A Force Distributing Dental Implant Assembly Using Metal Injection Molding Technology

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ABSTRACT

Dental implants of numerous designs have existed for many years including artificial teeth that are attached inside a patient's mouth to replace lost teeth and to restore natural dental function. Conventional dental implants have some disadvantages such as overloading during the patient's every day use and can become loose due to bone loss. In some extreme cases, the implant can break due to excessive loading. The new force distributing dental implant assembly consists of metal injection molded components made of metal such as Titanium and plastic injection molded components made of polymers such as PEEK, LLDPE, HDPE, UHMWPE, Silicone etc. The new dental implant assembly allows for resilient movement of the tooth-replacing device relative to the bone of the patient. This allows for transferring force from the bearing surface to the attachment surface via resilient material. As components for this new dental implant can be manufactured using metal & plastic injection molding technology the system cost can be economical.

As plastic injection molding technology is well known in the industry, this paper will discuss more about metal injection molding technology. Using metal injection molding technology, net shaped parts can be manufactured exhibiting design and economic benefit over wrought or cast components. A water based agar binder system for metal injection molding has been developed that offers the ability to produce parts which are competitive with those produced by investment casting. Other significant advantages of this system are a clean and rapid debind and the ability to mold into soft tooling. As a result, savings are achieved not only by eliminating machining and other processing steps but also by reduced development and inventory costs. The average tensile properties of the 17-4PH stainless steel alloy is compared against wrought and cast properties, tensile properties were essentially equivalent to wrought and exceed typical cast properties. Primary materials using water-based agar binding systems are; Stainless Steel, Titanium and other metal alloys.

The importance of this paper is that it allows dentists to have an option for recommending to their patient the new force distributing dental implant, which have several advantages over conventional dental implants. Additionally designers and engineers can use metal alloys and plastic injection molding technology to combine several machining steps to manufacture cost effective injection molded dental implant assembly.

INTRODUCTION

Dental implants of varying design have been in use for many years. These implants seek to restore natural dental function. The human tooth and its attachment to the jaw is a complex system, not easily replicated. The conventional implants were generally directly attached to the bone. The implant is made of metal/or ceramics shown in Figure 1. The conventional implants did not move along any axis. Conventional implants can become overloaded during the patient's use and may become loose through bone loss or in some extreme cases it may break. Even upon removal of forces, the implant remains loose and is usually eventually lost[1]. In an effort to produce long lasting implants, reduce breakage and prosthetic failure, many implant designs were created but they could not replicate a natural tooth to move along three axis. Conventional implants are often directly attached to the bone and for this reason implants cannot flex with bone causing concentrated load at jawbone. This concentration of stress on the bone results in the physiological phenomenon known as resorption where the density and mass of the jawbone decreases, eroding support for the implant. The final result is loss of the implant due to lack of support[2]. The force distributing dental implant assembly overcomes the limitation of the conventional implants as shown in Figure 2 and Figure 3.