normal function requirements (holding up the bite and chewing forces) therefore the dimensional size of these implant components and their ability to withstand these significant force loads over decades is critical to the long term success or failure of these implant components and the assembled implant in its entirety

SUMMARY OF THE INVENTION

[0018a] In a first aspect, there is provided a bone implant comprising i. a head component for securing the implant into a bone, wherein the head component has a proximal end and distal end and is adapted along its entire length to be implanted entirely in the bone, wherein the proximal end has a long direction and a short direction both orthogonal to the length of the head component, and the head component is adapted for orienting the long direction parallel to a long axis of the bone; ii. one or more bone attachment components including a first bone attachment component, each independent of and separate from the head component for securing the implant into a bone, wherein each bone attachment component has a proximal end and a distal end and is adapted along its entire length to be implanted in the bone and includes an internally threaded bore hole for receiving a connector component; wherein the head component is further adapted to be secured to each of the bone attachment components with the connector components at the time of initial implantation of the bone attachment component and the head component into the bone; and wherein the first bone attachment component oriented at a tilt angle to the proximal end of the head component is secured to the head component at the tilt angle, wherein the tilt angle is an acute angle between the length direction of the head component and an axis of rotation of the first bone attachment component; and iii. an abutment adapted to be secured independently to the head component in an overlying relation to the head component.

[0018b] In a second aspect, there is provided a bone implant comprising: i. one or more bone attachment components each adapted along its entire length to be implanted in a bone for securing the implant into a bone, wherein each bone attachment component has an axis of rotation and includes an internally threaded bore hole for receiving a connector component; ii. a head component independent of and separable from the bone attachment component, wherein the head component has a proximal end and is adapted along its entire length to be implanted in a bone wherein the proximal end has a long direction and a short directions both orthogonal to the length of the head component, and wherein the head component is adapted to be secured in the bone to the bone attachment component at the time of the initial implantation of the bone implant into a bone, and wherein the head component is further adapted to be secured to an abutment component at a later time; and iii. one or more first connector components having an axis of rotation and that temporarily secures the head component to the bone attachment component at the time of initial implantation of the bone component and the head component in a bone; wherein the head component includes one bore hole per bone attachment component, each bore hole of the head component having an internal limiting seat circumferential flange oriented at a tilt angle for receiving one of the first connector components; wherein each first connector component has a distal head section that substantially fills the distal region of the bore hole of the head component; and each first connector component is removable so that it may be replaced

by a second connector component that is sufficiently long for securing an abutment component that is distally positioned to the bone attachment component with the head component interposed between the abutment component and the bone attachment component; wherein a corresponding set of one of the bone attachment components and one of the first connector components are axially aligned and tilted relative to the head component at a tilt angle, wherein the tilt angle is the acute angle between the length direction and the axes of rotation.

[0018c] In a third aspect, there is provided a method comprising: a step of replacing the first connector component of the second aspect with a second connector component adapted to secure an abutment component to the head component and to the bone attachment component, wherein the step of replacing is following osseo-integration of the bone attachment component, the head component or both.

[0018d] In a fourth aspect, there is provided a kit for the bone implant of the first or second aspect, wherein the kit includes one or more of the bone attachment components and a plurality of the head components including at least two head components that differ with respect to at least one of their tilt angles.

[0019] One embodiment~~aspect~~ of the present teachings is directed at a bone implant comprising one or more bone attachment components for securing the implant to a bone, and a head component independent of and separable from the bone attachment components. Each bone attachment component has a longitudinal axis. Preferably each bone attachment component includes an internally threaded bore hole for receiving a connector component. The head component preferably is adapted so as to be secured to the one or more bone attachment components at the time of initial implantation (e.g., during the same visit) of the bone attachment components and the head component into the bone (e.g., substantially, or even entirely endosseously). The head component preferably is adapted to be oriented relative to at least one of the one or more bone attachment components at a predetermined tilt angle between 0 and 90° relative to the bone attachment component, so that the implant generally conforms with a natural root structure of a missing tooth (e.g., as defined by an extraction cavity of a patient), wherein the tilt angle defined by the acute angle between the longitudinal axis of the bone attachment component and the longitudinal axis of the head component. The longitudinal axis of the head component may be in the generally apical-coronal direction.

