

[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. 2016-212030, 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, resin with 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 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 of 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 a case in which general-purpose resin that is typically used in a toothbrush, such as polypropylene (PP), is used, in particular, this problem appears more significantly.

[0005]

An aspect of the present invention has been achieved in order to solve the above problems, and one of objects is to provide a toothbrush with a thin head capable of obtaining satisfactory operability.

[Solution to Problem]

[0006]

In order to achieve the aforementioned object, a toothbrush according to an

aspect of the present invention includes: a bristle implanted portion that is formed of a plurality of bristle bundles; a head portion with a bristle implanted surface in which the bristle implanted portion is provided; a neck portion that extends from the head portion; and a handle portion that extends from the neck portion, a thickness of the head portion is equal to or greater than 2.0 mm and equal to or less than 4.0 mm, the minimum width and the minimum thickness of the neck portion are equal to or greater than 3.0 mm and equal to or less than 4.5 mm, an angle between a straight line connecting a center point in a thickness direction of the handle portion at a gripping center position of the toothbrush and a center point in a thickness direction of the head portion at a center position of the bristle implanted portion and a plane that forms the bristle implanted surface is equal to or greater than 5.0 degrees and equal to or less than 10.0 degrees, and a distance between the center point in the thickness direction of the handle portion and the plane is equal to or greater than 6.0 mm and equal to or less than 12.0 mm.

[0007]

In the toothbrush according to the aspect of the present invention, a bending elastic modulus of a constituent material of the neck portion may be equal to or greater than 1000 MPa and equal to or less than 2200 MPa.

[0008]

In the toothbrush according to the aspect of the present invention, the constituent material of the neck portion may be polypropylene resin.

[Advantageous Effects of Invention]

[0009]

According to the aspect of the present invention, it is possible to realize a toothbrush with a thin head portion capable of obtaining satisfactory operability.

[Brief Description of Drawings]

[0010]

Fig. 1 is a plan view of a toothbrush according to an embodiment of the present invention.

Fig. 2 is a side view of the toothbrush.

Fig. 3A is a plan view of a toothbrush according to an embodiment of the present invention.

Fig. 3B is a side view of a toothbrush according to an embodiment of the present invention.

Fig. 4A is an explanatory diagram of a method of measuring the amount of deflection of a head portion.

Fig. 4B 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 the present invention will be described with reference to Figs. 1 and 2.

Note that the following embodiment shows an aspect of the present invention and is not intended to limit the present invention, and arbitrary modifications can be made within a technical idea of the present invention. In addition, in the following drawings, in order to make each of components easy to see, dimensions may be shown with a reduced scale depending on constituent elements.

[0012]

Fig. 1 is a plan view of a toothbrush according to the present invention.

Fig. 2 is a front view of the toothbrush.

As shown in Figs. 1 and 2, a toothbrush 1 according to the embodiment

includes a bristle implanted portion 11, a head portion 12 on which the bristle implanted portion 11 is provided, a neck portion 13 that extends from a base end side of the head portion 12, and a handle portion 14 that extends from a base end side of the neck portion 13. That is, the head portion 12, the neck portion 13, and the handle portion 14 are integrally formed. Hereinafter, a member obtained by the head portion 12, the neck portion 13, and the handle portion 14 being integrated will be referred to as a handle body 15. Note that illustration of the bristle implanted portion 11 is omitted in Fig. 1.

[0013]

Here, an upper surface of the head portion 12, in which the bristle implanted portion 11 is provided, will be referred to as a bristle implanted surface 12a. As shown in Figs. 1 and 2, a plane P (virtual plane) that forms the bristle implanted surface 12a is assumed to be an XY plane, a direction in which the handle body 15 extends as a whole is assumed to be an X-axis direction, and a direction that orthogonally intersects the X axis is assumed to be a Y-axis direction. The normal line direction of the plane P is assumed to be a Z-axis direction. In the following direction, dimensions of the respective members in the Y-axis direction will be referred to as widths of the members, dimensions of the respective members in the Z-axis direction will be referred to as thicknesses of the members, and dimensions of the respective members in the X-axis direction will be referred to as lengths of the members.

