

[DESCRIPTION]

[TITLE OF INVENTION]

TOOTHBRUSH

[Technical Field]

[0001]

The present invention relates to a toothbrush.

The present application claims priority on Japanese Patent Application No. 2016-045368, filed on March 9, 2016 and Japanese Patent Application No. 2016-211879, filed on October 28, 2016, the contents of which are incorporated herein by reference.

[Background Art]

[0002]

Patent Documents 1 to 3 propose toothbrushes that have heads with thin thicknesses in terms of operability in the oral cavity. The thin thicknesses of the heads lead to problems such as a decrease in strength. Therefore, a resin with a high strength such as polyacetal resin (POM) is used. In a case of metal piece-scheme bristle implanting in which brush bristles are held by driving metal pieces, which are made of metal, into a head made of resin, in particular, the strength of bristle implanting and the strength of a bending resistance of the head portion may become insufficient.

[Citation List]

[Patent Literature]

[0003]

[Patent Document 1]

Japanese Unexamined Patent Application, First Publication No. 7-143914

[Patent Document 2]

Japanese Unexamined Patent Application, First Publication No. 2011-4852

[Patent Document 3]

Japanese Unexamined Patent Application, First Publication No. 2011-200296

[Summary of the Invention]

[Technical Problem]

[0004]

As a result of a review made by the present inventors, it has been found that an effect of improving operability in the oral cavity due to a decrease in the thickness of a head portion deteriorates if a neck portion connecting the head portion and a handle portion is thick in a toothbrush as described above. If the neck has a wide width, in particular, the operability further deteriorates, and also the thin thickness of the head does not significantly feature in terms of an appearance thereof, which leads to deterioration in impression of the product. However, in a case in which the width of the neck portion is reduced in an opposite manner, there may be a problem in the operability since the neck portion is excessively deflected. Also, a further improvement is also required in terms of strength. In the case of general-purpose resins that are typically used in a toothbrush, such as polypropylene (PP), in particular, this problem appears more significantly.

[0005]

The present invention was made in consideration of the aforementioned points, and an object thereof is to provide a toothbrush with a thin head capable of obtaining satisfactory operability.

[Solution to Problem]

[0006]

According to a first aspect of the present invention, there is provided a toothbrush including: a head portion that is arranged on a tip end side and has a bristle implanted surface with bristle bundles implanted thereon; a neck portion that extends from a rear end side of the head portion; and a handle portion that extends on a rear end side of the neck portion, in which a thickness of the head portion is 2.0 to 4.0 mm, the neck portion is formed such that a minimum value of a width thereof in a direction that is parallel to the bristle implanted surface and intersects a length direction of the handle portion perpendicularly is equal to or greater than 3.5 mm and equal to or less than 4.5 mm, the width constantly or gradually increasing from a position corresponding to the minimum value toward the rear end side, and when the width at a position separated from the position corresponding to the minimum value at the neck portion toward the rear end side by 10 mm parallel to the bristle implanted surface is assumed to be W mm, and a thickness in a direction that intersects the bristle implanted surface perpendicularly is assumed to be D mm, a value obtained by D/W is equal to or greater than 0.7 and equal to or less than 2.5, and a deflection coefficient M (mm^4) = $W \times D^3$ is equal to or greater than 165 mm^4 and equal to or less than 625 mm^4 .

[0007]

In addition, in the toothbrush according to the above aspect of the present invention, the neck portion is formed of a resin material, and bending elastic modulus of the resin material is equal to or greater than 1000 MPa and equal to or less than 2200 MPa.

[0008]

In addition, in the toothbrush according to the above aspect of the present invention, the neck portion is formed of polypropylene resin.

[Advantageous effects of Invention]

[0009]

According to the present invention, it is possible to provide a toothbrush capable of obtaining satisfactory operability in the oral cavity even in a case in which a general-purpose resin is used.

[Brief Description of Drawings]

[0010]

Fig. 1 is a diagram showing an embodiment of the present invention and is a plan view of a toothbrush 11.

Fig. 2 is a side view of the toothbrush 11.

Fig. 3 is a plan view showing a tip end side of the toothbrush 11 in an enlarged manner.

Fig. 4 is a side view showing the tip end side of the toothbrush 11 in an enlarged manner.

Fig. 5A is a plan view of a toothbrush according to an embodiment of the present invention.

Fig. 5B is a side view of a toothbrush according to an embodiment of the present invention.

Fig. 6A is an explanatory diagram of a method of measuring the amount of deflection of a head portion.

Fig. 6B is an explanatory diagram of the method of measuring the amount of

deflection of the head portion.

[Description of Embodiments]

[0011]

Hereinafter, an embodiment of a handle body of a toothbrush and a toothbrush according to the present invention will be described with reference to Figs. 1 to 4.

Note that the embodiment described below shows a mode of the present invention and is not intended to limit the present invention, and arbitrary modifications can be added within a scope of the technical idea of the present invention. In addition, the scale, numbers, and the like of the respective structures in the following drawings may be different from those of actual structures for ease of understanding of the respective structures.

[0012]

Fig. 1 is a plan view of the toothbrush 11. Fig. 2 is a side view of the toothbrush 11. Fig. 3 is a plan view showing a tip end side of the toothbrush 11 in an enlarged manner. Fig. 4 is a side view showing the tip end side of the toothbrush 11 in an enlarged manner.

[0013]

The toothbrush 11 according to the embodiment includes a head portion 110, which is arranged at a tip end, on which bristle bundles 114 are implanted, a neck portion 120 that extends on a rear end side of the head portion 110, and a handle portion 130 that extends on a rear end side of the neck portion 120 (hereinafter, the head portion 110, the neck portion 120, and the handle portion 130 will be collectively referred to as a handle body 12).

[0014]

The handle body is integrally molded into a long shape as a whole and is obtained by injection molding using a resin, for example, as a material.

Examples of a material of the handle body includes resins with bending elastic modulus (JIS 7171) of equal to or greater than 1000 MPa and equal to or less than 2200 MPa, and examples thereof include polypropylene resin (PP), polyacetal resin (POM), polystyrene resin (PS), polyethylene terephthalate resin (PET), polybutylene terephthalate resin (PBT), acrylonitrile butadiene styrene resin (ABS), polyarylate resin, polycarbonate resin, and acrylonitrile styrene resin (AS). Among these examples, polypropylene resin that is general-purpose resin is preferably used in consideration of more significant effects of the present invention and the aspect of cost.

[0015]

One kind of the above resins may be used alone, or two or more kinds thereof may be used together.

Also, a part or the entirety of the handle body may be covered with a flexible resin such as an elastomer, for example, in order to improve gripping properties. In a case of using a flexible resin such as a elastomer, a polyolefin is preferably used, and PP is more preferably used, for example, from the viewpoint that it is then possible to enhance adhesiveness.

