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(54) **ORTHODONTIC ABUTMENT**

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(*) Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

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(51) **Int. Cl.**[7] **A61C 8/00**

(52) **U.S. Cl.** **433/173**; 433/24

(58) **Field of Search** 433/8, 23, 24, 433/173, 174, 180

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,836,890	*	6/1958	Silvis	433/174
3,028,671		4/1962	Berger .	
3,127,677		4/1964	Schachter .	

(List continued on next page.)

FOREIGN PATENT DOCUMENTS

2 425 842		1/1980	(FR) .	
9414388	*	7/1994	(WO)	433/174
WO 96/12451		5/1996	(WO) .	
96/19946		7/1996	(WO) .	

OTHER PUBLICATIONS

Salama, DMD, Henry, et al, The Role of Orthodontic Extrusive Remodeling in the Enhancement of Soft and Hard Tissue Profiles Prior to Implant Placement: A Systematic Approach to the Management of Extraction Site Defects, The International Journal of Periodontics & Restorative Dentistry, vol. 13, No. 4, 1993.

(List continued on next page.)

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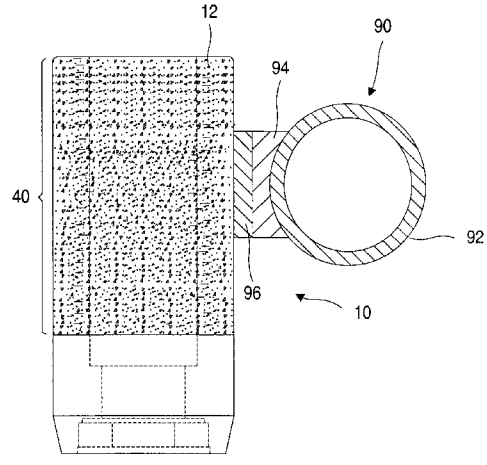
(57) **ABSTRACT**

An orthodontic abutment for attachment to a dental implant that is embedded living jawbone having overlying gingiva is set forth. The implant has a gingival surface exposed through the overlying gingiva. The orthodontic abutment is capable of receiving an orthodontic component. The orthodontic abutment comprises a generally cylindrical main body having a lower end for engaging the gingival surface of the implant and a supragingival end opposing the lower end for protruding above the overlying gingiva. The main body has an outer surface between the lower end and the supragingival end. The outer surface includes a roughened portion to which the orthodontic component is to be attached and a gingival portion for contacting the overlying gingiva. The gingival portion extends from the lower end for about 3 mm. The roughened portion typically extends 360° around a central axis of the main body and is preferably adjacent to the supragingival end.

42 Claims, 6 Drawing Sheets



U.S. PATENT DOCUMENTS

3,452,436		7/1969	DeWoskin .	
4,197,643		4/1980	Burstone et al. .	
4,522,596		6/1985	Ashkinazy .	
4,738,062		4/1988	Dickey .	
4,988,292		1/1991	Rosen .	
5,015,186	*	5/1991	Detsch	433/8
5,066,224		11/1991	Block et al. .	
5,071,345		12/1991	Rosen .	
5,082,442		1/1992	Rosen .	
5,141,435	*	8/1992	Lillard	433/176
5,232,364		8/1993	Rosen .	
5,407,359		4/1995	Balfour et al. .	
5,447,435	*	9/1995	Brodbeck	433/173
5,607,480	*	3/1997	Beaty	623/16
5,613,849	*	3/1997	Tanaka et al.	433/8

OTHER PUBLICATIONS

Douglass et al., "Dental Implants Used as Orthodontic Anchorage", *J. Oral Implantology* vol. XIII No. 1, 1987 28–35.

Shapiro et al., "Uses of Implants in Orthodontics", *Dental Clinics of North America* vol. 32 No. 3, Jul. 1988, 539–549.

Kraut et al., "Use of Endosteal Implants as Orthodontic Anchorage", *Compend Contin Educ Dent* vol. IX, No. 10, Nov./Dec. 1988, 796–801.

Van Noort, Richard. *Introduction to Dental Materials* Mosby/Times Mirror Internation Pub ltd., pp. 61–68, ©1994.*