[0014]

A handle body 15 is integrally formed into a long shape as a whole and can be produced by injection molding using resin, for example, as an example. Examples of a constituent material of the handle body 15 include polypropylene (PP), polyethylene terephthalate (PET), polybutylene terephthalate (PBT), polycyclohexylene dimethylene

terephthalate (PCT), polyacetal (POM), polyethylene naphthalate (PEN), polystyrene (PS), acrylonitrile butadiene styrene resin (ABS), cellulose propionate (CP), polyarylate, polycarbonate, and acrylonitrile styrene copolymer resin (AS). From among these resin materials, it is preferable to use a material such as POM, PBT, or PEN, in terms of high strength and easiness of thinning the head portion.

[0015]

In particular, polypropylene typically has a characteristic of a low bending elastic modulus while polypropylene has higher versatility, easiness of working, and lower cost as compare with resin such as polyacetal. For example, the bending elastic modulus of polyacetal is generally about 2500 MPa, while the bending elastic modulus of polypropylene is generally about 1500 MPa to 2000 MPa. Therefore, polypropylene is conventionally a material that is not easily used as a material for a toothbrush with a thin head portion and a neck portion with a small width. However, it is possible to use resin with a relatively low bending elastic modulus, such as polypropylene, by employing a shape for a toothbrush according to the embodiment, which will be described later.

[0016]

In the embodiment, the bending elastic modulus of the constituent material of the handle body 15, particularly, of the neck portion 13 is preferably equal to or greater than 1000 MPa and equal to or less than 2200 MPa. If the bending elastic modulus is less than 1000 MPa, there is concern that sufficient strength may not be able to be obtained when the width of the neck portion 13 is reduced. Also, if the bending elastic modulus exceeds 2200 MPa, there is concern that brittleness may increase while the hardness increases.

[0017]

One kind of the above resin may be used alone, or two or more kinds of the resin may be used in combination. In addition, a part or the entirety of the handle portion 14 of the handle body 15 may be covered with soft resin. When a part or the entirety of the handle portion 14 is covered with a soft resin a fitting feeling when the hand of a user grips the handle portion 14 is improved and the gripping fingers can be prevented from slipping. Preferable examples of the soft resin include resin with shore A hardness of equal to or less than 90, and more preferable examples of the soft resin include resin with shore A hardness of 10 to 40. Examples of such soft resin include elastomer resin such as polyolefin-based elastomer, styrene-based elastomer, polyester-based elastomer, and polyurethane-based thermoplastic elastomer and silicon resin.

[0018]

The entire length of the handle body 15 can be determined in consideration of operability and the like. The entire length of the handle body 15 is about 100 to 200 mm, for example.

[0019]

The head portion 12 has a substantially rectangular plate-like shape with four curved corners in a plan view. A plurality of bristle implanted holes 12h are provided in the bristle implanted surface 12a that is an upper surface of the head portion 12. The bristle implanted portion 11 that is formed of a plurality of bristle bundles 17 is formed by the bristle bundles 17, in which bristles are bundled, being implanted in the respective bristle implanted holes 12h. From among the plurality of bristle implanted holes 12h, a distance d1 between a bristle implanted hole 12h located at a furthestmost position on the tip end side of the head portion 12 and the tip end of the head portion 12 and a distance d2 between a bristle implanted hole 12h located at the furthestmost

position on the base end side of the head portion 12 and the base end of the head portion 12 are set to be equal to each other. In other words, a boundary position K1 between the neck portion 13 and the head portion 12, which will be described later, is a position separated from the bristle implanted hole 12h located at the furthestmost position on the base end side of the head portion 12 toward the side of the neck portion 13 by a distance that is equal to the distance d1.

[0020]

The dimension of the head portion 12 is determined in consideration of properties such as operability inside the oral cavity. If the width of the head portion 12 is excessively large, the operability in the oral cavity deteriorates. If the width of the head portion 12 is excessively small, the number of bristle bundles 17 to be planted is excessively reduced, which leads to a degradation of a cleaning effect. Therefore, the width of the head portion 12 is set to be about 5 mm to 16 mm, for example.

