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(72) Inventor; and
(71) Applicant: **PRINSELL, Jeffrey R.** [US/US]; 1950 Spectrum Circle SE, Suite B300, Marietta, Georgia 30067 (US).

(74) Agent: **CARLIN, Gregory J.** et al.; Meunier Carlin & Curfman LLC, 999 Peachtree Street, NE, Suite 1300, Atlanta, Georgia 30309 (US).

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(54) **Title:** TOOTH CROWN DENTAL IMPLANT GUIDE USING DENTAL DRILL BUR LENGTH STOPS

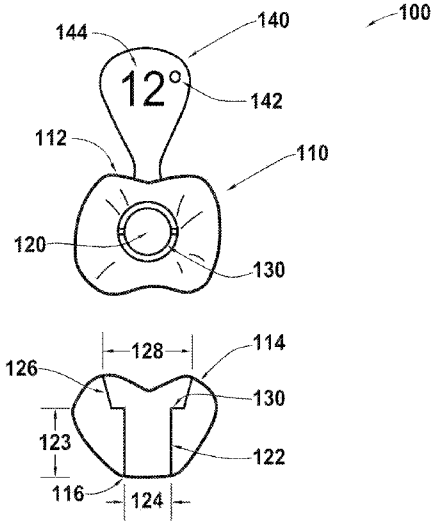

FIG. 1

(57) **Abstract:** Various implementations include a crown guide having a body and a handle. The body of the crown guide has a central hole having a first section distal to the occlusal surface with a first diameter and second section with a second diameter that is wider than the first diameter. The crown guide can be used in combination with dental burs equipped with bur stops. The dental burs have a shaft and a hub having a first section and a second section. The first section is proximal the drilling end of the hub and has a smaller diameter than the second section, which is distal to the drilling end. The bur stops have a hollow cylindrical body sized to fit over the first section of the hub. In use, the shaft of the dental bur is inserted through the central hole until the bur stop contacts the crown guide.

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TOOTH CROWN DENTAL IMPLANT GUIDE USING DENTAL DRILL BUR LENGTH STOPS

BACKGROUND

[0001] Dental implants are a common and successful way to replace missing teeth. They are typically titanium cylindrical posts that osseointegrate (fuse) with the jawbone and serve as the foundation for dental crowns, bridges, or dentures. They are inserted into the jawbone holes created by dental burs driven by slow-speed dental handpieces. Unfortunately, fears of complications as well as the additional time and expenses for lab work deter many potential patients from pursing—and some dentists from placing—dental implants.

[0002] Some dentists are reluctant to surgically place dental implants because of fears of: drilling "too deep" and damaging the underlying mandibular nerve or maxillary sinus; improper positioning such as too far buccally that can cause alveolar bone loss with resultant gingival recession and implant dehiscence; incorrect spacing such as too close to adjacent teeth that can cause papillary gingival loss and periodontal pockets; and poor angulation or alignment that can damage adjacent tooth roots. Some dentists are also intimidated by sophisticated and expensive technology and are hesitant to spend additional time and lab work and associated fees, such as, for single-use customized implant guides.

[0003] Conventional customized surgical dental implant drill guide stents are used routinely, particularly for more complex cases such as for multiple missing teeth. They are fabricated from replica models of individual patient dental arches. They range in design and materials from transparent vacuum-formed thermoplastic matrixes to acrylic resin stents, all having custom designed holes, sometimes with removable hollow cylindrical sleeves to accommodate different diameter burs for implant placement. They typically fit snugly over the patient's adjacent teeth to provide stability while the dentist drills the jawbone holes in the proper position, alignment, and sometimes at a controlled depth. On the other hand, custom guide stents require additional chair and laboratory time and expenses for dental arch impressions or digital imaging, stone or virtual study models, dental crown wax-ups and/or sophisticated software. They are single-use only, are relatively bulky, do not allow the patient to bite into occlusion to verify relationship with the opposing arch teeth, and can obstruct direct visualization of adjacent teeth and tissues while drilling holes in the jawbone.

[0004] Hence, many implants are often placed "freehand" by "guesstimating" the drilling of jawbone holes, particularly for straightforward single-tooth replacement cases. Most of the dental implant bur systems have imprinted and/or color coded rings at various set lengths around

the spiral bur flutes that indicate the designated bur cutting depths and correspond to their standard dental implant lengths. However, it is sometimes difficult to see these lines or colors, particularly in the setting of blood during surgery, or to remember which line and/or color denotes what length. Consequently, bur cuts and implants are sometimes placed too deep, most significantly into the maxillary sinus or mandibular sensory nerve, which can cause morbidity. Furthermore, many systems have no mechanical stops to prevent inadvertent over-penetration of a bur cut—even for single occurrences.

[0005] Some systems have separate ringed collars that attach (e.g., by small side screws) onto the bur at the desired lengths. However, these can be bulky and cumbersome, and may physically impede seating the burs if the ring and side screws hit adjacent teeth, particularly in relatively narrow interproximal spaces. Also, the manual attachments and adjustments these rings on progressing wider burs in a given series can be time-consuming, tedious, and imprecise. They can inadvertently slip to an incorrect length. Over multiple uses, the burs' side cutting flutes can be dulled by the impinging side screws. Another method to attempt to control bur depth penetration is for the dentist to slide small elastic ligatures to the desired bur length. However, these ligatures may be difficult to see and can inadvertently slip out of position, particularly when wet with saliva or blood.

[0006] Hence, even in the best hands of experienced dentists, unguided freehand with uncontrolled guestimation has inherent imprecision that can create imperfect results and complications. To gain greater acceptance, the placement of implants needs to be more accurate, safer with fewer complications, easier, quicker, and more affordable.

SUMMARY

[0007] Various implementations of a tooth crown-like dental implant surgical drill guide ("crown guide") includes a body and a handle. The body is shaped and sized to resemble a human tooth crown that is devoid of tooth roots. The body has an occlusal surface and a buccal surface. The occlusal surface defines a central hole having a first section with a first diameter and a second section with a second diameter. The second diameter is larger than the first diameter, and the second section is closer to the occlusal surface than the first section. The first section also defines a rim at an abutment of the first section and the second section. The handle extends from the buccal surface of the body.

[0008] In some implementations, the handle is a flat tab. In some implementations, the handle has a first side and a second side that are opposite and spaced apart from each other, and

the first side defines a hole, the hole extending from the first side to the second side. In some implementations, wherein the handle includes an information indicator relating to the crown guide. In some implementations, the information indicator is a number.

[0009] In some implementations, the body has an apical end opposite and spaced apart from the occlusal surface and the apical end is tapered and convex. In some implementations, an end of the second section of the central hole closest to the occlusal surface is tapered wider toward the occlusal surface.

[0010] Various implementations include a kit for a crown guide system. The kit includes a plurality of the crown guides mentioned above. Each of the first sections of the plurality of crown guides has a length, and the first section lengths of each of the plurality of crown guides are equal.

[0011] In some implementations, the kit includes at least one guide pin sized to be inserted through the central hole of at least one of the plurality of crown guides for attaching the crown guide to a jawbone of a patient. In some implementations, the plurality of the crown guides comprises at least two crown guides resembling different types of human tooth crowns. In some implementations, the plurality of the crown guides comprises at least two crown guides resembling the same type of human tooth and being differently sized. In some implementations, each of the plurality of crown guides is the same crown guide type and the first diameter of each of the plurality of crown guides are equal. In some implementations, the kit includes at least one hollow sleeve, the sleeve having an outer diameter sized for being inserted through the central hole of the plurality of crown guides.

[0012] Various implementations include a dental drill stop system. The dental drill stop system includes a dental bur and a bur stop. The dental bur includes a shaft having a cutting surface and a drilling end. The cutting surface extends from the drilling end of the shaft. The dental bur also includes a hub located at an end of the cutting surface opposite the drilling end of the shaft. The hub has a first section and a second section. The first section has a first diameter that is greater than the diameter of the shaft and the second section has a second diameter that is greater than the first diameter. The first section of the hub is closer to the cutting surface than the second section. A lip is defined by the abutment of the first section and the second section.

[0013] The bur stop includes a hollow body and a collar. The body has an inside surface, an inside diameter, a first end, and a second end. The inside diameter is greater than or equal to the first diameter but less than the second diameter. The collar extends radially from the first end of the cylindrical body. The inside surface of the bur stop is structured to be disposed over the

first section of the dental bur such that the second end of the bur stop is adjacent to the lip of the hub of the dental bur.

[0014] In some implementations, the dental drill stop system includes a plurality of bur stops having a central axis length. The central axis length of at least one of the plurality of bur stops is different than the central axis length of at least one other of the plurality of bur stops.

[0015] In some implementations, the dental drill stop system also includes a plurality of dental burs. The shaft of each of the plurality of dental burs has a shaft diameter, and the shaft diameter of at least one of the plurality of dental burs is different than the shaft diameter of at least one other of the plurality of dental burs.

