

Reconditioning of used metallic direct-bonding orthodontic brackets by using chemical solvents

Fadhil Y JASIM *

Amer A TAQA **

ABSTRACT

Thirteen different chemical solvents were used to remove the bonding adhesive from the metallic edgewise stainless steel direct-bonding orthodontic brackets. These solvents were Alcohol, Alcohol with (1) gm Ascorbic acid, Water with 1 gm Ascorbic acid, Acetic acid, Acetone, mixture of hydrochloric and sulfuric acid, Ammonium hydroxide, (40-50%) potassium hydroxide, trichloroacetic acid, Hydrogen peroxide (30%), Toluene, Pyridine. It was found that the Pyridine is the most powerful solvent that remove the adhesive material from the bracket base without damaging or weakening the delicate bracket base mesh.

Key Words: Orthodontic brackets, adhesive, reconditioning.

الخلاصة

هدف الدراسة هو إعادة استخدام الحاصرات التقويمية المستعملة بعد إزالة المادة اللاصقة بواسطة استعمال المذيبات الكيميائية. تم استعمال ثلاثة عشر مذيباً كيميائياً لإزالة المادة اللاصقة من الحاصرات التقويمية المعدنية. هذه المذيبات كانت الكحول، الكحول مع غرام واحد من حامض الأسكوربيك، الماء مع غرام واحد من حامض الأسكوربيك، حامض الخليك، اسيتون، خليط من حامض الهيدروكلوريك مع حامض الكبريتيك، هيدروكسيد الأمونيوم، (٤٠%) و (٥٠%) هيدروكسيد البوتاسيوم، حامض خلات الكلور الثلاثي، (٣٠%) بيروكسيد الهيدروجين، توليوين و بيريدين. أظهرت نتيجة البحث أن البيريدين هو أقوى مذيب يزيل المادة اللاصقة من قاعدة الحاصرة التقويمية بدون تلف أو تضعيف شبكة قاعدة الحاصرة الرقيقة.

* Fadhil Yasin JASIM; BDS, CES, DScO: Assistant Prof. Department of Pedodontics, Orthodontics, & Preventive Dentistry, College of Dentistry University of Mosul, Mosul, IRAQ.

** Amer Abdul-Rahman TAKA; BSc, MSc: Assistant Prof. Department of Basic Sciences, College of Dentistry, University of Mosul, Mosul, IRAQ.

INTRODUCTION

Few studies were submitted in the field of recycling of orthodontic brackets. In the late 1970's the thought about the concept of recycling began, and at that time doing recycling to orthodontic brackets was considered mediocre job and few practitioners were willing to do recycling procedures and even then only secret ⁽¹⁾.

Now a day recycling companies are mushrooming but even though recycling procedures are aqua and unknown, because they offer no information of their type of procedures that they use in recycling.

Many orthodontists now recondition and recycle orthodontic attachments, particularly brackets ⁽²⁾ to minimize the waste and the cost to the orthodontist and ultimately to the patient. From these studies we can conclude that recycling procedures has never been died or reported due to confidentiality in the manufacturing process adopted by concerned commercial companies. Also this could be due to the recent advance in this subject, which lead to the lack-related studies, and the lack of the relevant references.

Mascia and Chen ⁽²⁾, Wright and Powers ⁽³⁾, Hixson and associates ⁽⁴⁾, and McDea and Wallibrige ⁽⁵⁾ have been claimed that reconditioned brackets show a decrease in properties such as bond strength, a decrease that may interfere with orthodontic treatment. Other research, confined only to the metallurgical aspects of adhesive-charring procedures, has shown a decrease in corrosion resistance ⁽⁶⁾ and a weakening of the metal structure ⁽⁷⁾ which leads not only to less sturdy appliances, but to dermatitis and enamel staining ⁽⁸⁾.

The aim of the present study is to remove the adhesive from the bracket base completely by chemical solvent without damaging or weakening the delicate foil mesh or distortion the dimensions of bracket slot, and solvent did not used earlier.

