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(54) Abutment for a dental implant

Stütze für ein Dentalimplantat

Butée pour implant dentaire

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(73) Proprietor: **Nordin, Peter**
1822 Chernex (CH)

(72) Inventors:
- **Nordin, Harald**
  1822 Chernex (CH)
- **Nordin, Peter**
  1822 Chernex (CH)

(74) Representative: **AMMANN PATENTANWÄLTE AG**
Schwarztorstrasse 31
3001 Bern (CH)

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Description

[0001] The invention relates to an abutment for connecting a dental prosthesis to a dental implant, the abutment comprising a body portion for supporting the dental prosthesis and a contact surface apical to said body portion for contacting the dental implant.

[0002] Prosthodontic restorations replacing a natural tooth in a patient's dentition are commonly fixed on a dental implant that is surgically implanted into the patient's jawbone. Typically, since the early work of Per-Ingvar Branemark of Sweden in 1952, such an implant consists of a titanium screw which resembles a tooth root and comprises a roughened or smooth surface. The majority of dental implants are made out of pure titanium, which is commercially available in four grades depending upon the amount of contained carbon and iron.

[0003] An abutment is usually anchored at the coronal end of the dental implant. A dental prosthesis, such as a crown, a fixed bridge retainer or a removable denture, can be attached on the abutment serving as an interface between the dental prosthesis and the dental implant. The abutment is typically held in place with a screw. Abutments can be custom-made in a dental laboratory or purchased as a prefabricated part from a dental implant supplier.

[0004] Current abutments are typically made of titanium, stainless steel, gold or ceramic. All these materials have the disadvantage of being too stiff and brittle as compared to the natural dentine they are supposed to replace and mimic. In consequence, the masticatory stresses exerted on the artificial tooth structure cannot be adequately absorbed. This leads to a number of undesirable side effects including an unnatural feeling of pressure while chewing, increased bruxism, and an increased risk of breakage of the artificial tooth structure. Another disadvantage lies in the different refractive index of these materials as compared to the enamel and dentine of a natural tooth, resulting in an unnatural and unaesthetic appearance of the replacement structure. Moreover, these materials are difficult to rework, in particular to cut or grind or trim. In consequence, they are usually fabricated in specific standardized shapes which complicates an individual adaption to the shape of crown or bridge restorations.

[0005] DE 20 2010 008 938 U1 discloses a post having an implant post body made of resin and provided with a connection part at an outer circumference. The implant post body includes a set of fibers. Fiber bars e.g. glass fiber bars, quartz optical fiber bars, carbon fiber bars and glass optical fiber bars, are arranged in the implant post body and run via the implant post body and are fastened to the post body, where each fiber bar has a connecting end and a free end.

[0006] US 20060208393 discloses a formable fiber-reinforced composite which comprises an inner core and an outer sheath. The inner core comprises longitudinally extending fibers. The outer sheath comprises braided or woven fibers. The fibers have been treated to release the memory. The fibers are impregnated with a resin matrix material .

[0007] EP 1 319 375 discloses an implant pin formed by embedding in an epoxy resin matrix a bundle of fibers of carbon or Kevlar, quartz, glass or other suitable material. Said bundle is formed by fibers that are straight and parallel to the axis of the pin. The pin can be inserted into the cavity of a dental implant.

[0008] US 20090123891 discloses a system having a resin abutment member engageable with an implant fixture. Replacement tooth prosthesis is engaged with the abutment member. The member is chemically compatible with the composite resin material e.g. bis-GMA material, of the replacement tooth prosthesis.

[0009] US 5 328 372 discloses a physiological dental securing peg of composite material which is adapted to be inserted into a root canal. It is an object of the present invention to avoid at least one of the above mentioned disadvantages and to provide an improved abutment which allows an adjustment of the tooth restoration structure to properties of a natural tooth. This object is achieved with an abutment comprising the features of patent claim 1. Advantageous embodiments of the invention are defined by the dependent claims.

[0010] Accordingly, the invention suggests that the abutment is composed of a resin that is reinforced with fibers substantially extending over the total length of the body portion towards the contact surface with the dental implant. The proposed material composition of the abutment allows to mimic the properties of natural dentine in a number of ways, in particular with respect to the modulus of elasticity and/or the refractive index. Such a material can also provide an excellent biocompatibilty of the abutment. Moreover, the shape and size of the abutment can be easily reworked, even after its application on a dental implant, since the proposed material can be trimmed or cut similar to natural dentine.

[0011] Despite its smooth workability, a high flexural strength of the body portion can be achieved, in particular in the range of 1500 MPa or higher, due to the continous longitudinal arrangement of the fibers. Thus, the abutment can be highly resistant against fracture, bending or rupture and can provide a long durability.

[0012] Generally, a number of different materials of the fiber and/or resin constituents of the abutment are conceivable. For instance, the material of the resin may be selected from methyl metacrylate (MMA), urethane dimethacrylate (UDMA), bisgma, epoxy, peek optima, polyester, polyvinyl ester or a mixture thereof. The material of the fibers is glass. Advantageously, the individual properties of these materials and of their relative composition can be exploited to adapt the abutment with respect to the specific requirements of the respective dental structure to be replaced.

[0013] In order to reduce the risk of breakage of the abutment, said body portion preferably exhibits a modulus of elasticity of at least 10 GPa and at most 50 GPa.

In this way, the elastic properties of natural dentine can be imitated.