[0016]

The head portion 110 has a bristle implanted surface 111 on one side (hereinafter, referred to as an upper surface side) in the thickness direction. A plurality of bristle implanted holes 112 are formed on the bristle implanted surface 111, and bristle bundles 114 (see Fig. 2) are implanted in the bristle implanted holes 112.

Note that illustration of the bristle bundles 114 is omitted in Figs. 1, 3, and 4.

[0017]

An end portion of the head portion 110 on the rear end side according to the embodiment is defined at a position of a distance L11 from an outer edge of a bristle implanted hole 112, which is arranged at a furthestmost location on the rear end side, on the rear end side on the assumption that the distance from an outer edge of a bristle implanted hole 112, which is arranged at a furthestmost location on the tip end side, to the tip end of the head portion 110 is L11. That is, the head portion 110 is arranged within a range 110A that is separated from the respective bristle implanted holes 112 located at both ends in the length direction by the distance L11 as shown in Fig. 3. A position of the range 110A on the rear end side is a boundary P1' between the head portion 110 and the neck portion 120.

[0018]

An end of the handle portion 130 on the tip end side serves as a finger placing portion, and an end of the finger placing portion on the tip end side corresponds to a boundary P2' between the neck portion 120 and the handle portion 130. The finger placing portion is sectioned by a ridge formed at an intersecting portion between a surface on the side of the bristle implanted surface 111 on the rear end side of the neck portion 120 and a surface on the side of the bristle implanted surface 111 on the tip end side of the handle portion 130, or a ridge formed at an intersecting portion between a surface on the side opposite to the bristle implanted surface 111 on the rear end side of the neck portion 120 and a surface on a side opposite to the bristle implanted surface 111 on the tip end side of the handle portion 130, for example. In this case, the boundary P2' between the neck portion 120 and the handle portion 130 is defined by

the aforementioned ridge.

[0019]

In addition, in a case in which the surface on the side of the bristle implanted surface 111 on the rear end side of the neck portion 120 and the surface on the side of the bristle implanted surface 111 on the tip end side of the handle portion 130 are in a plane and do not form a ridge, the finger placing portion is sectioned by a ridge formed at an intersecting portion between a side surface in a width direction on the rear end side of the neck portion 120 and a side surface in the width direction on the tip end side of the handle portion 130. The boundary P2' between the neck portion 120 and the handle portion 130 is also defined by the ridge in this case.

[0020]

For example, in a case of a handle body 12 in an embodiment in which the handle portion 130 is formed into a substantially arc shape that protrudes toward the side of the bristle implanted surface 111 in a side view and the neck portion 120 is formed into a substantially arc shape that is recessed toward the side of the bristle implanted surface 111, the boundary P2' between the neck portion 120 and the handle portion 130 is defined as follows.

[0021]

A curved surface 133 with an arc outline, which has a center position arranged on the side opposite to the bristle implanted surface 111 (below the handle portion 130 in Figs. 2 and 4), in which the side of the bristle implanted surface 111 protrudes in a side view, is formed on the side of the bristle implanted surface 111 on the tip end side of the handle portion 130. Similarly, a curved surface 134 with an arc outline, which has a center position arranged on the side opposite to the bristle implanted surface 111,

in which the side of the bristle implanted surface 111 protrudes in a side view, is formed on the side opposite to the bristle implanted surface 111 on the tip end side of the handle portion 130.

[0022]

In addition, a curved surface 123 with an arc outline, which has a center position arranged on the bristle implanted surface 111 (above the handle portion 130 in Figs. 2 and 4), in which the side of the bristle implanted surface 111 is recessed in a side view, is formed on the side of the bristle implanted surface 111 on the rear end side of the neck portion 120. Similarly, a curved surface 124 with an arc outline, which has a center position arranged on the bristle implanted surface 111, in which the side of the bristle implanted surface 111 is recessed in a side view, is formed on a side opposite to the bristle implanted surface 111 on the rear end side of the neck portion 120.

[0023]

Intersecting angles between tangential lines of the curved surface 123 and the curved surface 133 and the bristle implanted surface 111 in a side view successively change as the curved surface 123 and the curved surface 133 respectively advance in the length direction of the handle portion 130, and the curved surface 123 and the curved surface 133 intersect one another at an intersecting angle θ_1 , which is neither 0 degrees nor 180 degrees, between the tangential lines at the intersecting portion between the curved surface 123 and the curved surface 133. Therefore, a ridge 131 is formed at the intersecting portion between the curved surface 123 and the curved surface 133.

[0024]

The intersecting angles between tangential lines of the curved surface 124 and the curved surface 134 and the bristle implanted surface 111 in a side view also successively change as the curved surface 124 and the curved surface 134 advance in the length direction of the handle portion 130, and the curved surface 124 and the curved surface 134 intersect one another at an intersecting angle θ_2 , which is neither 0 degrees nor 180 degrees, between the tangential lines at the intersecting portion between the curved surface 124 and the curved surface 134. Therefore, a ridge 132 is formed at the intersecting portion between the curved surface 124 and the curved surface 134. Therefore, the neck portion 120 and the handle portion 130 are formed into substantially S shapes in a side view by one side in the length direction with the ridges 131 and 132 interposed therebetween being connected to the curved surfaces 133 and 134 with the arc outlines that protrude on the side of the bristle implanted surface 111 in a side view and by the other side in the length direction with the ridges 131 and 132 interposed therebetween being connected to the curved surfaces 123 and 124 with the arc outlines that are recessed on the side of the bristle implanted surface 111 in a side view.

[0025]

A boundary of the neck portion 120 on the rear end side is defined by the ridges 131 and 132. Therefore, the range 130A in which the handle portion 130 is arranged is on the rear end side beyond the ridges 131 and 132, and the neck portion 120 is arranged in a range 120A between the range 110A in which the head portion 110 is arranged and the range 130A in which the handle portion 130 is arranged.

[0026]

An end on the side of the bristle implanted surface 111 on the tip end side of

the handle portion 130 (on the rear end side beyond the ridge 131) serves as the finger placing portion. A user can stably operate the toothbrush 11 by holding the handle portion 130 such that the user places the thumb on the finger placing portion. In addition, the position of the ridge 132 in the length direction of the handle portion 130 is on the rear end side beyond the ridge 131. Therefore, the thickness of the finger placing portion becomes thicker, and the operation of the toothbrush 11 can be further stabilized, as compared with a case in which the position of the ridge 132 is on the front end side beyond the ridge 131.

[0027]

The length of the handle body 12 is not particularly limited and is set to be 100 to 200 mm, for example.