[0016] In some implementations, the dental drill stop system also includes a plurality of dental burs, and the first diameter of the first section of the hub of each of the plurality of dental burs is equal.

[0017] In some implementations, the bur stop includes an information indicator relating to the length of the bur stop. In some implementations, the information indicator is a number.

[0018] In some implementations, the first section of the hub includes a frictional surface for frictionally securing the bur stop. In some implementations, the first section of the hub includes at least one protrusion for engaging and securing the bur stop.

[0019] Various implementations include a method of dental drilling a jawbone hole for dental implants. The method includes the step of providing a dental bur including a hub and a shaft having a cutting surface, a drilling end, and a diameter. The cutting surface extends from the drilling end of the shaft. The dental bur also includes a hub located at an end of the cutting surface opposite the drilling end of the shaft. The hub has a first section and a second section. The first section has a first diameter that is greater than the diameter of the shaft and the second section has a second diameter that is greater than the first diameter. The first section of the hub is closer to the cutting surface than the second section. A lip is defined by the abutment of the first section and the second section.

[0020] The method further includes the step of selecting a bur stop based on a predetermined drilling depth. The bur stop includes a hollow body and a collar. The body has an inside surface, an inside diameter, a first end, and a second end. The inside diameter is greater than or equal to the first diameter but less than the second diameter. The collar extends radially from the first end of the cylindrical body.

[0021] The method further includes the step of inserting the dental bur through the hollow body of the bur stop such that the inside surface of the bur stop is disposed over the first

section of the dental bur and the second end of the bur stop is adjacent the lip of the hub of the dental bur.

[0022] The method further includes the step of positioning a crown guide in the desired location on a patient's jawbone for a dental implant. The crown guide includes a body shaped and sized to resemble a human tooth crown. The body has an occlusal surface and a buccal surface. The occlusal surface defines a central hole that has a first section with a first diameter and a second section with a second diameter. The second diameter is larger than the first diameter and the second section is closer to the occlusal surface than the first section. The first section defines a rim at an abutment of the first section and the second section. The crown guide also includes a handle extending from the buccal surface of the body.

[0023] The method further includes the steps of inserting the dental bur through the central hole of the crown guide, rotating the dental bur, and advancing the dental bur through the central hole of the crown guide and into the patient's jawbone until the collar of the bur stop abuts the rim of the crown guide.

[0024] In some implementations, the handle is a flat tab. In some implementations, the handle has a first side and a second side that are opposite and spaced apart from each other, and the first side defines a hole, the hole extending from the first side to the second side. In some implementations, the handle includes an information indicator relating to the crown guide. In some implementations, the information indicator is a number.

[0025] In some implementations, the crown guide body has an apical end opposite and spaced apart from the occlusal surface and the apical end is tapered and convex.

[0026] In some implementations, an end of the second section of the central hole closest to the occlusal surface of the crown guide is tapered wider toward the occlusal surface.

[0027] In some implementations, the crown guide is selected from a plurality of the crown guides, wherein each of the first sections of the plurality of crown guides has a length, and the first section lengths of each of the plurality of crown guides are all equal.

[0028] In some implementations, the crown guide is selected from a plurality of the crown guides comprising at least two crown guides resembling different types of human tooth crowns.

[0029] In some implementations, the crown guide is selected from a plurality of the crown guides comprising at least two crown guides resembling the same type of human tooth crown and being differently sized.

[0030] In some implementations, the crown guide is selected from a plurality of the crown guides, and each of the plurality of crown guides being the same crown guide type, and the first diameter of each of the plurality of crown guides are equal.

[0031] In some implementations, the method further includes a hollow sleeve inserted into the central hole of the crown guide, wherein the dental bur is inserted through the sleeve.

[0032] In some implementations, the bur stop is selected from a plurality of bur stops, and each of the plurality of bur stops has a central axis length. The central axis length of at least one of the plurality of bur stops is different than the central axis length of at least one other of the plurality of bur stops.

[0033] In some implementations, the bur stop is selected from a plurality of bur stops, and the shaft of each of the plurality of dental burs has a shaft diameter. The shaft diameter of at least one of the plurality of dental burs is different than the shaft diameter of at least one other of the plurality of dental burs.

[0034] In some implementations, the bur stop is selected from a plurality of bur stops, and the first diameter of the first section of the hub of each of the plurality of dental burs is equal.

[0035] In some implementations, the bur stop includes an information indicator relating to the length of the bur stop. In some implementations, the information indicator is a number.

[0036] In some implementations, the first section of the hub includes a frictional surface for frictionally securing the bur stop. In some implementations, the first section of the hub includes at least one protrusion for engaging and securing the bur stop.

BRIEF DESCRIPTION OF DRAWINGS

[0037] Example features and implementations are disclosed in the accompanying drawings. However, the present disclosure is not limited to the precise arrangements and instrumentalities shown.

[0038] FIG. 1 is a top and side view of a crown guide in accordance with one implementation.

[0039] FIG. 2 is top and side view of a series of the crown guides of FIG. 1.

[0040] FIG. 3 is a perspective view of a dental drill stop system in accordance with another implementation.

[0041] FIGS. 4A and 4B are perspective views of two of the dental drill stop systems of FIG. 3.

[0042] FIG. 5 is a perspective view of a dental drill stop system of FIG. 3.

[0043] FIG. 6 is a perspective view of the dental drill stop system of FIG. 3 with the crown guide of FIG. 1.

[0044] FIG. 7 is a time lapse side view of the use of the dental drill stop system of FIG. 3 with the crown guide of FIG. 1.

[0045] FIG. 8 is a perspective view of the use of the dental drill stop system of FIG. 3 with the crown guide of FIG. 1.

[0046] FIG. 9 is a side view of a patient's mouth showing the use of the dental drill stop system of FIG. 3 with the crown guide of FIG. 1.

[0047] FIG. 10 is a perspective view of a kit in accordance with one implementation.

DETAILED DESCRIPTION

[0048] The following is a description of various implementations of systems and methods for drilling initial dental implant holes quickly, accurately, and safely with minimal complications at the proper position, alignment, angulation, and controlled depth into the jawbone for dental implants. These instruments are easy to use, 3-dimensional, prefabricated for immediate use without any modifications for individual cases, and autoclavable for reuse in multiple different patients. No dental arch impressions, study models, tooth wax-ups, digital or sophisticated technology, or bulky single-use-only expensive custom-fabricated guide stents are required—thus eliminating additional chair and laboratory time, fees, and related inconveniences that deter some dentists and patients from proceeding with implants. Instead of starting with imprecise freehand guesstimated drilling that might result in an improperly placed implant-borne crown, this system and method begins logically with the final product or ultimate goal—a simulated tooth crown ("Crown Guide")—as a guide for creating the critical initial jawbone hole, indicated particulary for straightforward single tooth replacement cases.

[0049] Certain terminology is used herein for convenience only and is not to be taken as a limitation on the present invention. In the drawings, the same reference numbers are employed for designating the same elements throughout the several figures. A number of examples are provided. Nevertheless, it will be understood that various modifications can be made without departing from the spirit and scope of the disclosure herein. As used in the specification, and in the appended claims, the singular forms "a," "an," "the" include plural referents unless the context clearly dictates otherwise. The term "comprising" and variations thereof as used herein is used synonymously with the term "including" and variations thereof and are open, non-limiting terms. Although the terms "comprising" and "including" have been used herein to describe various implementations, the terms "consisting essentially of" and "consisting of" can

be used in place of "comprising" and "including" to provide for more specific implementations and are also disclosed.

[0050] Generic anatomical teeth crown dental implant surgical drill bur guides with handles ("crown guides") are autoclavable (e.g., metal or ceramic) for reuse in many patients undergoing the drilling with dental burs in jawbones for the placement of cylindrical dental implants to replace missing teeth. Crown Guides have the anatomical morphology, size, and shape of typical natural human teeth but are devoid of roots, which are replaced with a smooth convex contoured apical region. Crown Guide styles can include generic incisors, canines, premolars, and molars, each of which can have different sizes (e.g., a first molar is wider than a second molar).

[0051] FIG. 1 shows one implementation of a crown guide 100. The crown guide 100 is a 3-dimensional, generic, and prefabricated tooth crown-like dental implant surgical drill guide. The crown guide 100 includes a tooth-like body 110 and a handle 140 extending from the buccal surface 112 of the body 110. The coronal surface anatomy of the crown guides do not necessarily need to be specific for right versus left, or even upper versus lower jaw. Rather, one generic type of crown guide can be used in various different sites. For example, a molar crown guide can be used when drilling the implant hole of a right versus left and upper versus lower missing molar tooth. In some implementations, the normally rounded point contact of the marginal ridges is slightly flattened to fit more snugly with less rotational variability in the crown guides.