[0021]

If the length of the head portion 12 is excessively long, the operability in the oral cavity tends to deteriorate. If the length of the head portion 12 is excessively short, the number of bristle bundles 17 to be implanted is excessively reduced, which leads to a degradation of the cleaning effect. Therefore, the length of the head portion 12 is set within a range of 10 mm to 33 mm, for example.

[0022]

The shape of each bristle implanted hole 12h is not particularly limited and may be a circular shape, such as a perfect circular shape or an elliptical shape, or may be a polygonal shape, such as a triangular shape or a rectangular shape. The number of bristle implanted holes 12h is not particularly limited and is set within a range of 10 to 60, for example. The diameter of each bristle implanted hole 12h is determined in

accordance with the thickness of each bristle bundle 17 and is set within a range of 1 mm to 3 mm, for example. An alignment pattern of the bristle implanted holes 12h is not particularly limited and may be any alignment pattern such as a so-called grid shape or a staggered shape.

[0023]

Examples of the bristles that form the bristle bundles 17 include bristles with diameters that gradually reduce toward the bristle tip ends (tapered bristles) and bristles with substantially a constant outer diameter except for rounded portions at the bristle tip ends (straight bristles). Examples of the material for the bristles that can be used include polyamide such as 6-12 nylon and 6-10 nylon, polyester such as PET, PBT, polytrimethylene terephthalate (PTT), PEN, and polybutylene naphthalate (PBN), polyolefin such as PP, and synthesized resin materials such as olefin-based elastomer and styrene-based elastomer. One kind of these resin materials may be used alone, or two or more kinds of these resin materials may be used in combination. Also, the bristles may have a multicore structure that has a core portion and at least one sheath portion layer provided outside the core portion.

[0024]

An outline of a cross section of each bristle is not particularly limited, and examples thereof include circular shapes such as a perfect round shape and an elliptical shape, polygonal shapes such as a triangular shape, a rectangular shape, a pentagonal shape, and a hexagonal shape, a star shape, a three-leaf clover shape, and a four-leaf clover shape.

[0025]

The thickness of each bristle is not particularly limited, and in a case in which the outline of the cross section thereof is a circular shape, the thickness is set to 3 mil to

11 mil (1 mil = 1/1000 inches = 0.025 mm), for example. The bristle bundles may be formed of bristles, all of which have the same thickness, or which have two or more different thicknesses in combination. The height of the bristles is not particularly limited and is set to 6 mm to 12 mm, for example.

[0026]

As shown in FIG. 2, a curved surface 14a with an arc-shaped outline, which has a center position arranged on a side opposite to the bristle implanted surface 12a (below the handle portion 14 in Fig. 2) and protrudes on the side of the bristle implanted surface 12a in a side view, is formed on the side of the bristle implanted surface 12a on the tip end side of the handle portion 14. Similarly, a curved surface 14b with an arc-shaped outline, which has a center position arranged on the side opposite to the bristle implanted surface 12a and protrudes on the side of the bristle implanted surface 12a in a side view, is formed on the side opposite to the bristle implanted surface 12a on the tip end side of the handle portion 14.

[0027]

In addition, a curved surface 13a with an arc-shaped outline, which has a center position arranged on the side of the bristle implanted surface 12a (above the handle portion 14 in Fig. 2) and is recessed on the side of the bristle implanted surface 12a in a side view, is formed on the side of the bristle implanted surface 12a on the rear end side of the neck portion 13. Similarly, a curved surface 13b with an arc-shaped outline, which has a center position arranged on the side of the bristle implanted surface 12a and is recessed on the side of the bristle implanted surface 12a in a side view, is formed on the side opposite to the bristle implanted surface 12a on the rear end side of the neck portion 13.

[0028]

Crossing angles of tangential lines of the curved surface 13a and the curved surface 14a and the bristle implanted surface 12a in a side view respectively successively change as the curved surfaces 13a and 14a advance in the length direction of the handle portion 14, while the curved surface 13a and the curved surface 14a cross one another at a crossing portion therebetween such that a crossing angle α_1 between the tangential lines thereof is neither 0 degrees nor 180 degrees. Therefore, a ridge line K2 is formed at the crossing portion between the curved surface 13a and the curved surface 14a.