[0014] The longitudinal extension of the fibers within the resin is exploited in such a way, that an anisotropic modulus of elasticity is achieved within the body portion. Thus, the body portion preferably exhibits a modulus of elasticity that varies in dependence of the direction of a force applied on the body portion with respect to the orientation of a longitudinal axis extending in the apical direction of the body portion. In this way, the inherent properties of the natural two-layer system between the enamel and the dentine can be further assimilated.

[0015] More precisely, an anisotropic behavior of the modulus of elasticity of natural enamel and dentine has been reported in various scientific studies. Such an anisotropic behavior of at least one layer of a multilayered biological system is believed to contribute to a protection against breakage or rupture of the system. Advantageously, the abutment according to the invention can be used to mimic the anistropic elastic modulus of one layer of such a natural system.

[0016] The modulus of elasticity is lower for a force applied perpendicular to the longitudinal axis of the abutment as compared to a force applied in parallel with respect to its longitudinal axis. In this way, a homogenous and therefore predictable behavior can be achieved over the whole length of the body portion of the abutment.

[0017] The fiber content is chosen in such a way, that a variation of the elastic modulus of at least 10 GPa, more preferred at least 30 GPa is achieved. Furthermore, the fiber content is preferably chosen in such a way, that a variation of the elastic modulus of at most 100 GPa, more preferred at most 40 GPa is achieved. More specifically, the modulus of elasticity preferably varies in between a value of at most 20 GPa for a force applied perpendicular to said longitudinal axis and a value of at least 30 GPa for a force applied in parallel with respect to said longitudinal axis.

[0018] Various possibilities of the arrangement of the fibers within the resin are conceivable. According to a first preferred configuration, at least part of said fibers are substantially uniformly directed in parallel with respect to a longitudinal axis of said body portion. According to a second preferred configuration, at least part of said fibers are arranged in the manner of a braided netting in a biaxial or multiaxial orientation. Such an arrangement of the fibers can further contribute to improve the flexural strength of the abutment. In particular, an arrangement of the fibers can be applied as described in patent application No. EP 1 078 608 A1.

[0019] The composition of the abutment comprises a resin that is derived from at least one methacrylate monomer, in particular methyl methacrylate (MMA) and/or urethane dimethacrylate (UDMA). Besides a high biocompatibility, an excellent bonding interaction between the abutment and the prosthetic structure can be expected from this material selection due to a chemical composition that resembles currently used composite resin cements that are used for fixing prosthetic devices in dentistry.

[0020] To provide an abutment that optically resembles to the properties of natural dentine, in particular to render the abutment aesthetically more pleasing, the fibers are preferably constituted by glass fibers. For instance, E glass, S glass and/or AR Glass fibers are conceivable for that purpose. To further assimilate the abutment to the optical properties of natural dentine, mineral particles are preferably embedded in said resin, wherein the content by volume of said mineral particles is matched in such a way that the index of refraction of said body portion is in between 1.3 and 1.8, more preferred in between 1.4 and 1.6. Most preferred, an index of refraction in between 1.50 and 1.55 is achieved by an appropriate composition of said resin, fibers and mineral particles in order to closely imitate the appearance of natural dentine.

[0021] In use, a basic prerequisite of the abutment is its radiopacity to allow a dentist to monitor the artificial tooth structure by X-ray analysis. In order to provide this property of the abutment, X-ray absorbing particles are preferably embedded in said resin, said X-ray absorbing particles being selected from a chemical compound comprising an element of an atomic number of at least 37, more preferred at least 57. Advantageously, the X-ray absorbing particles may be provided in the form of mineral particles for matching the refractive index of said body portion, as described above. Preferably, particles selected from an ytterbium compound are employed for this purpose, in particular ytterbium flouride and/or ytterbium oxide.

[0022] In order to achieve the above described properties with respect to an adaption of the abutment to natural dentine and by still ensuring a high flexural strength of the abutment, a fraction of at least 40% in volume of the total content of said body portion is constituted by said fibers. More preferred, the fiber content represents ideally at least 70% of the total volume, more preferred about 80% of the total volume. This material exceeds currently used abutment materials with respect to its fatigue properties under repeated stress, in particular by at least a factor of five. A further improvement of the flexural strength and the elastic properties of the abutment can be achieved by pretensing the fibers during the manufacturing process, in particular by a tension force of at least 100 N, more preferred at least 300 N. Such a tensioning of the fibers can be advantageously implemented during a fabrication process that is carried out by means of pultrusion.

[0023] In order to improve the bonding interaction between the fibers and the resin, the circumferential surface of the fibers is preferably covered with a coupling agent, in particular silane, for enhancing the adhesion of said fibers to the resin. On the one hand, such a treatment of the fibers contributes to increase the interlaminate shear strength (ISS) of the abutment. In this way, an ISS-value of at least 80 MPa, in particular about 90 MPa or higher, can be achieved, resulting in a further improvement of the fatigue properties under repeated stress. On the other hand, a delamination of the abutment can be effectively avoided, in particular during a reworking of the prefabricated abutment shape, for instance by grinding or cutting the suface of the body portion by means of diamond burs or discs. This advantageously allows to adapt the shape of the abutment to specific local requirements, even after it is fixed on a dental implant that is anchored in a jawbone.

