Title: The Intraoral Compass

Summary:

a device which contacts a plurality of teeth, wherein the distance between corresponding points on opposing top and bottom surfaces that contact the teeth is equal to the distance between the corresponding points on the surfaces of the teeth with which they contact when the coordinates of cephalometric landmarks on the skull and the mandible satisfy a plurality of geometric relationships comprising: the value of the angle K is less than the value of K measured in the initial image; the value of the angle J is less than the value of J measured in the initial image; the distance between the midpoint of GorGol and the point R is less than said distance measured in the initial image.

Abstract:

a device which contacts a plurality of teeth, wherein the distance between corresponding points on opposing top and bottom surfaces that contact the teeth is equal to the distance between the corresponding points on the surfaces of the teeth with which they contact when the coordinates of cephalometric landmarks on the skull and the mandible satisfy a plurality of geometric relationships comprising: the value of the angle K is less than the value of K measured in the initial image; the value of the angle J is less than the value of J measured in the initial image; the distance between the midpoint of GorGol and the point R is less than said distance measured in the initial image.

Detailed Description:

Before I describe the device itself it's important to understand what the goal of the device actually is. The goal of the device is to reduce the observed displacement of the patient's mandible when relaxed from the ideal range of positions described in the best mode below. To measure this displacement, first take a cone beam computed tomography scan or other 3dimensional image of the patients skull and mandible. The patient should position their mandible in a relaxed position that they are comfortable with. To ensure accuracy, do not attempt to reposition the patient or have them engage a bite pad or other stabilizing device or implement. We must measure how the patient positions their mandible themselves at rest, not as we wish them to.

Once said image is obtained, Identify the right and left gonions, and label them Gor and Gol. Identify the Frankfort horizontal plane and the cranial mid sagittal plane. Next, draw a line segment from Gor to Gol, and mark the point where this line intersects the cranial mid sagittal plane. We label this line GorGol and we label the intersection point P. Next, draw a line perpendicular to the cranial mid sagittal plane that intersects P, and label it R. Rotate the image so you are viewing the skull directly from the rear. From this view, the Frankfort horizontal plane and the cranial mid sagittal plane will appear as lines. Measure the angle between the line segment Gol-P and R , record the angle and label it J . Next, rotate the image so you are viewing the skull directly from the bottom. From this view, the Frankfort horizontal plane will

appear as a plane and the cranial mid sagittal plane will appear as a line. Measure the angle between the line segment Gol-P and R , record the angle and label it K.

The best mode as described below seeks to enforce the ideal position(s) of the mandible relative to the skull. However, any device which when engaged is closer to the best mode than it is in the initial image is beneficial. That is, it may not be ideal as the best mode is, but it would constitute an embodiment of a device which is beneficial, even if by a miniscule amount.

We enforce this position of the mandible relative to the skull wherein the device is shaped such that it contacts a plurality of teeth, wherein the distance between corresponding points on opposing top and bottom surfaces of the device that contact the teeth is equal to the distance between the corresponding points on the surfaces of the teeth with which they contact when the coordinates of cephalometric landmarks on the skull and the mandible satisfy the relationships described in the best mode, or a reduction of J and/or K and/or reduction of the distance between the midpoint of GorGol and the cranial mid sagittal plane, which would constitute a more desirable position of the mandible relative to the skull than in the initial image.

The device is constructed out of a plurality of different materials. The device contacts a plurality of teeth. The device may comprise a plurality of protrusions on the surface of the device that does not contact the teeth. The device may comprise a plurality of cavities, or a plurality of protrusions which extend outward from the mouth, wherein said protrusions may be detachable. Another embodiment of the device comprises a plurality of objects which combine to form a device , the surfaces of said objects optionally contact the patients teeth, and said

objects combine such that when the surfaces of the objects that contact the teeth are engaged by the patient, the patients mandible is positioned relative to the skull as described in the best mode or closer to the best mode than the position of the mandible obtained from the initial image.

The best mode of the device is shaped such that it contacts a plurality of teeth, wherein the distance between corresponding points on opposing top and bottom surfaces of the device that contact the teeth is equal to the distance between the corresponding points on the surfaces of the teeth with which they contact when the coordinates of cephalometric landmarks on the skull and the mandible satisfy a set of geometric landmarks comprising: GorGol is parallel to the Frankfort horizontal plane , GorGol is perpendicular to the cranial mid sagittal plane, GorGol intersects the cranial mid sagittal plane at the midpoint of GorGol.