* cited by examiner

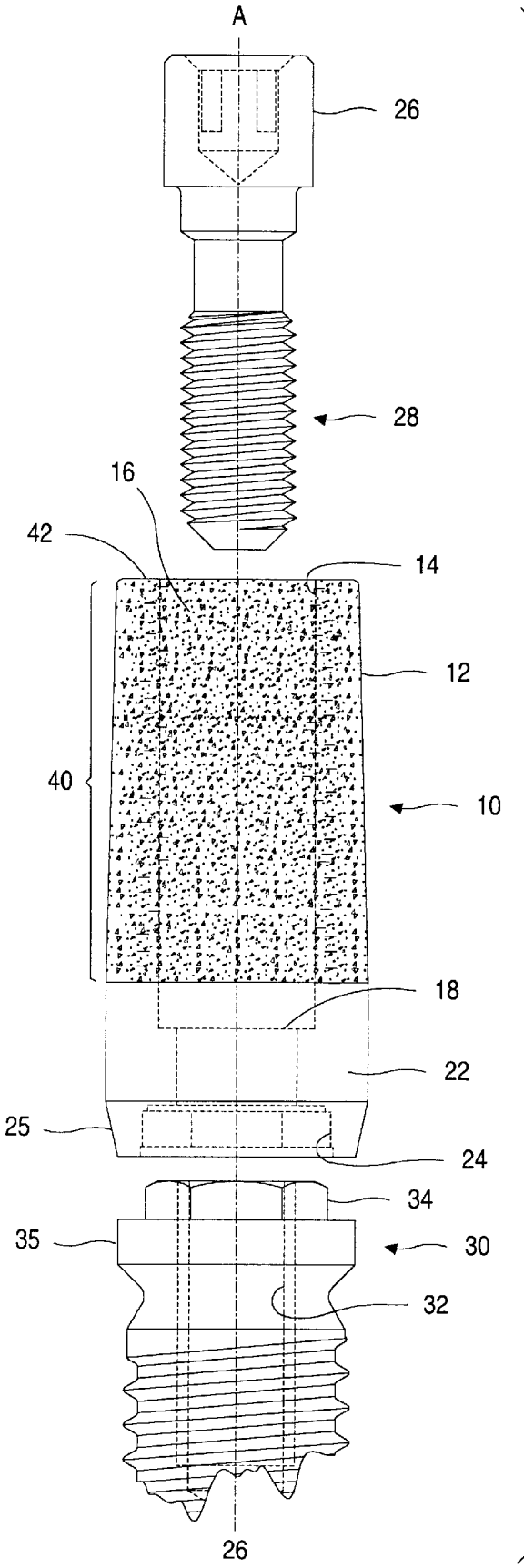


FIG. 1

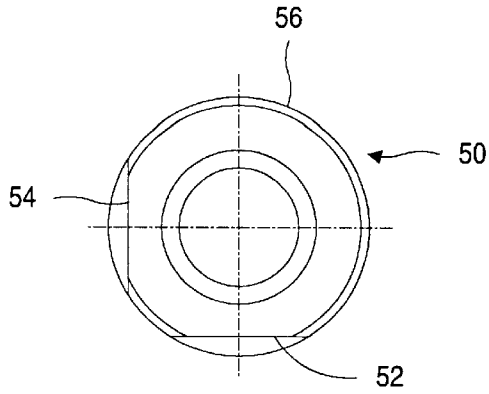


FIG. 2b

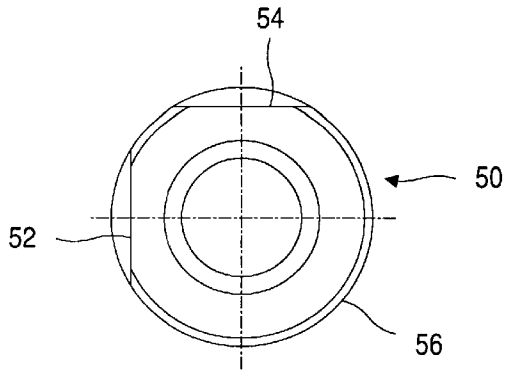


FIG. 3b

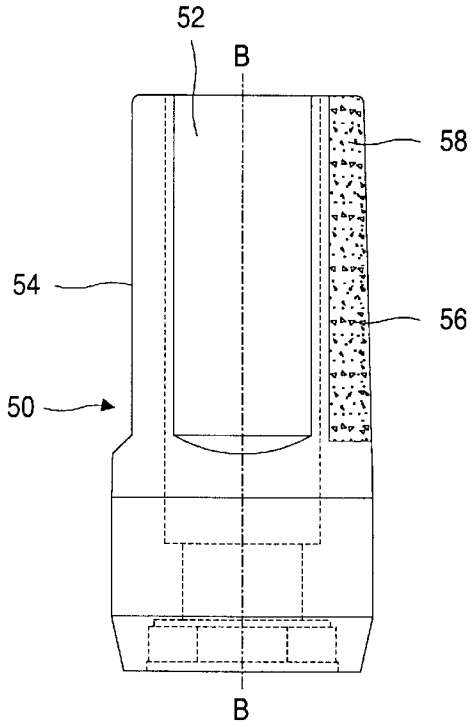


FIG. 2a

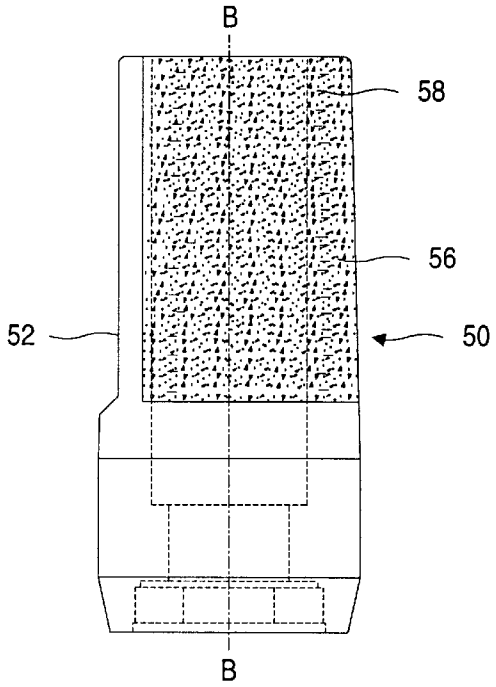


FIG. 3a