[0024] Preferably, the shape of the body portion is substantially symmetrical with respect to a longitudinal axis of the abutment. In particular a cylindrical, cylindro-conical, conical, spherical or hyperbolic shape or a combination thereof is conceivable. More preferred, the body portion has a substantially hyperbolic form. Such a hyperboloid may be geometricaly described in a x-y-z coordinate system by the general equation $x^2/a^2 + y^2/b^2 - z^2/c^2 = 1$, wherein a, b, c are predefined constant values. More preferred, a circular hyperboloid is applied, wherein a substantially equals b in the above equation. Such a hyperbolic body portion has the advantage of strengthening the overall tooth structure, in particular providing a reduced risk of breakage, combined with a better distribution a lateral forces that are transmitted from the prosthetic structure. Another advantage is provided in conjunction with the reworkability of the abutment by means of commonly used cuting tools, such as diamond burs and/or disks, since the hyperbolic form allows an easier adaption to a specific shape and reduces the tendency of fracture of the abutment during the cutting or grinding procedure.

[0025] In order to further improve the bonding interaction between the abutment and the prosthetic structure, mechanical retention structures are preferably applied at the surface of the body portion. According to a first preferred configuration, the mechanical retentions can be provided in a micrometer sized range by trimming the surface of the body portion with appropriate cutting burs or tools.

[0026] According to a second preferred configuration, the mechanical retentions can be provided by means of at least one retention groove that is provided at the circumferential surface of the body portion. Preferably, at least two longitudinal grooves are provided extending in the apical direction of the body portion, wherein the course of each groove extends over a different portion of the circumference of the body portion. In this way, an improved retention can be achieved, wherein the danger of a structural weakening of the abutment is minimised. More preferred, the groove extends over the whole length of the body portion in order to increase mechanical retention along its total length. Moreover, the groove preferably exhibits an inclined course with respect to the longitudinal axis of the body portion for allowing an improved retention, in particular a substantially helical form that is at least partially winding or wrapped around the body portion. The preferred width and/or depth of the grooves is at least 0.01 mm and at most 1 mm, wherein a range in between 0.1 mm and 0.5 mm is more preferred. Preferably, at most ten, more preferred at most five, retention grooves are provided in order to minimize a structural weaking of the body portion. Other preferred characteristics of such a retention groove are described in patent application No. EP 2 281 525 A2.

[0027] According to a third preferred configuration, an improved retention of the dental prosthesis on the abutment is achieved by combining both types of retention structures.

[0028] Preferably, the contact surface is constituted by a substantially flat bottom surface at the apical end of the body portion. This allows an easy application and positioning of the abutment on the dental implant before its actual fixation. Various fixation methods of the abutment on the implant are conceivable, in particular cementing, screwing or clipping or a combination thereof. Fixation by screwing can be achieved by means of an inward thread or an outward thread in or on the abutment. A particularly advantageous fixation of the abutment on the implant can be achieved in that a receiving bore is provided at the contact surface for receiving a connector portion of the dental implant. Alternatively, a connector portion can be provided at the contact surface configured for insertion into a receiving bore an the dental implant. In particular the cross section of the receiving bore may exhibit a circular, squared, triangular, hexagonal or octogonal shape. In this way, a cost efficient and yet easy applicable and reliable fixation can be realized.

[0029] According to a preferred implementation of the abutment, the optical properties of the fiber-reinforced resin structure are exploited for an advantageous light conduction through the body portion, which can be applied to achieve a proper polymerization of a setting product, such as resin cement. Advantageously, the ordered arrangement of the fibers extending over the total length of the body portion can be exploited to allow a superior light conduction both through the resin and through the optical fibers. The optical fibers are glass fibers, in particular to provide an optical resemblance to natural dentine. Preferably, the apical surface of the body portion is used as a light entering surface. In particular, a planar cutting or grinding of the fibers may be applied for achieving an effective coupling of light into the fibers. Preferably, a light conduction to the contact surface is exploited for cementing the abutment to the dental implant.

[0030] Various fabrication methods can be applied for producing the described abutment, in particular extrusion, injection molding, wetting or pultrusion. Preferably, a pultrusion process is applied in which the fibers are pulled through a resin bath containing above described mineral particles. Before the pultrusion, the fibers are preferably treated with a coupling agent, in particular silane, for enhancing the adhesion of said fibers to the resin. During the pultrusion process, the fibers are preferably tensed by applying a force of at least 50 N, more preferred at least 100 N, to increase the flexural strength and the elastic properties of the abutment according to the above description. After the pultrusion process, the shaping of the abutment can be achieved by molding and/or turning and/or grinding. Preferably, a turning lathe is used for this purpose.

[0031] The invention will be described in more detail in the following description of preferred exemplary embodiments with reference to the accompanying drawings. In the drawings:

Figg. 1 - 4 are schematic views of various embodiments of an artificial tooth structure in a longitudinal section; and

Figg. 5 - 11 are schematic perspective views of various embodiments of the body portion of an abutment for a dental implant.

[0032] Fig. 1 depicts an artificial tooth structure 1 comprising a dental implant 2, an abutment 3 and a dental prosthesis 4. The dental implant 2 is anchored into a jaw bone 5 and consists, for instance, of titanium, stainless steel, ceramics or another osseointegratable material.

[0033] The abutment 3 is arranged on the dental implant 2 in such a way that the abutment 3 has a contact surface 6 at its apical end with the coronal side of the implant 2. The abutment 3 is rigidly connected to the implant 2 by means of a connector portion 7 protruding from the center of the contact surface 6. The connector portion 7 is cylindrically shaped and has an outer thread that is engaged with an inner thread of a receiving bore in the implant 2.

[0034] The abutment 3 further comprises a body portion 8 which constitutes a prolongation of the implant 2 in a coronal direction along the longitudinal axis L. At the surface of the body portion 8 the dental prosthesis 4 is attached.