[0029]

Crossing angles of the tangential lines of the curved surface 13b and the curved surface 14b and the bristle implanted surface 12a in the side view also respectively successively change as the curved surfaces 13b and 14b advance in the length direction of the handle portion 14, while the curved surface 13b and the curved surface 14b cross one another at a crossing portion therebetween such that a crossing angle α_2 between the tangential lines thereof is neither 0 degrees nor 180 degrees. Therefore, a ridge line K3 is formed at the crossing portion between the curved surface 13b and the curved surface 14b. Therefore, the neck portion 13 and the handle portion 14 are formed into a substantially S shape in a side view by one side in the length direction with the ridge lines K2 and K3 interposed therebetween being connected to the curved surfaces 14a and 14b with the arc-shaped outlines that protrude on the side of the bristle implanted surface 12a in a side view and by the other side in the length direction with the ridge lines K2 and K3 interposed therebetween being connected to the curved surfaces 13a and 13b with arc-shaped outlines that are recessed on the side of the bristle implanted surface 12a in a side view.

[0030]

The boundary on the rear end side of the neck portion 13 is defined by the ridge lines K2 and K3. Therefore, the rear end side beyond the ridge lines K2 and K3 is a range in which the handle portion 14 is arranged, and the neck portion 13 is arranged in a range between a range in which the head portion 12 is arranged and the range in which the handle portion 14 is arranged.

[0031]

An end portion on the side of the bristle implanted surface 12a (on the rear end side beyond the ridge line K2) on the tip end side of the handle portion 14 serves as a finger placing portion 19. The user can stably operate the toothbrush 1 by holding the handle portion 14 such that the thumb thereof is placed on the finger placing portion 19.

[0032]

The neck portion 13 integrally connects the head portion 12 to the handle portion 14. The neck portion 13 has the thinnest thickness and the smallest cross-sectional area at a position separated from the boundary position K1 (the tip end of the neck portion 13) between the head portion 12 and the neck portion 13, which is closer to the handle portion 14, and the neck portion 13 extends toward the rear end side with the same cross-sectional shape and is formed into a shape in which the diameter thereof gradually increases to a boundary K2 with the handle portion 14 on the rear end side in one example. Deflection of the neck portion 13 is absorbed irrespective of the toothbrush 1 being used in various gripping or brushing manners, and excellent usability is achieved, by the thickness of the neck portion 13 gradually increasing from the side of the head portion 12 toward the side of the handle portion 14. However, it is necessary for the neck portion 13 to have elasticity and to be appropriately deflected in terms of the impression during use.

[0033]

The length of the neck portion 13 is preferably 25 mm to 70 mm since the neck portion 13 is then brought into contact with lips when the head portion 12 is inserted into the oral cavity.

[0034]

As shown in FIG. 1, a gripping center position G1 of the toothbrush 1 is located on the handle portion 14. The gripping center position G1 is defined as a position that is separated from the ridge line K2 toward the rear end side of the handle portion by 14 by 37 mm.

[0035]

As a method of holding a toothbrush, “palm gripping” in which a thumb is placed near the finger placing portion and the handle portion is gripped by the entire palm and “pen gripping” in which the thumb is placed near the finger placing portion and the toothbrush is held in a manner in which a pen is gripped are known. The present inventors have extensively studied positions to which a force is applied when various toothbrushes are operated in a case in which the toothbrushes are gripped in these respective holding methods. As a result, it has become obvious that a part of a finger is brought into contact with a position on average 37 mm away from a finger placing apex (the position of the ridge line K2) and that the location serves as one of operational center points. Therefore, this position will be defined as a gripping center. Note that it has also become obvious that this position approximately coincides with the position of the center of gravity of many typical toothbrushes.

[0036]

As shown in FIG. 1, if a virtual straight line connecting a center point G2 in the thickness direction of the handle portion 14 at the gripping center position G1 of the

toothbrush 1 and a center point S2 in the thickness direction of the head portion 12 at a center position S1 (see Fig. 1) of the bristle implanted portion 11 is assumed to be a straight line N, the straight line N is located above (+Z direction) the plane P. In other words, the handle body 15 has a curved shape in which the handle portion 14 that has the gripping center position G1 is located on the side of the bristle implanted portion 11 beyond the bristle implanted surface 12a of the head portion 12.