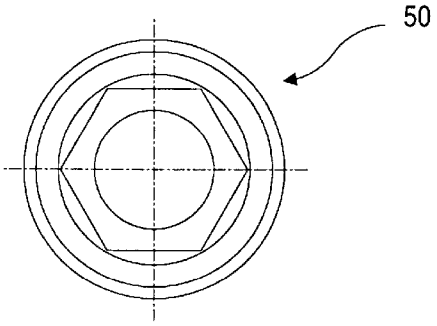


FIG. 2c

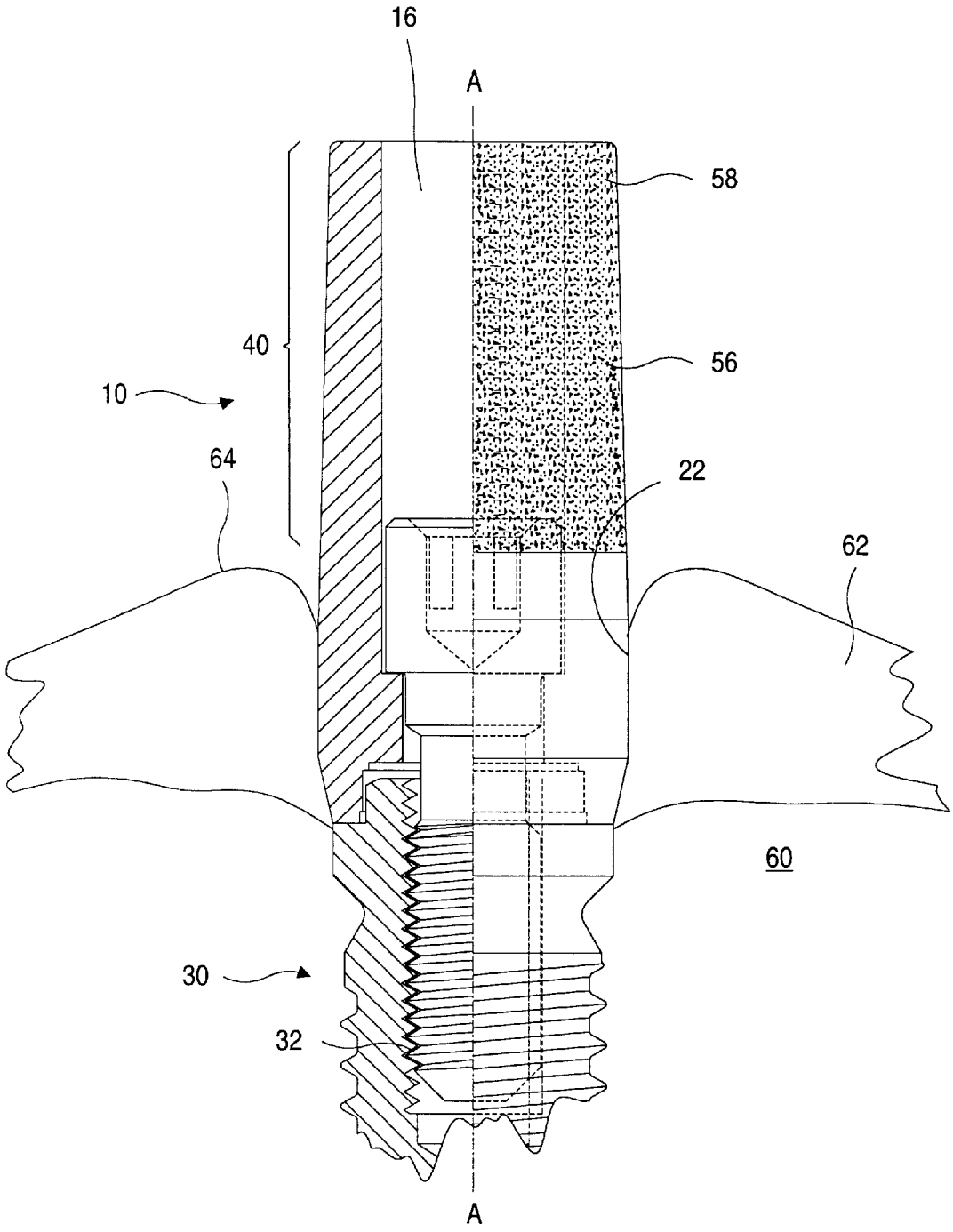


FIG. 4

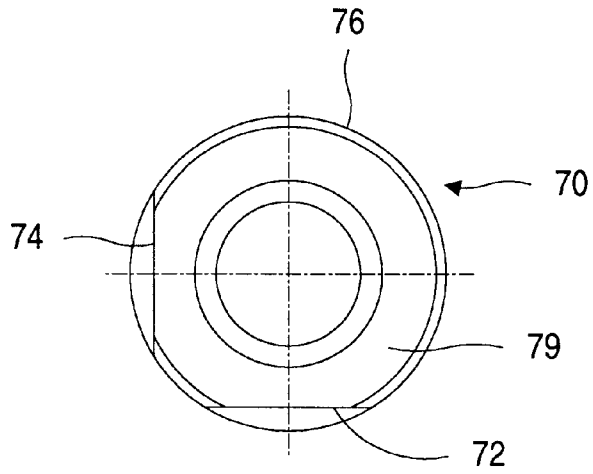


FIG. 5b

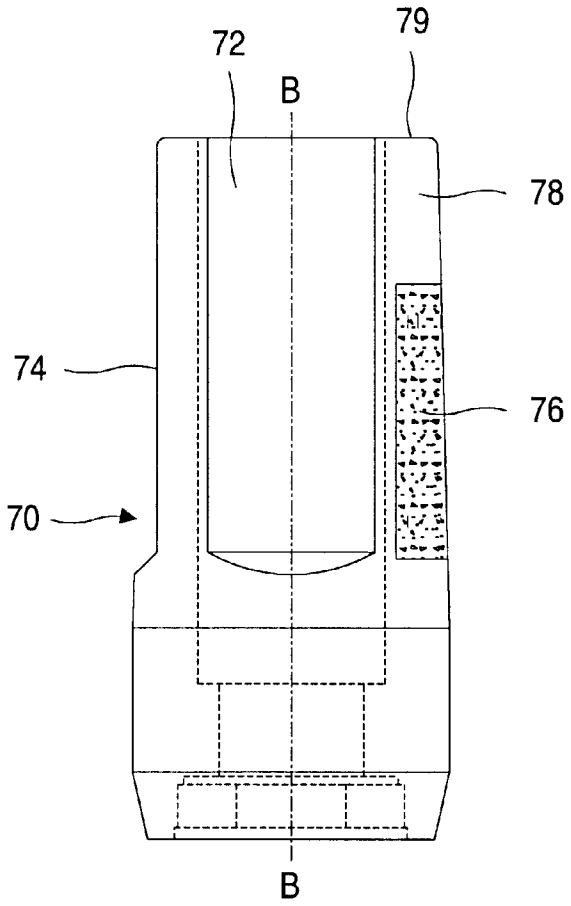


FIG. 5a

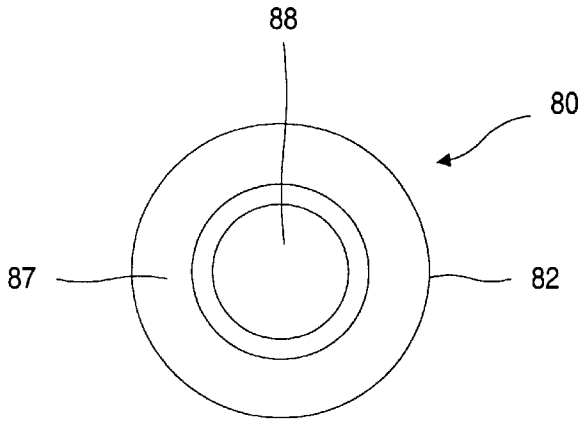


FIG. 6b

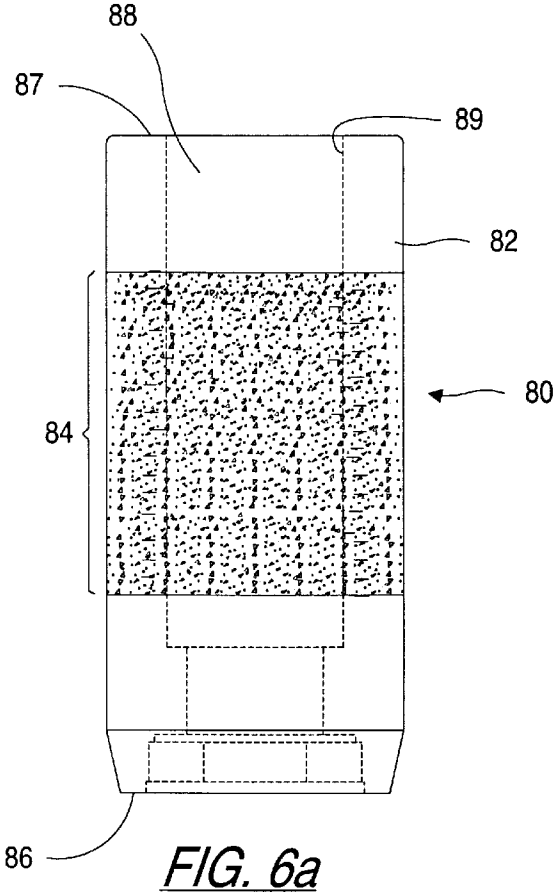


FIG. 6a

