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(54) Benævnelse: **DENTAL IMPLANT SYSTEM**

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Dental implant system

The invention relates to a dental implant system consisting of an implant and a superstructure.

In Germany, around 700,000 artificial replacement teeth are implanted every year. They usually consist of three components: an artificial root (root implant), a connecting piece – the so-called abutment, and a superstructure such as, e.g., a crown or a bridge.

To insert the artificial replacement tooth, first the rest of the defective tooth, such as, e.g., its roots, must be completely removed. Then, a drill hole is made in the jaw, or a thread is cut in it, and the root implant is hammered in or screwed in. Therefore, the implant is usually made in the form of a cylinder or a cone. After the implant is inserted into the jaw, it must heal in for three to six months, i.e., solidly grow together with the jaw. During this time, no mechanical stress may be placed on the implant. After the implant heals in, the abutment is usually screwed or glued together with the implant, and then the superstructure is put onto the abutment. The abutment has a so-called extension pin, which serves for mechanical fastening of the superstructure to the abutment.

However, this construction has several disadvantages. As a result of the design, there is a gap between the implant and the abutment that can be colonized by bacteria. Gingival sulci along the abutment in the direction of the bone form open entry points for bacteria. Acids excreted by the bacteria prevent the gum growing together with the implant / abutment in the area of the gap. The jawbone always resorbs according to the biologic width; in addition, there are often inflammations of the gum and other bone fractures and, consequently, further gum losses. As a consequence of this, bacterial pockets arise which, since they are not accessible to the patient himself, require dental recall measures for cleansing of the bacterial pockets; these measures are expensive and a nuisance for the patient; these bacterial pockets also regularly lead to loss of the implant. Cleansing the pockets also has the disadvantage that the gum, cannot, due to this, grow together with the abutment in the area above the gap between abutment and implant. In addition, the

poor accessibility of the gingival sulci, which is unavoidable in the meantime, prevents orderly oral hygiene in this area, and consequently the implant is perceived as very unpleasant by the patient. During this time, the inflammation and destruction of the healthy tissue continues to progress.

Another disadvantage is that the threaded connections between the root implant and the abutment are exposed to high mechanical stresses. This regularly produces micromotion between the implant and the abutment, and not least of all screw brakeage, which results in high costs. If the screw connection is fixed with cement or glue, then escaping material can also lead to irritation of the gum.

The root implants are usually in the form of prefabricated, rotationally symmetric standard implants that are graduated in various sizes. The CE regulations for the sterilization of medical products prohibit the dentist performing the implantation from individually adapting the prefabricated implants during the implantation. Because of the predetermined graduations, it is therefore often necessary to compromise with respect to the size of the implants that are used. Another disadvantage is that the implant cannot be adapted to bone dehiscences that arise due to the drilling of the implant bed into the comb-shaped jaw. Consequently, such implants have substantially smaller bone contact surface and, as a result, poorer anchoring than would be the case if they were individually adapted. Moreover, the anatomical soft tissue requirements of the gums are disregarded. This strongly limits aesthetics and hygiene. The uncompensated bone dehiscences are regularly a cause of the formation of unwanted gingival sulci. Finally, there are high storage costs, since it is necessary to keep many sizes and shapes of prefabricated standard implants on hand.

Fastening the superstructure to the abutment using an extension pin produces unfavourable force distributions and leverage conditions, presenting an increased danger of fracture. If the extension pins are screwed together, there is also micromotion, which has been demonstrated to be destructive.

In recent years there has been substantial progress in implantation technique; numerous developments are aimed at eliminating the above-mentioned problems.

For instance, DE 196 47 489 A1 proposes applying a directly electroplated, plastically deformable metal layer onto the abutment at the point of contact with the endosseous implant body. This is intended to prevent the formation, between the abutment and the implant, of the gap that is subject to bacteriological colonization. DE 196 47 490A1 makes the analogous suggestion of putting a gold disc between the implant and the implant extension. Although both solutions do minimize the gap, the contact between titanium, gold, and the gums and saliva should be expected to cause irritating chemical reactions. In addition, bacteriological colonization cannot be excluded.

WO2004/058096 A1 describes an abutment that has a drill hole through it in the axial direction. The abutment is screwed together with the implant, and the screw connection is additionally fixed with cement. The purpose of the through hole is that during the cementing excess cement is pressed out through the hole and collects on the flat head of the implant. The cement can simply be removed from the head. This makes it possible to prevent gum inflammation due to cement escaping in other places.

DE 10 2005 027 402 A1 discloses a process for producing an individualized replacement tooth that can be held, through a connection peg, in an implant that has healed in. To reduce the expense of creating the replacement tooth, it is proposed that it be made as a single piece. This makes it possible to do without a separate abutment. It is indisputable that this achieves a simplification, however the problem of the gap that can be bacteriologically colonized still remains.

EP 0 967 931 B1 presents a dental implant that consists of a conical shaft section and a divergent head section, the two sections being made as an integral part or as a connected part. The dental implant system also comprises an abutment that fits the dental implant and that serves to support a replacement tooth / crown. The abutment is screwed into the conical shaft section of the dental implant using a screw.

The single-piece or integral design of the shaft section and head section does avoid a microgap in the endosseous region, however the formation of a gap that can be

bacteriologically colonized between the shaft / head section and the abutment in the gingival region is unavoidable.

EP 0 891 163 B1 describes a dental supporting bearing that is built from an implant and an abutment. The upper edge of the abutment and, accordingly, the lower edge of the crown fastened to it, are, at the exit from the gum, adapted to the corresponding exit profile and the sizes of the tooth to be replaced.

The fact that the border between the abutment and the crown is adapted to the course of the gum achieves aesthetic and functional advantages over rotationally symmetric solutions. However, the border between the abutment and the crown lies exactly at, or above, the height of the gingival margin. Since the gum usually recedes over the course of time, it cannot be avoided that the metallic abutment will, after some time, extend above the gingival margin and become visible.