[0037]

The present inventors have found that if the thickness of the head portion is reduced and the width of the neck portion is reduced in a conventional toothbrush in which the handle body extends in a substantially straight line, the head portion and the neck portion are deflected, and the bristle implanted portion tends to be displaced to the rear surface side (-Z-axis direction in Fig. 2) of the head portion. If the neck portion is deflected when brushing is performed, the bristle implanted portion is displaced to the rear surface side of the head portion (that is, a direction away from the teeth and dental gum) from an ordinary position, and a force applied to the handle portion is not sufficiently delivered to the bristle implanted portion. As a result, it is found that operability of the handle portion significantly deteriorates.

[0038]

Thus, the present inventors conceived, as a result of extensive study, that the deflection of the head portion 12 and the neck portion 13 can be offset by the bending of the handle body 15 by bending the side of the handle portion 14 of the handle body 15 to the side of the bristle implanted portion 11 beyond the plane P that forms the bristle implanted surface 12a and further optimizing parameters such as the angle θ between the straight line N and the plane P as in the aforementioned toothbrush 1 according to the embodiment. According to the toothbrush 1 of the embodiment, it is

possible to realize the toothbrush 1 capable of satisfactorily maintaining handling operability even if the head portion 12 and the neck portion 13 are deflected in a case in which the thickness of the head portion 12 is reduced and the width of the neck portion 13 is reduced and capable of achieving both excellent operability inside the oral cavity and excellent operability of the handle portion.

[0039]

Hereinafter, characteristic design parameters of the toothbrush 1 according to the embodiment will be described.

[Thickness t of head portion]

Although higher operability inside the oral cavity can be achieved as the thickness t of the head portion 12 decreases, the excessively thin thickness t tends to lead to insufficient strength of the head portion 12. Therefore, the thickness t of the head portion 12 can be determined in consideration of the constituent material, the bending elastic modulus, and the like of the handle body 15. The thickness t of the head portion 12 is set within a range of 2.0 mm to 4.0 mm. The thickness t of the head portion 12 is more preferably about 2.5 mm to 3.5 mm.

[0040]

[Minimum width $W1$ of neck portion]

Although higher operability inside the oral cavity can be achieved as the minimum width $W1$ of the neck portion 13 decreases, the excessively small minimum width $W1$ tends to lead insufficient strength of the neck portion 13. Therefore, the minimum width $W1$ of the neck portion 13 can be determined in consideration of the constituent material, the bending elastic modulus, and the like of the handle body 15. The minimum width $W1$ of the neck portion 13 is set to 3.0 mm to 4.5 mm. The minimum width $W1$ of the neck portion 13 is preferably about 3.5 mm to 4.3 mm.

[0041]

[Minimum thickness D1 of neck portion]

The minimum thickness D1 of the neck portion 13 can be defined as a thickness of the neck portion 13 at a position at which the width of the neck portion 13 reaches the minimum width in the X-axis direction. That is, the shape of the cross section that intersects perpendicularly to the extending direction of the neck portion 13 is a substantially circular shape, and the position at which the width of the neck portion 13 reaches the minimum width coincides with the position at which the thickness reaches the minimum thickness in the X-axis direction, in the toothbrush 1 according to the embodiment. However, the shape of the cross section that intersects perpendicularly to the extending direction of the neck portion 13 may not necessarily be a circular shape and may be a polygonal shape, for example. In addition, the shape of the cross section that intersects perpendicularly to the extending direction of the neck portion 13 may be different depending on the position in the X-axis direction, and the position at which the width of the neck portion 13 reaches the minimum width may not necessarily coincide with the position at which the thickness reaches the minimum thickness.

