Release Of Nickel And Chromium Ions From Orthodontic Wires Following The Use Of Teeth Whitening Mouthwashes: An Original Research

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ABSTRACT Aim: Purpose of our research is to study the release of nickel as well as chromium ions from orthodontic wires in patients who are using teeth whitening mouthwashes.Methodology: In vitro, experimental study was carried out on 50 orthodontic wires of same length of SS, and NiTi. The samples were immersed in Oral B and Listerine (20 each) for 1, 6, 24, and 168 h. 10 samples immersed in distilled water served as the control group. Atomic absorption spectroscopy served to compute the number of released ions.Results: Nickel ions were released from both wires at all time-points; the highest amount was in Listerine and the lowest in Oral B mouthwashes. The process of release of chromium from the SS wire was the same as that of nickel. However, the release trend in NiTi wires was not uniform.Conclusion: Listerine caused the highest release of ions. Oral B showed the lowest amount of ion release.

Keywords Ions, Nickel, Chromium, Mouthwash, Wire

1. INTRODUCTION

Nickel (Ni)‑containing alloys has become an integral a part of almost every routine orthodontic intervention.[1] As contemporary orthodontics relies on various bonded attachments, arch wires, and other devices to realize tooth movement. the stress made on them are complex because they're placed under many stresses within the oral environment, which include immersion in saliva, ingested fluids, temperature fluctuations, and masticatory force. The orthodontic appliances, i.e., orthodontic bands, brackets, and arch wires were

introduced in 1930s. Since then the alloys became a useful material in orthodontics, which are manufactured from stainless-steel containing 8-12% Ni, 17-22% chromium, and various proportions of manganese, copper, titanium, and iron.[2] These are extremely durable and comparatively inexpensive. the mix of the alloys materials are in close proximity and in hostile conditions resulting in corrosion and adverse reaction biologically and increase the friction mechanically. When using nickel titanium (NiTi) arch wire for dental treatment, the possible danger related to arch wire corrosion derives from the biologically harmful effects thanks to the released Ni ion.[3-6] Therefore, NiTi arch wire with an honest corrosion resistance is crucial to its biocompatibility. On the opposite hand, the surface corrosion of NiTi arch wires may increase the friction that appears at the interface between the arch wire and bracket, reducing the free sliding action during treatment. The constant contact of those restorations with mucosa, saliva, periodontal tissues and bone highlights the importance of an in-depth analysis of their chemical and physical characteristics and biocompatibility assays for ensuring patient safety. Biocompatibility is said to corrosion in an exceedingly biological environment. the discharge of metal ions during corrosion might cause several possible consequences, including serious damage to patient's health, allergies, oral lesions and a salty or metallic taste.[7] Nickel is found in very low concentrations within the hu-man body. a rise within the concentration of this element is hazardous. According to statistics, around 1 in 10 people is allergic to Ni. Nickel exposure is related to variety of systemic disorders.[8] just in case of metal contact allergy, exposure to dental crowns could play a task.[9] Allergens can leach from an alloy and dissolve within the oral environment.[10] The corrosion of Ni–Cr alloys oc-curs by the preferential dissolution of Ni-rich grains.[8] Temperature and pH affect the corrosion resistance; however, Ni–Cr alloy is more liable to acid at-tack and ends up in decreased cell viability, increased oxidative and cellular toxicity levels, and enhanced cytokine inflammatory expression.[11,12] in step with several studies, the corrosion effect is increased by low pH conditions, resulting in a rise in leaching of Ni ions into the simulated oral environment.[13-15] Mercieca studied the corrosion resistance of cast cobalt– and Ni–Cr dental alloys in acidic saliva and concluded that Ni–Cr alloys are unstable in solution and leach Ni ions.[4] the utilization of mouthwashes containing fluoride, chloride or essential oils is occasionally recommended by prosthodontist as an adjunctive therapy to scale back the chance of caries and plaque formation and overcome periodontal conditions, like gingivitis.[16] However, only a limited number of studies have investigated the connection between mouthwashes and metal corrosion of Ni–Cr alloys. A previous study stated that orthodontists must take care when prescribing mouthwashes for orthodontic patients with orthodontic appliances.[17] Release of ions increases with increase within the pH.[18] it's been reported that the number of ions released from NiTi wires is beyond that released from SS wires.[19]

2. AIM OF THE STUDY

Purpose of our research is to study the release of nickel as well as chromium ions from orthodontic wires in patients who are using teeth whitening mouthwashes.

3. METHODOLOGY

In this in vitro, experimental study, release of nickel and chromium ions from a complex of one 0.016-in wire (NiTi or SS) immersed in different mouthwashes was evaluated. Two different mouthwashes (Listerine, Oral B) and distilled water as the control group were used in this study.

Group A- Distilled water as a control

Group B-Listerine mouthwash

Group C- Oral B mouthwash

A total of 50 wires were obtained (20 NiTi and 20 SS wires). The wires were cleaned using acetone, rinsed with distilled water, and dried. 10 wires were placed in control distilled water

as well. Wires were placed during a screw-top vial (10 mm volume). These sample wires were put into 10 ml of solutions. The samples were then incubated at 37 °C for 1, 6, and 12 h and 1 week. The wires were removed from the solution, and then, one drop of 65% nitric acid was added to stabilize the released ions. Calibration was done by measuring the number of nickel released using atomic absorption spectroscopy. Univariate ANOVA served to assess the effect of mouthwashes on release of nickel and chromium ions from the orthodontic wires.

