

Removing hepatitis C virus from polytetrafluoroethylene-coated orthodontic archwires and other dental instruments

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إزالة فيروس التهاب الكبد سي من أدوات التعويضات السنية المغلفة بالتيفلون
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الخلاصة: تم اختبار كفاءة إزالة فيروس التهاب الكبد سي ببدل تدميره، من أدوات التعويضات السنية، ونعني بها الأسلاك القوسية المغلفة بالتيفلون والمبارد والقطع التعويضية المغلفة بالتيفلون (20 من كل منها) بعد غمسها بدم مصاب بعدوى فيروس التهاب الكبد سي لمدة 24 ساعة. ثم غسل نصفها تحت تيار من الماء الجاري لمدة عشرة ثوان، بينما أُجري تنظيف البقية بـذلكها بفرشاة أسنان تحت تيار من الماء الجاري لمدة عشرة ثوان أيضاً. واحتفظ بكل من هذه المواد في أطباق منفصلة تحتوي على الماء المقطر لمدة 24 ساعة. ثم استخدم التفاعل التسلسلي للبوليمراز للتسخن العكسي لتحري الكائنات الفيروسية. ثم كشفت الفيروسات باستخدام طريقة الهلامية مع مصباح إضاءة عرضاني. وكانت الأدوات والأسلاك المغلفة بالتيفلون والتي تم تنظيفها بالدلك هي وحدها الخالية من فيروس التهاب الكبد سي. وهذا ما يدل على أن تنظيف الأدوات السنية بالتيفلون يبطئ التصاق فيروس التهاب الكبد سي عند غسلها بشكل جيد وذلكها تحت المياه الجارية لمدة عشرة ثوان.

ABSTRACT The efficacy of removing, rather than destroying, hepatitis C virus (HCV) from polytetrafluoroethylene (PTFE)-coated orthodontic archwires was tested. PTFE-coated archwires, pieces of PTFE and endodontic files (20 each) were immersed in HCV-infected blood for 24 hours. Half were washed under running water for 10 seconds while the remainder were thoroughly scrubbed with a toothbrush under running water for 10 seconds. Items were kept in separate dishes of distilled water for 24 hours. Reverse transcription polymerase chain reaction was used for viral replication. Viruses were detected by the gel method using a transilluminator. Only scrubbed PTFE pieces and coated archwires were negative for HCV. This suggests that PTFE coating of dental instruments inhibited HCV adhesion when thoroughly scrubbed.

Elimination du virus de l'hépatite C des arcs orthodontiques et d'autres instruments dentaires avec revêtement de polytétrafluoroéthylène

RESUME L'efficacité de l'élimination du virus de l'hépatite C (VHC) des arcs orthodontiques avec revêtement de polytétrafluoroéthylène, plutôt que sa destruction, a été testée. Des arcs orthodontiques avec revêtement de polytétrafluoroéthylène, des morceaux de polytétrafluoroéthylène et des limes endodontiques (20 de chaque) ont été plongés dans du sang infecté par le VHC pendant 24 heures. La moitié de ceux-ci ont été lavés à l'eau courante pendant 10 secondes tandis que les autres ont été brossés méticuleusement avec une brosse à dent sous l'eau courante pendant 10 secondes. Ils ont été laissés séparément dans des récipients d'eau distillée pendant 24 heures. La réaction en chaîne par polymérase après transcription inverse a été utilisée pour la réplication virale. Les virus ont été détectés par la méthode du gel utilisant un transilluminateur. Seuls les morceaux de polytétrafluoroéthylène et les arcs avec revêtement de polytétrafluoroéthylène qui avaient été brossés étaient négatifs pour le VHC. Ceci indique que le revêtement de polytétrafluoroéthylène des instruments dentaires a inhibé l'adhésion du VHC lorsque ceux-ci ont été brossés méticuleusement.

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Introduction

A great deal of attention is given to the prevention of cross-infection in orthodontic offices. One reason for this is that orthodontists are vulnerable to many infectious diseases that may be bacterial, viral, mycotic or protozoan in origin. Proper infection control procedures and sterilization of dental instruments prevent cross-contamination with infectious pathogens among dentists, office staff, laboratory technicians and patients [1].

Sterilization, either physical or chemical, is the complete destruction of all living microorganisms [2]. Methods of sterilization include chemical [3], dry heat [4], glass beads [5] and autoclaves [6], gamma radiation [1] and ethylene oxide [1]. Each method has advantages and disadvantages but all methods are directed towards killing the microorganisms, especially the viruses, which are the most resistant type to destruction [7].

Hepatitis C virus (HCV) is a bloodborne viral disease caused by a retrovirus that accounts for most of the hepatitis cases previously referred to as non-A non-B hepatitis [8]. The virus can be transferred during contact with an infected person's blood through cuts or abrasions, using contaminated instruments or household utensils such as razors or toothbrushes [9].

Epidemiologically, Egyptians show higher levels of anti-HCV antibodies than people in other countries [10,11]. The prevalence among Egyptians is 19.2% compared with 1.03% of Saudis, 1.9% of Sudanese and 2.4% of Yemenis [12].