[0035] The abutment 3 is composed of a resin that is reinforced with fibers extending over the total length of the body portion 8 to the contact surface 6. According to a first embodiment, the fibers are uniformly directed in parallel with respect to the longitudinal axis L of the body portion 8. According to a second embodiment, the fibers are arranged in the manner of a braided netting in a biaxial or multiaxial orientation. The resin consists of a polymer derived from a methacrylate monomer, preferably methyl methacrylate (MMA) or urethane dimethacrylate (UDMA).

[0036] Mineral particles, preferably ytterbium flouride and or ytterbium oxide, are homogenuosly distributed within the resin. The fibers are constituted by glass fibers, wherein the fiber content represents ideally 80% of the volume of the body portion 8. The fibers are treated with silane as a coupling agent to the resin matrix.

[0037] The abutment 3 exhibits several advantageous mechanical properties, in particular an elastic modulus similar to natural dentine that is anisotropic with respect to the longitudinal axis L and varying in between 13 to 45 GPa. Yet the abutment 3 has a high flexural strength of ca. 1600 MPa for fracture resistance and durability. Moreover, the interlaminate shear strength (ISS) of the bond between the fibers and the resin matrix is larger than 90 Mpa, leading to an improved value of its fatigue under stress as compared to competing materials such as titanium, stainless steel or ceramics. The shape of abutment 3 can be easily reworked by means of common cutting tools such as diamond burs and/or discs.

[0038] Furthermore, the abutment 3 has several advantageous optical properties. First, the incorporation of the mineral particles is chosen so that the material composition of glass fibers, resin and mineral particles yields an index of refraction of 1.52. This value corresponds closely to the refractive index of natural dentine (1.540). Secondly, the particular arrangement of the fibers in the resin allows good light conduction through the body portion 8. This can be exploited for a proper polymerization of a setting product, such as resin cement, in particular for fixing the abutment at its contact surface 6.

[0039] The mineral particles with a high atomic number embedded in the resin lead to a radiopacity of the body portion 8 that is larger than 200% to the value of Aluminium, more preferred above a value of 400 % of Aluminium. The chemical composition of the resin material similar to composite resin cement permits a chemically profound bonding-interaction between the abutment 3 and the dental prosthesis 4 and/or the implant 2.

[0040] The artificial tooth structures shown in Figg. 2 - 4 comprise the dental implant 2, the dental prosthesis 4 and an abutment with essentially identical properties with respect to the material and shape of its body portion 8 as the abutment of Fig. 1. The connection means at the contact surface 6 of the abutment is modified..

[0041] Fig. 2 depicts an abutment 11 of an artificial tooth structure 10 that is rigidly connected to the implant 2 by means of a receiving bore 12 at the center of the contact surface 6. The receiving bore 12 is cylindrically shaped and has an inner thread that is engaged with a connector portion protruding from the coronal end of implant 2.

[0042] Fig. 3 depicts an abutment 16 of an artificial tooth structure 15 that is connected to the implant 2 by means of a receiving bore 17 at the center of the contact surface 6. The receiving bore 17 is octogonally shaped and receives an adequately shaped connector portion of the implant 2 in a form-fitted manner. A rigid connection in between the abutment 16 and implant 2 at the contact surface 6 is established by means of resin cement.

[0043] Fig. 4 depicts an abutment 21 of an artificial tooth structure 20 that is connected to the implant 2 by means of a connector portion 22 protruding from the center of the contact surface 6. The connector portion 22 is octogonally shaped and is inserted in a adequately shaped receiving bore in the implant 2 in a form-fitted manner. A rigid connection in between the abutment 21 and implant 2 at the contact surface 6 is established by means of resin cement.

[0044] In Figg. 5 - 9 various abutments with a different shape of the body portion are depicted, which is symmetrical along the longitudinal axis of the abutment.

[0045] Fig. 5 shows an abutment 25 with a cylindrical shaped body portion 26.

[0046] Fig. 6 shows an abutment 27 with a hyperboloidal body portion 28.

[0047] Fig. 7 shows an abutment 29 with a conical body portion 30.

[0048] Fig. 8 shows an abutment 31 with a substantially spherical body portion 32. The body portion 32 comprises a cylindrical apical end 33 to be contacted with the implant 2.

[0049] Fig. 9 shows an abutment 34 with a cono-cylindrically shaped body portion 35. The body portion 35 comprises a conical coronal part 36 and a cylindrical apical part 37.

[0050] In Figg. 10 and 11 an alternative embodiment of the abutments 25, 27 is depicted. Three retention grooves 40, 41, 42 are provided at the lateral surface of the body portion 26, 28. Each of the retention grooves 30, 31, 32 extends over a different circumferential portion of this surface in order to avoid a weakening of the structure and a risk of breakage. The course of retention grooves 30, 31, 32 substantially extends in the apical direction and over part of the circumference of the body portion 26, 28 such that they are partially wrapped around the surface. In this way, the retention properties can be greatly improved when the filling member 10 is fixed in the cavity by means of resin cement. Preferably, the grooves 30, 31, 32 extend over the total length of the body portion 26, 28 to increase mechanical retention along the total device length. The retention grooves 30, 31, 32 can be analogously applied on the body portion 30, 32, 35 of the abutments 29, 31, 34.

[0051] The above described preferred embodiments are intended to illustrate the principles of the invention, but not to limit the scope of the invention. Various other embodiments and modifications to those preferred embodiments may be made by those skilled in the art without departing from the scope of the appended claims.