The technician or physician should locate a position of the mandible that satisfies as many of the geometric relationships described above as possible . It should be understood that the technician can use any data and any techniques to find said position, including but not limited to interpolation, data gathered from an articulator, or extrapolating valid positions of the jaw using software or mathematical or estimation techniques, so long as the position is indeed a valid one. One way to find said position is to take cone beam computed tomography scans of the entire skull with the patients mandible in various positions. The 3d images generated by the cone beam computed tomography scans are opened with cad software, or dental software or otherwise, to be chosen at the technicians discretion, and after geometric analysis of each image the one which most closely matches the best mode is chosen. Obtain an intraoral scan of

the patient and superimpose said scan with the corresponding surfaces of the teeth in the best mode 3d image, and use the resultant 3d image to generate a device using cad or any specialized dental software(wherein the device may be described as an occlusal splint), or by calculating its shape wherein the distance between corresponding points on opposing top and bottom surfaces of the device that contact the teeth is equal to the distance between the corresponding points on the surfaces of the teeth with which they contact as represented in the 3d image. 3d print the device and perform any post processing required.

For embodiments of the device that have a plurality of protrusions, said protrusions can be of any size or shape, and are positioned anywhere on the surface of the device that doesn't contact the teeth. It should be understood that any combination of protrusions is permitted, but combinations which are arranged in such ways that they form the endpoints or surfaces of a symmetric geometric object such as a line, square, rectangle or cube or otherwise are more desirable. The best mode of positioning of said geometric object should be one such that any combination of geometric relationships comprised of the following are satisfied: the surface or endpoints of the object facing the patients Frankfort horizontal plane is parallel to the Frankfort horizontal plane , the corresponding endpoints of the object on opposing sides of the cranial mid sagittal plane should be equidistant from the cranial mid sagittal plane, the line segments drawn between corresponding endpoints of the object on opposing sides of the cranial mid sagittal plane should be perpendicular to the cranial mid sagittal plane.

For embodiments of the device that have a plurality of cavities and/or have a plurality of protrusions that extend outward beyond the mouth, the core of the device should be

substantially rigid, so the device maintains its shape when the device is connected with an external implement, and said implement exerts mechanical force(s) on the device or vice versa. The cavities or protrusions may be detachable from the rigid core or be a part of the core itself. Said core may extend outside of the patients mouth or be completely contained in the mouth. It should be understood that the device should be shaped to engage the patient in a way consistent with the geometric relationships as described in the best mode or closer to the best mode than the initial values measured from the initial image as described in the first paragraph of the detailed description. It is desirable for the surfaces that contact the patient's teeth to be less rigid than the core material, for purposes of comfort.

For embodiments of the device that are comprised of a plurality of objects which combine to form a device, each object comprises a plurality of surfaces which form an interface with corresponding surfaces on other objects, and optionally a plurality of surfaces which each contact a subset of the surface of the teeth, wherein the dimensions of each object are such that when the objects are combined at their corresponding surfaces, they contact a plurality of teeth, such that the distance between corresponding points on opposing top and bottom surfaces that contact the teeth is equal to the distance between the corresponding points on the surfaces of the teeth with which they contact when the coordinates of cephalometric landmarks on the skull and the mandible satisfy a plurality of geometric relationships such as those described in the best mode or closer to the best mode than the initial image.

The method the patient uses that may reduce their spinal curvature is to engage their teeth with the surfaces of the device that correspond to said teeth and keep the device firmly and

securely in place for as long as the device is being worn. Results may be better when the patient exercises while keeping the device securely engaged.

Claims:

1- a device which contacts a plurality of teeth, wherein the distance between corresponding points on opposing top and bottom surfaces that contact the teeth is equal to the distance between the corresponding points on the surfaces of the teeth with which they contact when the coordinates of cephalometric landmarks on the skull and the mandible satisfy a plurality of geometric relationships comprising: the value of the angle K is less than the value of K measured in the initial image; the value of the angle J is less than the value of J measured in the initial image; the distance between the midpoint of GorGol and the point P is less than said distance measured in the initial image.

2- the device in claim 1, wherein said device further comprises an occlusal splint.

3- the device in claim 2, wherein said device further comprises a plurality of protrusions on the surfaces of the device which do not contact the surface of the teeth.