[0052] While the handle 140 in FIG. 1 is a flat tab, the handle may be any shape or size in other implementations. The handle 140 includes a hole 142 through the handle 140 for attaching a safety string (e.g., to retrieve the crown guide if dislodged to prevent accidental swallowing or aspiration) or other device for the operator to secure the crown guide (e.g. to adjacent teeth if necessary). In some implementations, the handle 140 is sized so that it does not interfere with opposing jaw teeth or thus impede full mouth closure (e.g., when instructing a patient to "bite down"), which offers the advantage of the dentist being able to verify the desired occlusal relationship of the crown guide (and eventual dental implant crown restoration) with the opposing jaw dentition.

[0053] The body 110 has an occlusal surface 114 and an apical end 116, which is tapered with a convex and smooth surface. This shape offers the advantages of better visualization of the bur entry into the jawbone (to better ensure the accuracy of bur placement for drilling), and better access for irrigation (with water squirted via a separate syringe by the dental assistant) to better prevent bur over-heating and subsequent jawbone necrosis.

[0054] The body 110 has a central hole 120 extending from the occlusal surface 114 to the apical end 116 of the body 110. The central hole 120 has a first section 122 proximal to the apical end 116 and a second section 126 proximal to the occlusal surface 114. The second section 126 has a wider diameter 128 than the diameter 124 of the first section 122. In some implementations, the central hole 120 is grossly equidistant in all dimensions (e.g., buccal-lingual/palatal and mesio-distal of the center of the tooth) and oriented parallel (not tilted) to the long axis of the missing tooth (e.g., incisors, canines, and some premolars) or center of multi-rooted teeth (e.g., some premolars and molars) and grossly perpendicular to the alveolar ridge surface of the upper or lower jawbone, corresponding to where the single (per tooth) dental implant will be placed. Proper spacing, alignment, and angulation of this initial drill hole can prevent iatrogenic damage to adjacent tooth roots and help better place the implant in the jawbone for periodontal stability and for an esthetic tooth crown emergence profile. With the central holes slightly off-center to the lingual or palatal side, more buccal alveolar bone about the coronal surface of the bur hole is retained, resulting in less risks of long-term buccal bone loss and overlying gingival recession and implant dehiscence. It also allows for more buccal room for cosmetic contours and porcelain thickness of the eventual permanent crown restoration.

[0055] In FIG. 1, the entire second section 126 is tapered, but in other implementations, only a portion of the second section, or none of the second section, is tapered. The tapered portion of the second section 126 allows easy access of all components. Given that different crown guides' styles and sizes have different total crown heights, the coronal entrance opening above the top of the central hole can vary. That is, taller crown guides can have wider coronal entrances than do shorter crown guides. A rim 130 is formed where the smaller diameter 124 of the first section 122 abuts the larger diameter 128 of the second section 126. This smooth rim 130 accommodates a seated bur stop, which prevents inadvertent over penetration of the drill into the jawbone.

[0056] FIG. 2 shows a three different views (top view, lingual view, and side view) of a series 150 of seven of the crown guides 100 of FIG. 1. Each crown guide 100 is of a different size, shape, and/or tooth crown type than the other crown guides 100 in the kit 150. Each of the handles 140 of the crown guides 100 includes an indicator 144 in the form of a different number ("6" through "12"), which indicates the mesial-distal width in millimeters. In other implementations, the indicator can represent any other information, for example, size, shape, and/or tooth crown type of that particular crown guide 100. While the indicators 144 in FIG. 2 are numbers, in other implementations, the indicators could be anything that indicates to the operator information regarding the crown guides (e.g., different colors, letters, markings, etc.).

[0057] While the size, shape, and/or tooth crown type of the crown guides 100 in the series 150 vary, the lengths 123 of the first section 122 of the central hole 120 in each of the crown guides 100 are equal (e.g., 5 mm of all crown guides). In other words, the distance from the rim 130 of the central hole 120 to the apical end 116 of the body 110 are the same for all crown guides 100. In some implementations, the diameters of the first and/or second sections, respectively, are equal in some of the crown guides.

[0058] FIG. 3 shows a dental drill stop system 200 including a dental bur 210 and a bur stop 300. The dental bur 210 includes a shaft 212 and a hub 218. The shaft 212 of the dental bur 210 has a fluted cutting surface 214 starting at a drilling end 216 and extending a portion of the way along the shaft 212. The other end of the shaft 212 includes a portion for interfacing the dental bur 210 inside a slow-speed dental drill handpiece 250.

[0059] The hub 218 of the dental bur 210 is located along the shaft 212 at the end of the cutting surface 214 opposite the drilling end 216. The hub 218 has a first section 220 proximal to the cutting surface 214 and a second section 224 distal to the cutting surface 214. The first 220 and second sections 224 are both cylindrical, the diameter of the first section 222 being smaller than the diameter of the second section 226. A lip 228 is formed where the smaller diameter of the first section 222 and the larger diameter of the second section 226 meet.

[0060] The bur stop 300 includes a hollow cylinder body 302 with a collar 306 extending radially outwardly from apical end of the body 302. The inner diameter 304 of the body 302 is slightly greater than the diameter of the first section 222 of the hub 218 of the dental bur 210, but less than the diameter of the second section 226 of the hub 218 of the dental bur 210.

[0061] In use, the drilling end 216 of the dental bur 210 is inserted through the hollow cylinder body 302 of the bur stop 300 such that the bur stop 300 is positioned over the first section 220 of the dental bur hub 218 and the end of the bur stop 300 opposite the collar 306 abuts the lip 228 of the hub 218. The lip 228 of the hub 218 prevents the bur stop 300 from advancing further along the dental drill shaft 212. In this position, only a portion of the shaft 212 of the dental bur 210 will be protruding beyond the collar 306 of the bur stop 300. Thus, in use, an operator will only be able to drill into the jawbone of a patient the known length of the protruding portion of the dental bur shaft 212 that extends beyond the apical end of the crown guide 100.

[0062] FIGS. 4A and 4B show two implementations of hubs 218 having frictional surfaces 230 on the first sections 220 of the hubs 218. In FIG. 4A, the frictional surface 230 includes an O-ring 232 fit into a circumferential groove 234 in the first section 220. When a bur stop 300 is placed over the first section 220 of the hub 218, the inside surface 314 of the bur stop

300 contacts the O-ring 232, securing the bur stop 300 in place. In FIG. 4B, the frictional surface 230 again includes a groove circumscribing 234 the first section 220 of the hub 218. The hollow cylinder body 302 of the bur stop 300 includes slits 310 at the end of the body opposite the collar 306 with protrusions 312 on the inside surface 314 of the coronal end. When the bur stop 300 is placed over the first section 220 of the hub 218, the protrusions 312 of the bur stop 300 engage the groove 234 in the hub 218, securing the bur stop 300 in place. While FIGS. 4A and 4B show the frictional surfaces 230 as an O-ring 232 and groove/protrusion 234, 312, in other implementations, the frictional surfaces can be any surface designed to secure the bur stop in place on the dental bur hub.

[0063] FIG. 5 shows a set of dental burs 210 and a set of bur stops 300. Each of the dental burs 210 has a different shaft diameter 213. Otherwise, all of the other dimensions of each of the dental burs 210 are equal (e.g., the length of the cutting surface 214 extending from the drilling end 216 of the dental bur 210 to the hub 218, the distance from the drilling end 216 of the dental bur 210 to the lip 228 of the hub 218, the diameter 222 of each of the first section 220 of the hub 218 of each of the dental burs 210).

[0064] Each of the bur stops 300 of FIG. 5 has a different length 316. Otherwise, all of the other dimensions of each of the bur stops 300 are equal (e.g., inner diameter 304 of the hollow cylinder body 302).

[0065] In use, an operator can combine a bur stop 300 having a desired length 316 with any of the dental burs 210 having a desired shaft diameter 213 to create a jawbone hole with a desired specific maximum drill depth and drill diameter.

[0066] When used together, as shown in FIG. 6, the dental burs 210 fitted with bur stops 300 and crown guides 100 can be used to quickly, accurately, and economically ensure the correct position, alignment, and depth of the drill hole in the jawbone. As seen in FIG. 7, the operator selects a crown guide 100 that resembles the crown type and size of the missing natural tooth. The operator also selects a dental bur 210 with a desired shaft diameter 213 (e.g., beginning with a more narrow dental bur, then progressing to a wider diameter dental bur) and equips the dental bur 210 with a bur stop 300 having a desired length 316 based on the desired drilling depth. Because the length 123 of the first section 122 of the central hole 120 of each of the crown guides 100 is uniformly the same in all crown guide of the system and the distance from the drilling end 216 of each dental burs 210 to the lip 228 of its hub 218 is the same in all dental burs in the system, the operator can easily select the appropriate length bur stop 300 since the length bur stop 316 is the only variable across any combination. Furthermore, an indicator 308, represented here by a number, on each bur stop 300 can represent the drilling depth (e.g., in

millimeters of the dental bur length that extends beyond the apical end of the crown guide) for ease of use. The operator then holds the crown guide 100, by the handle 140, in the proper position and orientation where the implant hole is to be drilled, as shown in FIG. 8. Using the dental bur 210 equipped with the bur stop 300, the operator drills through the central hole 120 of the body 110 of the crown guide 100 and into the jawbone of the patient until the collar 306 of the bur stop 300 contacts and seats onto the rim 130 of the crown guide 100.