Alternatively to the replacement tooth described above, the general prior art is to use a rotationally symmetric implant in which the implant's endosseous parts, the abutment, and possibly the extension pin are made out of one piece, or at least are seamlessly joined (see DE 10 2005 001 185 A1).

Accordingly, from the start such implants avoid a gap in the border area between the jawbone and the gum, and the gum can grow together with the implant without problems, since micromotion is avoided. Nevertheless, these implants were unable to gain acceptance for several essential reasons. One reason is that as a result of its design, the extension pin projects into the oral cavity. This inevitably leads to mechanical stresses on the implant while it is growing in, and consequently frequently leads to failure of the implantation. Another reason is that due to the rotational symmetry of the implant, it remains visible at the transition from the crown to the gum, which is unacceptable for aesthetic reasons, especially if titanium is used. It is especially disadvantageous that the shape of the implant does not take into consideration vestibular / buccal and palatal / lingual bone dehiscences caused by the drilling into the comb-shaped jawbone.

Other dental implants or dental implant systems in which the lower endosseous region and/or thread for screwing into the bone has a rotationally symmetric cross-section are disclosed in WO 2005/065571 A, US 2006/252009 A1, DE 10 2004 055 831 A1, US 5 759 036 A, WO 2006/084346 A, EP 1 013 236 A, and RU 2 146 113 C1.

US 2004/0185419 A1 also describes a single-piece implant with a thread in the endosseous region.

A single-piece implant made of zirconium oxide, whose transgingival region is ground to the required shape only once it has been implanted, is disclosed in WO 01/34056 A1.
GB-A-1 431 563 discloses an implant made of modified carbon whose surface is enlarged by circling channels that have a saw-tooth structure in the longitudinal section.

DE 195 13 881 A1 describes an implant production process that involves copy-milling a blank according to the natural cavity of the dental root region, to reproduce it.

US 2006/0292523 A1 discloses a dental implant system with an implant and a superstructure built on it. The implant has a lower endosseous region structured with channels, an upper endosseous region widening upwardly and having a roughened surface, a transgingival region with a smooth wall surface, and a transgingival hexagonal implant head. The border between the roughened upper endosseous region and the smooth transgingival region is crooked, and the coronal edge of the transgingival region is also crooked. In a cross-section perpendicular to the implant axis, the transgingival region has a rotationally symmetric shape.

The goal of the invention is to eliminate the disadvantages of the prior art. In particular, the goal is to create an aesthetically appealing dental implant system that is invisible at the gingival margin, that allows good growth of the gum in the gingival region, and that ensures a mechanically stable and durable connection of a tooth structure with the jawbone.

The invention accomplishes this by the characterizing features of claim 1; other advantageous embodiments follow from claims 2 through 10.

The invention starts from a dental implant system that consists of an implant and a superstructure built on top of it. The implant is composed of a lower endosseous region structured in a honeycomb-like manner, an upper endosseous region widening upwardly and having a roughened surface, a transgingival region with smooth wall surface, and a transgingival implant head. All these regions are connected to one another seamlessly and without gaps.

The shape of the lower endosseous region is usually rotationally symmetric cylindrical / conical, combined rotationally symmetric cylindrical / conical, rotationally symmetric step-shaped cylindrical / conical, or combined rotationally symmetric step-shaped cylindrical / conical. It is preferable for it to have a honeycomb structure with tips at the vertices, this structure being known to have good behaviour for growing into jawbones.

According to the invention, the upper endosseous region is shortened in each of the vestibular / buccal and palatal / lingual directions. Accordingly, the upper endosseous region is higher at the places where it lies against the side of the alveolar ridge. This exactly adapts the implant to the patient-specific comb shape of the jawbone and consequently the implant completely takes into consideration the bone dehiscences arising from the drilling of the implant bed. The fact that the upper endosseous region widens upwardly achieves a larger bone contact surface during the implantation, and consequently the implant holds better in the jawbone.

The smooth transgingival region is shaped according to the cavity in the patient's gum. Due to this anatomical shape, the transgingival region has, in any longitudinal section and any cross-section, a shape different than in any longitudinal or cross-section disposed therebefore or thereafter.

The transgingival region is upwardly limited by an individually shaped transgingival implant head whose shape is three-dimensionally differentiated in height, width, and depth, i.e., the implant head forms the "covering surface" of the implant. It also has,

in any longitudinal section and any cross-section, a shape different than in any longitudinal or cross-section disposed therebefore or thereafter. This peripheral edge formed by the arrangement of the transgingival region and the implant head corresponds to the preparation border such that, following successful implantation, the peripheral edge will run just below, typically 1 mm below the gingival margin.

The transgingival implant head has, in the middle, a flat region. This flat region is adjoined by a steeply sloping region surrounding said flat region, by means of which sloping region the flat region and the transgingival region are connected to each other. The plateau formed by the flat region of the implant head is arranged exactly high enough that it lies at the height of the upper gingival margin in the approximal direction.

According to the invention, the steeper region of the implant head is longer and steeper in the vestibular/buccal direction and in the palatal/lingual direction than in the other directions.

Thus, the upper endosseous region is adapted to the patient-specific comb shape of the jaw.

The entire surface of the implant head has the bottom of a superstructure glued or cemented onto it, this superstructure bottom being adapted to the shape of the implant head. This connection absorbs most of the forces acting between the implant and the superstructure. To avoid lateral displacement and achieve further mechanical stabilisation, in addition an extension pin is screwed into the transgingival region of the implant approximately in the centre of the preparation surface, and connected with the superstructure on the other side. The basal surface of the extension pin lies on the flat part of the transgingival implant head and acts as a force-compensating anti-tilt device and as a force-absorbing and transferring part.

It is advantageous for the implant to be made from one piece (a blank). Possible materials that have proved themselves in medical technology are titanium and zirconium oxide, and all materials that are suitable for tooth implantation.