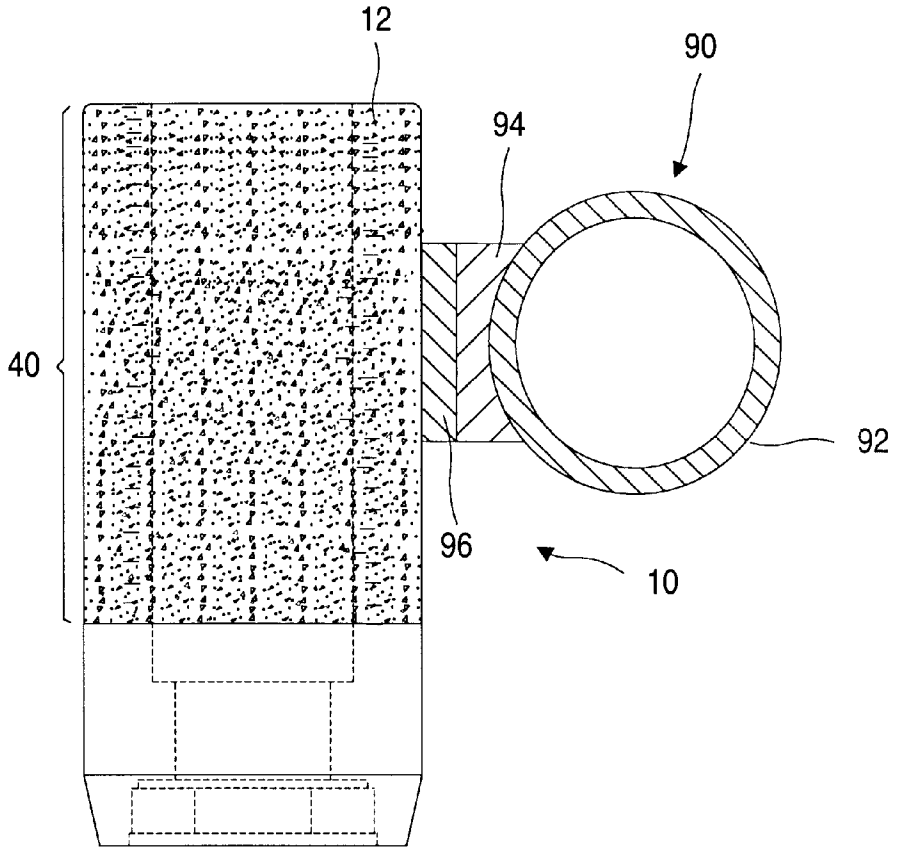


FIG. 7

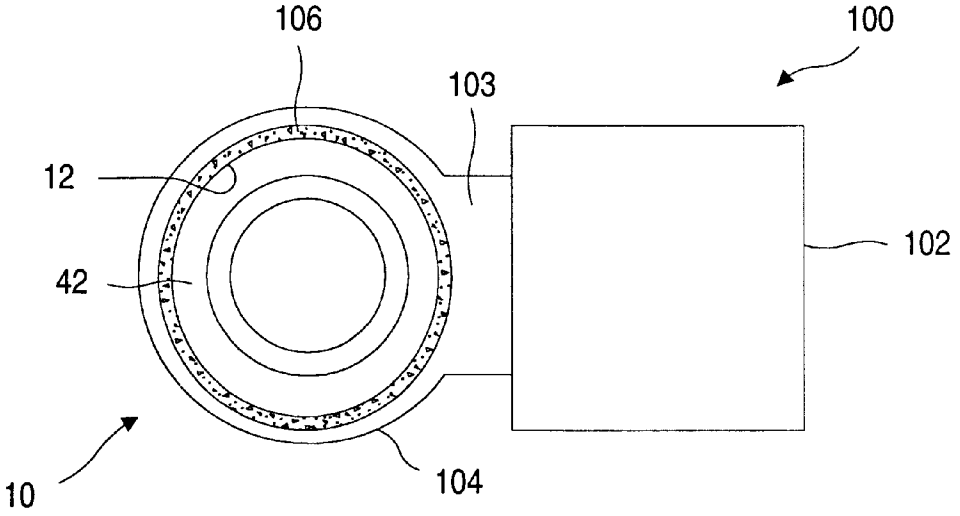


FIG. 8

ORTHODONTIC ABUTMENT

CROSS REFERENCES TO RELATED APPLICATIONS

This is a complete application claiming the benefit of copending provisional patent application Ser. No. 60/017,523, filed May 10, 1996.