[0067] As shown in FIG. 9, by mechanically limiting the depth of the drill hole, the bur stops 300 help to prevent accidental over-drilling into the jawbones, which can cause iatrogenic damage to the underlying maxillary sinus or mandibular neurovascular bundles. The shorter the bur stop, the longer the amount of dental bur extends beyond the apical end of the crown guide, creating a deeper hole in the jawbone. When bur stops are not utilized in this system, the entire length of the cutting portion of the dental bur can be inserted into the crown guide to drill the deepest possible jawbone hole.

[0068] Because the shafts 212 of some of the dental burs 210 may have a smaller diameter 213 than the first diameter 124 of the crown guide 100, a hollow sleeve 400 can be inserted into the first section 126 of the crown guide 100 to better accommodate the dental bur shaft 212, as shown in FIG. 7. The hollow sleeves 400 can be useful in wider crown guide types (e.g., molars) where progressively wider dental burs are used to sequentially drill wider holes in the jawbone. Each hollow sleeve 400 has an outer diameter 402 slightly smaller than the first diameter 124 of the crown guide 100, but all hollow sleeves 400 have a different inner diameter 404 to accommodate different dental bur shaft diameters 213. By using a series of dental burs 210 having different diameter shafts 213 along with hollow sleeves 400 with corresponding inner diameters 404, an operator can use the same crown guide 100 throughout an operation, while incrementally increasing the diameter of the hole drilled into the jawbone. Following initial drilling with the narrow burs, the hollow sleeve 400 can be removed so that the wider central hole 120 can accept wider dental bur shafts 212 to create a wider jawbone hole to accept a wider implant to support wider implant borne restorations (e.g., molar crowns).

[0069] Periodically throughout the drilling, an operator can insert a guide pin 500 with a diameter 502 slightly less than the shaft diameter 213 of the most recently used dental bur 210 width into the central hole 120 of the crown guide 100 to hold the crown guide 100 in position hands-free, which allows the dentist to clinically evaluate whether the initial implant jawbone hole is in a satisfactory position and alignment before proceeding with wider shaft diameter burs and subsequent implant placement for ultimate custom crown restoration. Because the guide pins 500 do not extent above the occlusal surface 114 when seated in the crown guides 100, the

patient can be instructed to bite into occlusion to verify that the crown guide 100, and thus the jawbone hole, is in the desired relationship with the opposing dental arch teeth. Also, the guide pins 500 have small coronal holes 506 through which safety string can be inserted to help retrieve the guide pins 500 if dislodged to prevent accidental swallowing or aspiration.

[0070] FIG. 10 shows an autoclavable kit 600 including multiple tooth crown types and sizes of crown guides 100, multiple dental burs 210 with varying shaft diameters 213, multiple bur stops 300 with varying lengths 316, a hollow sleeve 400, and multiple guide pins 500 with varying lengths 504 and diameters 502.

[0071] The systems and methods discussed above eliminate the need for dental arch impressions, study models, tooth crown wax-ups, or digital or sophisticated technology, thus, eliminating the additional chairtime, fees, inconvenience and related hassles of customized stents that deter many dentists and patients from proceeding with dental implants.

[0072] A number of implementations of the invention have been described. Nevertheless, it will be understood that various modifications may be made without departing from the spirit and scope of the invention. Accordingly, other implementations are within the scope of the following claims.

[0073] Disclosed are materials, systems, devices, methods, compositions, and components that can be used for, can be used in conjunction with, can be used in preparation for, or are products of the disclosed methods, systems, and devices. These and other components are disclosed herein, and it is understood that when combinations, subsets, interactions, groups, etc. of these components are disclosed that while specific reference of each various individual and collective combinations and permutations of these components may not be explicitly disclosed, each is specifically contemplated and described herein. For example, if a device is disclosed and discussed each and every combination and permutation of the device, and the modifications that are possible are specifically contemplated unless specifically indicated to the contrary. Likewise, any subset or combination of these is also specifically contemplated and disclosed. This concept applies to all aspects of this disclosure including, but not limited to, steps in methods using the disclosed systems or devices. Thus, if there are a variety of additional steps that can be performed, it is understood that each of these additional steps can be performed with any specific method steps or combination of method steps of the disclosed methods, and that each such combination or subset of combinations is specifically contemplated and should be considered disclosed.

WHAT IS CLAIMED IS:

1. A tooth crown-like dental implant surgical drill guide ("crown guide"), comprising:

a body shaped and sized to resemble a human tooth crown that is devoid of tooth roots, the body having an occlusal surface and a buccal surface, wherein the occlusal surface defines a central hole having a first section with a first diameter and a second section with a second diameter, the second diameter being larger than the first diameter and the second section being closer to the occlusal surface than the first section, wherein the first section defines a rim at an abutment of the first section and the second section; and

a handle extending from the buccal surface of the body.

2. The crown guide of claim 1, wherein the handle is a flat tab.

3. The crown guide of claim 2, wherein the handle has a first side and a second side that are opposite and spaced apart from each other, and the first side defines a hole, the hole extending from the first side to the second side.

4. The crown guide of claim 2, wherein the handle includes an information indicator relating to the crown guide.

5. The crown guide of claim 4, wherein the information indicator is a number.

6. The crown guide of claim 1, wherein the body has an apical end opposite and spaced apart from the occlusal surface and the apical end is tapered and convex.

7. The crown guide of claim 1, wherein an end of the second section of the central hole closest to the occlusal surface is tapered wider toward the occlusal surface.

8. A kit for a crown guide system, the kit comprising:

a plurality of the crown guides of claim 1, wherein each of the first sections of the plurality of crown guides has a length, and the first section lengths of each of the plurality of crown guides are equal.

9. The kit of claim 8, further comprising at least one guide pin sized to be inserted through the central hole of at least one of the plurality of crown guides for attaching the crown guide to a jawbone of a patient.

10. The kit of claim 8, wherein the plurality of the crown guides comprises at least two crown guides resembling different types of human tooth crowns.

11. The kit of claim 8, wherein the plurality of the crown guides comprises at least two crown guides resembling the same type of human tooth and being differently sized.

12. The kit of claim 8, wherein each of the plurality of crown guides is the same crown guide type and the first diameter of each of the plurality of crown guides are equal.

13. The kit of claim 8, further comprising at least one hollow sleeve, the sleeve having an outer diameter sized for being inserted through the central hole of the plurality of crown guides.

14. A dental drill stop system, comprising:

a dental bur comprising a shaft having a cutting surface and a drilling end, the cutting surface extends from the drilling end of the shaft, and a hub located at an end of the cutting surface opposite the drilling end of the shaft, and the hub has a first section and a second section, the first section has a first diameter that is greater than the diameter of the shaft and the second section with a second diameter that is greater than the first diameter, wherein the first section of the hub is closer to the cutting surface than the second section, and a lip is defined by the abutment of the first section and the second section; and

a bur stop comprising a hollow body and a collar, the body having an inside surface, an inside diameter, a first end, and a second end, the inside diameter being greater than or equal to the first diameter but less than the second diameter, and the collar extending radially from the first end of the cylindrical body;

wherein the inside surface of the bur stop is structured to be disposed over the first section of the dental bur such that the second end of the bur stop is adjacent to the lip of the hub of the dental bur.

15. The dental drill stop system of claim 14, further comprising a plurality of bur stops, each of the plurality of bur stops having a central axis length, wherein the central axis length of at

least one of the plurality of bur stops is different than the central axis length of at least one other of the plurality of bur stops.

16. The dental drill stop system of claim 14, further comprising a plurality of dental burs, the shaft of each of the plurality of dental burs having a shaft diameter, wherein the shaft diameter of at least one of the plurality of dental burs is different than the shaft diameter of at least one other of the plurality of dental burs.

17. The dental drill stop system of claim 14, further comprising a plurality of dental burs, wherein the first diameter of the first section of the hub of each of the plurality of dental burs is equal.

18. The dental drill stop system of claim 14, wherein the bur stop includes an information indicator relating to the length of the bur stop.

19. The dental drill stop system of claim 18, wherein the information indicator is a number.

20. The dental drill stop system of claim 14, wherein the first section of the hub includes a frictional surface for frictionally securing the bur stop.