[0042]

Although higher operability inside the oral cavity can be achieved as the minimum thickness D1 of the neck portion 13 decreases similarly to the minimum width W1 of the neck portion 13, the excessively small minimum thickness D1 tends to lead to insufficient strength of the neck portion 13. Therefore, the minimum thickness D1 of the neck portion 13 can be determined in consideration of conditions such as the constituent material and the bending elastic modulus of the handle body 15. The minimum thickness D1 of the neck portion 13 is set to 3.0 mm to 4.5 mm. The

minimum thickness D1 of the neck portion 13 is preferably about 3.5 mm to 4.3 mm. Since the shape of the cross section that intersects perpendicularly to the extending direction of the neck portion 13 is a substantially circular shape, the width and the thickness are substantially the same. That is, the minimum diameter of the neck portion 13 is preferably 3.0 mm to 4.5 mm and is more preferably 3.5 mm to 4.3 mm, [0043]

[Distance a from base end of head portion to tip end of finger placing portion]

While the bristle implanted portion 11 reaches a further location in the oral cavity and an increased cleaning effect can be caused to reach to every corner in the oral cavity as the distance between the base end (the boundary position K1 between the neck portion 13 and the head portion 12) of the head portion 12 and the tip end (the boundary K2 between the neck portion 13 and the handle portion 14) of the finger placing portion 19 increases, the deflection of the neck portion 13 increases. In contrast, although it is possible to reduce the deflection of the neck portion 13 as the distance a decreases, it becomes difficult for the bristle implanted portion 11 to reach the further location in the oral cavity. Thus, the distance a is set to about 25 mm to 70 mm, for example, although it depends on conditions such as the constituent material and the bending elastic modulus of the handle body 15.

[0044]

[Gripping center point angle θ]

The angle θ between the straight line N connecting the center point G2 in the thickness direction of the handle portion 14 at the gripping center position G1 of the toothbrush 1 and the center point S2 in the thickness direction of the head portion 12 at the center position S1 of the bristle implanted portion 11 and the plane P that forms the bristle implanted surface 12a will be referred to as a gripping center point angle θ

below.

[0045]

If the gripping center point angle θ is excessively large, the difference between the extending direction of the handle portion 14 and the extending direction of the head portion 12 increases, and the operability of the handle portion 14 deteriorates. In addition, if the gripping center point angle θ is excessively small, the shape of the handle body 15 approaches a straight line, and original effects of the embodiment cannot be obtained. In consideration of these points, the gripping center point angle θ is set to be equal to or greater than 5.0 degrees and equal to or less than 10.0 degrees. The gripping center point angle θ is more preferably equal to or greater than 6.0 degrees and equal to or less than 8.0 degrees.

[0046]

[Gripping center point height h]

The distance between the center point G2 in the thickness direction of the handle portion 14 at the gripping center position G1 of the toothbrush 1 and the plane P that forms the bristle implanted surface 12a is defined as a gripping center point height h.

[0047]

If the gripping center point height h is excessively high, the difference between the extending direction of the handle portion 14 and the extending direction of the head portion 12 increases, and the operability of the handle portion 14 deteriorates similarly to the gripping center point angle θ . Also, if the gripping center point height h is excessively short, the shape of the handle body 15 approaches a straight line, and the original effects of the embodiment cannot be obtained. In consideration of these

points, the gripping center point height h is set to be equal to or greater than 6.0 mm and equal to or less than 12.0 mm. The gripping center point height h is more preferably equal to or greater than 7.0 mm and equal to or less than 11.0 mm.

[0048]

(Amount of deflection A of head portion)

The 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.

[0049]

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 the 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.

[0050]

Specific description will be given with reference to a toothbrush 21 shown in Figs. 3A, 3B, 4A, and 4B. 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 the 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.

[0051]

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. 3A, 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 the 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 the 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 the 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.

[0052]

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 the 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.

[0053]

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

As shown in Fig. 4A, 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. 4B, 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 L4 (Fig. 3A) 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 the average value of the aforementioned amount of displacement a is assumed to be the amount of deflection A of the head portion 22.

[0054]

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 the 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 becomes 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.

[0055]

(Amount of deflection B of neck portion)

The 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 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.

[0056]

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. 3A, 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 the 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.

[0057]

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.

[0058]

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 deletion 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.