FIELD OF THE INVENTION

This invention relates in general to the dental field of orthodontics and, more particularly, to an abutment for orthodontic anchorage to a dental implant which has osseointegrated with bone in a patient's mouth.

BACKGROUND OF THE INVENTION

In one class of systems used in orthodontic practice, arch-wires cooperating with brackets fixed to buccal surfaces of teeth are used to adjust the relative positions of teeth in a dental arch with appropriate forces applied over time to individual teeth in the arch. These wires are anchored at their ends to tubes, hooks and the like which are affixed to the patient's molars or other suitable teeth. Elastics and ligature threads are also used in orthodontics and these, too, cooperate with traction hooks and buttons affixed to the surfaces of a patient's teeth.

In cases where the patient is edentulous at the site where orthodontic anchorage is desired, an artificial root, notably an endosseous implant, with a suitable abutment attached, may provide support for orthodontic anchorage. It is known to attach molar bands to temporary crowns affixed to dental implants. The present invention discloses a new abutment to which molar bands and other orthodontic components may be directly attached, eliminating the need to construct a temporary crown.

SUMMARY OF THE INVENTION

A dental implant in the class of endosseous implants consists essentially of an elongated body implanted in the patient's mandible or maxillary and a socket for receiving a fitting or fittings which fix a prosthodontic restoration on the elongated body. Commonly, the socket is an internally-threaded bore. The restoration is then fixed to the implanted body with a screw threaded into the bore. Other forms of dental implants are in use and a wide variety of materials are used to make these implants. This invention is disclosed in connection with a typical endosseous implant as currently known to be the best mode of practice. It will be understood that the invention is not limited to the details of the illustrative embodiments of that implant. To the contrary, the invention is intended for use with any and all substitutes for natural root structures that are capable of providing the required anchorage, whether presently known or made available in the future.

Generally, according to the invention, an abutment (or post) which may be tubular in shape is fixed endwise to the implant so as to extend supragingivally through the overlying gingiva or mucosa. The tubular shape produces an internal bore in the abutment. The abutment is fastened to the implant with a screw that passes through the bore from the supragingival end to a shoulder within the bore on which the head of the screw rests.

The abutment is provided on its outer surface with a roughened surface. In a preferred embodiment, the roughened surface begins approximately 3 mm from the lower end which is seated on the implant so that there is about 3 mm

of smooth external surface confronting the overlying gingiva. Because the roughened surface begins above the gingiva, the chances of the abutment irritating the gingiva are reduced. This roughened surface may extend in a coronal or supragingival direction for approximately 5 mm. In a preferred embodiment, it extends to the supragingival end of the abutment which opposes the lower end seated on the implant The roughened surface may extend all around the abutment. Alternatively, the roughened surface may extend approximately 180 degrees around the abutment so long as the abutment can be oriented around its longitudinal axis to place the roughened surface at the appropriate location (i.e. typically buccal confronting location) desired by the orthodontist. Using the available "hex" interlock that is in wide use in systems employing endosseous implants, the abutment can be fixed on the implant in any axial orientation desired.

The roughened surface on the abutment should be sufficiently rough to allow direct bonding of an orthodontic band or an orthodontic component to the material of the abutment. This material is usually titanium or a dilute alloy of titanium as presently in widespread use in the practice of dental implantology.

This invention will be described in greater detail with reference to the accompanying drawings illustrating exemplary embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings:

FIG. **1** is an exploded side view of a dental implant, an abutment and an attaching screw;

FIG. **2**A is a side view of another embodiment of the abutment of the invention;

FIG. **2**B is a top view of FIG. **2**A;

FIG. **2**C is a bottom view of FIG. **2**A;

FIG. **3**A is a side view of the abutment in FIG. **2**A, turned 90 degrees clockwise around its longitudinal axis;

FIG. **3**B is a top view of FIG. **3**A;

FIG. **4** shows the components of FIG. **1** assembled in a site in the patient's mouth;

FIGS. **5**A and **5**B illustrate an alternative embodiment in which the roughened portion stops below the supragingival end of the abutment;

FIG. **6** is a side view of an alternative abutment which is similar to the embodiment of FIG. **1**;

FIG. **7** is a side view of the abutment of FIG. **1** with an orthodontic component attached thereto and shown in cross-section; and

FIG. **8** is a top view of the abutment of FIG. **1** with an orthodontic band attached therearound.

DETAILED DESCRIPTION OF THE DRAWINGS

In FIG. **1**, an abutment **10** is generally tubular in form, having an outer generally cylindrical surface **12** and an inner surface **14** surrounding a hollow space which is commonly referred to as a bore **16**. The bore **16** narrows to a smaller diameter near a lower portion **22** of the abutment **10** and provides a shoulder **18**. Below the shoulder **18** is a nonrotational socket **24** which is shown as hexagonal.

To attach the abutment **10** to an implant **30**, a head **26** of a screw **28** is engaged by a tool to screw the screw **28** into a receiving bore **32** of the implant **30**. The implant **30** and the abutment **10** are also fitted with an interlocking hexagonal boss **34** and socket **24** of known form for non-rotationally

connecting the abutment **10** to the implant **30** in a fashion that permits the abutment **10** to be fixed in one of several orientations around its longitudinal axis A—A on the implant **30**. A lowermost end **25** of the abutment **10** is tapered down in diameter to match the diameter of an uppermost, gingival end **35** of the implant **30** to provide a smooth transition from the implant **30** to the abutment **10** in the region of the abutment **10** that is under the gingiva (**62** in FIG. **4**).