4. RESULTS

The results showed a rise in release of nickel and chromium ions in both the mouthwashes and in the slightest degree time-points from both kinds of wires. New wires were used for various immersion periods in our study. the discharge of nickel ions from both styles of wires in the least time-- points was the very best in Listerine and also the lowest in Oral B. Also, the discharge of chromium from SS wires was just like that of nickel from NiTi with the difference that chromium release failed to follow a regular trend as in NiTi wires.

Our results showed the discharge of nickel and chromium ions from orthodontic wires in mouthwashes but not in H_2O. This release from SS wires was but that from NiTi wires. in any respect time-points, release of both ions in Listerine was the very best from both wires. (Table 1) Statistically significant result was observed that nickel (p=0.02) as well as chromium ions (p=0.0378) was leaching out when put inside Listerine mouthwash.

Table 1 – Release of Nickel and Chromium ions from various solutions

		Nickel ions (mean + SD)				**P value**	**Chromium ions** (mean + SD)				**P value**
		1 hr	**6hr**	**24 hr**	**168 hr**		**1 hr**	**6hr**	**24 hr**	**168 hr**	
Distilled water Group A	NiTi wire	10 ± 0	16 ± 2.8	20 ± 0	23.3 ± 2.8	1.34	16.6 ± 5.7	26.6 ± 5.7	31.6 ± 2.8	33.3 ± 2.8	2.37
	SS wire	10 ± 0	13.3 ± 2.8	21.6 ± 2.8	53.3 ± 2.8	0.95	20 ± 0	23.3 ± 2.8	33.3 ± 2.8	45 ± 5	0.811
Listerine Group B	NiTi wire	276 ± 20.8	576 ± 25.1	3180 ± 20	11,500 ± 500	0.02	33.3 ± 2.8	48.3 ± 2.8	51.6 ± 2.8	61.6 ± 2.8	0.0378
	SS wire	53.3 ± 2.8	61.6 ± 2.8	63.3 ± 2.8	83.3 ± 2.8	0.46	28.3 ± 2.8	33.3 ± 2.8	45 ± 5 6	1.6 ± 2.8	0.29
Oral B Group C	NiTi wire	26.6 ± 2.8	31.6 ± 2.8	81.6 ± 2.8	85 ± 5	0.07	28.3 ± 2.8	33.3 ± 2.8	40 ± 5	75 ± 5	0.124
	SS wire	11.6 ± 2.8	15 ± 0	21.6 ± 2.8	43.3 ± 2.8	0.091	16.6 ± 5.7	20 ± 0 23	23.3 ± 2.8	28.3 ± 2.8	0.083

**SD- Standard Deviation, NiTi- Nickel Titanium, SS- Stainless Steel*

5. DISCUSSION

Many authors have explored the corrosive effects in alloys used in dental prosthesis due to various environmental conditions. [20] It is imperative that usage of alloys in the prosthesis must not be affected by any chemical corrosion. [21] It has been described that normally also these alloys releases metals in the saliva. pH has an important co-relation between metal leaching and salivary environment. Nickel and Chromium have been shown to have a corrosive effect.[22] Mouthwashes have become popular for prevention of caries, periodontal diseases, decreasing malodour as well as maintenance of implants. [23,24] mouthwashes can initiate ions leaching out from these alloys which is utilized in prosthetic appliances used in orthodontics mainly.[25] In addition, metals like chromium and nickel can produce atom species from molecular oxygen, which successively produce superoxide and highly toxic hydroxyl group.[26] The generated free radicals also prevent antioxidant enzymes and consume the intracellular glutathione levels, thus intensifying the consequences of prooxidants.[27] the discharge of metal ions can cause DNA damage in human cells thanks to oxidative DNA damage (direct interaction) or interference with DNA replication (indirect interaction).[28-30] The mutative action of nickel may derive from its action on inhibiting several enzymes known to revive DNA breaks, promoting mutations, thereby contributing to genetic instability.[31] It seems that multidisciplinary approach toward the matter of the assessment of exposure of the human organism to trace elements may reveal different aspects related to the applying of metals in dentistry.[32] Although some studies within the past have shown that the amount of metals released from orthodontic appliances in saliva or serum was significantly below the common dietary intake and failed to reach toxic concentrations,30 those were short‐term studies conducted over few weeks to months. In our study, nickel release was noticeable from SS wires in Oral B at 24 h and 1 week, and in Listerine at 1 week. Chromium release was noted in Oral B in the slightest degree timepoints. the number of nickel released in Listerine the least bit time-points was near the brink, but the discharge of chromium wasn't concerning in our study. The results of our study showed that the discharge of ions from both wires in Oral B within the safe threshold, but the discharge of nickel from NiTi wires in Listerine was on top of this threshold probably thanks to the low pH of this solution. Thus, it seems that more attention must be paid when prescribing this rinse for patients with NiTi wires. thanks to differences in physiological conditions of the oral fissure and in vitro conditions, in vivo studies on this subject and use of artificial saliva are recommended to get more accurate results.

6. CONCLUSION

The Ni–Cr alloy is susceptible to corrosion when ex-posed to mouthwashes. According to the findings, the amount of ion release was within the safe limit. Based on our results, further randomized clinical trials are recommended to evaluate the exact effect of mouth-washes on ion release. Therefore, Listerine mouth-wash should be used cautiously in patients allergic to Ni.

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