Infection with hepatitis C virus may be the most serious of the viral hepatitis infections because of its ability to produce chronic infections [13]. HCV infection can give rise to a broad spectrum of extra-hepatic manifestations affecting different

tissues, including oral diseases such as lichen planus and oral cancer [14,15]. HCV may be present in the saliva of 83% of hepatitis patients associated with sialoadenitis [16].

Polytetrafluoroethylene (PTFE), which is derivative of DuPont Teflon®, is a commercial synthetic resin that is often used when it is desirable to prevent the adhesion of film to a surface [17]. PTFE is used in orthodontics for coating archwires or ligature wires for aesthetic improvement but this leads to high friction between the archwire and the brackets [18].

The polymerase chain reaction (PCR) is an extremely sensitive technique that can amplify rare or single-copy gene sequences to high levels and can be used to detect HCV [19].

More recently, an intracellular reverse transcription (RT) step to generate complementary DNA from messenger RNA templates prior to PCR was introduced for intracellular detection of low copy RNA sequences. This technique has become known as the reverse transcription polymerase chain reaction, or RT-PCR [20].

This study investigated the effect of PTFE coating on the adherence of hepatitis C virus to orthodontic instruments when trying to remove the virus (rather than destroy it).

Methods

In our study, endodontic files (K-type No. 15, Kerr Dental, Karlsruhe, Germany), pieces of PTFE (Egyptian Co. for Chemicals and Pharmaceuticals, Cairo, Egypt) and PTFE-coated archwires (nitinol 16 × 16, Ortho Technology, Tampa, Florida, United States of America) were used; 20 pieces of each type. The PTFE pieces were smooth-surfaced cylindrical pieces, 10

cm long and 1 cm in diameter. Endodontic files (with serrations) were used because they resemble the tips of orthodontic pliers. PTFE-coated archwires were used as they are the only coated material available in the orthodontic field. The other pieces of PTFE were used to ensure that the results obtained were due to the PTFE and not to any other factor.

All samples were immersed for 24 hours in blood heavily infected with HCV (1 million/mL) obtained from the blood bank of the National Cancer Institute.

The samples were then divided into 2 equal groups. The first group was washed under running water for 10 seconds while the other group was thoroughly washed and scrubbed with a toothbrush under running water for 10 seconds.

All samples were immersed in distilled water for 24 hours (each piece in a separate dish), centrifuged and the deposits were treated as follows:

1. Reverse transcription polymerase chain reaction (Abi Prism, Applied Biosystems, Foster City, California, USA) for virus replication using a QIAamp kit (Qiagen GmbH, Hilden, Germany)
2. Thermocycling (UNO II, Biometra GmbH, Gottingen, Germany)
3. Detection of virus by the gel method using a transilluminator (TI 1, Biometra GmbH, Gottingen, Germany)

All technical procedures were carried out in the laboratory of the Department of Clinical Pathology, National Cancer Institute, Cairo, Egypt.

Results

The results of RT-PCR are expressed as positive, indicating presence of virus, or negative, if the virus was absent (Table 1).

Table 1 Effect of PTFE coating on adherence of hepatitis C virus using RT-PCR test

Instrument	Washing	Thorough washing
Endodontic files	Positive	Positive
PTFE pieces	Positive	Negative
PTFE-coated archwire	Positive	Negative

Positive = presence of virus; Negative = no virus detected.

All pieces washed under running water for 10 seconds were positive for HCV. Of the pieces washed thoroughly under running water and scrubbed with a toothbrush for 10 seconds, RT-PCR results were negative for PTFE-coated archwires and pieces of PTFE. Results for the endodontic files in both groups were positive.

Discussion

Prevention of cross-infection in orthodontic offices is of prime importance. Sterilization, either chemical or physical [1-3], is an effective method for destroying living microorganisms including bacteria, fungi and viruses. Hepatitis C virus cannot be destroyed by chemical sterilization [6]. Autoclaving is an effective method for virus destruction, but is not available in all rural or suburban areas. Infection with HCV through contaminated instruments is dangerous because of serious complications like liver cirrhosis and liver cancer [8, 9]. Antiviral drugs have little effect because of the speed with which the virus multiplies; by the time the symptoms appear, the virus is so numerous that drugs do not produce a noticeable improvement [21]. Dental and surgical instruments and

orthodontic pliers can transmit the virus if the proper rules of sterilization are neglected.

The aim of our study was to remove the virus from dental instruments rather than to kill it. PTFE is a synthetic resin that prevents surface adherence [16]. The reverse transcription polymerase chain reaction (RT-PCR) test is a developed method for HCV diagnosis [20].

Application of the RT-PCR test for all specimens revealed that thorough washing and scrubbing with a toothbrush for 10 seconds of PTFE pieces and PTFE-coated instruments was an effective method for prevention of virus adherence.

From a practical point of view for dealing with HCV, we suggest coating all dental and surgical instruments with PTFE to prevent adherence of HCV after

thorough washing for 10 seconds. The cost of PTFE coated archwires does not differ greatly from the cost of non-coated archwires, so their use is recommended to aid the removal of HCV from dental instruments. Further studies, however, must be carried out to determine if PTFE prevents or reduces adherence of other viruses, fungi and bacteria and the practicality of coating instruments used in traditional health settings.

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