4- the device in claim 3, wherein the surfaces of said protrusions represent the endpoints or surfaces of a plurality of geometric objects.

5- the device in claim 4, wherein the pairs of corresponding endpoints of said geometric objects on opposing sides of the constructed plane form the endpoints of line segments wherein said line segments are substantially perpendicular to the constructed plane.

6- the device in claim 2, wherein said device further comprises a substantially rigid material.

7- the device in claim 6, wherein said rigid material contains a plurality of cavities.

8- the device in claim 6, wherein said rigid material contains a plurality of protrusions.

9- the device in claim 8, wherein a plurality of said protrusions extend outside of the mouth.

18- the device in claim 9, wherein said protrusions are detachable.

10- the device in claim 1, wherein said device further comprises a plurality of protrusions on the surfaces of the device which do not contact the surface of the teeth.

11- the device in claim 10, wherein the surfaces of said protrusions represent the endpoints or surfaces of a plurality of geometric objects.

12- the device in claim 11, wherein the pairs of corresponding endpoints of said geometric objects on opposing sides of the constructed plane form the endpoints of line segments wherein said line segments are substantially perpendicular to the constructed plane.

13- the device in claim 1, wherein said device further comprises a substantially rigid material.

14- the device in claim 13, wherein said rigid material contains a plurality of cavities.

15- the device in claim 13, wherein said rigid material contains a plurality of protrusions.

16- the device in claim 15, wherein a plurality of said protrusions extend outside of the mouth.

19- the device in claim 16, wherein said protrusions are detachable.

17- a device comprising a plurality of objects, wherein each object comprises a plurality of surfaces which form an interface with corresponding surfaces on other objects, and optionally a plurality of surfaces which each contact a subset of the surface of the teeth, wherein the dimensions of each object are such that when all of the objects are combined at their interfaces they contact a plurality of teeth, wherein the distance between corresponding points on opposing top and bottom surfaces that contact the teeth is equal to the distance between the corresponding points on the surfaces of the teeth with which they contact when the coordinates of cephalometric landmarks on the skull and the mandible satisfy a plurality of geometric relationships comprising: the value of the angle K is less than the value of K measured in the initial image; the value of the angle J is less than the value of J measured in the initial image; the distance between the midpoint of GorGol and the point P is less than said distance measured in the initial image.