The inventive dental implant system has multiple advantages over the systems that are generally used.

An essential advantage of the implant system is that it does without an abutment, which avoids, from the start, a gap that can be bacteriologically colonized in the border area between the jawbone and the gum. Since the preparation border runs just below the gingival margin, it is accessible to the patient, who can easily clean it. This dispenses with the necessity of dental pocket cleansing. Moreover, already during the phase in which the endosseous region grows into the jawbone, the implant can simultaneously grow together with the gum in the transgingival region. This is especially advantageous when the gum is still “fresh and bloody” due to the implantation procedure. Since it is unnecessary to cleanse pockets, it is also unnecessary later to detach the gum that has grown onto the implant. This has the consequence of avoiding recall measures that are expensive and a nuisance for the patient and in addition, since gingival sulci do not form, as would otherwise be usual, the patient hardly perceives the implant as a foreign body, since the measures for oral hygiene in this region are simple and above all safe to cope with.

Doing away with the screw connection between the implant and the abutment eliminates the design-based micromotion between the implant and the abutment that would otherwise be present, which is frequently the cause of screw fractures but also of recession of the surrounding jawbone section and consequently also the cause of the recession of the gum located over the jawbone and supported and stabilised by this very bone.

The lower endosseous region’s individual size and shape, which are adapted to the patient’s anatomy, achieve the largest possible bone contact surface. The upwardly widening shape and exact adaptation of the upper endosseous region to the comb shape of the jawbone and the associated complete adaptation to the bone dehiscences arising due to the implant bed drilling equally ensures a large supporting surface in the upper region of the jawbone. The structured or rough surface of the endosseous region of the implant allows it to grow together with the jawbone quickly and securely.

The single connection point of the dental implant system is selected in such a way that, on the one hand, this connection point can be cleaned by the patient himself, however on the other hand so that during the growing-in phase mechanical stresses due to mechanical contact, such as, e.g., with other teeth, are largely avoided.

In contrast to the dental implant systems used up to now, in which the implant and the superstructure are mechanically connected mainly through an abutment / extension pin, in the inventive system a large-area, materially bonded connection, formed by glue or cement, between the implant head and the bottom of the superstructure absorbs the mechanical stresses. The prosthetic post used has a supportive function, prevents lateral displacement during the placement of the superstructure, and in the case of laterally incident forces it functions as a force-absorbing element due to its basal mounting on the flat part of the transgingival implant head.

The invention also provides that the lower and the upper endosseous regions of the dental implant system have a non-rotationally symmetrical geometry corresponding to the superimposition of at least two rotationally symmetrical geometric bodies of which the axes of symmetry run parallel to one another and are offset, or are tilted relative to one another such that they intersect one another at least in the lower endosseous region. The geometric bodies always overlap at least in the upper endosseous region, forming non-rotationally symmetrical closed cross-sectional areas there. The lower endosseous region can be in the form of a dental root or also have a closed cross-sectional area.

The non-rotationally symmetrical shape of the endosseous region causes the inserted implant to form, with the jawbone, a support that withstands comparatively high rotational and tilting stresses. Furthermore, this design allows unique positioning and fixation of the implant in the jawbone.

For the parts of the upper and lower endosseous region that have closed cross-sectional areas, it is preferable to select geometries that correspond to the superimposition of cylindrical geometric bodies with conical tips. The cylinders can have the same or different radii. The axes of symmetry of the bodies are arranged so

that they intersect at least in the lower endosseous region. The tilt angles of the axes of symmetry to one another are usually 1° to 45°.

For parts of the lower endosseous region that are shaped like a dental root, it is preferable to select geometries that correspond to the superimposition of conical geometric bodies that are arranged in parallel.

The process for producing a dental implant system and placing it in the jaw or oral cavity of the patient comprises the following steps:

First, recording the shape of the jaw and the shape of the gum of the patient to be treated using CT (computed tomography), DVT (digital volume tomography), or alternatively using OPG.

On a blank from which the entire implant should be produced, the endosseous region is first shaped using the CAD/CAM technique on the basis of the anatomical diagnostic data that has been determined. The shape of this section is rotationally symmetric cylindrical / conical, combined rotationally symmetric cylindrical / conical, rotationally symmetric step-shaped cylindrical / conical, or combined rotationally symmetric step-shaped cylindrical / conical. To allow good growth into the bones, the endosseous region is provided with a structure. It is preferable for it to be a honeycomb structure with tips at the vertices, this structure being known to have good behaviour.

Then, another endosseous region bordering the endosseous section is shaped by CAD/CAM according to the anatomical diagnostic data. For individual adaptation to the comb shape of the jaw, a larger shortening is made in the vestibular / buccal direction and a smaller shortening is made in the palatal / lingual direction. In this way, the shape of the implant will completely take into consideration bone dehiscences arising later during the drilling of the implant bed.

After that, a transgingival region is produced by manual machining or possibly by CAD/CAM on the basis of the anatomical diagnostic data that is determined. The individual shaping has the result that in every case the transgingival region in any

longitudinal section and any cross-section has a shape different than in any longitudinal or cross-section disposed therebefore or thereafter.

Following that, the transgingival implant head upwardly bordering the transgingival region is produced by manual machining or possibly by CAD/CAM. The implant head is shaped according to the diagnostic measurement data of the shape and edge course of the cavity in the gingiva so that after the implantation the edge formed by the preparation surface and the transgingival region runs below the gingival margin. The implant head has a flat region approximately in its middle, which flat region is adjoined by a steeply sloping region surrounding said flat region. The sloping region connects the flat region and the transgingival region to each other. In addition, a threaded hole is made in the flat region of the implant head to hold a holding post.

Next, the transgingival region and the transgingival implant head are smoothed. The smoothing is preferably done by manual mechanical polishing or by CAD/CAM. After that, the surface of the entire endosseous region of the implant is roughened by means of suitable techniques.

