on Blood Agar and MacConkey Agar media and incubated aerobically at 37°C for 24 hours for microscopic examination [23].
For samples that could not be accurately diagnosed through traditional culture methods, the VITEK system was used. This system allows for rapid identification of bacterial and fungal species within hours, compared to conventional methods that take 24–48 hours or more [24].

Bacterial Counting and Analysis

After identifying the bacterial species, a serial dilution method was performed to estimate the number of viable bacteria before and after disinfection. The dilution process included 10 dilution tubes, with the initial stock sample being discarded [25].

- The first dilutions showed dense bacterial growth, which gradually decreased as the dilution progressed.
- The samples were then plated on Plate Count Agar medium and incubated at 37°C for 24 hours.
- Bacterial counting was conducted, focusing on samples where colonies ranged between 30 and 300, as these were considered optimal for accurate counting [25].

Results

This study aimed to evaluate the effectiveness of different disinfectants in reducing bacterial colonies on removable orthodontic appliances. Three disinfectants were tested: mouthwash, normal saline, and tap water with salt, by measuring bacterial colony counts before and after disinfection.
Mouthwash
Klebsiella pneumonia. Effect: Highly effective, with a reduction rate of 100% in most samples (1, 6, 11, 14) and 67.2% in sample 3.
Escherichia Coli. Effect: Highly effective, with a reduction rate of 100% in samples (2, 13) and 48.51% in sample 10.
Streptococcus mutants. Effect: Highly effective, with a reduction rate of 100% in samples (8, 9, 12) and 69.23% in sample 4.
Staphylococcus aureus. Effect: Effective, with a reduction rate of 62.38% in sample 5.
Streptococcus sanguinis. Effect: Highly effective, with a reduction rate of 100% in sample 7 and 68.23% in sample 15.

Normal Saline

Klebsiella pneumonia. Effect: Weak, with reduction rates ranging from 7.14% (sample 21) to 14.67% (sample 30).
Escherichia Coli. Effect: Very weak, with reduction rates ranging from 1.03% (sample 19) to 3.11% (sample 27).
Streptococcus mutants. Effect: Weak, with reduction rates ranging from 1.05% (sample 23) to 16.53% (sample 28).
Staphylococcus aureus. Effect: Weak, with reduction rates ranging from 4.24% (sample 26) to 18.79% (sample 17).
Streptococcus sanguinis. Effect: Weak, with reduction rates ranging from 6.67% (sample 18) to 9.05% (sample 24).

Water and Salt (Tap Water)

Klebsiella pneumonia. Effect: Effective, with reduction rates ranging from 50% (sample 38) to 56.28% (sample 34).
Escherichia Coli. Effect: Effective, with reduction rates ranging from 19.63% (sample 36) to 50.96% (sample 40).
Streptococcus mutants. Effect: Effective, with reduction rates ranging from 39.16% (sample 42) to 53.93% (sample 35).
Staphylococcus aureus. Effect: Effective, with reduction rates ranging from 25.56% (sample 39) to 50.59% (sample 43).
Streptococcus sanguinis. Effect: Effective, with reduction rates ranging from 52.08% (sample 31) to 62.28% (sample 37).

Statistical Findings

The collected data were entered into the computer (MSOffice, Excel), after which it was subjected to statistical analysis using Statistical Package for Social Sciences Version 22.0 software (IBM, Armonk, NY, USA). We employed mean and standard deviation for descriptive statistics and a one-way ANOVA test for the comparison of bacterial count before and after applying the disinfectants. P-values less than 0.05 were considered statistically significant.
1. Mouthwash showed the highest efficiency, reducing bacterial colonies by an average of 88,800, which corresponds to an 83.83% reduction.
2. Tap water with salt demonstrated moderate effectiveness, reducing bacterial colonies by an average of 60,333, with a 48.40% reduction.
3. Normal saline had the least impact, reducing bacterial colonies by an average of 11,400, with only a 7.53% reduction.

Discussion

Orthodontic therapy makes it more difficult to maintain good oral hygiene [28], which enhances the accumulation of bacterial plaque. Gingival hyperplasia and bleeding on probing are common during orthodontic treatment [29].
Deep probing depth spurred on by gingival hyperplasia may provide a favorable habitat for periodontopathogenic anaerobic bacteria [30]. The frequency of biofilm formation and its problems have persisted despite several preventative measures used to reduce plaque formation on orthodontic appliances, particularly in youngsters and immune-compromised patients [31]. The present study was conducted to find out the effect of removable intraoral appliances on oral health status.
This study showed five different types of microorganisms appear in the 3 groups, after wearing the removable appliance, which are Klebsiella pneumonia, Escherichia Coli, Streptococcus mutants, Staphylococcus aureus and Streptococcus sanguinis [32], this in agreement with Scheie [33], because the duration of treatment in oral microflora. Any appliance or device placement in the oral cavity causes increased retention sites of plaque and microorganisms and will be affected the overall microflora [34].

Applying chlorohexdine mouthwash decreases the levels of S. mutans. This agrees with Anderson (1997) [34] found that the use of CHX oral rinse contributes to improving oral hygiene in patients with fixed orthodontic appliances. Numerous in vitro studies have demonstrated that 0.01% to 0.2% chlorhexidine glucoronate (CHX) has a potent bactericidal effect on single species and multispecies cultures containing Streptococcus mitis, Fusobacterium nucleatum, Porphrymonas gingivalis, and Aggregatibacter actinomycetemcomitans [35]. Chlorhexidine also decreases bacterial diversity [36] and vitality in saliva and on the tongue [37]. Chlorhexidine mouthwashes reduce plaque and gingivitis [38], and chlorhexidine may be used as an adjunct to manage periodontal disease in certain countries [39]. Veillonella, Actinomyces, Haemophilus, Rothia, and Neisseria are also inhibited by chlorhexidine [40]. Saltwater rinses can be helpful in stopping growth of bacteria in your mouth [41]. Saltwater rinses are effective at decreasing the dental plaque and oral microbial count, when used alongside routine plaque control [42].

Conclusions

Based on these findings, mouthwash is the most effective disinfectant for cleaning removable orthodontic appliances, significantly reducing bacterial growth. Tap water with salt provides a moderate alternative, while normal saline is the least effective. Regular disinfection using mouthwash is recommended to maintain oral hygiene and reduce microbial contamination on orthodontic appliances.

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