Claims

1. An abutment for connecting a dental prosthesis (4) to a dental implant (2), the abutment comprising a body portion (8, 26, 28, 30, 32, 35) for supporting the dental prosthesis (4) and a contact surface (6) apical to said body portion (8, 26, 28, 30, 32, 35) for contacting the dental implant (2), the abutment **being** composed of a resin that is reinforced with glass fibers substantially extending over the total length of said body portion (8, 26, 28, 30, 32, 35) towards said contact surface (6), **characterized in that** a fraction of at least 40%, more preferred at least 70%, in volume of the total content of said body portion is constituted by said fibers, **in that** said body portion (8, 26, 28, 30, 32, 35) exhibits a modulus of elasticity varying in dependence of the direction of a force applied with respect to the orientation of a longitudinal axis (L) extending in the apical direction of said body portion (8, 26, 28, 30, 32, 35), **such that** said modulus of elasticity is at least 10 GPa, more preferred at least 30 GPa, lower for a force applied perpendicular to said longitudinal axis (L) as compared to a force applied in parallel with respect to said longitudinal axis (L), and **in that** said resin is derived from at least one methacrylate monomer, preferably methyl methacrylate (MMA) and/or urethane dimethacrylate (UDMA).

2. The abutment according to claim 1, **characterized in that** said body portion (8, 26, 28, 30, 32, 35) exhibits a modulus of elasticity of at least 10 GPa and at most 50 GPa.

3. The abutment according to one of the claims 1 to **2**, **characterized in that** at least part of said fibers are substantially uniformly directed in parallel with respect to a longitudinal axis (L) of said body portion (8, 26, 28, 30, 32, 35) .

4. The abutment according to one of the claims 1 to **3**, **characterized in that** at least part of said fibers are arranged in the manner of a braided netting in a biaxial or multiaxial orientation.

5. The abutment according to one of the claims 1 to **4,** **characterized in that** mineral particles are embedded in said resin, wherein the content by volume of said mineral particles is matched in such a way that the index of refraction of said body portion is in between 1.3 and 1.8, more preferred in between 1.4 and 1.6.

6. The abutment according to one of the claims 1 to **5**, **characterized in that** X-ray absorbing particles are embedded in said resin, said X-ray absorbing particles being selected from a chemical compound comprising an element of an atomic number of at least 37, more preferred at least 57.

7. The abutment according to claim **5** and **6**, **characterized in that** said mineral particles for matching the refractive index of said body portion are constituted by said X-ray absorbing particles.

8. The abutment according to one of the claims 1 to **7**, **characterized in that** the circumferential surface of said fibers is covered with a coupling agent, in particular silane, for enhancing the adhesion of said fibers to said resin.

9. The abutment according to one of the claims 1 to **8**, **characterized in that** said body portion (28) has a substantially hyperbolic form.

10. The abutment according to one of the claims 1 to **9**, **characterized in that** said contact surface (6) is constituted by a substantially flat bottom surface at the apical end of said body portion (8, 26, 28, 30, 32, 35).

11. The abutment according to one of the claims 1 to **10,** **characterized in that** a receiving bore (12, 17) is provided at said contact surface (8, 26, 28, 30, 32, 35) for receiving a connector portion of the dental implant (2).

12. The abutment according to one of the claims 1 to 11, **characterized in that** at least one retention groove (40, 41, 42) is provided at the circumferential surface of said body portion (8, 26, 28, 30, 32, 35).

Patentansprüche

1. Abutment zum Verbinden einer Zahnprothese (4) mit einem Zahnimplantat (2), wobei das Abutment einen Körperteil (8, 26, 28, 30, 32, 35) zum Tragen der Zahnprothese (4) und eine apikal zum Körperteil (8, 26, 28, 30, 32, 35) angeordnete Kontaktfläche (6) für den Kontakt mit dem Zahnimplantat (2) aufweist, wobei das Abutment aus einem Harz besteht, das mit Glasfasern verstärkt ist, die sich im Wesentlichen über die ganze Länge des Körperteils (8, 26, 28, 30, 32, 35) zur Kontaktfläche (6) hin erstrecken, **dadurch gekennzeichnet, dass** ein Anteil von mindestens 40 %, bevorzugt mindestens 70 % des Volumens des gesamten Inhalts des genannten Körpers aus den genannten Fasern besteht, dass der genannte Körperteil (8, 26, 28, 30, 32, 35) einen Elastizitätsmodul aufweist, der in Abhängigkeit von der Richtung einer ausgeübten Kraft in Bezug auf die Ausrichtung einer in der apikalen Richtung des Körperteils (8, 26, 28, 30, 32, 35) verlaufenden Längsachse (L) variiert, so dass der genannte Elastizitätsmodul für eine senkrecht zur genannten Längsachse (L) wirkende Kraft mindestens 10 GPa, bevorzugt mindestens 30 GPa geringer ist als für eine parallel zur genannten Längsachse wirkende Kraft, und dass das genannte Harz von mindestens einem Methacrylatmonomer, vorzugsweise Methylmethacrylat (MMA) und/oder Urethandimethacrylat (UDMA) abgeleitet ist.

2. Abutment nach Anspruch 1, **dadurch gekennzeichnet, dass** der Körperteil (8, 26, 28, 30, 32, 35) einen Elastizitätsmodul von mindestens 10 GPa und höchstens 50 GPa aufweist.

3. Abutment nach einem der Ansprüche 1 bis 2, **dadurch gekennzeichnet, dass** mindestens ein Teil der genannten Fasern im Wesentlichen einheitlich parallel zu einer Längsachse (L) des genannten Körperteils (8, 26, 28, 30, 32, 35) ausgerichtet ist.