The width of the head portion 110, that is, the width in a direction that is parallel to the bristle implanted surface 111 and intersects the length direction of the handle portion 130 perpendicularly (hereinafter, simply referred to as a width) is not particularly limited, is preferably 5 to 16 mm, and is more preferably 8 to 12 mm, for example. If the width is equal to or greater than the aforementioned lower limit value, it is possible to secure a sufficient area in which the bristle bundles 114 are implanted. If the width is equal to or less than the aforementioned upper limit value, it is possible to further enhance operability in the oral cavity.

The length of the head portion 110 is not particularly limited, is preferably 10 to 33 mm, and is more preferably 12 to 28 mm, for example. If the length is equal to or greater than the aforementioned lower limit value, it is possible to secure the sufficient area in which the bristle bundles 114 are implanted. If the length is equal to or less than the upper limit value, it is possible to further enhance the operability in the

oral cavity.

The thickness of the head portion 110 can be decided in consideration of a material and the like and is preferably 2.0 to 4.0 mm, for example. If the thickness is equal to or greater than the aforementioned lower limit value, the strength of the head portion 110 is further enhanced. If the thickness is equal to or less than the aforementioned upper limit value, a property that the toothbrush can be caused to reach the back teeth is enhanced, and also, the operability in the oral cavity is further enhanced.

[0028]

The length of the neck portion 120 is preferably 25 to 70 mm, for example, since the neck portion 120 is then brought into contact with lips when the head portion 110 is inserted into the oral cavity.

The neck portion 120 is formed such that the width thereof constantly or gradually increases from a position corresponding to the minimum value toward the rear end side. In a case in which the width of the neck portion 120 is constant from a position corresponding to the minimum value toward the rear end side, the position corresponding to the minimum value is defined as a position at the furthestmost location on the tip end side. The neck portion 120 according to the embodiment is formed such that the width gradually increases from the position 121 corresponding to the minimum value toward the rear end side. The width of the neck portion 120 can be decided in consideration of a material and the like, and the minimum width of the neck portion 120 is preferably equal to or greater than 3.5 mm and equal to or less than 4.5 mm, and is more preferably equal to or greater than 3.7 mm and equal to or less than 4.3 mm. If the width is equal to or greater than the aforementioned lower limit

value, the strength of the neck portion 120 is further enhanced. If the width is equal to or less than the aforementioned upper limit value, the lips are easily closed, the property that the toothbrush can be caused to reach the back teeth is enhanced, and also, operability in the oral cavity is further enhanced.

[0029]

In addition, when the width at the position 122 that is separated from the position 121, at which the width of the neck portion 120 is the minimum value, on the rear end side by 10 mm parallel to the bristle implanted surface 111 is assumed to be W_1 mm, and the thickness in the direction that intersects the bristle implanted surface 111 perpendicularly at the position 122 is assumed to be D_1 mm, a value obtained by D_1/W_1 is preferably equal to or greater than 0.7 and equal to or less than 2.5, is further preferably equal to or greater than 0.8 and equal to or less than 2.0, and is particularly preferably equal to or greater than 0.8 and equal to or less than 1.5.

[0030]

In a case in which the minimum width of the neck portion 120 is equal to or greater than 3.5 mm and equal to or less than 4.5 mm and the value obtained by D_1/W_1 is less than the aforementioned lower limit value, there is a likelihood that the neck portion 120 will tend to be deflected during brushing and the operability will deteriorate, and there is also a likelihood that the width of the neck portion 120 increases, the operability deteriorates, and the thin thickness of the head portion 110 does not significantly appear in terms of an appearance thereof, which degrades an impression of the product.

Meanwhile, in a case in which the value obtained by D_1/W_1 exceeds the aforementioned upper limit value, there is a likelihood that the thickness D_1 increases

and it becomes difficult to close the lips when a biting surface is brushed. In addition, there is a likelihood that an effect of improving the operability, which is obtained by thinning the head portion 110, deteriorates. Therefore, if the value obtained by D_1/W_1 is equal to or greater than 0.7 and equal to or less than 2.5, it becomes easier to perform brushing with the lips closed while the improvement in the operability, which is obtained by thinning the head portion 110, is maintained.

[0031]

In addition, it is generally known that the amount of deflection of a rigid body is greatly affected by “sectional secondary moment” in a case of the same material. Since the amount of deflection is proportional to the first power of the width W and the cube of the thickness D , it is desirable that the width be minimized while the thickness D is maintained in order to reduce the amount of deflection.

If it is assumed that a deflection coefficient $M \text{ (mm}^4\text{)} = W \times D^3$, a deflection coefficient M_0 calculated from a width W_0 and a thickness D_0 at the position 121 of the neck portion 120 is preferably equal to or greater than 165 mm^4 and equal to or less than 625 mm^4 , is further preferably equal to or greater than 180 mm^4 and equal to or less than 525 mm^4 , and is particularly preferably equal to or greater than 200 mm^4 and equal to or less than 330 mm^4 . In addition, a deflection coefficient M_1 calculated from a width W_1 and a thickness D_1 at the position 122 of the neck portion 120 is equal to or greater than 165 mm^4 and equal to or less than 625 mm^4 , is more preferably equal to or greater than 180 mm^4 and equal to or less than 525 mm^4 , is further preferably equal to or greater than 200 mm^4 and equal to or less than 330 mm^4 , and further preferably equal to or greater than 270 mm^4 and equal to or less than 310 mm^4 . A deflection coefficient M_2 calculated from a width W_2 and a thickness D_2 at the neck

portion 120 at a position that is separated from the position 121 by 20 mm on the rear end side parallel to the bristle implanted surface 111 is preferably equal to or greater than 350 mm^4 and equal to or less than 550 mm^4 . A deflection coefficient M_3 calculated from a width W_3 and a thickness D_3 at the neck portion 120 at a position that is separated from the position 121 by 30 mm on the rear end side parallel to the bristle implanted surface 111 is preferably equal to or greater than 600 mm^4 and equal to or less than 1500 mm^4 .

If the deflection coefficient M at the position 122 is equal to or greater than 165 mm^4 and equal to or less than 625 mm^4 , it is possible to contribute to an improvement in brushing properties with the lips closed and to prevent deterioration of operability due to excessive deflection.

[0032]

The rate of change of the deflection coefficient M between the position 121 and the position 122 is preferably equal to or greater than 1.0 and equal to or less than 1.3. Also, the rate of change of the deflection coefficient M between the position 122 and the position that is separated from the position 121 by 20 mm on the rear end side is preferably equal to or greater than 1.3 and equal to or less than 1.8. The rate of change of the deflection coefficient M between the position that is separated from the position 121 by 20 mm on the rear end side and the position that is separated from the position 121 by 30 mm on the rear end side is preferably equal to or greater than 1.7 and equal to or less than 3.0 and is more preferably equal to or greater than 1.8 and equal to or less than 3.0. Note that the rate of change is a value obtained by dividing the deflection coefficient at the position on the rear end side by the deflection coefficient at the position on the tip end side, and for example, the rate of change

between the position 121 and the position 122 is a value calculated as M_1/M_0 from the deflection coefficient M_0 at the position 121 and the deflection coefficient M_1 at the position 122.

