Assessment of Bacterial Contamination of Orthodontic Arch wire

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ABSTRACT

Background: The microorganisms can impend the life of health care professional and particularly the dental practitioners. They can be transmitted by different ways like airborne and droplet transmission. The current study was carried out to identify whether the arch wires that received from the manufactures are free from microbial contamination and to determine the bacterial species attached to the arch wires.

Materials and Methods: This study involved eighty samples, consisted of two types of arch wires (nitinol and stainless-steel) from four companies (3M, G&H, Jiscop, OrthoTechnology). These wires inserted in a plane tube that contains 10 -ml of (Tris [tris(hydroxymethyl)aminomethane] and EDTA (ethylenediaminetetraacetic acid) tris-EDTA and brain heart infusion (BHI) broth. A 0.1 ml was withdrawn from the tube and spread on agar plates. The control groups consist of 16 plane tube (8 tubes with tris-EDTA and other 8 tubes with (BHI).

Results: Microbial sampling yielded growth from 5 of the 80 arch wires. The predominant bacteria that isolated were *Bacillus spp*. No growth was recovered from 75 of the samples **and from controls**. The bacteria were isolated by BHI reagent and no growth was observed by tris-EDTA reagent with statistically significant difference (P<0.05). The *Bacillus spp.* found only in the G&H and Jiscop companies, however, no statistically significant difference was found among them (P>0.05). With regard to the presence and distribution of bacteria according to the types of wires, the present results clarified that cases of contamination with *Bacillus spp.* were found in the nitinol arch wires with statistically significant difference (P<0.05).

Conclusions: The results of the current study revealed low count of bacterial contamination in the two types of companies (G&H and Jiscop). Not all materials that received from the manufactures are free from contamination and an effective sterilization regimen is needed to avoid cross-contamination.

Keywords: Arch wires, contamination, *Bacilli*. **(Received: 10/2/2018; Accepted: 4/3/2018)**

INTRODUCTION

Many people need orthodontic treatment to improve their quality of life and get beautiful and healthy smile, but placement of orthodontic appliances like brackets, tubes, bands, ligating materials and arch-wires reduce the ability to maintenance proper oral hygiene which enhances microbial adhesion and creates new retentive areas of plaque and debris accumulation, this predisposes to increase the microbial burden and subsequent gingival inflammation and white spot lesions [(1)].

Skin discontinuity with contaminated instruments or sharp edges of orthodontic appliance components lead to greater danger for the orthodontist and his staff for microbial transmission, as any cuts or abrasions will allow micro-organisms to pass in the body. The microorganisms can also spread by different ways such as the direct contact with a lesion, indirect contact through contaminated instruments or office equipment's', inhalation of aerosols induced by hand pieces and ultrasonic cl- exposed to direct contact with blood and oral fluids of all kinds of patients including those with infectious diseases patients during placement or removal of fixed appliances [(2)].

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eaner and while scrubbing of instruments. Orthodontists do not achieve oral surgery, but

Some orthodontic instruments that used frequently have hinges and cutting edges, and this makes disinfection prior to sterilization sensitive procedure. Instruments should be cleaned and dried prior to sterilization in order to minimize damage and corrosion when applies, and to increase lifecycle [(3)].

Transition of infectious diseases occur by improper disinfection of the dental environment and leads to a health hazard to both dental personnel, as well as the patients, and this can prove to be fatal for immune compromised patients. The control of cross infection and biosecurity are issues of great importance to dental practice and in recent years have attracted greater interest of health professionals due to the spread of infectious diseases such as AIDS and Hepatitis B. Various studies revealed that diseases of this kind have led to a general awareness of the risks of contamination and have changed the habits of professionals in dental clinics [(4,5)].

Nosocomial infections caused by multi-drug resistant Gram-positive organisms such as *staphylococcus aureus* (*S.aureus*) and *Enterococcal species are a growing problem in many health c*are institutions. Hands and instruments used by health care workers serve as vectors for the nosocomial transmission of microorganisms [(6)]**.** Microbial contamination of

the dental environment out of which some of the contaminated microorganisms such as *S. aureus* were epidemiologically important nosocomial pathogens [7].

The purpose of the present study were firstly, to assess whether as-received arch wires from manufacture are free from microbial contamination and secondly, to determine the bacterial types that attached to the orthodontic arch-wires.

MATERIALS AND METHODS

Eighty samples were included in this study consisted of two types of arch wires; (nitinol and stainless-steel) from four companies (3M, OrthoTechnology, Jiscop and G&H). The wires were cut into four pieces using a sterilized cutter (Ortho Technology, USA) then inserted into all sterile plane tubes that contain 10-ml of brain (BHI) and tris-EDTA buffer solution. The solutions were homogenized using vortex mixed (Griffin and George LTd. England) for one minute.