[0020] This embodiment~~aspect of the present teachings~~ may be characterized by one or any combination of the following features: the bone implant is a dental implant; the tilt angle is at least about 1°; the bone implant comprises two or more bone attachment components including two bone attachment components having longitudinal axis that are not parallel; the bone attachment components are root screws; the implant includes a first connector component; the first connector component is a screw; the head component includes a bore shaft having a first section that is angled relative to a second section of the bore shaft; or the implant includes an abutment component.

[0021] Another embodiment~~aspect~~ of the present teachings is directed at a bone implant comprising a bone attachment component for securing the implant into a bone, a head component independent of and separable from the bone attachment component, wherein the head component is adapted to be secured in the bone (e.g., substantially, or even entirely endosseously) to the bone attachment component at the time of the initial implantation of the bone implant; and a first connector component that temporarily secures the head component to the bone attachment component at the

time of initial implantation of the bone attachment component and the head component in a bone. The head component is also adapted to be secured to an abutment component at a later time. Preferably, each bone attachment component includes an internally threaded bore hole for receiving a connector component. The head component generally includes one bore hole per bone attachment component. Preferably, each bore hole of the head component has a limiting seat circumferential flange for receiving one of the first connector components. Each first connector component preferably has a distal head section that substantially fills the distal region of a bore hole of the head component. The first connector component preferably is removable so that it may be replaced by a second connector component that is sufficiently long for securing an abutment component that is distally positioned to the bone attachment component with the head component generally interposed between the abutment component and the bone attachment component. A further embodimentaspeet of the present teachings is directed at a method for implanting a bone implant comprising the sequential steps of milling a recess in a bone, wherein the recess has a generally flat floor; drilling one or more bore holes in the bone through the floor of the recess, including at least one bone bore hole that is tilted at a predetermined tilt angle relative to the normal direction of the floor; inserting a bone attachment component in each bone bore hole through the floor; inserting a head component into the cavity of the first bone preparation and placing it over the distal ends of the bone attachment components; and securing the head component to a bone attachment component using a connecting component. Preferably, the predetermined tilt angle of at least one bore hole through the floor of the recess is about 1° or more. The process preferably is employed to install a bone implant having one or more of the features described herein. The process preferably employs a bone installing apparatus having one or more of the features described herein.

[0022] Another process related embodimentaspeet of the present teachings is directed at a process for implanting a bone implant comprising the steps of: securing a surgical jig having a drilling platform to a patient jawbone; attaching and securing a removable sliding first drill guide assembly to said jig wherein said drill guide assembly is adapted to enable a controlled milling procedure in the jawbone of a symmetrical or asymmetrical bone preparation; performing a milling procedure to prepare a first bone preparation with a predetermined cross-sectional shape and uniform depth, using a hand piece guide sleeve adapter containing the drill head and attached milling drill bit which relates to the first drill guide assembly; and performing a guided drilling procedure to prepare a second bone preparation of one or more bore holes in the floor of the previously prepared first bone preparation, using a second drill guide assembly to which is related the hand piece guide

sleeve adapter containing the drill head and attached bore drill bit. The guide sleeve preferably has a cut-out slot adapted to be attached and removed from a drill head. Such a guide sleeve may include a separate hole cut into the guide sleeve to allow for the unimpeded spray of irrigating solution from the drill head when drilling into a hard tissue. The process preferably is employed to install a bone implant having one or more of the features described herein. The process preferably employs a bone installing apparatus having one or more of the features described herein.

[0023] Alternatively, the surgical jig described above may incorporate a drilling platform which allows for the securing of multiple drill guide assemblies and the subsequent preparation of multiple implant bone preparations and or the insertion and securing of multiple implants into said multiple implant bone preparations or alternatively their insertion and securing in multiple natural extraction sockets that remain after the prior extraction of these teeth.