If the deflection coefficient M and the rate of change thereof are within the aforementioned ranges, it is possible to easily perform brushing with the lips closed without this leading to deterioration of operability.

[0033]

The bristle bundles 114 are obtained by bundling a plurality of bristles. The length (bristle height) from the bristle implanted surface 111 to the tip ends of the bristle bundles 114 can be decided in consideration of the bristle flexibility and the like required for the bristle bundles 114 and is set to be 6 to 13 mm, for example. All the bristle bundles 114 may have the same bristle height or bristle heights may be different from one another.

[0034]

The thickness (bristle bundle diameter) of each bristle bundle 114 can be decided in consideration of bristle flexibility and the like required from the bristle bundles 114 and may be set to be 1 to 3 mm, for example. All the bristle bundles 114 may have the same bristle bundle diameter or bristle bundle diameters may be different from one another.

[0035]

Examples of the bristles that form the bristle bundles 114 include bristles with diameters that gradually decrease toward the bristle tips and with sharpened bristle tips (tapered bristles), bristles with substantially a constant diameter from the bristle implanted surface 111 toward the bristle tips (straight bristles), and the like.

Examples of straight bristles include bristles with bristle tips that are planes substantially parallel to the bristle implanted surface 111 and bristles with bristle tips rounded into semi-spherical shapes.

[0036]

Examples of a material of the bristles include polyamides such as 6-12 nylon (6-12 NY) and 6-10 nylon (6-10 NY), polyesters such as PET, PBT, polytrimethylene terephthalate (PTT), polyethylene naphthalate (PEN), and polybutylene naphthalate (PBN), polyolefin such as PP, and elastomer resins such as polyolefin-based elastomers and styrene-based elastomers. One kind of these resin materials can be used alone, or two or more kinds thereof can be used in combination. In addition, bristles that have a multicore structure that has a core portion and at least one sheath portion layer provided outside the core portion and that is made of polyester may be exemplified as the bristles.

[0037]

The cross-sectional shape of each bristle is not particularly limited and may be a circular shape such as a perfect round shape or an elliptical shape, a polygonal shape, a star shape, a three-leaf clover shape, a four-leaf clover shape, or the like. The cross-sectional shapes of the bristles may all be the same or different from each other.

[0038]

The thickness of each bristle can be decided in consideration of the material thereof and the like, and in a case in which the cross-sectional shape is a circular shape, the thickness is set to 6 to 9 mil, for example (1 mil = 1/1000 inches = 0.025 mm). In addition, a plurality of bristles with different thicknesses may be arbitrarily combined and used in consideration of an impression during use, a feeling of

cleanliness, a cleaning effect, durability, and the like.

[0039]

As a method of manufacturing the toothbrush 11, the handle body 12 is molded first by injection molding.

Then, the bristle bundles 114 are implanted in the head portion 110 of the obtained handle body 12. As a method of implanting the bristle bundles 114, metal piece-scheme implanting in which the bristle bundles 114 are folded into two, and metal pieces interposed therebetween are driven into the bristle implanted holes 112, thereby implanting the bristle bundles 114, a thermal fusion method in which lower ends of the bristle bundles 114 are press-fitted into and fixed to melted resin, an in-mold method in which lower ends of the bristle bundles are heated to form a melted substance, and melted resin is then injected into a mold, thereby molding the bristle implanted portion, and the like may be exemplified.

[0040]

According to the toothbrush 11 of the embodiment, it is possible to secure a state in which brushing is easily performed with the lips closed by the minimum width of the neck portion 120 being equal to or greater than 3.5 mm and equal to or less than 4.5 mm, and it is also possible to avoid deterioration of operability in a case in which an engineering plastic such as a polyacetal is used, of course, and even in a case in which a general-purpose resin such as polypropylene is used, by the value obtained by D/W being equal to or greater than 0.7 and equal to or less than 2.5, as described above.

[0041]

In a case of the metal piece-scheme bristle implanting, stress due to the

driving of the metal pieces is applied to the head portion 110. In a case in which the thickness of the head portion 110 is thin and a strength in response to deformation when a force is applied is low while the thickness of the neck portion 120 is thick and the strength is high, the stress occurring when the teeth are brushed is concentrated on the head portion 110, warping of the head portion 110 becomes large, and usability deteriorates in some cases. In contrast, according to the toothbrush 11 of the embodiment, it is possible to disperse the stress occurring when the teeth are brushed from the head portion 110 to the entire neck portion 120, and the usability is improved, by reducing the width of the neck portion 120 and providing a deflection property to some extent. Therefore, it is possible to significantly obtain the effects of the present invention in the case of the metal piece-scheme bristle implanting, in particular.

[0042]

(Amount of deflection A of head portion)

An amount of deflection A of the head portion is measured by the following method (α).

Method (α): The height of the tip end of the handle body in a state in which the bristle implanted surface of the head portion is directed upward in the vertical direction and the position of a boundary P1 between the head portion and the neck portion of the toothbrush is fixed. Further, the amount of displacement of the height (the unit is mm) from a reference height of the tip end of the handle body 10 seconds after a 200 g spindle is suspended at a position of $10 \pm 3\%$ relative to the length of a longer axis direction of the bristle implanted portion at the head portion from the tip end of the bristle implanted portion in a state in which the position of the boundary P1 is fixed is assumed to be the amount of deflection A of the head portion.

Note that “the length in the longer axis direction of the bristle implanted portion” means a distance between the tip end of the bristle implanted hole located at the furthestmost position on the tip end side and the rear end of the bristle implanted hole located at the furthestmost position on the rear end side in a plan view of the head portion.

[0043]

The boundary P1 in the toothbrush provided with the head portion with a shape that is narrowed in the width direction near the neck portion corresponds to an end point of a curved line at both edges that form the cut corner, which is close to the neck portion, of the head portion in a plan view, that is, a position at which a curving direction of the curved line that forms the cut corners change. Note that the plan view means viewing the toothbrush from the side of the bristle implanted surface of the head portion.

[0044]

A specific description will be given with reference to a toothbrush 21 shown in Figs. 5A, 5B, 6A, and 6B. The toothbrush 21 includes a head portion 22 with a substantially rectangular shape in a plan view, a neck portion 24 that extends from the head portion 22, and a handle portion 26 that extends from the neck portion 24. A bristle implanted portion (not shown) is provided at the head portion 22. Hereinafter, the head portion 22, the neck portion 24, and the handle portion 26 will also collectively be referred to as a handle body 210.