21. The dental drill stop system of claim 14, wherein the first section of the hub includes at least one protrusion for engaging and securing the bur stop.

22. A method of dental drilling a jawbone hole for dental implants, the method comprising:

providing a dental bur comprising a shaft having a cutting surface, a drilling end, and a diameter, the cutting surface extends from the drilling end of the shaft, and a hub located at an end of the cutting surface opposite the drilling end of the shaft, and the hub has a first section and a second section, the first section has a first diameter that is greater than the diameter of the shaft and the second section with a second diameter that is greater than the first diameter, wherein the first section of the hub is closer to the cutting surface than the second section, and a lip is defined by the abutment of the first section and the second section;

selecting a bur stop based on a predetermined drilling depth, the bur stop comprising a hollow body and a collar, the body having an inside surface, an inside diameter, a first end, and a

second end, the inside diameter being greater than or equal to the first diameter but less than the second diameter, and the collar extending radially from the first end of the cylindrical body;

inserting the dental bur through the hollow body of the bur stop such that the inside surface of the bur stop is disposed over the first section of the dental bur and the second end of the bur stop is adjacent the lip of the hub of the dental bur;

positioning a crown guide in the desired location on a patient's jawbone for a dental implant, the crown guide comprising a body shaped and sized to resemble a human tooth crown, the body having an occlusal surface and a buccal surface, wherein the occlusal surface defines a central hole having a first section with a first diameter and a second section with a second diameter, the second diameter being larger than the first diameter and the second section being closer to the occlusal surface than the first section, wherein the first section defines a rim at an abutment of the first section and the second section, the crown guide further comprising a handle extending from the buccal surface of the body;

inserting the dental bur through the central hole of the crown guide;

rotating the dental bur; and

advancing the dental bur through the central hole of the crown guide and into the patient's jawbone until the collar of the bur stop abuts the rim of the crown guide.

23. The method of claim 22, wherein the handle is a flat tab.

24. The method of claim 23, wherein the handle has a first side and a second side that are opposite and spaced apart from each other, and the first side defines a hole, the hole extending from the first side to the second side.

25. The method of claim 22, wherein the handle includes an information indicator relating to the crown guide.

26. The method of claim 26, wherein the information indicator is a number.

27. The method of claim 22, wherein the crown guide body has an apical end opposite and spaced apart from the occlusal surface and the apical end is tapered and convex.

28. The method of claim 22, wherein an end of the second section of the central hole closest to the occlusal surface of the crown guide is tapered wider toward the occlusal surface.

29. The method of claim 22, wherein the crown guide is selected from a plurality of the crown guides, wherein each of the first sections of the plurality of crown guides has a length, and the first section lengths of each of the plurality of crown guides are all equal.

30. The method of claim 22, wherein the crown guide is selected from a plurality of the crown guides comprising at least two crown guides resembling different types of human tooth crowns.

31. The method of claim 22, wherein the crown guide is selected from a plurality of the crown guides comprising at least two crown guides resembling the same type of human tooth crown and being differently sized.

32. The method of claim 22, wherein the crown guide is selected from a plurality of the crown guides, each of the plurality of crown guides being the same crown guide type, and the first diameter of each of the plurality of crown guides are equal.

33. The method of claim 22, further comprising a hollow sleeve inserted into the central hole of the crown guide, wherein the dental bur is inserted through the sleeve.

34. The method of claim 22, wherein the bur stop is selected from a plurality of bur stops, each of the plurality of bur stops having a central axis length, wherein the central axis length of at least one of the plurality of bur stops is different than the central axis length of at least one other of the plurality of bur stops.

35. The method of claim 22, wherein the bur stop is selected from a plurality of bur stops, the shaft of each of the plurality of dental burs having a shaft diameter, wherein the shaft diameter of at least one of the plurality of dental burs is different than the shaft diameter of at least one other of the plurality of dental burs.

36. The method of claim 22, wherein the bur stop is selected from a plurality of bur stops, wherein the first diameter of the first section of the hub of each of the plurality of dental burs is equal.

37. The method of claim 22, wherein the bur stop includes an information indicator relating to the length of the bur stop.

38. The method of claim 37, wherein the information indicator is a number.

39. The method of claim 22, wherein the first section of the hub includes a frictional surface for frictionally securing the bur stop.

40.The method of claim 22, wherein the first section of the hub includes at least one protrusion for engaging and securing the bur stop.

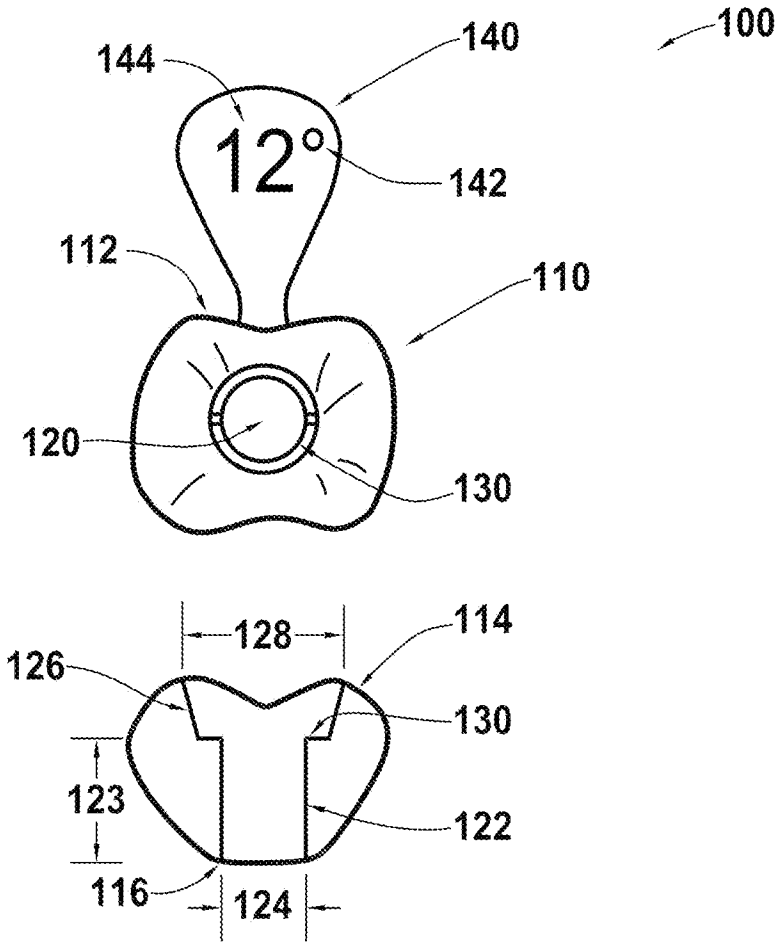
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FIG. 1