Next, the diameter of the implant bed to be drilled is gradually approached. To accomplish this, first the implant bed is gradually drilled into the jawbone with corresponding burs, beginning with one whose diameter is about 1 mm smaller than the lower endosseous region of the implant, all the way to one whose diameter is 0.5 mm smaller. Then, the hardness or quality of the bone is determined on the basis of the drilling or by other test procedures. Since the bone quality and hardness can drastically change during the widening of a drill hole, the diameter of the drill hole is gradually enlarged in steps of 0.1 mm. Every time the hole is drilled, the bone quality is redetermined and the diameter of the drill hole is checked using suitable measuring instruments and processes. The drill hole is gradually enlarged until the bone quality and the size of the drill hole are optimally matched.

After that, the implant is inserted by hammering the endosseous region into the drill hole.

Then, the implant heals into the jaw over a time period of 3 to 6 months.

In another step, a suitable extension pin is selected or produced. If the implant does not show any angulation, then it is possible to use a straight, prefabricated extension pin that has a thread for screwing into the transgingival implant head on one side and a pin for fastening to the superstructure on the opposite side. If there is an angulation, then a sleeve made of a plastic that can be burned off is individually shaped, either subtractively by mechanical removal or additively by applying wax. The model produced in this way is then cast out of metal according to the lost mould casting method, a screw being passed through the sleeve in the longitudinal direction and the pin sleeve being screwed on the transgingival implant head by means of this screw. Alternatively, the extension pin can also be completely produced by means of CAD/CAM.

Furthermore, a superstructure, such as, e.g., a crown or a bridge, that is individually adapted to the diagnostic data of the patient is produced. For the bottom of the superstructure, which serves as the connection surface to the implant, and for shaping the edge, it is possible to use the already available geometric data of the preparation border, and for shaping the topology of the surface of the bottom it is possible to use the inverted data of the surface of the implant head.

After the implant has healed in, the extension pin is screwed into the threaded hole located on the implant head.

Then, the bottom of the superstructure, whose shape corresponds to the shape of the implant head, is glued or cemented onto the entire surface of the implant head. In the same step, the extension pin is mechanically connected with the superstructure.

The invention is explained in detail below on the basis of four sample embodiments; for this purpose, first the following schematic figures are provided:

Fig. 1: A dental implant with a crown (section; vestibular view);
Fig. 2: A dental implant (section; approximal view);
Fig. 3: Top view of an implant head.

Fig. 1 shows a cross-section of a single-piece dental implant made of titanium with a crown 10 fastened to it, viewed in the palatal direction. For better clarification, Fig. 2 shows a cross-section of an implant with a prosthetic extension pin 7, however viewed in the direction of the jawbone.

The implant consists of a lower endosseous region 1, an upper endosseous region 2, a transgingival region 3, and a transgingival implant head 4. To produce the implant, region 1 and region 2 are made using CAD/CAM, and region 3 and the transgingival implant head 4 are made using CAD/CAM or manual machining, from a blank.

The lower endosseous region 1, which is deeply seated in the jawbone, has a honeycomb pattern, each of the corners of the honeycomb having a tip in it. This structure is known to allow the implant to grow in optimally.

The lower endosseous region 1 is followed by the upper endosseous region 2, which is shaped so that its upper edge extends exactly to the upper edge of the comb-shaped jawbone 5. To achieve this, the upper endosseous region 2 is usually substantially shorter on the vestibular side and somewhat shorter on the palatal side than on the rest of the places. However, there are also cases in which the palatal side must be made shorter than the vestibular side to adapt it exactly to the comb shape of the jaw. Bone dehiscences, which arise due to the drilling of the implant bed, are completely anatomically taken into consideration by this special shaping. In order also to achieve a wider supporting surface and better distribution of forces in the bone 5, the upper endosseous region 2 is wider in the upward direction (funnel-shaped). The roughened surface of region 2 also allows it to grow together with the jawbone 5.

The region 2 is followed by the smoothly polished transgingival region 3. This region is shaped in such a way that around the periphery it extends about 1 mm below the gingival margin, which approximately corresponds to the depth to which the gum does not, even in the case of a healthy tooth, grow together with the tooth, but rather only lies loosely against it. The smoothly polished titanium surface allows good and irritation-free growth of the gum 6.

The end of the transgingival region 3, which simultaneously forms the preparation border 11, is followed by the transgingival implant head 4. The implant head 4 consists of a flat, almost level inner region 12 and a steeply sloping region surrounding it; the regions 12/13 can also be combined without a transition, for instance in a crowned shape (not shown here). The steep region 13 connects the level region 12 with the transgingival region 3. The adaptation of the implant to the comb shape of the jawbone 5 means that the region 13 is usually substantially longer and steeper in the vestibular / buccal direction and somewhat longer and steeper in the palatal / lingual direction than in the rest of the places.

As can be seen in Fig. 3, the flat region 12 of the implant contains a threaded hole for fastening the prosthetic extension pin. In addition, region 12 contains a groove 14 in the form of a circular sector, which prevents twisting of the crown; to accomplish this, the bottom of the crown 10 has a corresponding counterpart on it. As can be seen in Fig. 2, an individually created prosthetic extension pin 7 is used. This pin also engages in the groove 14, and thus is also secured against twisting. If a straight, standardized extension pin 7 is used, then it does not engage into the groove 14, but rather only its pin-shaped part is bevelled. If the pin is later cemented into the crown 10, which in turn is fastened to the implant so that it is secured against twisting, through the groove 14 and the real shape of the implant head 4 all the way to the preparation border 11, then the implant is connected with the crown 10 so that it is secured against twisting.

The bottom of the crown 10 serving as connection to the implant is exactly adapted to the shape of the implant head 4 all the way to the preparation border 11. It is advantageous that for shaping the edge of the bottom it is possible to use the already available geometric data of the preparation border 11, and for the producing the surface of the bottom it is possible to use the inverted geometric data of the surface of the implant head 4.

