

METAL ION RELEASE OF FAKE ORTHODONTIC BRACES

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Introduction

Fake orthodontic braces usage in South East Asia is a trend among teenagers for stylish accessories and seen as an alternatives for those who cannot afford a proper orthodontic treatment at dental clinic. The appliances are sold tremendously in online platforms and it is a concern to the oral health as these teenagers are unsupervised by dental specialists.

Fake braces usage posed risks to subjects since the source and composition of the materials are unknown. Not many study is available regarding the toxic effects of fake braces in human; either it is under reported or difficult to document cases related to fake braces since most wearers rarely disclosed it to friends or dental professionals.

SBF is commonly used as a standard medium to assess the bone-binding ability of an implants by examining its ability to form an apatite layer. The apatite layer can be produced on the implant surface when immersed in SBF, as its ion concentration is close to human blood plasma. Although blood is not in direct contact with fake braces on the teeth, it is possible that metal ion leaches into the blood vessels as a consequence of gingivitis due to the subject's poor oral hygiene or when consuming drinks with acidic pH.

Objective

To determine metal leachable from fake orthodontic braces immersed in simulated body fluid (SBF) using inductively coupled plasma atomic emission spectroscopy (ICP-OES)

Materials and methods

1) Three sets of fashion braces were bought online (Figure 1) from separated suppliers. The appliances were then disassembled where in each types of fake braces, there were four brackets and four archwires cut into 10mm each. Standard samples were represented by 0.018" stainless steel archwire (3M Unitek) and orthodontic metal bracket (mini MBT 022 Hook 345). Each samples were weighted.

2) SBF medium was prepared¹ at pH 7.4.

3) The samples were then immersed in SBF, according to the weight of the sample, incubated in an incubator shaker (IKA Ks 4000, USA) at temperature of 37°C with 50 rpm to mimic the body temperature and salivary flow. 3.0ml of SBF was taken out from the sample's containers at day 7, 14 and 28 and kept in -20°C freezer for further analysis.

4) The analysis of metal ion leaching was done using ICP-OES (Figure 2).

5) Final data were analyzed using SPSS version 26.0. Descriptive and ANOVA analysis were used to determine the significance difference of the amount of metal ions release in SBF, in comparison between fake braces and standard samples. All results were analyzed at a significance level of 5%.



Fig 1: Samples of fake orthodontic braces

Reagents	Amount
NaCl	8.035g
NaHCO ₃	0.355g
KCl	0.225g
K ₂ HPO ₄ ·2H ₂ O	0.231g
MgCl ₂ ·6H ₂ O	0.311g
1.0 _M HCl	39ml
CaCl ₂ ·2H ₂ O	0.292g
Na ₂ SO ₂	0.072g
Tris 1T	6.118g
1.0 _M HCl	39 ml

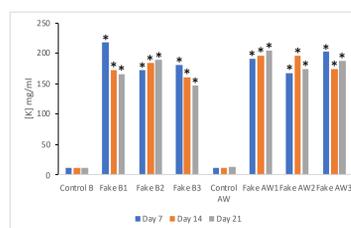
Table 1: Components of SBF

Concentration (mg/mL)	Ions detected
>100	Na*, Ca*, K*
10 - 100	Mg*, Pb*, Al*, P*
1-10	Ti, V, Cr, Fe, Co, Ni, Cu, Zn, Mo*, Cd, Sb, B*
<1	Ba, Li, Mn
Absent	Si

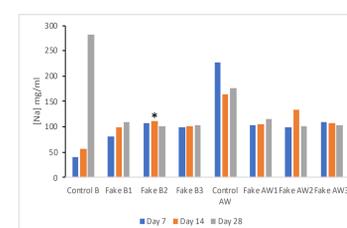
Table 2: Ions detected in fake orthodontic braces during immersion period (wire and bracket)

All transition metal elements and Li had ion released below 10mg/ml. The trend of these ion release showed increased concentration at day 7 and then become plateau until day 28.

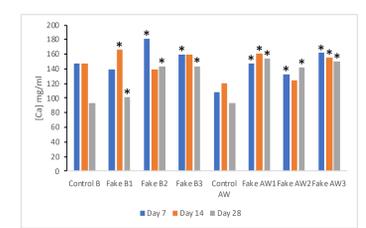
Result



Significant high concentration of K was found in fake braces with the highest level of 204.3 mg/ml at day 7 of immersion



Control brackets released high concentration of Na with 250mg/ml at day 28 and control wires released 154.05mg/ml of calcium at day 7 of immersion



There was significant differences between Ca release in control and fake braces during immersion periods

*ions with significant difference to control



Fig 2: ICP-OES (Optima 8000, Perkin Elmer, USA)

Discussion

- K ion has the benefit effects in promoting natriuresis and diuresis in the body but alarming increase of K ion release in fake braces may results in hyperkalemia. Patients at risk include those with chronic kidney disease, congestive heart failure or diabetes mellitus².
- The high increase of Na ion release in control sample may be related to manufacturing process³. It was noted as the limitation of this study in which more control samples from different manufacturer/brand should be included.
- Although some of the released ions reported to be small, minute changes with the ion concentration in the blood can impose serious illness.
- The best medium would be the saliva of patients wearing fake braces but it is unethical to recruit subjects to wear fake braces and it is difficult to find subjects who wear fake braces as it is an illegal act. Artificial saliva is the next best medium and the result is recorded in other publication.
- Only 3 samples of fake braces chosen for this study raised concern that the result should be appraised with caution; however the random selection from the online platform represent the purchase of fake braces by teenagers.

Conclusion

Fake orthodontic braces released more than 100mg/ml of Na, Ca and K ions during the immersion period; with Ca and K were significantly different from the control samples.

Other elements such as Li, Ba, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Mo, Cd and Sb had increased concentration at day 7 and the concentration become plateau until day 28.

Although Mg, B, Pb, Al and P ions recorded small level of ion release, the difference to control were significant. Si ion was absent in all sample during immersion period.

References

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- 3) Hafez HS, Selim EMN, Kamel Eid FH, Tawfik WA, Al-Ashkar EA, Mostafa YA. 2011. Cytotoxicity, genotoxicity, and metal release in patients with fixed orthodontic appliances: A longitudinal in-vivo study. *Am J Orthod Dentofac Orthop*.