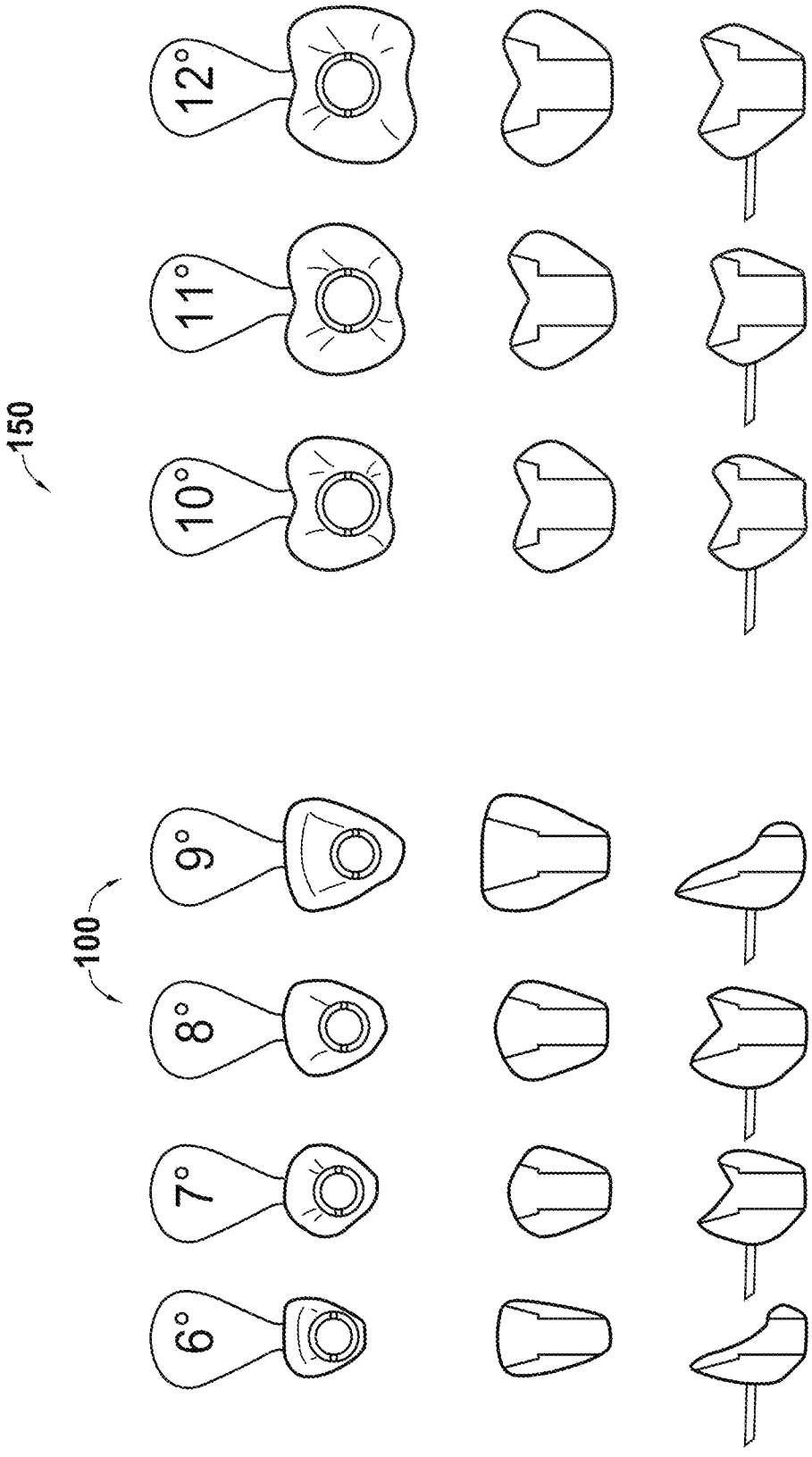

FIG. 2

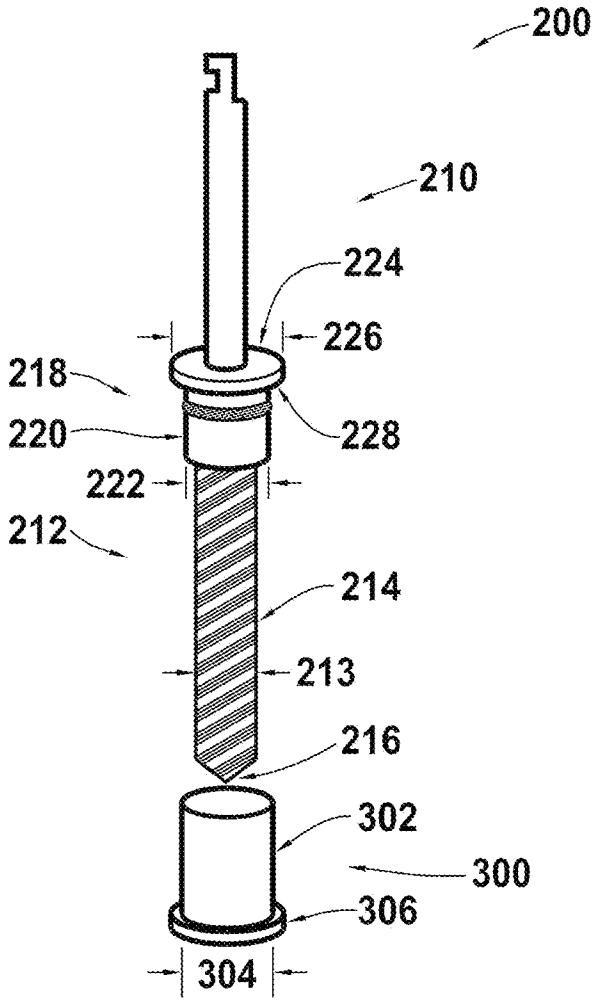

FIG. 3

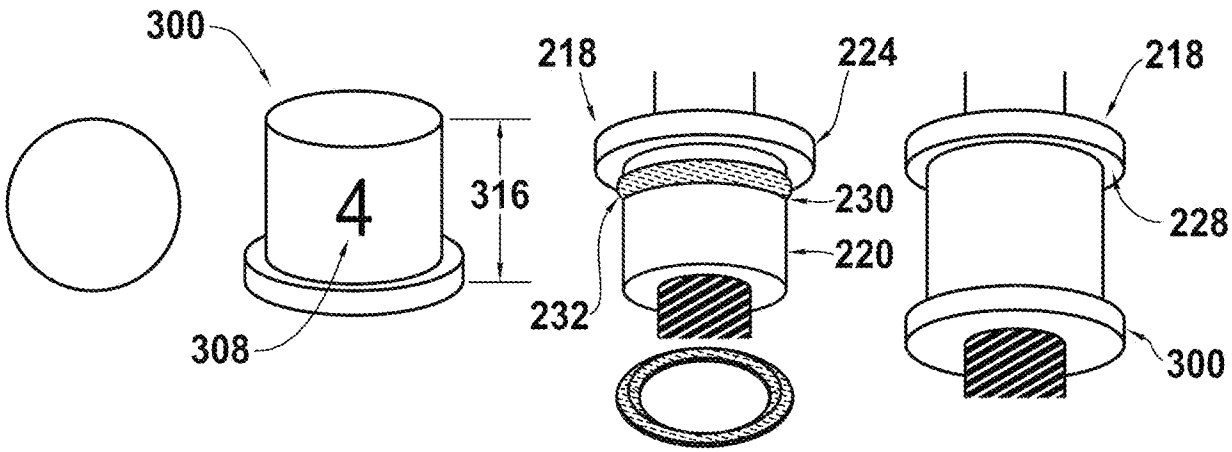
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FIG. 4A

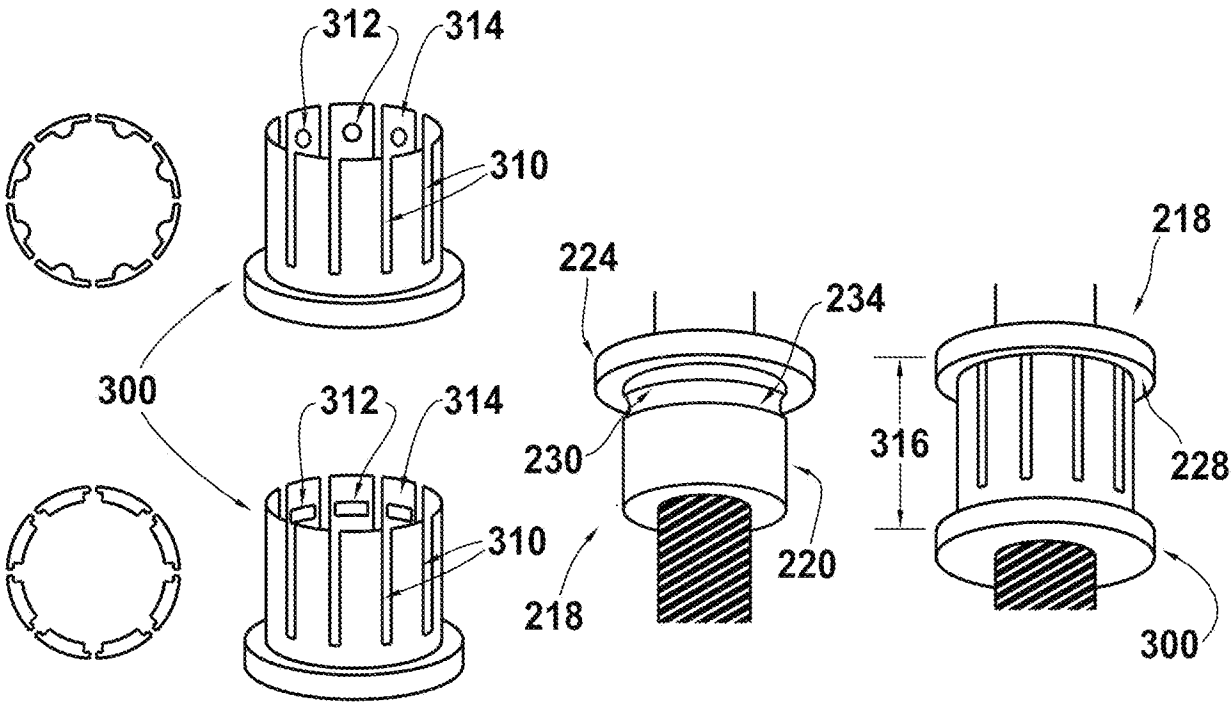
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FIG. 4B