The so adapted bottom of the crown 10 is connected by cement or glue with the transgingival implant head 4 over the entire surface and without gaps. It is not complicated to remove material that might escape during gluing or cementing due to the good accessibility of the preparation border 11. In addition, the smooth part of the

prosthetic extension pin 7 is cemented into the crown. The other screw-shaped side of the extension pin 7 is screwed into the implant head 4. The adhesion over the entire surface between the crown 10 and the implant absorbs a large proportion of the forces that arise during chewing. The connection produced through the prosthetic post 7 and the extensive support on the flat part 12 of the implant head 4 prevents lateral displacement and plays a supportive role in absorbing and passing on shearing forces.

Fig. 4 through 7 show how the drill holes are made in the alveolar ridge to produce the shape of the implant bed and ultimately determine the geometry of the endosseous region of the dental implant system. In particular, the figures are as follows:

Fig. 4: Introduction of two drill holes that are offset to one another, and the resulting (figure 8-shaped) implant bed (top view);

Fig. 5: Introduction of three drill holes that are spaced apart in the form of a line and tilted toward one another (not visible, top view);

Fig. 6: Introduction of three drill holes that are spaced apart in the form of an equilateral triangle and tilted toward one another (not visible, top view);

Fig. 7: Introduction of three drill holes that are spaced apart in a line and tilted toward one another (side view).

The upper parts of Figures 4 through 6 show the positions of the individual drill holes 17-19 required for the implant bed, and the lower parts show the shape of the implant bed 20 that results by superimposing them. The drill holes are cylindrical and have the same diameter.

Fig. 4 shows two drill holes [17-18] and Fig. 5 shows three drill holes [17-19] spaced in a line, and Fig. 6 shows three drill holes 17-19 spaced in the form of an equilateral triangle, these drill holes being tilted toward one another. If the drill holes 17-19 are arranged in a line and the implant bed 20 is formed from them, the implant withstands comparatively higher rotational stresses, while an implant bed that is formed by drill holes 17-19 arranged in the form of an equilateral triangle is not sensitive with respect to moments of tilt.

From Fig. 7 it can be seen, on the one hand, that the tips of the drill holes 17-19 meet at the lowest point of the implant bed 20, and on the other hand, that the drill holes 17-19 overlap over the entire length of the implant bed. This achieves a conical shape of the implant bed 20 or the lower endosseous region in which every cross-sectional surface is joined together.

List of reference numbers used:

1	Lower endosseous region
2	Upper endosseous region
3	Transgingival region
4	Transgingival implant head
5	Jawbone
6	Gingiva
7	Prosthetic extension pin
8	Thread
9	Threaded hole
10	Crown
11	Preparation border / edge
12	Flat region
13	Steep region
14	Groove
15	Vestibular / buccal shortening
16	Palatal / lingual shortening
17-19	Drill hole
20	Implant bed

Abstract

The invention relates to a dental implant system consisting of an implant and a superstructure (10, crown, bridge, etc.). The implant is made from one piece and extends from the bone region all the way to the height of the approximal gingival papillae. The endosseous region (1, 2) and the gingival region (3) of the implant are shaped according to diagnostically determined patient data. Consequently, the endosseous region is exactly adapted to the comb shape of the jaw and completely fills out bone dehiscences arising due to the implantation. The gingival region (3) correspondingly fills out the cavity in the gingiva. The superstructure (10) is connected over its entire surface with the transgingival implant head (4), and both of these fill out the rest of the cavity of the gingiva; the superstructure (10) is additionally fastened to the implant with a prosthetic extension pin (7). The adapted surface structure allows the endosseous and also the gingival region to grow in completely. The development of gingival sulci is completely prevented. The implant system does not allow design-based micromotion. In addition, it ensures optimal distribution of forces. The endosseous region of the implant can also have a non-rotationally symmetrical shape.

Fig. 1

Patentkrav

1. Tandimplantat, der består af et implantat og en suprastruktur, der monteres derpå, hvor implantatet består af et nedre osseointegrerbart område (1) med en bikagelignende struktur, et øvre osseointegrerbart område (2), der udvides opad og har en ru overflade, et transgingivalt område (3) med glat vægoverflade og et transgingivalt implantathoved (4), og alle områder er forbundet sømløst og uden mellemrum til hinanden,
- hvor det øvre osseointegrerbare område (2) har en afkortning (15) i den vestibulære/bukkale retning og har en afkortning (16) i den palatale/linguale retning, således at det øvre osseointegrerbare område (2) er højere på de punkter, hvor det hviler lateralt mod den alveolære forhøjning,
- og det transgingivale område (3) i ethvert længdesnit og ethvert tværsnit har en form, der er forskellig fra ethvert længdesnit eller tværsnit, der er disponeret før eller efter dette,
og det transgingivale område (3) er afgrænset opad af et transgingivalt implantathoved (4), der er tredimentionelt formet forskelligt i højde, bredde og dybde, hvor der dannes en perifer kant (11) af indretningen af implantathovedet (4) og det transgingivale område (3), der grænser op til hinanden, således at den perifere kant (11) efter succesfuld implantation vil være placeret under gingivalranden,
- hvor implantathovedet (4) har et fladt område (12) omtrent i dets midte, hvilket flade område støder op til et stejlt skrånende område (13), der omgiver det flade område, idet det skrånende område forbinder det flade område (12) og det transgingivale område (3) med hinanden,
- hvor det stejle område (13) af implantathovedet (4) er længere og stejlere i den vestibulære/bukkale retning og i den palatale/linguale retning end i de andre retninger.

2. Tandimplantatsystem ifølge krav 1, der er kendetegnet ved, at implantatet, der består af det nedre osseointegrerbare område (1), det øvre osseointegrerbare område (2), det transgingivale område (3) og det transgingivale implantathoved (4), er formet i ét stykke.