A portion **40** on the outer surface **12** beginning approximately 3 mm from the lower-most end **25** and extending to or toward the coronal or supragingival end **42** of the abutment **10** is roughened surrounding the abutment **10**. This roughened portion **40** of the surface **12** can be roughened in any of several known ways, used singularly or in combination (e.g. grit-blasting, acid etching, plasma coating).

In one preferred embodiment which has been successful in producing a roughened portion **40** capable of bonding an orthodontic component thereon, a plasma-coating technique in which the surface **12** is first grit-blasted and then coated from a plasma of chemically-pure titanium particles is utilized. A mask can be used to prevent particles from impacting segments of the surface **12** outside of the portions of the surface **12** where the particles are to be deposited. One type of grit-blasting methodology is disclosed in U.S. Pat. No. 5,607,480 which is herein incorporated by reference. The size of the particles should be greater than about −60+100, and preferably about −80+200. A thickness of the plasma layer in this technique is in the range of approximately 0.004 inch to approximately 0.006 inch.

The bonding strength of the particles that is required to remove the plasma-coated layer from the body of abutment is typically in the range of about 7,000 psi to 10,000 psi. The roughness produced by the particles gives the roughened portion **40** of the surface **12** a feel like fine sandpaper.

The roughness needed for such bonding is greater than the roughness that is suitable for osseointegration of the implant in living bone. A roughness value in the range of about 700 to about 900 μ-inch RMS or greater produces acceptable results.

FIGS. **2**A and **3**A are two views of a second abutment **50** according to the invention which has two flattened sides **52** and **54**. The roughened portion **56** of the outer surface **58** extends less than all the way around the abutment **10** and does not include the flattened sides **52** and **54**. The roughened portion **56** extends at least 90 degrees around the abutment **50** and preferably extends approximately 180 degrees around the abutment **50**. In all other respects, the abutment **50** of FIGS. **2**A and **3**A is similar to the abutment **10** in FIG. **1**. As is disclosed in connection with FIG. **1**, the abutment **50** of FIGS. **2**A and **3**A can be fixed on the implant (not shown) in any of several desired angular positions around its longitudinal axis B—B to locate the roughened portion **56** at whatever location is desired by the orthodontist (typically the buccal confronting side). FIGS. **2**B and **2**C illustrate the abutment **50** in top views.

FIG. **2**C illustrates the bottom view of the abutment **50** which is the same as the bottom view of the abutment **10**. The hexagonal socket which mates with the hexagonal boss **34** (FIG. **1**) can be readily seen.

In FIG. **4**, the abutment **10**, implant screw **28** and implant **30** of FIG. **1** are shown assembled. The implant **30** is located in bone **60** with overlying gingival **62** surrounding the lower portion **22** of the abutment **10**. The roughened portion **40** begins above the gingival surface **64** of the overlying gingival **62**. Thus, the lower portion **22** can be considered a gingival portion since it is the surface which contacts the overlying gingiva **62**. This lower portion **22** is preferably smooth so that the overlying gingiva **62** in contact therewith is not irritated by a rough surface.

FIGS. **5**A and **5**B illustrate an alternative embodiment of the present invention.

An abutment **70** includes two flat portions **72** and **74** along its outer surface **78**. A roughened portion **76** is located in regions outside of the flat portions **72** and **74**. However, the roughened portion **76** is spaced from a supragingival end **79** by a redetermined distance. In other embodiments, it may be useful to provide a flat portion which is roughened through various ways (e.g. grit blast, acid etch, plasma-coating, etc.) so that an orthodontic component can be attached to a flat region as well.

Furthermore, if the orthodontic component includes a band which entirely surrounds the abutment, the band may have a corresponding flat portion or portions to resist the rotation of the band on the abutment. This will require a custom band to match the contour of the abutment. Furthermore, to provide accurate positioning of the orthodontic component in the patient's mouth, this also requires the boss of the implant to be properly aligned during its installation process since the position of the flat or flats (and, therefore, the orthodontic component) is aligned with the socket that mates non-rotationally on the boss of the implant.

FIGS. **6**A and **6**B illustrate a generally cylindrical orthodontic abutment **80** similar to abutment **10** in FIG. **1**. However the abutment **80** has an outer surface **82** with a roughened portion **84** that begins at an intermediate point between a lower end **86** and a supragingival end **87**. Typically, the roughened portion **84** preferably starts at least about 3 mm from the lower end **86**. In this embodiment, the roughened portion **84** of the outer surface **82** terminates below the supraginginval end **87**. A bore **88** for receiving a screw extends through the main body of the abutment **80** and is defined by an inner surface **89**.

FIG. **7** illustrates the abutment **10** of FIG. **1** with an orthodontic component **90** (in cross-section) attached along the roughened portion **40** of the outer surface **12**. As shown, the orthodontic component **90** is a molar tube for receiving orthodontic wire. The component **90** includes a cylindrical portion **92** (circular in cross-section) which is attached to a base portion **94**. The base portion **94** is bonded directly on the roughened portion **40** by an adhesion material **96**. The adhesion material **96** can be one of many kinds of typical materials commonly used to bond orthodontic components to natural tooth. One example is the material known as the Phase II composite from Reliance Orthodontics Inc.

FIG. **8** illustrates the abutment **10** of FIG. **1** in a top view with an alternative orthodontic component **100** being attached thereto below the supraginigival end **42**. The orthodontic component **100** includes a cylindrical portion **102** (rectangular from the top view) which is attached to a base portion **103**. The base portion **103** is further coupled to a band **104** which surrounds the entire abutment **10**. The band **104** is attached to the outer surface **12** of the abutment **10** (at the roughened portion **40** which is not shown) with an adhesion material **106**. As stated above, the adhesion material **106** may be one of many types of common materials currently used to attach orthodontic components to natural teeth.