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FIG. 4

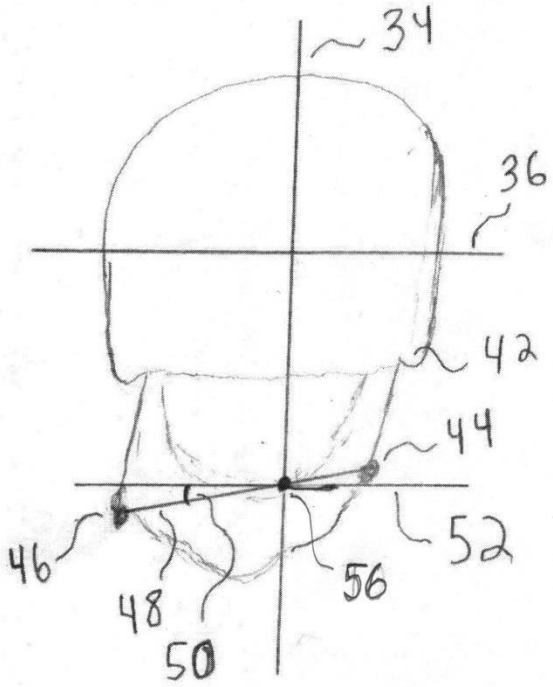


FIG. 6

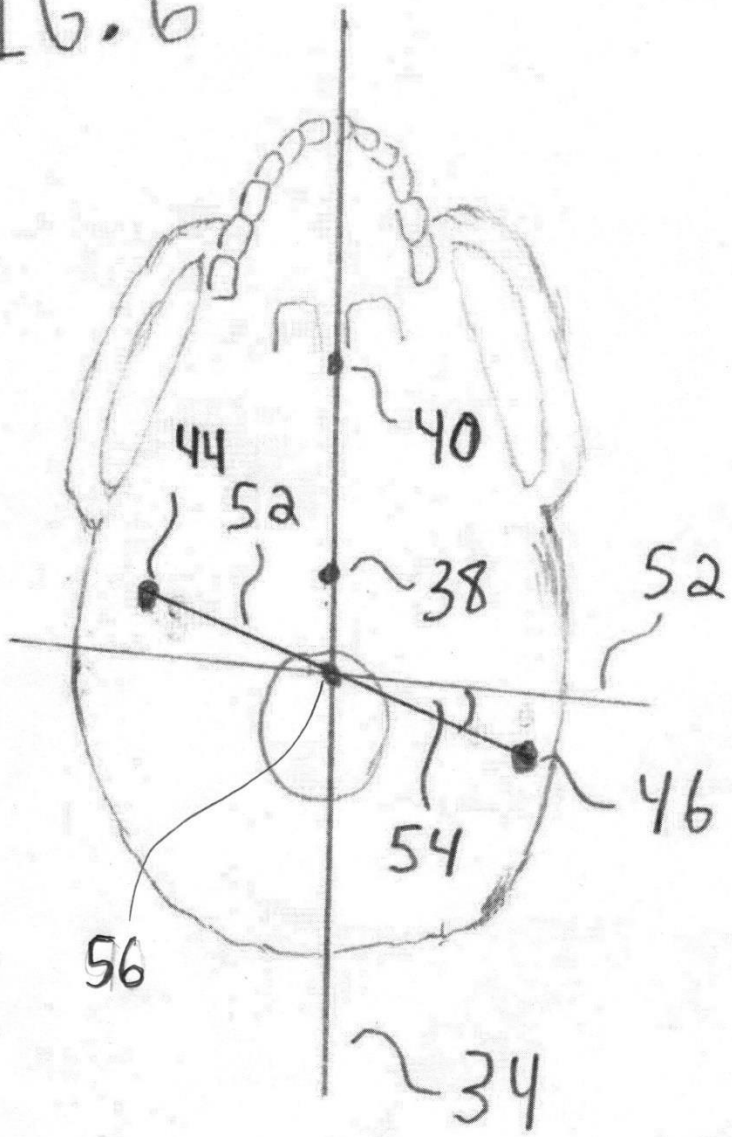


FIG. 8

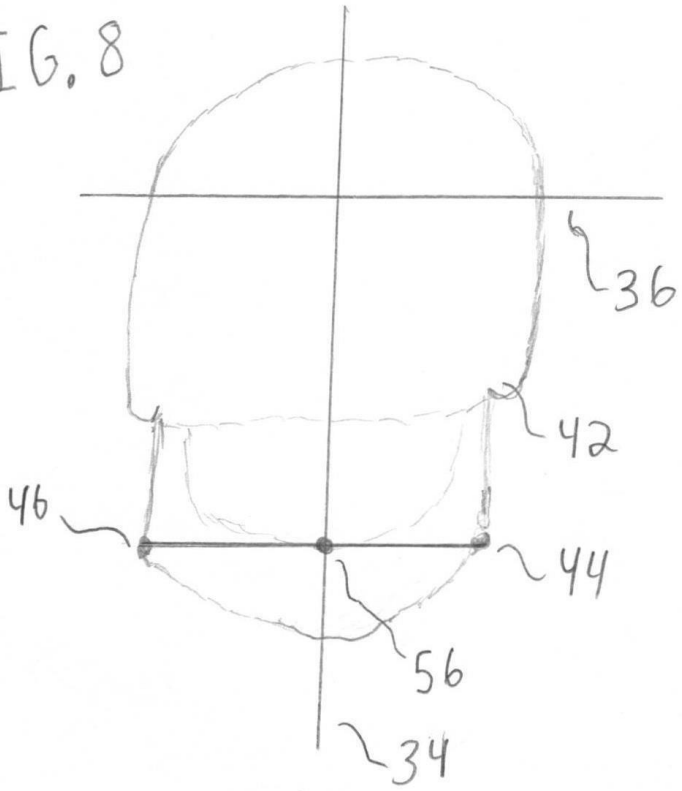


FIG. 10

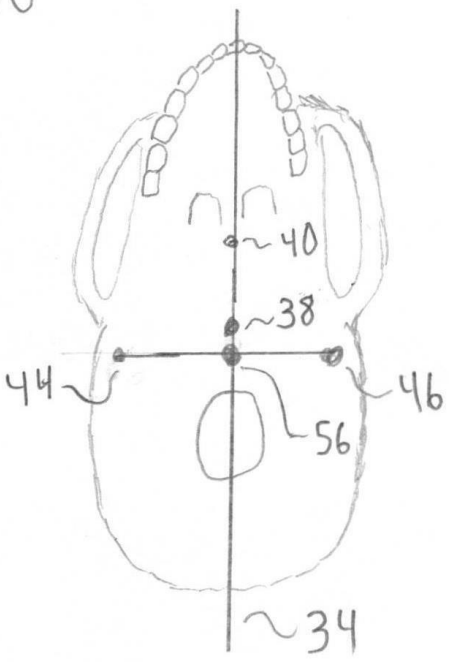


FIG. 12

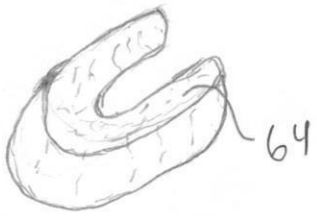