The head portion 22 expands in a width direction from a tip end 29 to the neck portion 24, then extends with a similar width, is then narrowed in the width direction, and reaches a boundary P1 with the neck portion 24 in a plan view. The neck portion

24 extends with substantially the same diameter from the boundary P1 toward the handle portion 26, then increases in diameter, and reaches a boundary P2 with the handle portion 26.

[0045]

The boundary P1 in the toothbrush 21 corresponds to an end point of curved lines that form both edges of the cut corner, which is close to the neck portion 24, of the head portion 22 in a plan view shape of the head portion 22, that is, a position at which a curving direction of the curved line that form the cut corner changes. In Fig. 5A, the boundary P1 between the head portion and the neck portion is a position at which a curved line R1 with which the width forming the both edges of the cut corner of the head portion 22 in a plan view is narrowed is changed into a straight line that form both edges with the same width. In addition, in a case of a toothbrush with a width of the neck portion that expands toward the handle portion in a plan view, the boundary P1 coincides with the position, at which the widths of the head portion and the neck portion are the smallest, in a plan view.

Note that there is a case in which it is difficult to specify the position of the boundary P1 as a toothbrush in which the head portion and the neck portion are formed to have the same width, for example. In such a case, a position corresponding to 17.5% from the tip end 29 of the handle body 210 (a position corresponding to 31.5 mm from the tip end 29 of the handle body 210 in a case in which the length L1 is 180 mm, for example) relative to the length L1 is assumed to be the boundary P1.

[0046]

In a case in which the width of a portion, which is close to the head portion, of the neck portion is the same in a plan view, for example, the width is measured at

gradually changed positions toward the head portion in a portion, which is close to the head portion, of the neck portion, and a position of a change between the portion with the same width and the position at which the width starts to increase is assumed to be the boundary P1. In addition, in a case in which the width of the portion, which is close to the head portion, of the neck portion is narrowed toward the head portion in a plan view, the width is measured at gradually changed positions toward the head portion in the portion, which is close to the head portion, of the neck portion, and the position at which the width reaches the minimum width is assumed to be the boundary P1.

[0047]

The amount of deflection A of the head portion 22 is measured as follows.

As shown in Fig. 6A, the toothbrush 21 is fixed by using a jig 2100 at a position of a narrowest portion (the boundary P1) of the neck portion such that the bristle implanted surface 220 is directed upward in the vertical direction. At this time, the height of the tip end 29 of the handle body 210 is assumed to be a reference height H_0 .

Then, a 200 g spindle 2102 is suspended at a position S as shown in Fig. 6B, the height of the tip end 29 of the handle body 210 ten seconds later is measured, and the height is assumed to be H_1 . Aforementioned S is a position corresponding to $10 \pm 3\%$ from the tip end of the bristle implanted portion relative to a length L24 (Fig. 5A) in the longer axis direction of the bristle implanted portion at the head portion 22. In a case in which the bristle implanted portion has a length of 19 mm, for example, S is a position of 2.0 mm from the tip end of the bristle implanted portion.

Then, an absolute value of a difference between H_1 and H_0 is obtained as a

(the unit is mm). Aforementioned a is measured by a height gauge, for example.

The measurement is performed at a room temperature of $25 \pm 3^{\circ}\text{C}$.

The aforementioned measurement is performed five times, and an average value of the aforementioned amount of displacement a is assumed to be the amount of deflection A of the head portion 22.

[0048]

The amount of deflection A is preferably 0.4 to 3.0, is more preferably 0.4 to 2.5, and is further preferably 0.4 to 2.0. Also, the amount of deflection A is preferably 0.5 to 3.0, is more preferably 0.5 to 2.5, and is further preferably 0.5 to 2.0. If the amount of deflection A is within the aforementioned range, the head portion 22 itself is appropriately deflected, and flexibility of the bristle implanted portion implanted at the head portion 22 appears, which leads to a more satisfactory feeling of touch to the dental gum, that is an impression from the use. In addition, if the amount of deflection A is equal or greater than the aforementioned lower limit value, the impression from the use become satisfactory. If the amount of deflection A is equal to or less than the aforementioned upper limit value, sufficient strength of the head portion 22 tends to be secured. Further, the toothbrush 21 does not become excessively bristle, and satisfactory operability inside the oral cavity and cleaning power can easily be obtained.

Note that the amount of deflection A is adjusted by adjusting the bending elastic modulus of the material of the head portion (that is, the material of the handle body) and the thickness, the width, and the like of the head portion.

[0049]

(Amount of deflection B of neck portion)

An amount of deflection B of the neck portion is measured by the following method (β).

Method (β):

The height of the tip end of the handle body in a state in which the bristle implanted surface of the head portion is directed upward in the vertical direction and the position of the boundary P2 between the neck portion and the handle portion in the toothbrush is fixed is assumed to be a reference height. Further, 200 g spindle is suspended at a position corresponding to $50 \pm 3\%$ from the tip end of the bristle implanted portion relative to the length in the longer axis direction of the bristle implanted portion at the head portion in the fixed state, and the amount of displacement (the unit is mm) of the height from the reference height of the tip end of the handle body 10 seconds later is assumed to be the amount of deflection B of the neck portion.

[0050]

The boundary P2 between the neck portion and the handle portion corresponds to an end point of the increase in the diameter of the neck portion, that is, an end point of the straight line that forms both edges of the portion with the increasing width or a position at which the bending direction of the curved line forming the both edges of the portion with the increasing width changes. In Fig. 5A, the boundary P2 is a position at which the straight line or the curved line R2 that forms the both edges of the portion with the increasing width of the neck portion in a plan view of the neck portion and the handle portion changes into a curved line with a gradually decreasing width.

Note that there is a case in which it is difficult to specify the position of the

boundary P2 as in a toothbrush in which a neck portion and a handle portion are formed to have the same width. In this case, a position corresponding to 42.2% from the tip end 29 of the handle body 210 relative to the length L1 (a position corresponding to 76.0 mm from the tip end 29 of the handle body 210 in a case in which the length L1 is 180 mm, for example) is assumed to be the boundary P2.

[0051]

The amount of deflection B of the neck portion 24 in the toothbrush 21 is measured similarly to the amount of deflection A of the head portion other than that the position at which the toothbrush 21 is fixed with the jig 2100 and the position S from which the spindle 2102 is suspended are different from those in the method of measuring the amount of deflection A of the head portion 22.