4. Abutment nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass** mindestens ein Teil der genannten Fasern in der Art eines Geflechts in einer biaxialen oder multiaxialen Ausrichtung angeordnet sind.

5. Abutment nach einem der Ansprüche 1 bis 4, **dadurch gekennzeichnet, dass** Mineralpartikel im genannten Harz eingebettet sind, wobei der Volumenanteil der genannten Mineralpartikel derart angepasst ist, dass der Brechungsindex des Körpers zwischen 1,3 und 1,8 liegt, bevorzugt zwischen 1,4 und 1,6.

6. Abutment nach einem der Ansprüche 1 bis 5, **dadurch gekennzeichnet, dass** röntgenabsorbierende Partikel im genannten Harz eingebettet sind, wobei die röntgenabsorbierenden Partikel aus einer chemischen Verbindung ausgewählt sind, die ein Element mit einer Ordnungszahl von mindestens 37, mehr bevorzugt mindestens 57 enthält.

7. Abutment nach Anspruch 5 und 6, **dadurch gekennzeichnet, dass** die genannten Mineralpartikel zur Anpassung des Brechungsindex des genannten Körpers aus den genannten röntgenabsorbierenden Partikeln bestehen.

8. Abutment nach einem der Ansprüche 1 bis 7, **dadurch gekennzeichnet, dass** die Umfangsfläche der genannten Fasern mit einem Haftvermittler bedeckt ist, insbesondere Silan, um die Haftung der genannten Fasern am genannten Harz zu erhöhen.

9. Abutment nach einem der Ansprüche 1 bis 8, **dadurch gekennzeichnet, dass** der genannte Körperteil (28) eine im Wesentlichen hyperbolische Form aufweist.

10. Abutment nach einem der Ansprüche 1 bis 9, **dadurch gekennzeichnet, dass** die genannte Kontaktfläche (6) aus einer im Wesentlichen flachen Unterseite am apikalen Ende des genannten Körpers (8, 26, 28, 30, 32, 35) besteht.

11. Abutment nach einem der Ansprüche 1 bis 10, **dadurch gekennzeichnet, dass** an der genannten Kontaktfläche (8, 26, 28, 30, 32, 35) eine Aufnahmebohrung (12, 17) zur Aufnahme eines Verbindungsteils des Zahnimplantats (2) vorhanden ist.

12. Abutment nach einem der Ansprüche 1 bis 11, **dadurch gekennzeichnet, dass** an der Umfangsfläche des genannten Köpers (8, 26, 28, 30, 32, 35) mindestens eine Rückhaltenut (40, 41, 42) vorhanden ist.

Revendications

1. Pilier implantaire permettant de relier une prothèse dentaire (4) à un implant dentaire (2), le pilier implantaire comprenant une partie corps (8, 26, 28, 30, 32, 35) destinée à porter la prothèse dentaire (4) et une surface de contact (6) apicale par rapport à ladite partie corps (8, 26, 28, 30, 32, 35), qui est destinée à entrer en contact avec l'implant dentaire (2), le pilier implantaire étant composé d'une résine qui est renforcée de fibres de verre s'étendant substantiellement sur la longueur entière de ladite partie corps (8, 26, 28, 30, 32, 35) vers ladite surface de contact (6), **caractérisé en ce qu'**une fraction d'au moins 40 %, plus préférablement d'au moins 70 % en volume du contenu total de ladite partie corps est constituée desdites fibres, **en ce que** ladite partie corps (8, 26, 28, 30, 32, 35) présente un module d'élasticité qui varie en fonction de la direction d'une force appliquée par rapport à l'orientation d'un axe longitudinal (L) s'étendant dans la direction apicale de ladite partie corps (8, 26, 28, 30, 32, 35), de manière que ledit module d'élasticité est inférieur d'au moins 10 GPa, plus préférablement d'au moins 30 GPa, pour une force appliquée perpendiculairement audit axe longitudinal (L) que pour une force appliquée parallèlement audit axe longitudinal (L), et que ladite résine est dérivée d'au moins un monomère méthacrylate, préférablement méthacrylate de méthyle (MMA) et/ou diméthacrylate d'uréthane (UDMA).

2. Pilier implantaire selon la revendication 1, **caractérisé en ce que** ladite partie corps (8, 26, 28, 30, 32, 35) présente un module d'élasticité d'au moins 10 GPa et ne dépassant pas 50 GPa.

3. Pilier implantaire selon l'une des revendications 1 à 2, **caractérisé en ce qu'**au moins une partie desdites fibres sont substantiellement uniformément orientées parallèlement à un axe longitudinal (L) de ladite partie corps (8, 26, 28, 30, 32, 35).

4. Pilier implantaire selon l'une des revendications 1 à 3, **caractérisé en ce qu'**au moins une partie desdites fibres sont arrangées à la manière d'un filet tressé en une orientation biaxiale ou multiaxiale.

5. Pilier implantaire selon l'une des revendications 1 à 4, **caractérisé en ce que** des particules minérales sont encastrées dans ladite résine, le contenu en volume desdites particules minérales étant adapté de telle manière que l'indice de réfraction de ladite partie corps est compris entre 1,3 et 1,8, plus préférablement entre 1,4 et 1,6.

6. Pilier implantaire selon l'une des revendications 1 à 5, **caractérisé en ce que** des particules absorbantes de rayons X sont encastrées dans ladite résine, lesdites particules absorbantes de rayons X étant choisies parmi un composé chimique comprenant un élément d'un nombre atomique d'au moins 37, plus préférablement d'au moins 57.