[0059]

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 the 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 use. Further, the strength of the toothbrush 21 is enhanced, and the durability is improved.

[0060]

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 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.

[0061]

The handle portion 26 is gripped when the toothbrush 21 is used. The 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.

[0062]

[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.

[0063]

Toothbrushes in Examples 1 to 6 and Comparative Examples 1 and 2 were produced by an injection molding method in accordance with the specifications shown in Table 1. The widths, the lengths, the thicknesses, and the shapes of handle portions in all the above toothbrushes were set to be the same. Various kinds of resin described in Table 1 was injection-molded to obtain integrally molded articles of the head portions, the neck portions, and the handle portions shown in Figs. 1 and 2.

Alignment of bristle implanted holes was set in a pattern of three holes $\times$ one array, four holes $\times$ six arrays, and three holes $\times$ one array from the tip end of the head portion toward the neck portion. The widths and the lengths of the head portions will be shown in Table 1. The toothbrushes were produced by implanting bristle bundles of tapered bristles (7.5 mil) made of PBT filaments at the head portion through metal piece-scheme implanting.

[0064]

Two items, namely operability inside an oral cavity and handle operability were listed as items of evaluating the respective samples. For the operability inside the oral cavity, “a” represents “significantly excellent”, “b” represents “excellent”, “c” represents “slightly inferior”, and “d” represents “significantly inferior”. For the handle operability, “a” represents “significantly excellent”, “b” represents “excellent”, “c” represents “slightly inferior”, and “d” represents “significantly inferior” in a similar manner.

Sample	Specification						Evaluation item				
	Material	Head portion		Length [mm]	Neck portion		Distance a from base end of head portion to tip end of finger placing portion [mm]	Handle portion		Operability inside oral cavity	Handle operability
		Thickness t [mm]	Width [mm]		Minimum width W1 [mm]	Minimum thickness D1 [mm]		Gripping center point angle θ [°]	Gripping center point height h [mm]		
Numerical range of the present invention		2.0 to 4.0			3.0 to 4.5	3.0 to 4.5		5.0 to 10.0	6.0 to 12.0	a	a
Example 1	PP	3.0	9.1	23.0	4.0	4.0	45	6.3	9.5	b	a
Example 2	PP	3.0	10.3	29.7	4.0	4.0	42	6.5	7.2	b	a
Example 3	PP	3.0	10.6	19.5	4.0	4.0	50	6.5	9.5	a	a
Example 4	PP	3.0	10.5	22.0	4.0	4.0	47	7.0	10.0	b	a
Example 5	PP	3.0	10.3	22.0	4.0	4.0	46	7.5	10.5	b	a
Example 6	PBT	3.5	9.8	23.0	3.5	3.5	53	5.1	8.0	b	a
Comparative example 1	Saturated polyester	3.5	9.2	25.0	6.3	3.5	38	1.2	0.0	d	d
Comparative Example 2	PP	4.7	10.3	29.7	5.1	5.0	43	6.3	7.0	c	b

[0066]

As shown in Table 1, both the gripping center point angle θ and the gripping center point height h of the toothbrush in Comparative Example 1 were outside the numerical ranges of the present invention. That is, the toothbrush in Comparative Example 1 had a handle body with a shape that is relatively close to a straight line shape. Therefore, it was confirmed that the toothbrush in Comparative Example 1 was inferior in terms of the operability inside the oral cavity and the handle operability. Further, the thickness t of the head portion, the minimum width W of the neck portion, and the minimum thickness $D1$ of the neck portion of the toothbrush in Comparative Example 2 are outside the numerical ranges of the present invention. Therefore, it was confirmed that the toothbrush in Comparative Example 2 was inferior in terms of the operability inside the oral cavity.

[0067]

In contrast, all the parameters, namely the thicknesses t of the head portions, the minimum widths $W1$ of the neck portions, the minimum thicknesses $D1$ of the neck portions, the gripping center point angles θ , and the gripping center point heights h of the toothbrushes in Examples 1 to 6 were within the numerical ranges of the present invention. In this manner, it was confirmed that the toothbrushes exhibited both excellent operability inside the oral cavity and excellent handle operability even if the neck portions were deflected.