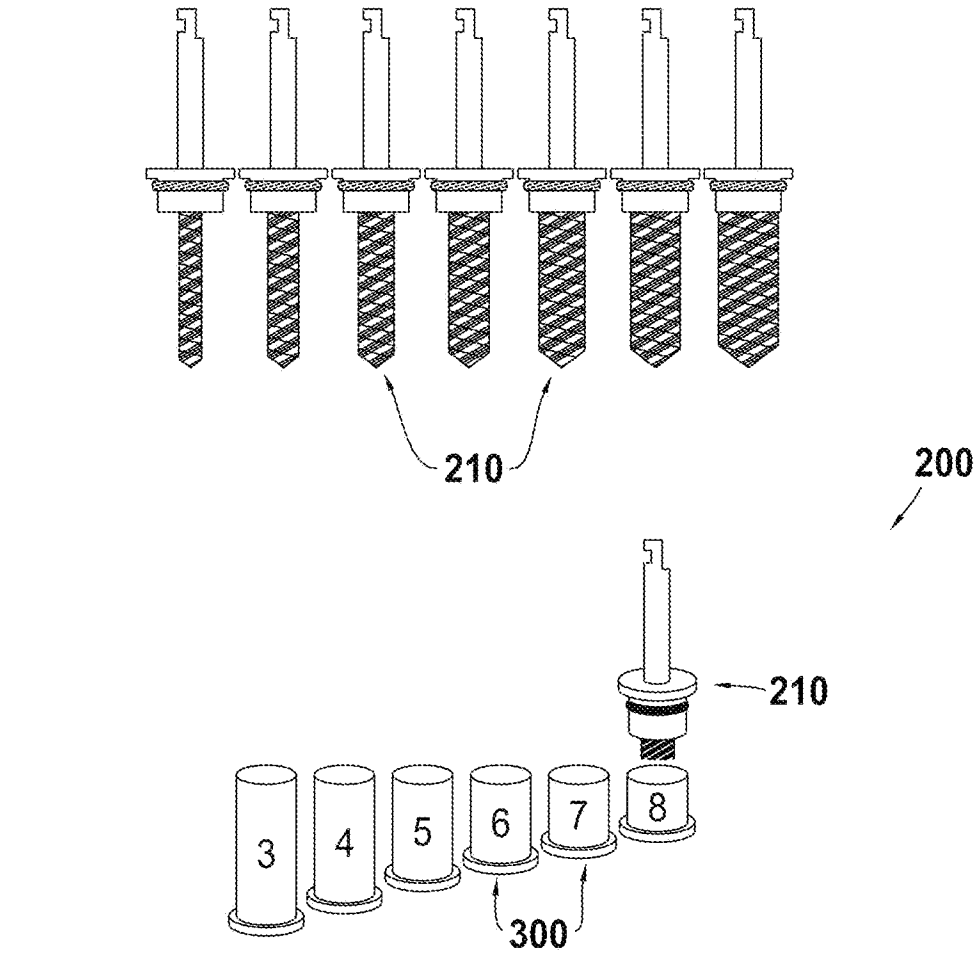

FIG. 5

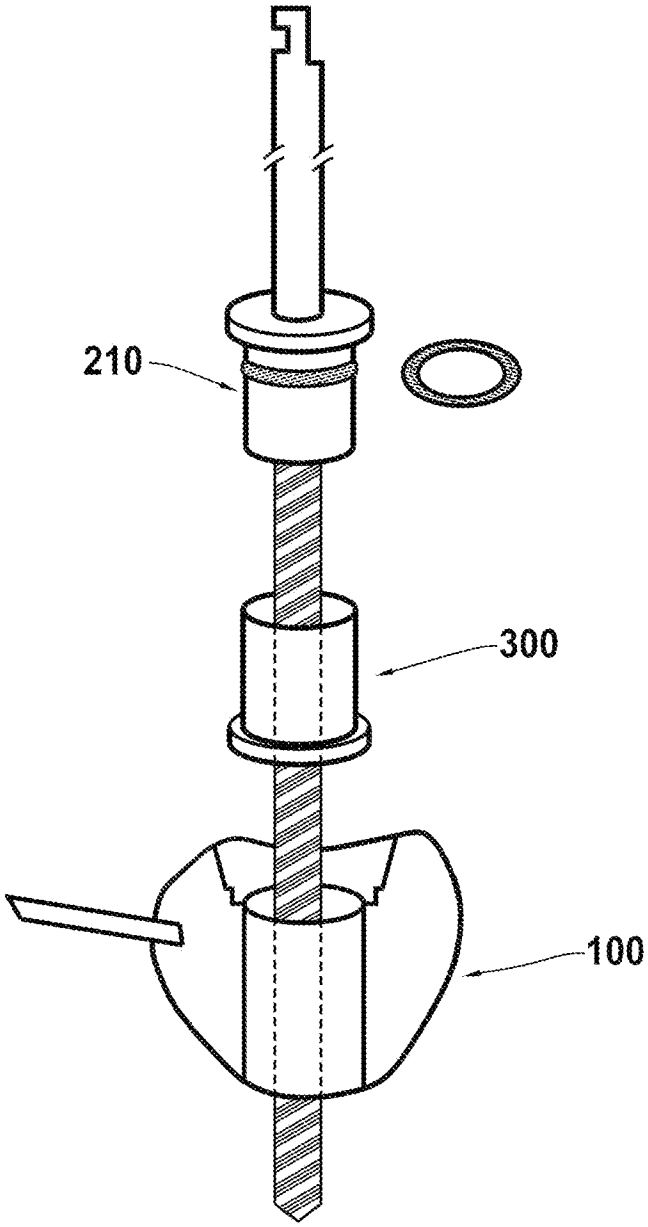

FIG. 6

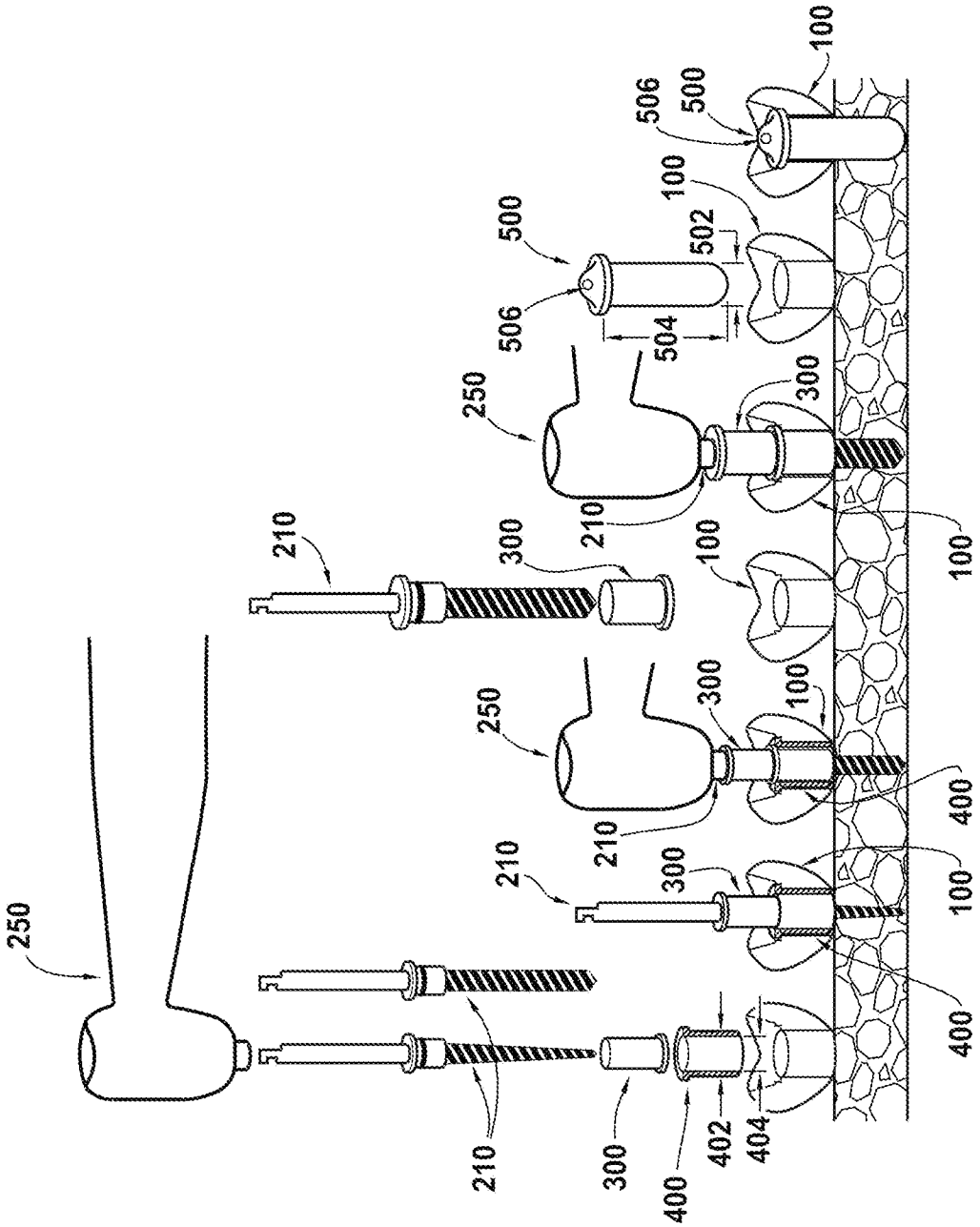
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FIG. 7