In the measurement of the amount of deflection B of the neck portion 24, the position at which the toothbrush 21 is fixed with the jig 2100 is the boundary P2. In Addition, S is a position corresponding to $50 \pm 3\%$ from the tip end of the bristle implanted portion relative to the length in the longer axis direction of the bristle implanted portion. In a case in which the bristle implanted portion has a length of 19 mm, for example, S is a position corresponding to 9.5 mm from the tip end.

Then, the absolute value (the unit is mm) of the difference between the reference height H_0 before the spindle 2102 is suspended and the height H_1 after elapse of 10 seconds from the suspension of the spindle 2102 is obtained similarly to the method of measuring the amount of deflection A of the head portion. The measurement is performed at the room temperature of $25 \pm 3^\circ\text{C}$. The measurement is performed five times, and an average value thereof is assumed to be the amount of deflection B of the neck portion 24.

[0052]

The amount of deflection B is preferably 2.1 to 5.0, is more preferably 2.3 to 4.5, and is further preferably 2.5 to 4.0. If the amount of deflection B is within the aforementioned range, the neck portion is appropriately deflected, an appropriate cushion property appears, and a feeling of touch of the bristle implanted portion to the dental gum becomes more satisfactory. In addition, if the amount of deflection B is equal to or greater than the aforementioned lower limit value, it is possible to cause the bristles to reach every corner in the oral cavity, such as a portion behind the back teeth, and to enhance the power of cleaning inside the oral cavity. Further, a property of the bristles entering periodontal pockets is enhanced, and the power of cleaning inside the periodontal pockets is further enhanced. If the amount of deflection B is equal to or less than the aforementioned upper limit value, it becomes easier to suppress a decrease in the strength of the neck portion. Further, the toothbrush 21 does not become excessively bristle, and a satisfactory impression from use tends to be obtained.

Note that the amount of deflection B is adjusted by adjusting the bending elastic modulus of the material of the neck portion (that is, the material of the handle body) and the minimum diameter of the neck portion, the cross-sectional shape of the boundary P2, and the like.

[0053]

The product ($A \times B$) of the amount of deflection A of the head portion and the amount of deflection B of the neck portion is 0.8 to 10, is preferably 1 to 10, is further preferably 1 to 6, and is further preferably 1 to 3.5. Moreover, ($A \times B$) is preferably 2 to 10. If ($A \times B$) is within the aforementioned range, appropriate deflection with

which the head portion 22 and the neck portion 24 cooperate can be obtained. In this manner, the flexibility and the cushion property of the bristle implanted portion appear when the bristle implanted portion is made to slide along sites to be cleaned (tooth, dental gum, and the like), and a feeling of touch of the bristle implanted portion becomes satisfactory. In addition, the lower limit value of $(A \times B)$ is equal to or greater than 0.8 and is preferably equal to or greater than 1. Moreover, the lower limit value is preferably equal to or greater than 2. A satisfactory feeling of touch to the dental gum and a high massage effect for the dental gum are obtained, and an impression from use is improved by $(A \times B)$ being equal to or greater than the lower limit value, which leads to appropriate deflection. The upper limit value of $(A \times B)$ is equal to or less than 10, is preferably equal to or less than 6, and is more preferably equal to or less than 3.5. It is possible to suppress excessive deflection of a region formed by the head portion 22 and the neck portion 24, degradation of the operability, and degradation of the cleaning power by $(A \times B)$ being equal to or less than the upper lower limit value. In addition, it is possible to suppress a decrease in the massage effect for the dental gum due to excessive deflection and a user's feeling that the toothbrush 21 is too soft and weak during the use. Further, the strength of the toothbrush 21 is enhanced, and the durability is improved.

[0054]

The amount of deflection A and the amount of deflection B preferably satisfy $A < B$. If $A < B$, the operability of the toothbrush 21 is further enhanced.

In addition, a difference $(B - A)$ between the amount of deflection A and the amount of deflection B is preferably equal to or greater than 1, is preferably equal to or greater than 1.5, and is further preferably equal to or greater than 2. If $(B - A)$ is

equal to or greater than the lower limit value, the amount of deflection of the neck portion 24 can be maintained to be large with respect to the head portion 22, the cushion property is enhanced, a feeling of touch to the dental gum becomes satisfactory, and the user tends to feel the massage effect for the dental gum.

In addition, $(B - A)$ is preferably equal to or less than 4 and is more preferably equal to or less than 3. If $(B - A)$ is equal to or less than the upper limit value, the amount of deflection of the neck portion 24 does not become excessively large with respect to the head portion 22, and the operability in the oral cavity tends to be enhanced. Further, it becomes easy to suppress the user's feeling that the toothbrush 21 is too soft and weak during the use.

$(B - A)$ is preferably 1 to 4 and is more preferably 1 to 3.

In addition, a ratio (B/A) between the amount of deflection B and the amount of deflection A is preferably 1.5 to 5.0 and is more preferably 1.8 to 4.8.

[0055]

The handle portion 26 is gripped when the toothbrush 21 is used. A form in which the handle portion 26 is gripped is not particularly limited and may be a palm gripping scheme or a pen gripping scheme. Since cleaning is typically performed while a pressure is applied to a target site, the handle portion 26 is gripped with the thumb or the like placed in the vicinity of the boundary P2 at the rear end of the neck portion in any of the gripping form.

Next, the head portion 22 is inserted into the oral cavity, and the bristle implanted portion is made to slide along the site to be cleaned with a pressure applied to the handle portion 26. The force applied to the handle portion 26 is delivered to the head portion 22 via the neck portion 24 and is further delivered from the head

portion 22 to the bristle implanted portion, and the bristle implanted portion thus performs cleaning while applying the pressure to the site to be cleaned. If the product $(A \times B)$ between the amount of deflection A of the head portion and the amount of deflection B of the neck portion is 0.8 to 10 at this time, appropriate deflection with which the head portion and the neck portion cooperate is obtained. As a result, it is possible to easily cause the bristles implanted at the head portion 22 of the toothbrush 21 to reach every corner in the oral cavity, such as behind the back teeth, and the power of cleaning in the oral cavity is enhanced. Further, it is possible to easily cause the bristles to enter the periodontal pockets and to enhance the power of cleaning in the periodontal pockets. In addition, the appropriate deflection obtained leads to an improvement in the flexibility and the cushion property of the bristle implanted portion, a satisfactory feeling of touch of the bristle implanted portion with respect to the periodontal gum, a satisfactory massage effects for the periodontal gum, and an improvement in the impression from use.

[0056]

[Examples]

Although examples will be shown below to describe the present invention in detail, the present invention is not limited to the following examples and can be implemented by appropriately adding modifications without departing from the gist thereof.

