Titanium brackets used in dentistry

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Abstract:

OBJECTIVE: To know the uses of titanium brackets in dentistry.

BACKGROUND:
Titanium alloys have been widely used for dental implants, endoprostheses, pacemakers, stents, orthodontal brackets, and eyeglass frames. Titanium has been considered to be the suitable material for use in both dental and prosthetic implants because of the advantage of titanium brackets are with improved alloys of increased hardness and corrosion resistance. Titanium brackets were fabricated by the sintering of pure titanium powder after injection moulding. In this review we can discuss various aspects of titanium brackets that are used in dentistry.

REASON:
The purpose of our study here was to know the different uses of titanium brackets in dentistry

Keywords: titanium, brackets, allergy.

Introduction:

The use of titanium (Ti) in medicine and dentistry has increased in the last three decades. Titanium alloys have been widely used for dental implants, endoprostheses, pacemakers, stents, orthodontal brackets, and eyeglass frames [1]. An oxide film is immediately formed on the surface of this highly reactive transition metal, and this has been claimed to result in good corrosion behaviour and high biocompatibility [2]. Therefore, Titanium has been considered to be the suitable material for use in both dental and prosthetic implants. Titanium brackets have been introduced to overcome the deficiencies and disadvantages of stainless steel brackets. The Ni and Cr elements in stainless steel brackets are known to induce allergy, toxic, or carcinogenic effects [3-7] . The use of titanium brackets is advantageous in the orthodontic treatment of patients with an allergy to nickel and other specific substances. Main advantage of titanium brackets are with improved alloys of increased hardness and corrosion resistance and Titanium (Ti) has been recently introduced as an alternative material for the production of metallic orthodontic brackets [8]. The reason underlying the choice of this metal resides in its proven biocompatibility, lack of allergenicity and increased corrosion resistance [9-11]. Moreover, there has been extensive evidence from a wide variety of long- term titanium biomedical applications, such as dental implants, arthroplasty components, and plates/screws used in orthopaedic and maxillofacial surgery [12]. In this review we can discuss various aspects of titanium brackets that are used in orthodontics.

Composition and types:

An alpha Ti alloy is commercially pure (CP) titanium alloyed with alpha-stabilising elements such as oxygen and nitrogen. This alloy exhibits high creep strength and improved weldability. Titanium brackets consists of pure titanium or a titanium alloy (Ti-6Al-4V) and are currently available in 2 types: one with Vickers hardness (HV) close to grade II commercially pure titanium and only the wing component is of Ti-6Al-4V alloy and another type made up of grade IV commercially pure titanium [13,14]. The chemical composition of titanium brackets is 99% Ti , 0.30% iron, 0.35% oxygen , 0.35% nitrogen , 0.05% carbon and 0.06% hydrogen.

Properties:

The surface structure and the color of titanium and steel brackets are very different. The surface of the rolled wings of titanium brackets is very rough, and the biocompatibility of titanium supports plaque adherence. These are the reasons for significantly more plaque accumulation and a more marked change of color with titanium brackets. The slots of titanium brackets are not as rough as the wings because the slots are milled and not rolled. The difference in hardness between the brackets tested might have significant effects on the wear phenomena when an arch wire is engaged into the preadjusted bracket slot. The hardness of titanium brackets has been found to be about 270 HV for the 1-piece bracket and from 160 to 350 HV for the base and wing of the 2-piece appliance, respectively— values much lower than those of nickel-titanium and steel arch wires. The clinical significance of this effect relates to the formation of obstacles in transferring torque because low hardness induces wear, which precludes full engagement of the wire to the slot walls and possibly causes plastic deformation of the wing. Also, the Ti-6Al-4V alloy with a friction coefficient of 0.28 might have different frictional variants from the commercially pure titanium with a coefficient of 0.34, whereas, from a corrosion perspective, brackets formed from 2 components might be more susceptible to galvanic corrosion [15-17].

Titanium brackets Vs other brackets in dentistry:

Most of the brackets used in orthodontic mechanotherapy are made of metallic materials because of their mechanical strength and because they can easily be formed into various designs. Recently, patients' allergic reactions to metallic intra-oral prostheses have become an issue of concern. In particular, several articles have been published referring to clinical cases of nickel and chromium allergy [18,19]. Orthodontic brackets containing these elements might cause allergic reaction due to contact with intra-oral soft tissue and/or metallic ion release. Hence, metallic brackets that would not be harmful in the intra-oral environment must be developed. On the other hand, for aesthetic reasons, which are usually of great importance to patients, non-metallic brackets made of plastics, ceramics, or new materials have been used. However, there are several drawbacks associated with these non-metallic brackets [20,21]. For example, plastic brackets might deteriorate due to water sorption and deform from applied torque force. Moreover, with ceramic brackets, the antagonistic teeth are subjected to attrition due to the high hardness of the ceramics [22]. Furthermore, the tooth surface is susceptible to damage when these brackets are removed. Brackets fabricated from any type of metal that possesses high biocompatibility and color capacity would offer a promising solution to the aforementioned drawbacks. Although many other metallic materials have been used in orthodontics, titanium possesses the highest degree of biocompatibility [23]. After in vitro sliding test with a beta titanium wire in two conventional brackets, there were significant increases in the five roughness parameters for only the conventional SS bracket. It seemed that although the beta titanium arch wire experienced higher frictional resistance in the ceramic brackets than in the SS and nickel–titanium brackets [24]. The ceramic brackets showed significant decrease in surface roughness because of their inherent hardness. It has been previously reported that ceramic brackets showed rather increased smoothness after metal wire sliding than titanium [25]. Finally, the self-ligating SS bracket experienced significantly increased values for Sa, Sq, and Sz after 2 years in an intraoral environment. Self-ligating ceramic brackets showed less significant changes in general roughness parameters of Sa, Sq, Sz than those of titanium one under these same conditions. It is known that ceramic brackets, which are the aesthetic alternative to plastic brackets, provide better hardness and stiffness despite their brittle nature than titanium [26]. In particular, self-ligating ceramic brackets are more comfortable and easier to clean because of the absence of a wire ligature [24]. The titanium brackets showed lower static and kinetic frictional force as the wire size increased, whereas stainless steel brackets showed higher static and kinetic frictional force as the wire size increased [27]. The titanium brackets transmitted higher loads on application of torsional forces in comparison to stainless steel brackets. The titanium brackets demonstrated superior dimensional stability compared to stainless steel brackets [28]. Compared to the 2002 Study, more practices used combination or titanium brackets, but fewer used plastic or gold brackets. Appliances with .022" slots gained even more popularity over those with .018" slots, while twin brackets remained an overwhelming choice over single brackets. Both standard-size and miniaturised brackets continued to decline in usage, with selfligating brackets again showing a notable increase. Nearly all brackets still had mesh bases, but micro etching and chemical enhancement were used less often than in 2002. Recycling stayed at about the same level as it was six years ago, used by fewer than 10% of the respondents.

Conclusion:

In the present study we can possibly conclude titanium brackets were fabricated by the sintering of pure titanium powder after injection molding. The fabricated brackets were subjected to enamel bonding as well as hardness tests so that they could be compared with the stainless steel bracket that served as a control. Thus has good biocompatibility and experiences less friction, which would aid in the effectiveness of arch-guided tooth movement. But Titanium brackets show higher plaque accumulation and more discolouration than steel brackets . And also the combined use of titanium brackets in combination with the use of acidic fluoride dentifrice and fluoridated foods is completely harmless for the bracket and does not give rise to corrosion [29].

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