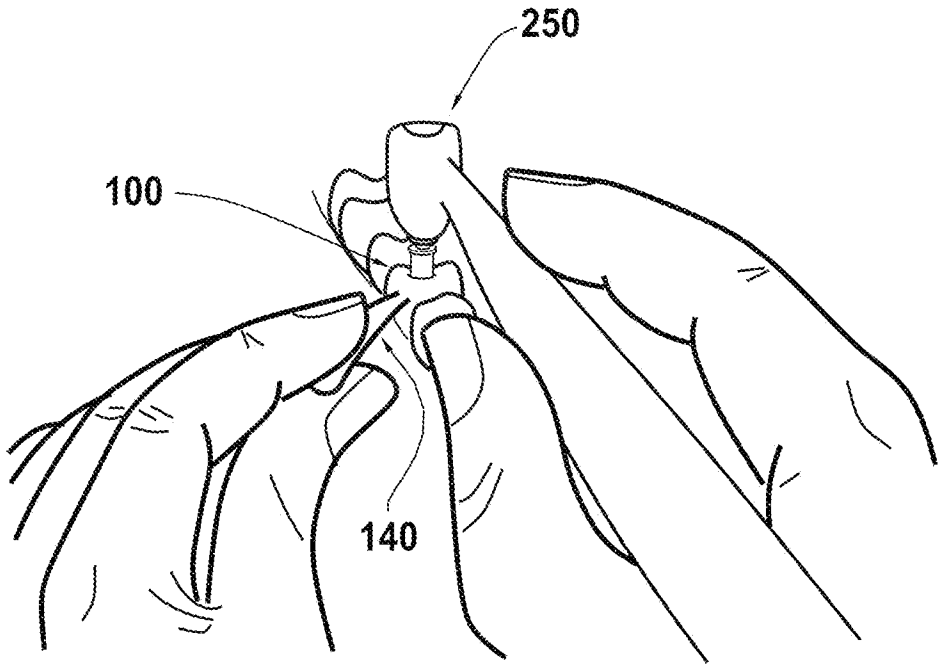

FIG. 8

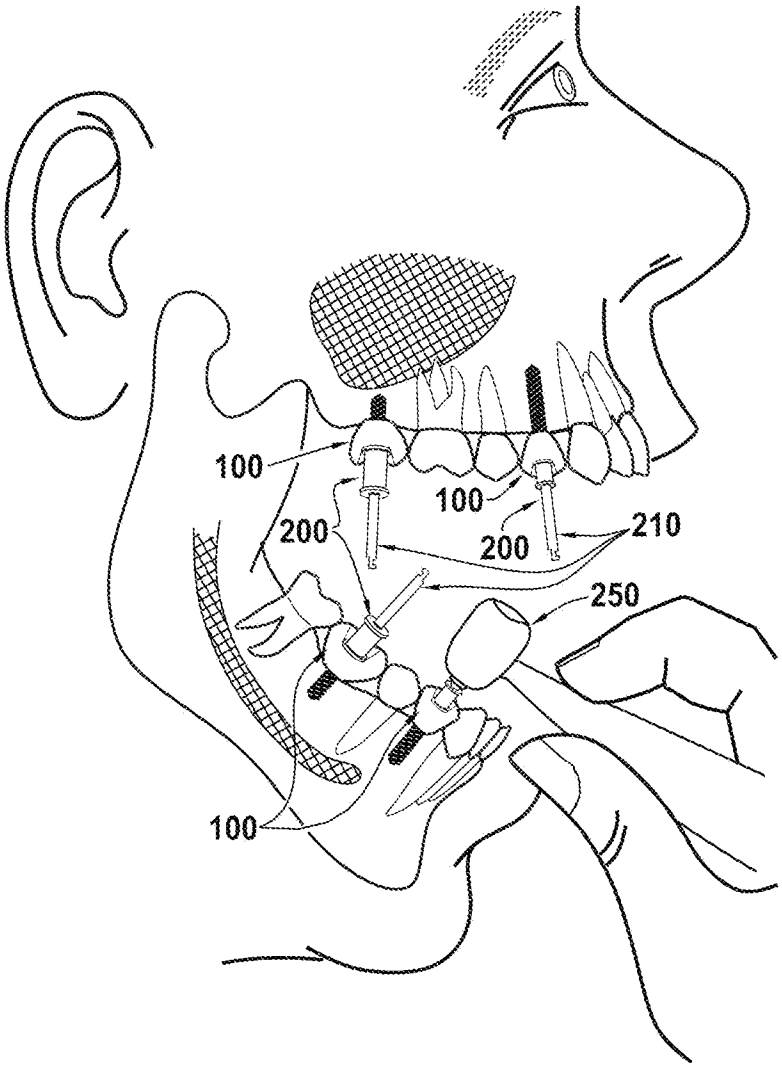

FIG. 9

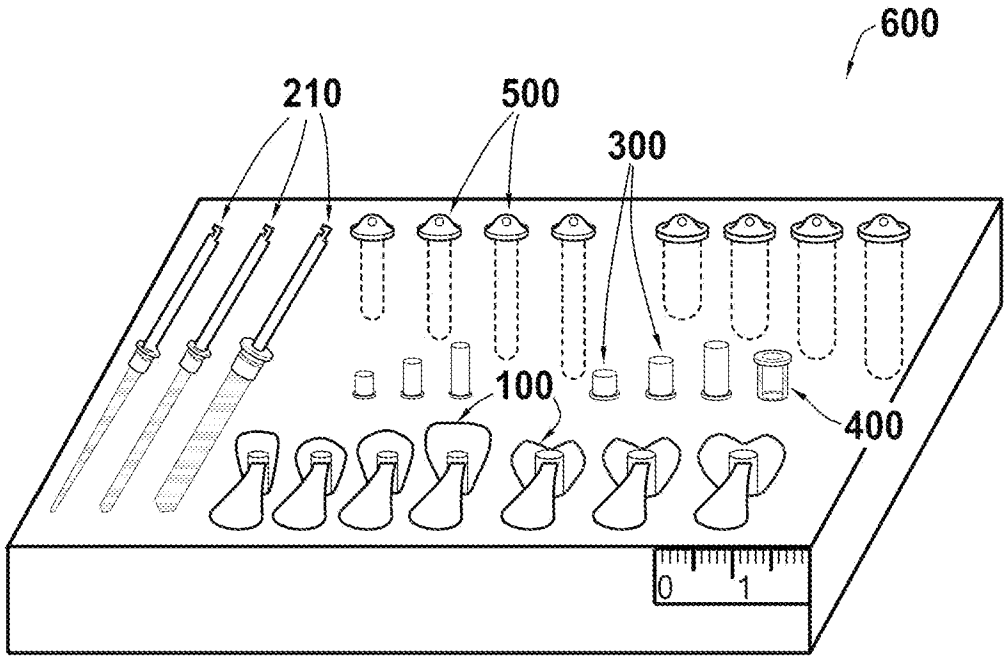

FIG. 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2018/021951

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - A61B 17/00; A61B 17/15; A61B 17/16; A61B 17/56; A61B 17/66; A61C 1/10 (2018.01)

CPC - A61C 1/082; A61B 17/15; A61B 17/1633; A61B 17/56; A61B 17/66; A61B 17/663; A61C 1/08; A61C 1/084; A61C 1/10; A61C 1/12; A61C 1/14; A61C 3/02; A61C 3/04; A61C 8/0027; A61C 8/0089; A61C 8/009 (2018.02)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

See Search History document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

USPC - 433/72; 433/74; 433/75; 433/77; 433/81; 433/82; 606/93; 606/96; 606/102; 606/104 (keyword delimited)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2009/0017418 A1 (GITTELSON) 15 January 2009 (15.01.2009) entire document	1-4, 6, 8-13
Y	US 2004/0265781 A1 (COATOAM) 30 December 2004 (30.12.2004) entire document	1-4, 6, 8-13
Y	US 2013/0023888 A1 (CHOI et al) 24 January 2013 (24.01.2013) entire document	2-4
Y	US 2015/0320516 A1 (BIOMET 3I, LLC) 12 November 2015 (12.11.2015) entire document	13
A	US 2005/0136374 A1 (CARMICHAEL et al) 23 June 2005 (23.06.2005) entire document	1-40
A	US 2008/0124672 A1 (SUSSMAN) 29 May 2008 (29.05.2008) entire document	1-40

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

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"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 April 2018	21 MAY 2018
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, VA 22313-1450 Facsimile No. 571-273-8300	Authorized officer Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774