MATERIALS AND METHOD

A total of (130) stainless steel brackets with (0°) angulation and (0°) torque edgewise brackets for maxillary incisors, (Dentaurum company) are used. Those brackets were examined to make sure that the adhesive is covering the mesh of the bracket base. The used adhesive was Concise 3M by Dentaurum.

Different chemical solvents, solutions, were used, and these were: alcohol (ethanol), alcohol with (1) gm ascorbic acid, water with (1) gm ascorbic acid, acetic acid (glycial), Acetone, mixture of hydrochloric and sulfuric acid with ratio (1:3), Ammonium hydroxide, (40-50%) potassium hydroxide, trichloroacetic acid (TCA), Hydrogen Peroxide (30%), Toluene and Pyridine.

The method for adhesive removal which was done by a batch of ten used bracket were reflux on mental with (150) ml for each of the above solvents for (48) hours, then each group was heated in an oven for an half hour, at (250) °C for sterilization the brackets.

The cleaned brackets were examined according to the method of reconditioning services of Ortho-Cycle Company. This decision was based on the visual examination of the brackets, both macroscopically (when the shine of the bracket was evaluated vs. the metal-gray appearance of the base) and microscopically (when the roughness of the pad was investigated)⁽⁹⁾ to see the amount of the adhesive removal within the mesh, and to compare different types of solvents uses in order to find the most efficient one.

RESULTS

Alcohol: It caused no effect on the adhesive or brackets and was no change at all on the adhesive layer. This response was similar to that of alcohol with (1) gm ascorbic acid, water with (1) gm ascorbic acid, Ammonium hydroxide, Toluene, hydrogen peroxide (30%).

Trichloroacetic acid: The adhesive appeared transparent in color and very brittle. The brackets became black in color.

Acetic acid: This acid causes corrosion to material of the brackets but the adhesive remained stable did not effect.

Acetone: There was thinning in the adhesive thickness and it became brittle.

Potassium hydroxide (40%): Removal of adhesive from the mesh of the brackets during their boiling period. Parts of the adhesive were seen hanging in the solution, and it became brittle.

Potassium hydroxide (50%): It was similar to 40% potassium hydroxide; adhesive became more brittle.

Mixture hydrochloric acid and sulfuric acid (1:3): Completely soluble the adhesive and bracket material. The solution changed to green color.

Pyridine: Cause a complete removal of the adhesive from the mesh of the bracket base during their boiling period. The solution of pyridine changed its color from clear to dark. The bracket base mesh appears clear, for naked eye.

DISCUSSION

Alcohol, ammonium hydroxide, toluene gave no response at all. Hydrogen peroxide give similar result to the above solvent although it is consider a strong oxidizing agent, this indicates that adhesive did not effect or react with oxidizing agent. So these solvents were not strong enough to produce any effect on the adhesive layer.

The used Ascorbic acid with alcohol and water gave similar results as alcohol alone in spite of ascorbic acid consider as a reducing agent, and that mean the adhesive can not react with reducing agent and still stable during boiling. Also Ammonium hydroxide as a base can not affect the adhesive composition.

Trichloroacetic acids, acetic acid, are solvents, which affect brackets properties, so these solvents were destructive to the bracket material more than the effect on the adhesive layer. Acetone solvent showed a response to adhesive, which made it thinner and brittle. Potassium hydroxide (40-50%) made the adhesive very brittle and soluble partially.

Mixture of sulfuric acid and hydrochloric acid dissolve the adhesive and bracket material together, because this mixture is very strong solvent and it can dissolve any material or alloy.

Pyridine, the adhesive could either be peeled away from the mesh of used bracket or the adhesive layer may be separated by itself. So this solvent was considered the most powerful one, its power was based on removing the organic parts of the orthodontic adhesive.

CONCLUSION

The major conclusions concerning those basic solvents effect on adhesive composition without affect on metallic bracket. Pyridine was found to be the strongest base, which dissolve completely the adhesive material.

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