3. Tandimplantatsystem ifølge krav 1 og 2, der er kendetegnet ved, at det nedre (1) og det øvre (2) osseointegrerbare område af implantatet har en ikke-

rotationssymmetrisk geometri, der svarer til overlejring af mindst to rotationssymmetriske geometriske legemer, hvis symmetriakser løber parallelt med hinanden eller er skrå i forhold til hinanden, således at de skærer hinanden mindst i det nedre osseointegrerbare område, hvor de geometriske legemer overlapper mindst i det øvre osseointegrerbare område.

4. Tandimplantatsystem ifølge krav 3, der er kendetegnet ved, at geometrien af det øvre og nedre osseointegrerbare område af implantatet svarer til overlejringen af geometriske legemer, der har form som en cylinder med en konisk spids, hvor symmetriakserne for cylindrene skærer hinanden i den nedre ende af det nedre osseointegrerbare område.

5. Tandimplantatsystem ifølge krav 3, der er kendetegnet ved, at geometrien af det øvre og nedre osseointegrerbare område af implantatet svarer til overlejringen af geometriske legemer, der har form som en cylinder med en konisk spids, hvor symmetriakserne for cylindrene løber parallelt med hinanden og er adskilt fra hinanden ved en form med n sider.

6. Tandimplantatsystem ifølge et hvilket som helst af kravene 1 til 5, der er kendetegnet ved, at implantatet består af titan.

7. Tandimplantatsystem ifølge et hvilket som helst af kravene 1 til 5, der er kendetegnet ved, at implantatet består af zirconiumoxid.

8. Tandimplantatsystem ifølge et hvilket som helst af kravene 1 til 7, der er kendetegnet ved, at det transgingivale implantathoved (4) har en forsænkning (14), der fungerer som et middel til at forhindre rotation af suprastrukturen (10).

9. Tandimplantatsystem ifølge krav 8, der er kendetegnet ved, at forsænkningen (14) har form som et segment af en cirkel.

10. Tandimplantatsystem ifølge krav 8 og 9, der er kendetegnet ved, at en protesemonteringsstift (7) kobles i forsænkningen (14).