[0057]

[Table 1]

	Thickness of neck portion [D]				Width of neck portion [W]				Material
	Minimum	+10	+20	+30	Minimum	+10	+20	+30	
Example 1	3.97	4.15	4.60	5.48	4.02	4.08	4.38	4.99	PP
Example 2	4.03	4.20	4.84	6.37	4.03	4.11	4.63	5.40	PP
Example 3	4.03	4.10	4.51	5.26	4.03	4.03	4.23	4.69	PP

Example 4	3.99	4.13	4.63	5.60	4.00	4.10	4.42	5.00	PP
Example 5	3.99	4.16	4.65	5.48	4.02	4.09	4.40	5.01	PP
Comparative Example 1	4.09	4.51	4.80	5.38	4.97	5.42	6.00	6.62	PP
Comparative Example 2	3.88	3.97	4.34	5.06	4.92	5.32	5.84	6.39	PP
Comparative Example 3	3.78	4.75	5.41	5.92	6.73	6.39	8.45	10.95	Saturated polyester
Comparative Example 4	5.04	5.12	5.56	6.73	5.01	5.16	5.27	5.44	PP
Comparative Example 5	4.97	5.01	5.20	5.82	4.96	5.04	5.13	5.19	PP
Comparative Example 6	4.79	4.93	5.04	5.59	4.97	5.06	5.13	5.19	PP
Comparative Example 7	5.14	5.23	5.57	6.44	5.56	5.92	6.23	6.70	PP

[0058]

(Examples 1 to 5 and Comparative Examples 1 to 7)

Toothbrushes in Examples 1 to 5 and Comparative Examples 1 to 7 with the neck portions 120 formed in accordance with the specifications shown in above [Table 1] were produced. The widths, the lengths, the thicknesses, and the shapes of all the head portions and the handle portions were the same. PP resin was injection-molded, thereby obtaining integrally molded articles of the head portions and the handle bodies shown in Figs. 3 and 4 were obtained (The bristle implanted holes were aligned in a pattern of 3 holes $\times$ 1 array, 4 holes $\times$ 6 arrays, and 3 holes $\times$ 1 array from the tip end of the head portion toward the handle body; the width of the head portion was 10 mm, the length was 25 mm, and the thickness was 3.0 mm; the length of the handle body was 110 mm; the length of the neck portion was 48 mm.) Bristle bundles of tapered bristles (7.5 mil) made of PBT filaments were implanted at the head portions by the metal piece-scheme bristle implanting, thereby producing the toothbrushes.

[0059]

Values obtained by D/W and values obtained by $W \times D^3$ at a position at which the width of the neck portion was minimum and at the respective positions of 10 mm,

20 mm, and 30 mm on the rear end side from the position corresponding to the minimum width in each example are shown in [Table 2]. In addition, the rates of change of the values obtained by $W \times D^3$ from the deflection coefficients at the respective positions as described above in each example are shown in [Table 3].

[0060]

(Evaluation method)

“Operability of the toothbrush in the oral cavity (easiness in moving the toothbrush in the mouth)” of the toothbrushes in the respective examples were evaluated by the following method.

<Operability of toothbrush>

For the operability of the toothbrushes, ten dedicated panels used the toothbrushes in the respective examples and evaluated the “operability in the oral cavity” with the following evaluation criteria. An average point of the ten dedicated panels that was equal to or greater than 2.5 points was evaluated as “a”, an average point that was equal to or greater than 2.0 points and less than 2.5 points was evaluated as “b”, an average point that was equal to or greater than 1.5 points and less than 2.0 points was evaluated as “c”, and an average point that was less than 1.5 points was evaluated as “d”.

[0061]

<<Evaluation criteria>>

3 points: There is a strong feeling of easiness in moving the toothbrush in the mouth.

2 points: There is a feeling of easiness in moving the toothbrush in the mouth.

1 point: There is little feeling of easiness in moving the toothbrush in the mouth.

0 points: There is no feeling of easiness in moving the toothbrush in the mouth.

[0062]

[Table 2]

	Thickness/width [D/W]				Width × thickness ³ [W × D ³]				Evaluation
	Minimum	+10	+20	+30	Minimum	+10	+20	+30	
Example 1	0.99	1.02	1.05	1.10	252	292	426	821	a
Example 2	1.00	1.02	1.05	1.18	264	305	525	1396	b
Example 3	1.00	1.02	1.07	1.12	264	278	388	683	a
Example 4	1.00	1.01	1.05	1.12	254	289	439	878	a
Example 5	0.99	1.02	1.06	1.09	255	294	442	824	a
Comparative Example 1	0.82	0.83	0.80	0.81	340	497	664	1031	c
Comparative Example 2	0.79	0.75	0.74	0.79	287	333	477	828	d
Comparative Example 3	0.56	0.74	0.64	0.54	363	685	1338	2272	d
Comparative Example 4	1.01	0.99	1.06	1.24	641	693	906	1658	c
Comparative Example 5	1.00	0.99	1.01	1.12	609	634	721	1023	c
Comparative Example 6	0.96	0.97	0.98	1.08	546	606	657	907	c
Comparative Example 7	0.92	0.88	0.89	0.96	755	847	1077	1790	d

[0063]

[Table 3]

Rate of change of width × thickness³ [W × D³]

	Position corresponding to +10 mm from minimum position	Position corresponding to +20 mm from position corresponding to +10 mm	Position corresponding to +30 mm from position corresponding to +20 mm	Evaluation
Example 1	1.16	1.46	1.93	a
Example 2	1.15	1.72	2.66	b
Example 3	1.05	1.40	1.76	a
Example 4	1.14	1.52	2.00	a
Example 5	1.15	1.50	1.86	a
Comparative Example 1	1.46	1.33	1.55	c
Comparative Example 2	1.16	1.43	1.73	d
Comparative Example 3	1.88	1.95	1.70	d
Comparative Example 4	1.08	1.31	1.83	c
Comparative Example 5	1.04	1.14	1.42	c
Comparative Example 6	1.11	1.08	1.38	c
Comparative	1.12	1.27	1.66	d

Example 7				
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[0064]

As shown in Table 2, it was confirmed that satisfactory operability was obtained in a case in which the thickness of the head portion was 2.0 to 4.0 mm, the minimum value of the width of the neck portion was equal to or greater than 3.5 mm and equal to or less than 4.5 mm, a value obtained by D/W at the position that was separated from the position corresponding to the minimum value at the neck portion by 10 mm on the rear end side was equal to or greater than 0.7 and equal to or less than 2.5, and the deflection coefficient $M \text{ (mm}^4\text{)} = W \times D^3$ was equal to or greater than 165 mm⁴ and equal to or less than 625 mm⁴.

[0065]

Although the preferred embodiment of the present invention has been described above with reference to the accompanying drawings, it is needless to say that the present invention is not limited to such an example. The various shapes, the combinations, and the like of the respective constituent members shown in the aforementioned example are just an example, and various modifications can be made on the basis of design requirements and the like without departing from the gist of the present invention.