The present invention also contemplates the use of a set of orthondontic abutments provided to the orthodontist. The abutments in the set have varying characteristics such as height, diameter in the roughened portion, or possibly

roughness. For example, a set may include abutments having diameters of 4 mm, 5 mm, and 6 mm through the roughened portion. Alternatively, the set may include abutments which have various diameters at their lower ends that mate with the implant so as to accommodate implants of varying widths (e.g. 3.75 mm, 4.25 mm, and 5.0 mm).

Referring again to FIGS. **1**, **4**, **7** and **8**, the abutment **10** is mounted onto an implant **30** which has osseointegrated with the host bone. When the implant **30** is used for restoration purposes, the osseointegration stage is typically followed by a gingiva-healing stage whereby a healing component is placed on the implant **30** and the overlying gingiva is permitted to heal therearound. In the case where the implant **30** is used as the anchorage device for the orthodontic abutment **10**, the use of the healing component is not necessary as the gingiva can simply grow around the smooth, lower portion **22** of the abutment **10**. However, if desired, a healing abutment, which preferably matches the intra-gingival contour of the lower portion **22** of the abutment **10**, may be mounted on the implant **30** before installing the orthodontic abutment **10**.

The orthodontic component can be directly bonded to the abutment **10** in the patient's mouth. Alternatively, the abutment **10** can be mounted onto the implant **30** in the patient's mouth, marked for alignment purposes, and removed from the patient's mouth. The orthodontic component can then be attached to the abutment **10** outside the patient's mouth at the marked location and subsequently mounted on the implant **30**.

After the abutment **10** has been installed on the implant **30**, the bore **16** is filled with a common material (e.g. soft composites) which can be removed at a later time to access the implant screw **28**. Furthermore, the orthodontist may decide to remove a portion of the abutment **10** not attached to the orthodontic component to ensure a proper bite. This can be done in the same manner as commonly performed on posts which are coupled to a prosthetic tooth.

Upon completion of the orthodontic therapy, the abutment can be removed and the underlying implant **30** can be used for a conventional restoration. Alternatively, the abutment can be converted for use as an abutment in that restoration which may, for example, be the structure for holding the ceramic material used for the prosthetic tooth. It will be understood that abutments according the invention can be provided with features of abutments intended for use as part of the procedure for making a temporary or permanent restoration. Conversely, the present invention encompasses modifying conventional abutments to endow them with the features of the invention.

While the present invention has been described with reference to one or more preferred embodiments, those skilled in the art will recognize that many changes may be made thereto without departing from the spirit and scope of the present invention which is set forth in the following claims.

What is claimed is:

1. An orthodontic abutment for attachment to a dental implant that is embedded in living jawbone having overlying gingiva, said implant having a gingival surface with a non-round fitting that is accessible through said overlying gingiva, said orthodontic abutment capable of receiving various types of orthodontic components each having a different size of adhesive-bonding area, said orthodontic abutment comprising:

a unitary main body having a lower end with means for non-rotationally engaging said non-round fitting on said gingival surface of said implant, a supragingival end opposing said lower end for protruding above said overlying gingiva, and an outer surface between said lower end and said supragingival end, said outer surface including a roughened portion extending at least about 90° around a central axis of said main body for receiving said various types of said orthodontic components, said roughened portion extending from substantially said supragingival end to an intermediate position no closer than about 3 mm from said lower end, said roughened portion having an area that is larger than said adhesive-bonding area of at least one of said orthodontic components, said roughened portion of said outer surface for being in a fixed relationship with respect to said dental implant due to the cooperation of said non-round fitting and said non-rotational engaging means of said lower end; and

means for securing said unitary body to said dental implant.

2. The orthodontic abutment of claim **1**, wherein said outer surface is smooth from said intermediate position to said lower end.

3. The orthodontic abutment of claim **1**, wherein said outer surface includes at least one flat area between said lower end and supragingival end such that a periphery of said unitary main body has a non-round shape when viewed in cross-section, said roughened portion being positioned outside of said at least one flat area.

4. The orthodontic abutment of claim **1**, wherein said outer surface is cylindrical.

5. The orthodontic abutment of claim **4** wherein said roughened portion extends 360° around said central axis of said main body.

6. The orthodontic abutment of claim **1**, wherein said securing means includes a screw.

7. The orthodontic abutment of claim **6**, wherein said main body includes a through-bore for receiving said screw that secures said main body to said implant.

8. The orthodontic abutment of claim **1** in combination with an orthodontic component, wherein said orthodontic component is attached to said roughened portion of said outer surface along one segment of a 360° revolution around said central axis of said main body.

9. The orthodontic abutment of claim **1** in combination with an orthodontic component, wherein said orthodontic component is attached to said roughened portion of said outer surface along an entire 360° revolution around said central axis of said main body.

10. The orthodontic abutment of claim **1**, wherein said roughened portion has a roughness in the range of about 700 to about 900 μ-inch RMS.

11. The orthodontic abutment of claim **1**, wherein said outer surface includes a smooth gingival portion for contact with said overlying gingiva, said gingival portion being adjacent to said lower end.

12. The orthodontic abutment of claim **11**, wherein said gingival portion is adjacent to said roughened portion.

13. The orthodontic abutment of claim **11**, wherein at least a segment of said gingival portion tapers outwardly from said lower end.

14. The orthondontic abutment of claim **1**, wherein said body is modifiable by a clinician at chairside.

15. An orthodontic abutment for attachment to a dental implant that is embedded in a living jawbone having overlying gingiva, said implant having a non-round fitting that is accessible through said overlying gingiva, said orthodontic abutment capable of receiving an orthodontic component, said orthodontic abutment comprising:

a main metallic body having a lower end with means for engaging said non-round fitting of said implant, a supragingival end opposing said lower end for protruding above said overlying gingiva, and an outer surface between said lower end and said supragingival end, said outer surface including a smooth gingival portion extending from said lower end toward said supragingival end for at least about 3 mm, said outer surface further having a plasma-coated portion between said smooth gingival portion and said supragingival end; and

means for securing said main body to said dental implant.