7. Pilier implantaire selon la revendication 5 et 6, **caractérisé en ce que** lesdites particules minérales permettant d'adapter l'indice de réfraction de ladite partie corps sont constitués desdites particules absorbantes de rayons X.

8. Pilier implantaire selon l'une des revendications 1 à 7, **caractérisé en ce que** la surface circonférentielle desdites fibres est couverte d'un agent de couplage, en particulier du silane, afin d'améliorer l'adhésion desdites fibres à ladite résine.

9. Pilier implantaire selon l'une des revendications 1 à 8, **caractérisé en ce que** ladite partie corps (28) a une forme substantiellement hyperbolique.

10. Pilier implantaire selon l'une des revendications 1 à 9, **caractérisé en ce que** ladite surface de contact (6) est constituée d'une surface inférieure substantiellement plate à l'extrémité apicale de ladite partie corps (8, 26, 28, 30, 32, 35).

11. Pilier implantaire selon l'une des revendications 1 à 10, **caractérisé en ce qu'**un alésage récepteur (12, 17) est pourvu à ladite surface de contact (8, 26, 28, 30, 32, 35) afin de recevoir une partie de connexion de l'implant dentaire (2).

12. Pilier implantaire selon l'une des revendications 1 à 11, **caractérisé en ce qu'**au moins une rainure de retenue (40, 41, 42) est pourvue à la surface circonférentielle de ladite partie corps (8, 26, 28, 30, 32, 35).

