Comparison of Metal Ions Release and Corrosion Potential from Different Bracket Archwire Combinations

(An in Vitro Study)

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Abstract

Ceramic brackets were received to solve the esthetic problems with fixed orthodontic appliances in addition the development of coated wires with polymeric materials. This comparative study was done to measure the amount of ions released and sites of corrosion when used monocrystalline ceramic brackets with different arch wires materials combination.

Eighty halves sets of upper fixed orthodontic appliances prepared, each set consist of (band, five brackets, half arch wire and ligature elastics), these sets divided into two main groups. Group A (monocrystalline brackets) divided into five subgroups each one with ten sets and with different arch wires. According to the group's number starting with stainless steel, nickel-titanium, thermally nickel-titanium, coated stainless steel, and coated nickel-titanium arch wires respectively. Group B (stainless steel brackets) divided in to three subgroups, each groups with ten sets and with different arch wires. According to the group's number starting with stainless steel, nickel-titanium, and thermally nickel-titanium arch wires respectively.

Each orthodontic sample was immersed in artificial saliva of pH= 6.7±0.10 at 37^{o}C for four periods of time (7 days, 14 days, 21 day and 28 days). At the end of each period, a specimen of artificial saliva was collected from each group for elementals analysis.

The measurement of the released Aluminum, Nickel, and Chromium into artificial saliva was done by using the flameless atomic absorption spectrophotometer, while Iron ions measured by spectrophotometer.

The distribution of the corroded areas was examined using optical microscope.

The Electrochemical behavior was performed by using a potentiostatic polarization technique in artificial saliva solution at 37°C and pH = 6.7.

The results of atomic absorption spectrophotometer and spectrophotometer with group A indicated that the release of ions take irregular pattern with time, and

both total Aluminum and Iron ions increased in groups with coated than uncoated arch wires, while Nickel and Chromium ions increased in groups with uncoated than coated arch wires. Also there were non-significant differences between all types of ions with groups of coated arch wires although with different composition. In group B indicated that the release of ions was increased with increased time and there were non-significant differences in the total Nickel, Chromium and Iron ions released in different groups even with different arch wires combination.

The results reveal that pitting, crevice, and intergranular corrosion were obvious in different parts of monocrystalline appliances, and more when used stainless steel than nickel titanium arch wires, but more corrosive coated nickel titanium than coated stainless steel arch wires, while more corrosive with nickel titanium and thermally nickel titanium than stainless steel arch wires when used stainless steel brackets.

The results of the potentiostatic technique indicate that the stainless steel arch wires with monocrystalline bracket enhances higher corrosion rate than nickel-titanium arch wires, while coated stainless steel enhances lower corrosion rate than coated nickel-titanium arch wires, but thermally nickel-titanium enhances highest corrosion rate than all the above. The use of stainless steel arch wires in combination with stainless steel brackets enhances less corrosion rate than both nickel titanium and thermally nickel-titanium arch wires.