[0068]

In a case in which the metal piece-scheme implanting is employed, stress due to the driving of the metal pieces is typically applied to the head portion. In a case in which the thickness of the head portion is thin, and strength against deformation when force is applied is low while the neck portion is thick and has high strength, stress

occurring when the tooth are brushed concentrates on the head portion, deflection of the head portion increases, and the usability deteriorates in some cases. In such cases, it is possible to disperse the stress occurring when the tooth are brushed in the entire neck portion and to improve the usability by reducing the width of the neck portion and providing a deflecting property to some extent as in the toothbrush 1 according to the embodiment. 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.

[Reference Signs List]

[0069]

- 1 Toothbrush
- 11 Bristle implanted portion
- 12 Head portion
- 12a Bristle implanted surface
- 13 Neck portion
- 14 Handle portion
- 17 Bristle bundle

[CLAIMS]

What is claimed is:

[Claim 1]

A toothbrush comprising:

a bristle implanted portion that is formed of a plurality of bristle bundles implanted by the metal piece-scheme bristle implanting;

a head portion with a bristle implanted surface in which the bristle implanted portion is provided;

a neck portion that extends from the head portion;

and a handle portion that extends from 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 3.0 to 4.5 mm,

a minimum thickness of the neck portion is 3.0 to 4.5 mm,

a curved surface with an arc-shaped outline, which has a center position arranged on the side of the bristle implanted surface and is recessed on the side of the bristle implanted surface in a side view, is formed on the side of the bristle implanted surface on the rear end side of the neck portion,

a gripping center point height which is a distance between the center point in the thickness direction of the handle portion at a gripping center position of the toothbrush and a plane that forms the bristle implanted surface is 6.0 to 12.0 mm,

a difference ($B - A$) between an amount of deflection A (a unit is mm) of the head portion, which is measured by a method (α) described below and an amount of deflection B (a unit is mm) of the neck portion, which is measured by a method (β) described below is 1 to 4 mm, and

the amount of deflection B is 2.1 to 5.0 mm;

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 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 fixed state, 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 the amount of deflection A is 0.5 to 2.0 mm.

[Claim 3]

The toothbrush according to claim 1 or 2,
wherein the amount of deflection B is 2.1 to 4.0 mm.

[Claim 4]

The toothbrush according to claim 1 or 2,
wherein a gripping center point angle, which is an angle between a straight line connecting a center point in a thickness direction of the handle portion at a gripping center position of the toothbrush and a center point in a thickness direction of the head portion at a center position of the bristle implanted portion and a plane that forms the bristle implanted surface, is 5.0 to 10.0 degrees.

[Claim 5]

The toothbrush according to claim 1 or 2,
wherein a ratio (B/A) between the amount of deflection B (the unit is mm) and the amount of deflection A (the unit is mm) is 1.5 to 5.0.

[Claim 6]

The toothbrush according to claim 1 or 2,
wherein a product ($A \times B$) of the amount of deflection A (a unit is mm) and the amount of deflection B (a unit is mm) is 0.8 to 10.

[Claim 7]

The toothbrush according to claim 4,
wherein the gripping center point angle is 6.0 to 10.0 degrees.

[Claim 8]

The toothbrush according to claim 1 or 2,
wherein a length of the neck portion is 25 to 70 mm.

[Claim 9]

The toothbrush according to claim 1 or 2,
wherein a constituent material of a handle body which includes the head portion, the neck portion, and the handle portion includes at least one of the group of

polypropylene, polyethylene terephthalate, polybutylene terephthalate, polycyclohexylene dimethylene terephthalate, polyacetal, polyethylene naphthalate, polystyrene, acrylonitrile butadiene styrene resin, cellulose propionate, polyarylate, polycarbonate, and acrylonitrile styrene copolymer resin.

[Claim 10]

The toothbrush according to claim 1 or 2,
wherein a bending elastic modulus of a constituent material of the neck portion is equal to or greater than 1000 MPa and equal to or less than 2200 MPa.

[Claim 11]

The toothbrush according to claim 1 or 2,
wherein a constituent material of the neck portion is polypropylene resin.