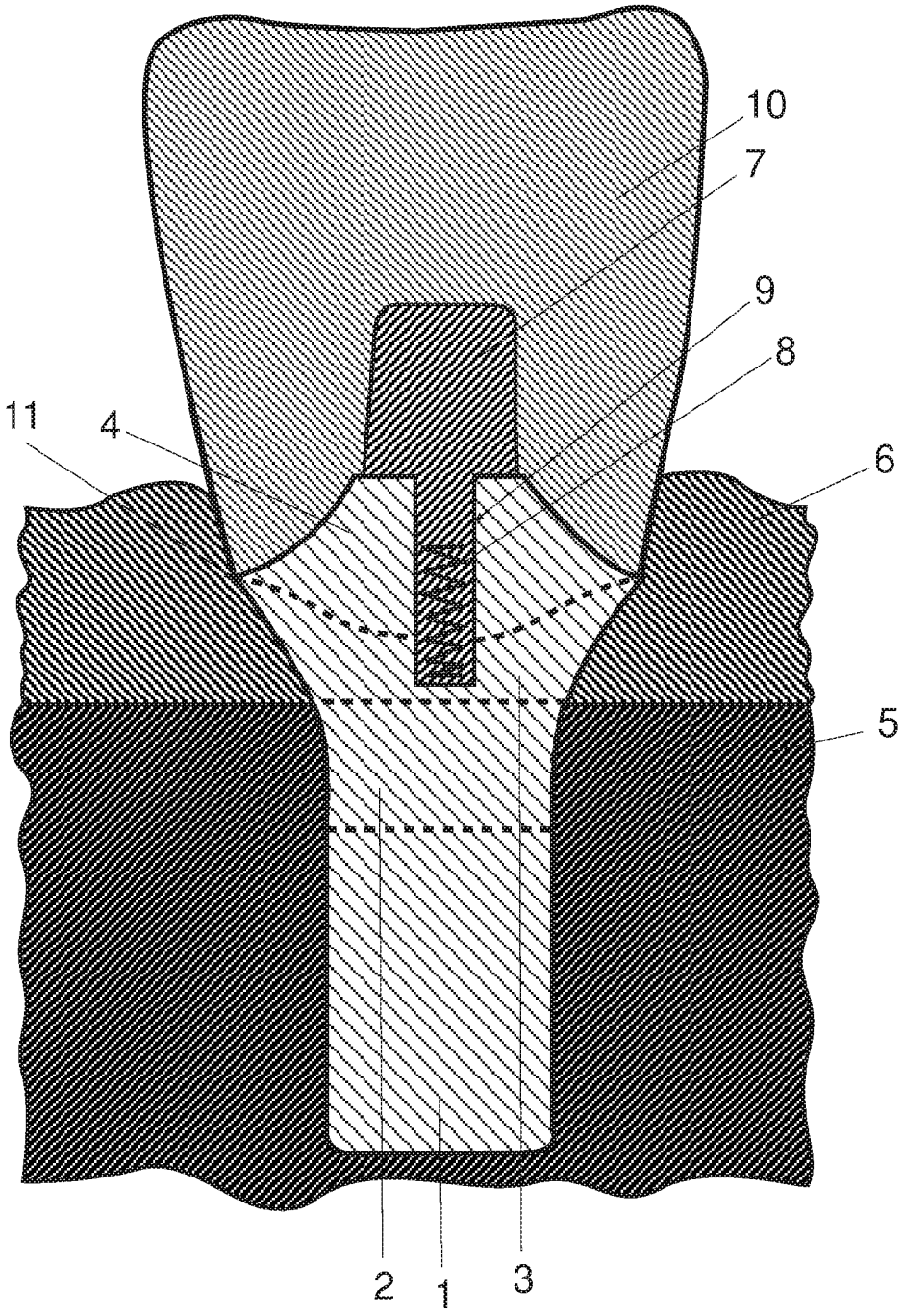

Fig. 1

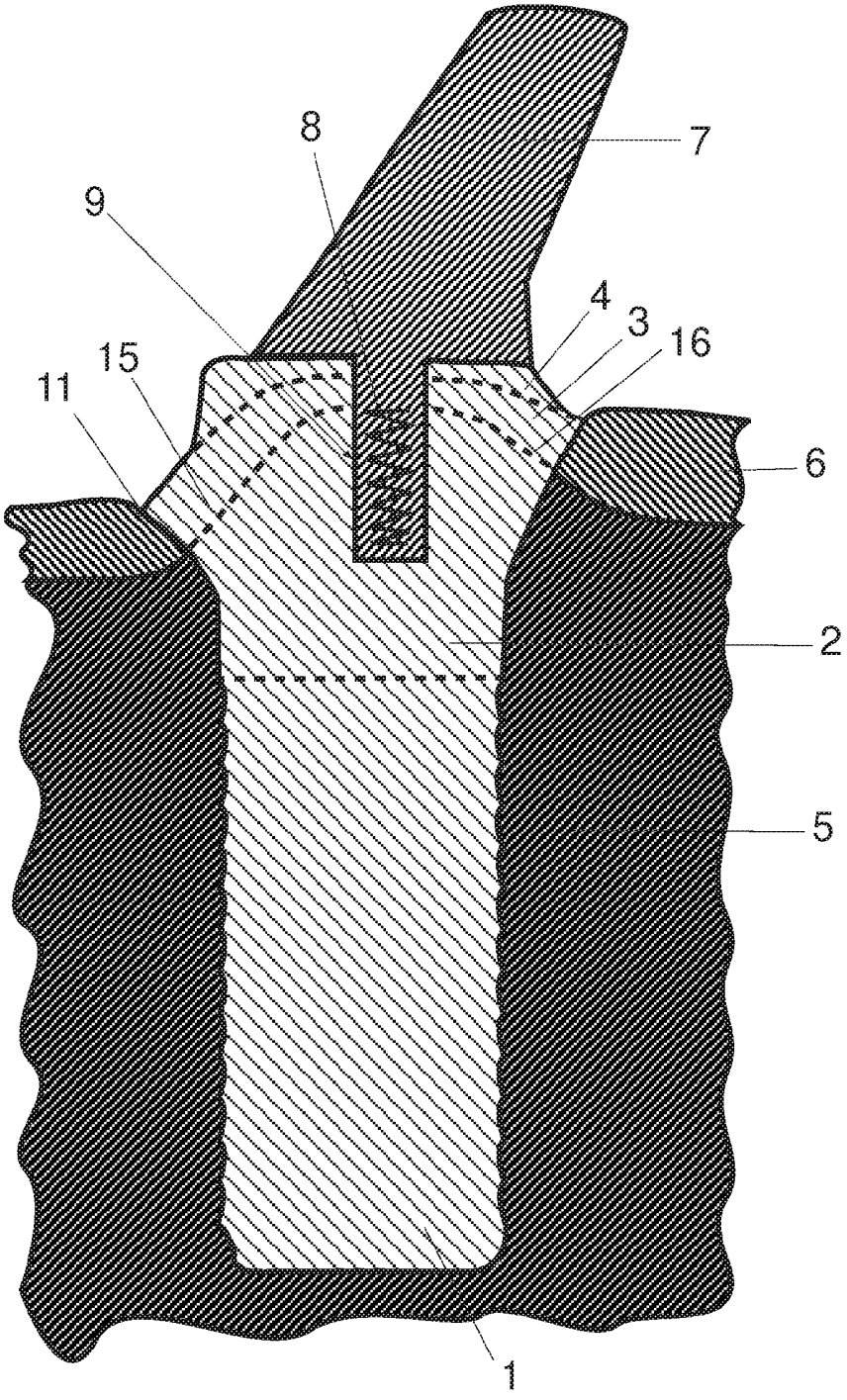

Fig. 2

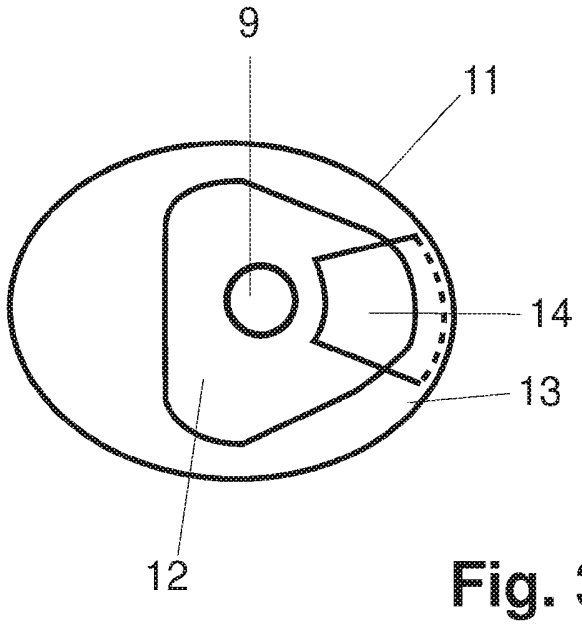

Fig. 3

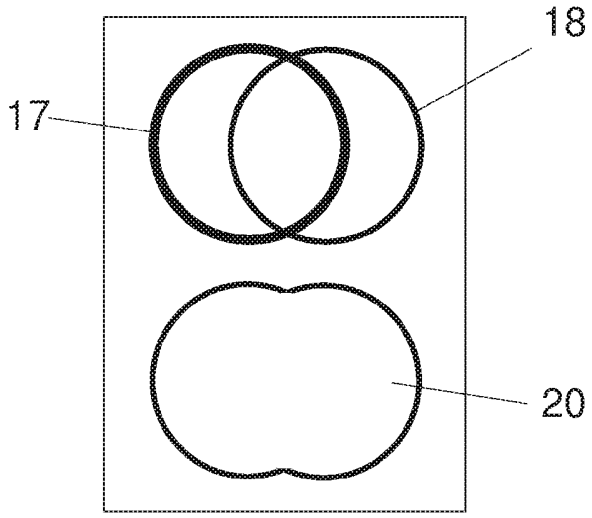