16. The orthodontic abutment of claim **15**, wherein said plasma-coated portion extends from said supragingival end to an intermediate position between said lower end and said supragingival end.

17. The orthodontic abutment of claim **15**, wherein said main body is made of titanium and said plasma-coated portion is produced by plasma spraying titanium particles.

18. The orthodontic abutment of claim **17**, wherein said titanium particles have a size of about −80+200.

19. The orthodontic abutment of claim **17**, wherein said titanium particles have a size greater than −60+100.

20. The orthodontic abutment of claim **17**, wherein said plasma-coated portion is approximately 0.004 inch to about 0.006 inch in thickness.

21. The orthodontic abutment of claim **15**, wherein said plasma-coated surface extends 360° around said central axis of said main body.

22. The orthodontic abutment of claim **15**, wherein said plasma-coated portion is spaced away from said supragingival end.

23. The orthodontic abutment of claim **15**, wherein said plasma-coated portion has a roughness greater than about 700 μ-inch RMS.

24. The orthodontic abutment of claim **23**, wherein said roughness is less than about 900 μ-inch RMS.

25. The orthodontic abutment of claim **15**, wherein said plasma-coated portion includes a plasma layer that is attached to said main body with a bonding strength in the range from about 7,000 psi to about 10,000 psi.

26. The orthondontic abutment of claim **15**, wherein said body is modifiable by a clinician at chairside.

27. A method for providing an orthodontic anchor in a mouth comprising the steps of:

installing a dental implant in a jawbone of said mouth where said orthodontic anchor is needed;

allowing said implant to osseointegrate with said jawbone;

providing a unitary orthodontic abutment having an integal outer surface with a roughened portion extending entirely around said outer surface;

installing said orthodontic abutment on said implant in a manner which retains said roughened portion of said outer surface in a fixed position relative to said dental implant; and

attaching an orthodontic component to said roughened portion of said orthodontic abutment with an adhesive compound.

28. The method of claim **27**, further including the step of removing a portion of said orthodontic component to ensure a proper bite.

29. The method of claim **27**, wherein said step of attaching an orthodontic component occurs after said step of installing said orthodontic abutment so that said compound is applied in said mouth.

30. The method of claim **27**, wherein said step of attaching an orthodontic component precedes said step of installing said orthodontic abutment so that said compound is applied outside said mouth.

31. An orthodontic abutment for attachment to a dental implant that is embedded living jawbone having overlying gingiva, said implant having a gingival surface exposed through said overlying gingiva, said orthodontic abutment capable of receiving an orthodontic component, said orthodontic abutment comprising:

a generally cylindrical main body having a lower end for engaging said gingival surface of said implant and a supragingival end opposing said lower end for protruding above said overlying gingiva, said lower end including a non-rotational fitting to be mated with a corresponding non-rotational fitting on said implant, said main body further including a through-bore for receiving a screw that secures said main body to said implant; and

an outer surface between said lower end and said supragingival end, said outer surface including a plasma-coated portion to which said orthodontic component is to be attached and a gingival portion for contacting said overlying gingiva, said gingival portion extending from said lower end for about 3 mm, said plasma-coated portion extending 360° around a central axis of said main body and being adjacent to said supragingival end, said plasma-coated portion being from approximately 0.004 inch to approximately 0.006 inch in thickness.

32. The orthondontic abutment of claim **31**, wherein said body is modifiable by a clinician at chairside.

33. An orthodontic abutment for attachment to a dental implant that is embedded in living jawbone having overlying gingiva, said implant having a gingival surface with a non-round fitting that is accessible through said overlying gingiva, said orthodontic abutment being capable of receiving an orthodontic component, said orthodontic abutment comprising:

a unitary titanium main body having a lower end with a fitting for non-rotationally engaging said non-round fitting on said gingival surface of said implant and a supragingival end opposing said lower end for protruding above said overlying gingiva;

an outer surface between said lower end and said supragingival end, said outer surface including a roughened portion extending at least about 90° around a central axis of said main body, said roughened portion being adjacent to said supragingival end and at least about 3 mm from the lower end, said roughened portion having a roughness of greater than 700 μ-inch RMS, said outer surface further having a smooth gingival portion for contacting said overlying gingiva; and

means for securing said unitary body to said dental implant.

34. The orthodontic abutment of claim **33**, wherein said roughened surface is a plasma-coated surface.

35. The orthondontic abutment of claim **32**, wherein said body is modifiable by a clinician at chairside.

36. An orthodontic abutment for attachment to a dental implant installed in living jawbone having overlying gingiva, said implant having a first non-round fitting, said orthodontic abutment comprising:

a lower end;

a second non-round fitting adjacent to said lower end for mating with said first non-round fitting of said implant;

a supragingival end opposing said lower end for protruding beyond said overlying gingiva;

an outer surface between said lower end and said supragingival end, said outer surface including a roughened portion extending at least about 90° around a central axis of said orthodontic abutment, said roughened portion extending from substantially said supragingival end to an intermediate position on said outer surface no closer than about 3 mm from said lower end, said roughened surface being in a fixed relationship with respect to said second non-round fitting; and

means for securing said unitary body to said dental implant.

37. The orthodontic abutment of claim **36**, wherein said outer surface includes at least one flat area between said lower and supragingival ends, said roughened portion being positioned outside of said at least one flat area.

38. The orthodontic abutment of claim **36**, wherein said outer surface is generally cylindrical.

39. The orthodontic abutment of claim **36**, wherein said roughened portion extends 360° around said central axis of said main body.

40. The orthodontic abutment of claim **36**, wherein said roughened portion has a roughness in the range of about 700 to about 900 μ-inch RMS.

41. The orthodontic abutment of claim **36**, wherein said outer surface includes a smooth gingival portion for contact with said overlying gingiva, said gingival portion being adjacent to said lower end.

42. The orthodontic abutment of claim **36**, wherein said roughened portion is a plasma-coated surface.

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