FIG. 14

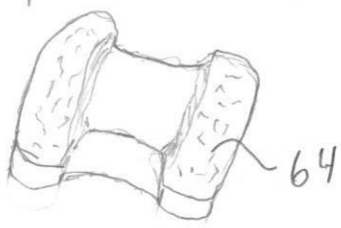


FIG. 16

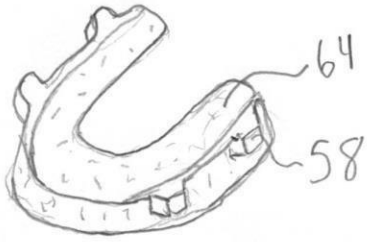


FIG. 18

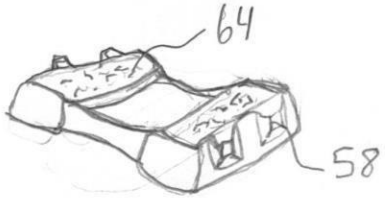


FIG. 20

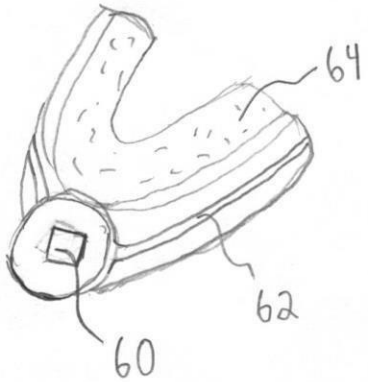
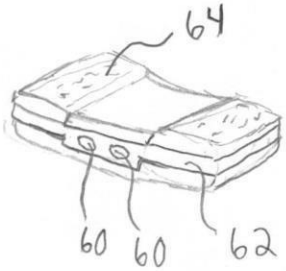
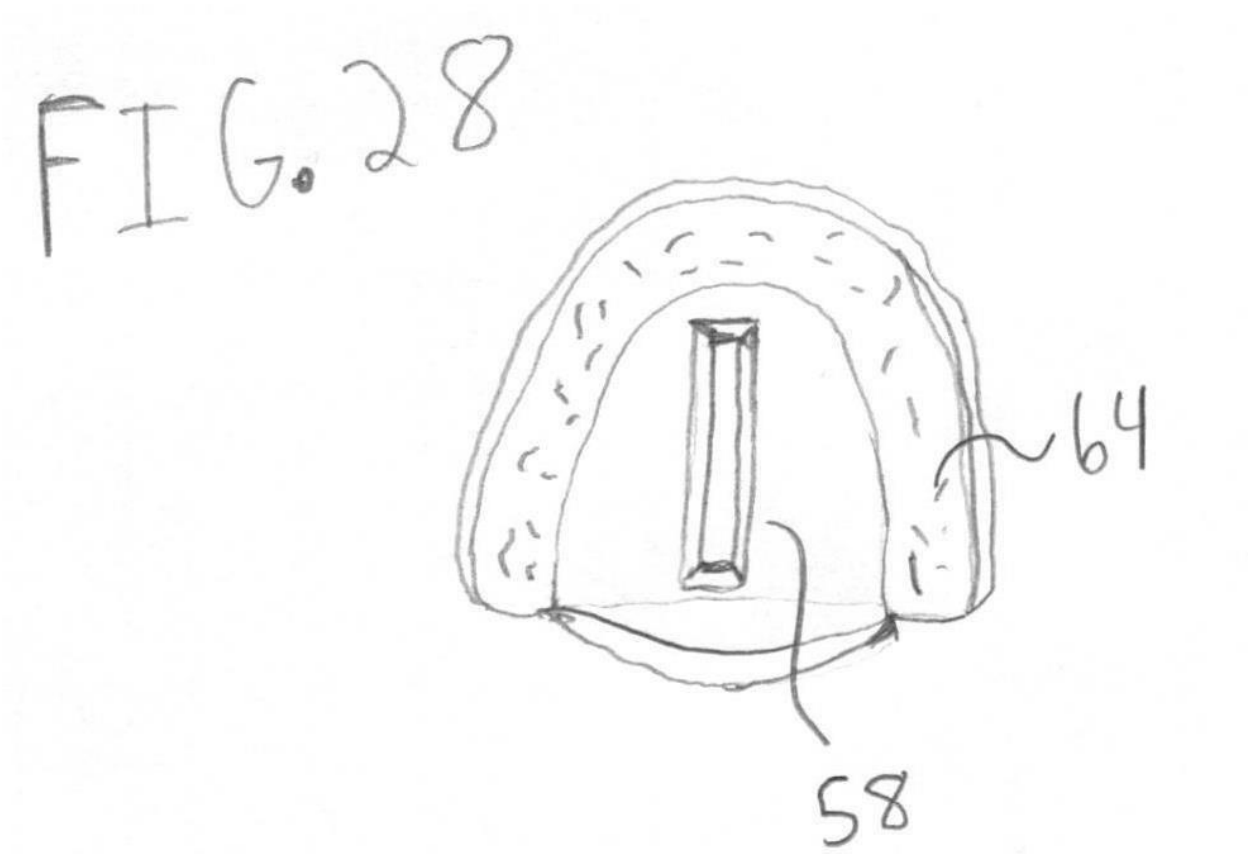