[0024] Another method related embodimentaspect of the present teachings is directed at a method of securing an implant comprising a step of replacing a first connector component that connects a head component and a bone attachment component with a second connector component adapted to secure an abutment component to the head component and to the bone attachment component, wherein the step of replacing is following osseo-integration of the bone attachment component, the head component or both.

[0025] Yet another embodimentaspect of the present teachings is directed at an apparatus for the guided installing of a bone implant, such as a dental implant. The same apparatus used to prepare the osteotomy can also be used to install the endosseous implant components in a guided and controlled manner. Utilizing the second drill guide assembly which has been secured to the surgical jig, a driver tool, to which has been securely attached a root screw, is adapted to slide into the guide ring of the drill guide assembly at the same location and angle as the guide tube so as to screw the root screw into the previously prepared bone bore shafts or alternatively the natural root socket of a recently extracted tooth. The driver tool has a limiting collar that engages the guide ring of the second drill guide assembly, and so controls the maximum depth the root screw can be driven down into the bone bore hole or alternatively, the natural root socket void.

[0026] Yet another embodimentaspect of the present teachings is directed at tools which act as templates to check the accurate preparation of the osteotomy or to check the accurate insertion of the root screw(s) into the previously prepared bone bore hole(s) or alternatively, the natural extraction root sockets of a recently missing tooth.

[0027] The implants, methods, and apparatus of teachings herein may include one or any combination of the following: a head component having a limiting flange in (e.g., each of) its bore

holes that allows for the tight securing of the bone attachment components (e.g., root screw(s)) to the head component in the bone at the time of initial implanting; a head component that allows for an angled relation and/or angled securing of the head component to one or more bone attachment components (preferably multiple root screws), such as with angled connector components, so that the assembled bone attachment component and head component is an analog of the entire natural root structure (e.g., implant parts generally match the extraction sockets of a recently extracted tooth with minimal drilling and minimal need for bone regrowth (e.g., no drilling and no need for bone regrowth); a ball and socket coupling of the neck of the bone attachment component and the head component so that a generally tight fit with substantially no micro-gaps can be obtained (e.g., thus allowing for greater tolerances in the preparation of an implant site); an implant that does not have an angled relationship between the head component and the root screw component wherein the implant includes a temporary first connector component that protects a bore hole of the head component (e.g., the first connector component may act as a cover screw to secure the head component to the root screw at the time of an initial implantation; a bone attachment component (e.g., a root screw) that is headless and that can be related (e.g., tightly related) to the head component and whose body diameter is larger than the smallest diameter of the bore hole of the head component; the bone attachment component has a generally convex neck or convex neck collar; the bone attachment component has a locking feature, such as a petal-shaped external locking feature (e.g., on its neck) that corresponds to a similar matching feature in the head component (e.g., in a bore hole of a head component); an apparatus for installing an implant that includes a surgical jig having novel clamping features according to the teachings herein; a novel *first drill guide and/or second* drill guide according to the teachings herein; a apparatus and methods for a novel milling procedure according to the teachings herein; novel apparatus and methods for drilling an angled bone bore hole; template(s) and methods for employing template(s) for checking and/or evaluating a bone preparation; a novel root screw driver according to the teachings herein; or a novel dental drill guide sleeve adapter for controlling and/or guiding a dental drill during one or more steps of a bone preparation.

[0028] A further embodiment~~aspect~~ of the present teachings is directed at an implant kit including a plurality of head components including two or more (e.g., four or more, 6 or more, or even 10 more) head components having different tilt angles so that a bone surgeon can choose an appropriate head component for an implant site. The implant kit preferably includes one or more bone attachment components, one or more first connector components, or any combination thereof.

21. A kit for the bone implant of any of claims 1 to 19, wherein the kit includes one or more of the bone attachment components and a plurality of the head components including at least two head components that differ with respect to at least one of their tilt angles.

22. The bone implant of claim 1, wherein each bone attachment component has a longitudinal axis, and wherein the head component has a longitudinal axis generally orthogonal to a jawbone into which it is installed, and wherein the head component is tilted relative to the bone attachment component, such that the tilt angle is defined by the acute angle between the longitudinal axis of the bone attachment component and the longitudinal axis of the head component.