Fig. 4

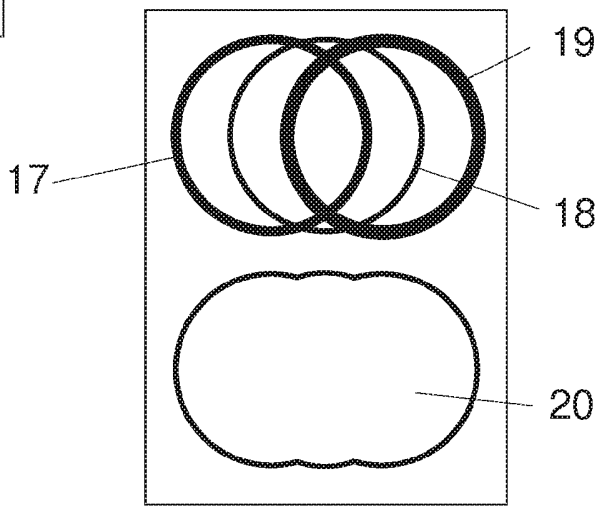

Fig. 5

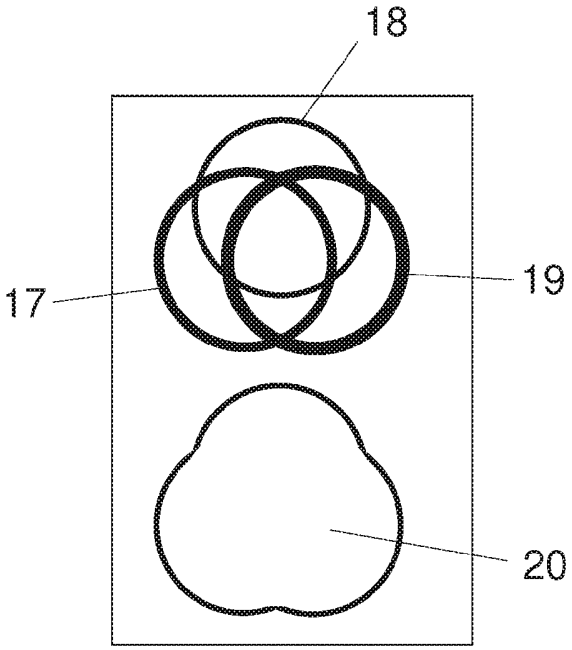

Fig. 6

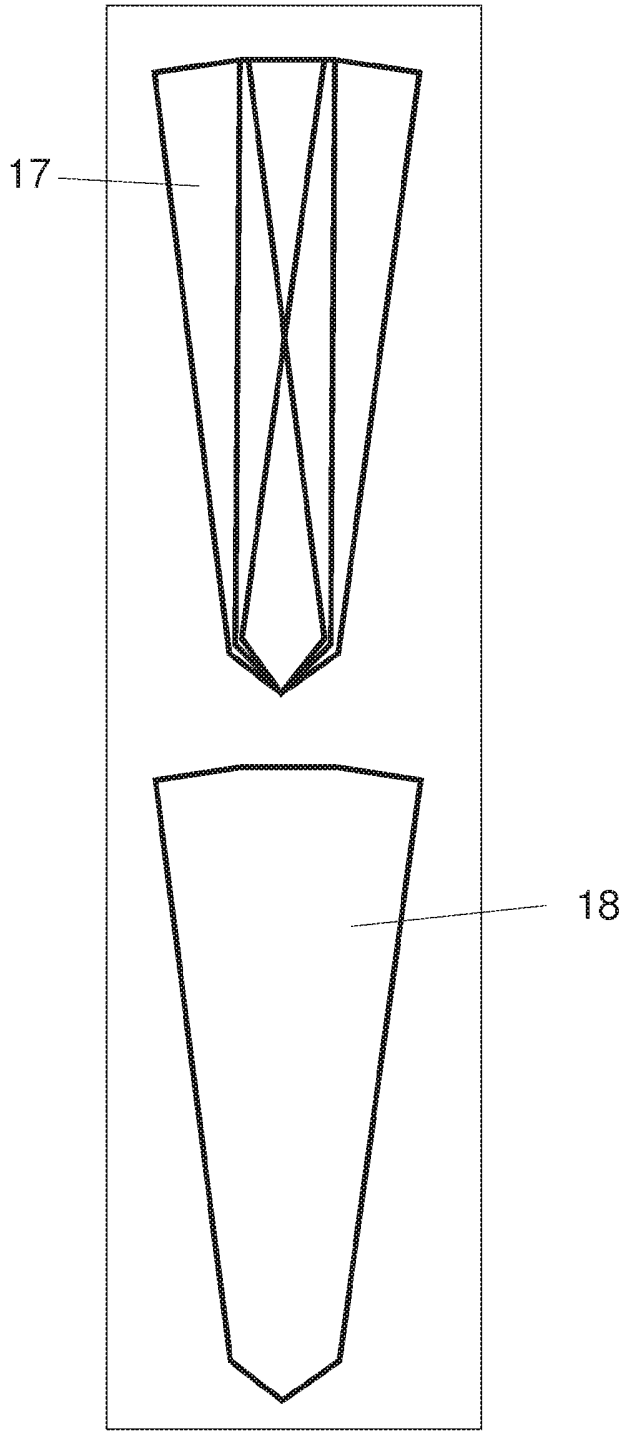

Fig. 7