FIG. 22





Description of the Drawings:

Fig. 4 depicts the initial 3d image of the skull and mandible as viewed from the rear.

Fig. 6 depicts the initial 3d image of the skull and mandible as viewed from the bottom.

Fig. 8 depicts the 3d image of the skull from the rear when the mandible is positioned according to the best mode.

Fig. 10 depicts the 3d image of the skull from the bottom when the mandible is positioned according to the best mode.

Fig. 12 depicts an embodiment of a device that contacts all of the teeth.

Fig. 14 depicts an embodiment of a device that contacts the molars and premolars.

Fig. 16 depicts an embodiment of a device with protrusions on the sides.

Fig. 18 depicts an embodiment of a device that contacts the molars and premolars with protrusions on the sides.

Fig. 20 depicts an embodiment of a device that contacts all of the teeth with a substantially rigid core which comprises a cavity.

Fig. 22 depicts an embodiment of a device that contacts the molars and premolars, comprising a substantially solid core and two cavities.

Fig. 24 depicts an embodiment of a device as viewed from the side which comprises a substantially rigid core and a protrusion that interfaces with a cavity on an external device.

Fig. 28 depicts an embodiment of a device with a protrusion when viewed from the bottom. The protrusion in this case represents a line which is superpose with the cranial mid sagittal plane.

Glossary:

34- A cephalometric plane known as the cranial mid sagittal plane.

36- A cephalometric plane known as the Frankfort horizontal plane.

38- The cephalometric landmark known as the basion.

40- The cephalometric landmark known as the posterior nasal spine.

42- The mastoid process.

44- A cephalometric landmark known as Gor, also called the right gonion.

46- A cephalometric landmark known as Gol, also called the left gonion.

48- The line segment GorGol. The endpoints of said line segment are Gor and Gol.

50- The angle known as J, which is the angle between R and a line segment with the endpoints Gol and P(aka Gol-P) when the skull is viewed from the rear.

52- The line known as R, which intersects the cranial mid sagittal plane perpendicularly at the point P where GorGol intersects the cranial mid sagittal plane.

54- The angle known as K, which is the angle between R and a line segment with the endpoints Gol and P(aka Gol-P) when the skull is viewed from the bottom.

56- The point P at which GorGol intersects the cranial mid sagittal plane.

58- A protrusion on the surface of a device.

60- A cavity in the device.

62- A core made of a substantially rigid material.

64- The surface of the device which contacts the teeth.

66- A protrusion which is part of a substantially rigid core.