On the other hand, another 16 sterile plane tubes (8 tubes with brain heart infusion broth and 8 tubes with tris-EDTA buffer solution) without arch wires were considered as controls group.

A 0.1-ml was withdrawn from the plane tube and spread, using sterile microbiological spreader (Citotest, China), on agar plates. The specimens were cultured on blood agar and Macconckey agar to quantify the total number of bacteria. The blood agar plates were incubated aerobically for 48 hours at 37 C^{o} and an aerobically using a gas pack supplied in an anaerobic jar for 48 hours at 37C^{o}. While Macconckey agar plates were incubated aerobically for 48 hours at 37 C^{o}.

After incubation, bacterial counts were recorded by colony counter. Isolated microorganisms were identified using gram stain, morphology and biochemical tests that include coagulate test and catalase test [8].

Statistical analyses

Data description, analysis and presentation were performed using Statistical Package for social Science (SPSS version 21). Statistical analyses can be classified into two categories: descriptive analysis for nominal variables and inferential analysis which include (Fisher Exact Probability test, Wilcoxon-sum rank test, and Kruskal wallis test).

RESULTS

The microbial growth was detected in 5 samples. No growth was recovered from 75 of the samples and no growth of microorganism was detected from tris-EDTA samples and controls of both tris EDTA and BHI reagent.

Gram-positive bacteria which include *Bacillus spp.* (which detected by colony morphology and by gram stain) were mostly isolated. The present results shown that all isolates of *Bacillus spp.* Were cultivated in BHI reagent with statistically significant differences (P<0.05) as indicated in table (1).

On the other hand, findings in table (2) showed that the isolated bacteria were distributed into 2 sampes from Jiscop and 3 samples from G&H companies with no statistically significant association F.E.P.T (Fisher Exact Probability test) =4.754, P-value=0.161.

Table (3) shows that, all the contaminations detected as *Bacillus spp.* were found in the nitinol wires with statistically significant association (F.E.P.T=5.275, P-value =0.022).

Table 1: Association between contaminations with *Bacillus spp*. among reagent

		Wires			F.E.P.T	df	P-value
		Tris-EDTA	BHI	Total			
With Contamination	No.	0	5	5	5.275	1	0.022 Sig.
	%	0	100	100			
Without Contamination	No.	40	35	75			
	%	52.70	47.30	100			

F.E.P.T=Fisher probability test, Sig. =Significant at P<0.05.

Table 2: Association between contaminations with *Bacillus spp.* among companies

		Company					F.E.P.T	df	P-value
		3M	Jiscop	G&H	Ortho Technology	Total			
With Contamination	No.	0	2	3	0	5	4.754	3	0.161 NS
	%	0	40	60	0	100			
Without Contamination	No.	20	18	17	20	75			
	%	26.66	24.00	22.68	26.66	100			

F.E.T=Fisher exact probability test, NS=Non-significant at P>0.05

Table 3: Association between contaminations with Bacillus *spp.* among wires

		Wires			F.E.P.T	df	P-value
		Stainless Steel	Nitinol	Total			
With Contamination	No.	0	5	5	5.275	1	0.022 Sig.
	%	0	100	100			
Without Contamination	No.	40	35	75			
	%	53.34	46.66	100			

F.E.P.T=Fisher probability test, Sig. =Significant at P<0.05.

DISCUSSION

In orthodontic treatment, the disease may be transposed through a direct interaction with contaminated instruments or materials, the use the material directly from manufacture packing or utilizing instruments without an appropriate sterilization or disinfection protocols [9].

Orthodontic arch wires used for alignment of teeth, come in contact with mucous membrane and sometime cause tear of mucosa; therefore, the orthodontic arch-wires consider a semi-critical instrument and must be sterilized before used [10,11].

The current result was consistent with previous studies that show the bacteria were existed on arch wires "as-received from the manufactures". However, this approves the outcome of previous studies on dental burs [12], endodontic files [13], orthodontic molar tubes [14] and orthodontic pliers [15].

In this study, the BHI was more efficient for detected bacteria that stick to the arch-wires than tris-EDTA buffer. This comes in agreement with result reported by Barker *et al.*, who showed that the detection of bacteria using tris-EDTA buffer was not effective compared to BHI. Similarly, Roth *et al.*, [13] used BHI for assessing the microbial contamination of as recived endodontic files.

Additionally, it was found that as received bracket dispersed in a test tube that contained BHI, showed a change in the color of BHI indicating bacterial growth [17].