FIG. 1

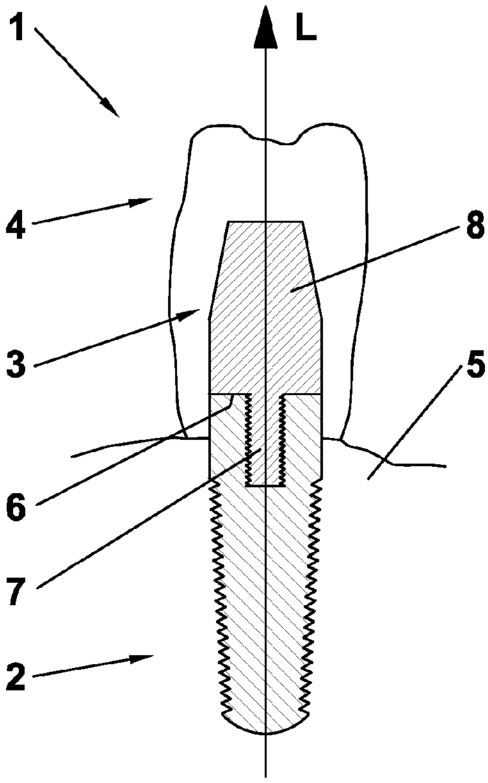


FIG. 2

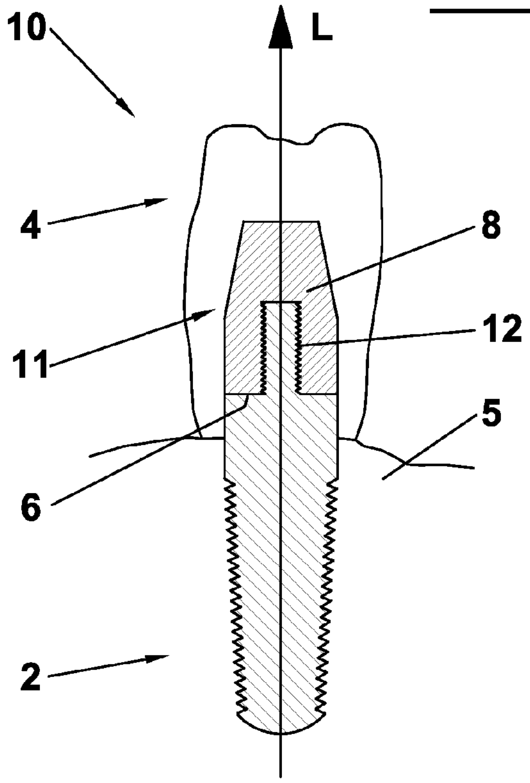


FIG. 3

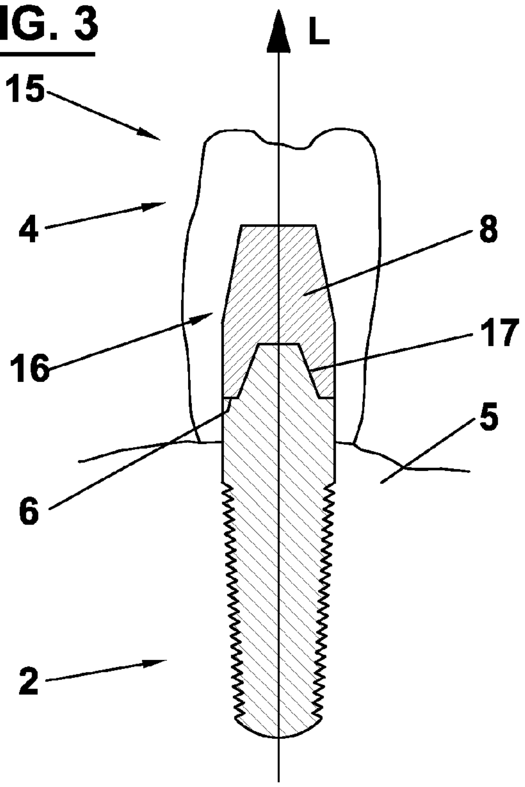


FIG. 4

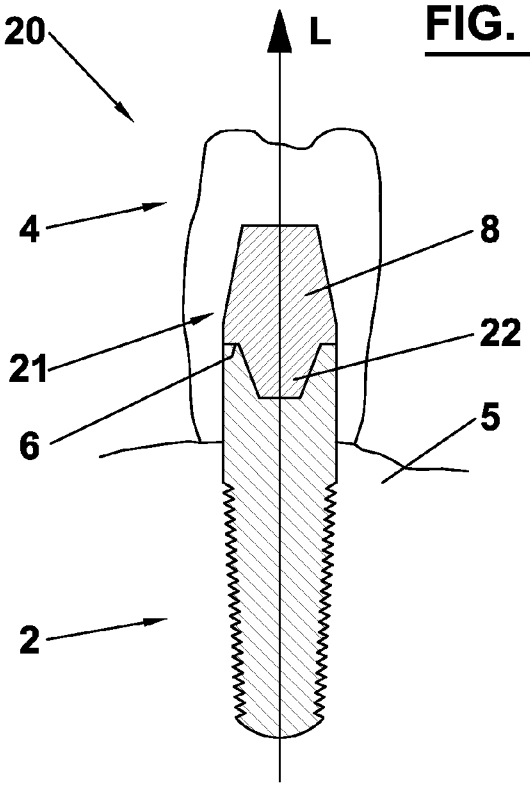


FIG. 5

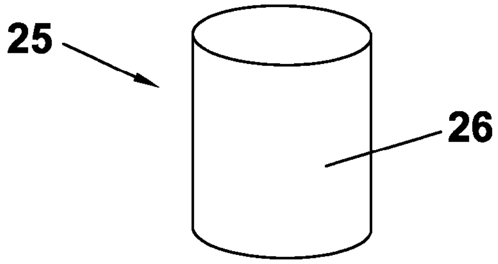


FIG. 6

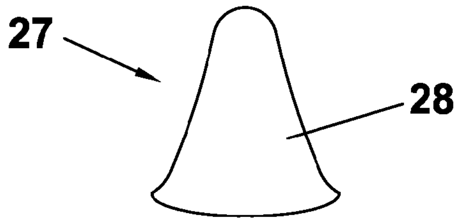


FIG. 7

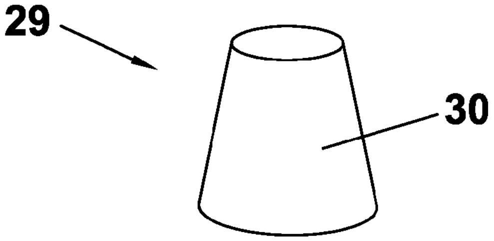


FIG. 8

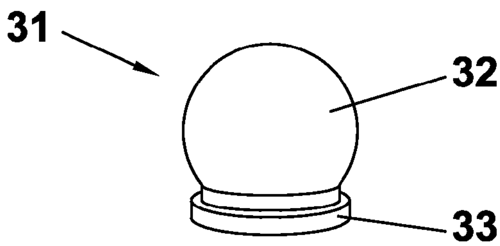


FIG. 9

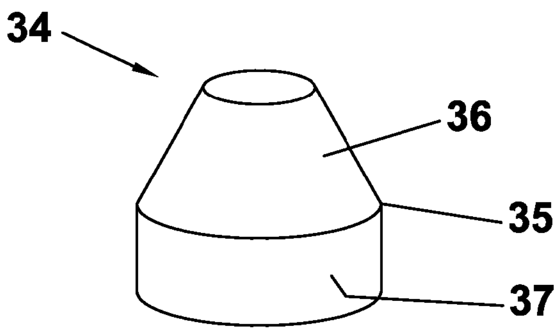


FIG. 10

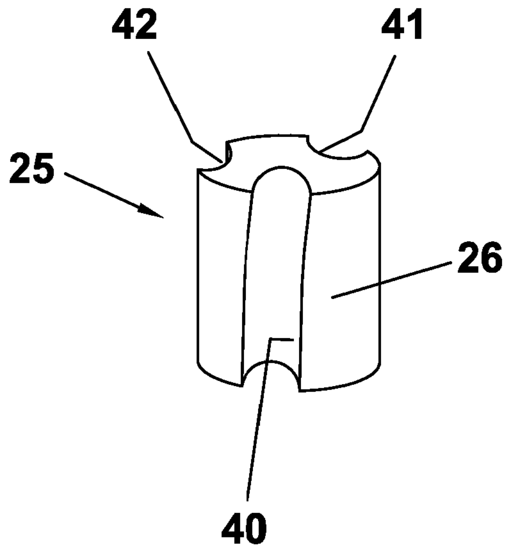
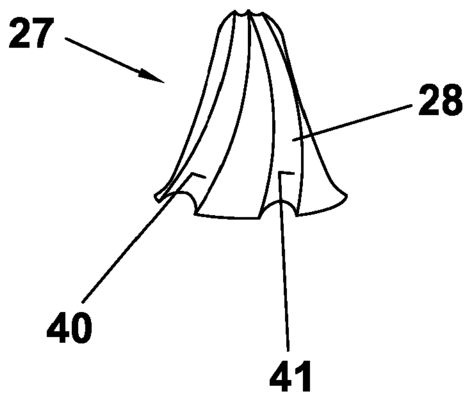


FIG. 11



REFERENCES CITED IN THE DESCRIPTION

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