[0066]

Although the configuration of the toothbrush 11 in which the width gradually increases from the position at which the neck portion 120 has the minimum width toward the rear end side has been described as an example in the aforementioned embodiment, the present invention is not limited to this configuration and may have a configuration in which the neck portion 120 extends on the rear end side with the same width, for example. The value obtained by D/W at the position that is separated from

the position corresponding to the minimum width by 10 mm on the rear end side is preferably equal to or greater than 0.7 and equal to or less than 2.5 even in the configuration in which the neck portion 120 extends on the rear end side with the same width.

[Reference Signs List]

[0067]

11 Toothbrush

12 Handle body

110 Head portion

111 Bristle implanted surface

120 Neck portion

130 Handle portion

[CLAIMS]

What is claimed is:

[Claim 1]

A toothbrush comprising:

a head portion that is arranged on a tip end side and has a bristle implanted surface with bristle bundles implanted by the metal piece-scheme bristle implanting;

a neck portion that extends on a rear end side of the head portion; and

a handle portion that extends on a rear end side of the neck portion,

wherein a thickness of the head portion is 2.0 to 4.0 mm,

a minimum width of the neck portion is 3.5 to 4.5 mm,

the neck portion is formed such that the width constantly or gradually increases toward the rear end side from a position corresponding to a minimum value of a width in a direction that is parallel to the bristle implanted surface and intersects a length direction of the handle portion perpendicularly,

when a width of the neck portion is assumed to be W mm, a thickness of the neck portion in a direction that intersects the bristle implanted surface perpendicularly is assumed to be D mm, and a deflection coefficient is assumed to be $M \text{ (mm}^4\text{)} = W \times D^3$,

a position corresponding to the minimum value of the width at the neck portion is

assumed to be a reference point,

a deflection coefficient $M_1 \text{ (mm}^4\text{)} = W \times D^3$ at a position that is separated from the reference point by 10 mm on the rear end side is equal to or greater than 165 mm^4 and equal to or less than 310 mm^4 ,

a value D_1/W_1 is equal to or greater than 0.7 and equal to or less than 2.5 which is a ratio of a value D_1 of a thickness relative to a value W_1 of a width at the position that is separated from the reference point by 10 mm on the rear end side,

when an amount of deflection of the head portion which is measured by a method (α) described below is assumed to be amount of deflection A, and an amount of deflection of the neck portion which is measured by a method (β) described below is assumed to be amount of deflection B,

a difference ($B - A$) between the amount of deflection A and the amount of deflection B is 1 to 4 mm, and

the amount of deflection A is 0.4 to 3.0mm;

Method (α): A height of a tip end of a handle body in a state in which the bristle implanted surface of the head portion is directed upward in the vertical direction and a position of a boundary P1 between the head portion and the neck portion is fixed is assumed to be a reference height, a 200 g weight is suspended at a position corresponding to $10 \pm 3\%$ from a tip end of the bristle implanted portion relative to a length in a longer axis direction of the bristle

implanted portion at the head portion in the state in which the position of the boundary P1 is fixed, and an amount of displacement (a unit is mm) of the height from the reference height of the tip end of the handle body 10 seconds later is assumed to be the amount of deflection A of the head portion; and

Method (β): The height of the tip end of the handle body in a state in which the bristle implanted surface of the head portion is directed upward in the vertical direction and the position of the boundary P2 between the neck portion and the handle portion is fixed is assumed to be a reference height, a 200 g spindle is further suspended at a position corresponding to $50 \pm 3\%$ from the tip end of the bristle implanted portion relative to the length in the longer axis direction of the bristle implanted portion at the head portion in the fixed state, and the amount of displacement (the unit is mm) of the height from the reference height of the tip end of the handle body 10 seconds later is assumed to be the amount of deflection B of the neck portion.

[Claim 2]

The toothbrush according to claim 1,

wherein a rate of change ($M_1 \div M_0$) of the deflection coefficient M_1 at the position that is separated from the reference point by 10 mm on the rear end side relative to a deflection coefficient M_0 at the reference point is equal to or greater than 1.0 and equal to or less than 1.3.

[Claim 3]

The toothbrush according to claim 1 or 2,

wherein a rate of change ($M_3 \div M_2$) of a deflection coefficient M_3 at a position that is separated from the reference point by 30 mm on the rear end side relative to the deflection coefficient M_2 at the position that is separated from the reference point by 20 mm on the rear end side is equal to or greater than 1.7 and equal to or less than 3.0.

[Claim 4]

The toothbrush according to claim 1 or 2,

wherein a deflection coefficient M_0 (mm^4) = $W \times D^3$ at the reference point is equal to or greater than 165 mm^4 and equal to or less than 330 mm^4 .

[Claim 5]

The toothbrush according to claim 3,

wherein the deflection coefficient M_3 is equal to or greater than 600 mm^4 and equal to or less than 1500 mm^4 .

[Claim 6]

The toothbrush according to claim 1,

wherein the difference ($B - A$) between the amount of deflection A and the amount of deflection B is 1.5 to 4 mm.

[Claim 7]

The toothbrush according to claim 1,

wherein the amount of deflection A is 0.4 to 2.5 mm.

[Claim 8]

The toothbrush according to claim 1,

wherein the value D_1/W_1 is equal to or greater than 0.8 and equal to or less than 1.5.

[Claim 9]

The toothbrush according to claim 1,

wherein a rate of change ($M_2 \div M_1$) of a deflection coefficient M_2 at a position that is separated from the reference point by 20 mm on the rear end side relative to the deflection coefficient M_1 at the position that is separated from the reference point by 10 mm on the rear end side is equal to or greater than 1.3 and equal to or less than 1.8.

[Claim 10]

The toothbrush according to claim 1 or 2,

wherein a length of the neck portion is 25 to 70 mm.

[Claim 11]

The toothbrush according to claim 1 or 2,

wherein a length of the head portion is 10 to 33 mm.

[Claim 12]

The toothbrush according to claim 1 or 2,

wherein the head portion, the neck portion and the handle body are formed of a resin

material, and

bending elastic modulus of the resin material which is measured in accordance with JIS 7171:2016 is equal to or greater than 1000 MPa and equal to or less than 2200 MPa.

[Claim 13]

The toothbrush according to claim 1 or 2,

wherein a resin material of the handle body includes at least one of the group of polypropylene resin, polyacetal resin, polystyrene resin, polyethylene terephthalate resin, polybutylene terephthalate resin, acrylonitrile butadiene styrene resin, polyarylate resin, polycarbonate resin, and acrylonitrile styrene resin.

[Claim 14]

The toothbrush according to claim 13,

wherein the resin material of the handle body is polypropylene resin.