In the current study, the bacteria isolated from arch wires were *Bacillus spp*. Similarly, Hauptman reported that bacterial growth was found in 8 of 100 non-sterilized burs after incubation [12]. The bacteria identified were from the genus Bacillus. Examination of "as received" endodontic files showed that 13% of the sample investigated (150) were contaminated with bacteria; after sequencing, the bacteria included *Paenibacillus amylolyticus*, *Paenibacillus polymyxa*, *Bacillus megaterium*, and *Staphylococcus epidermidis* [13].

The isolation of *Bacillus spp*. confirms the ubiquitous nature of the *Bacillus spp*. giving it greater colonization ability as well as the ability of its spores to resist environmental changes, with stand dry heat and certain chemical disinfectants for moderate periods. Some of *Bacillus spp*. such as *Bacillus cereus* is a normal flora of the water, vegetables, cereals and cooked food. It can cause food poisoning and opportunistic infections in immune compromised persons [18].

The *Bacillus spp.* can cause several disease ranging from ear infection, to meningitis, urinary tract infections to septicemia. They occur as secondary infections in immuno-deficient hosts or otherwise compromised hosts. They may aggravate previous infection by creating tissue-damaging toxins or metabolites that interfere with treatment. In addition to that, the microorganism may be transfer from one patient to another through inadequate sterilized instruments or touching contaminated hand or surfaces and this finding have been confirmed by several researchers [18, 19].

Clinical Consideration

From the result of this study, not all materials that received from the manufactures are free from contamination and needed an effective method for sterilization and disinfection to avoid cross-contamination among the patients. The arch-wires must be sterilized using a suitable method before clinical use. An effective procedure must be followed and the manufactures of these materials should increase the quality control of materials packing procedure. Clinician on the other hand, should use a suitable method of disinfection or sterilization.

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الخلاصة

الخلفية: الكائنات الحية الدقيقة يمكن أن تعيق حياة ذو المهن الصحية وخاصة ممارسين الأسنان. يمكن للكائنات الحية الدقيقة أن تنتقل بطرق مختلفة مثل الانتقال عن طريق الهواءوعن طريق قطرات السوائل، وبالتالي؛ يجب تعقيم أي مادة أو تطهيرها قبل استخدامها في تجويف الفم. قد أجريت الدراسة الحالية لتحديد ما إذا كانت أسلاك التقويم التي تم الحصول عليها مباشرة من المصنع خالية من التلوث الميكروبي وتحديد العدد البكتيري وأنواع البكتيرياالملتصقة على أسلاك التقويم.

المواد والطرق: تضمنت هذه الدراسة ثمانين عينة، وتتكون من نوعين من أسلاك التقويم (النيتينول والفولاذالمقاوم للصدء) من اربع انواع من الشركات
(3M, G&H, Jiscop, OrthoTechnology) (tris-EDTA,BHIتم ادخال السلك في انابيب مختبرية تحتوي على 10 مل من
وبعد ذلك يتم سحب 0.1 مل من الانابيب ونشرها على الاجارالزراعي.عينات السيطرة تتألف من 16انبوب (8 انابيب tris-EDTA و 8 انابيب اخرى BHI).

النتائج: اسفرت نتائج العينات البكتيرية عن نموالبكتريا في 5 من80سلك تقويم.وكانت البكتريا السائدة التي تم عزلها هي العصوية. لا يوجد نمو في ال 75 سلك الباقية من العينات ولايوجد نمو ايضا في عينات السيطرة.البكتريا تم عزلها بواسطة الكاشف
مع اختلاف ذو دلاله tris-EDTAولم يتم ملاحظة اي نمو في كاشف (BHI).
(P>0.05.ولاتوجد في بقية الشركات ولا يوجد فرق ذو دلالة احصائية بينهم (Jiscop و G&H العصيات موجودة فقط في شركة P<0.05) احصائية بينهم (

وبخصوص وجود و انتشار البكتريا في الانواع المختلفة من الوايرات, بينت النتائج الحالية ان حالات التلوث بالبكترية العصويه موجوده في اسلاك التقويم من
مقارنه مع السلك القاوم للصدا.(P<0.05) نوع النيتينول مع فرق ذو دلاله احصهئية

الاستنتاجات: أظهرت نتائج الدراسة الحالية اوجود معدلات التلوث الجرثومي في نوعين من الشركات. ليس كل المواد التي تم الحصول عليها من التصنيع خالية من التلوث وتحتاج إلى طريقة فعالة للتعقيم والتطهير لتجنب انتشار العدوىبين المرضى وأسلاك التقويم واللازم يجب تعقيمها بالطريقة المناسبة قبل استخدامها..

كلمات البحث:اسلاك التقويم، التلوث، عصيات.