

DESCRIPTION

Title of Invention

TOOTHBRUSH

5

Technical Field

[0001]

The present invention relates to a toothbrush.

Priority is claimed on Japanese Patent Application No. 2016-212030, filed on

10 October 28, 2016, the content of which is incorporated herein by reference.

Background Art

[0002]

Patent Documents 1 to 3 propose a toothbrush including a head that is thin in
15 thickness in terms of operability or the like in an oral cavity. When the head is thin in
thickness, a problem of a decrease in strength or the like arises. Therefore, a resin such
as polyacetal resin (POM) having a high strength is used. In particular, in a case of
flat-bristle implantation in which a metal flat wire is placed into a resin head such that a
brush is held, bristle implantation strength and folding strength of a head section are
20 insufficient in some cases.

Citation List

Patent Literature

[0003]

25 [Patent Document 1] Japanese Unexamined Patent Application, First

Publication No. H7-143914

[Patent Document 2] Japanese Unexamined Patent Application, First

Publication No. 2011-4852

[Patent Document 3] Japanese Unexamined Patent Application, First

5 Publication No. 2011-200296

Summary of Invention

Technical Problem

[0004]

10 The present inventors have found, through studies, that, when a neck section that connects a head section and a handle section is thick in the toothbrush described above, an improvement effect of operability in an oral cavity due to the thin head section is impaired. In particular, when the neck has a wide width, the operability is further impaired, and an impression of a product is also impaired, with thinness of the head
15 being unnoticed, even regarding the external appearance of the toothbrush. However, in a case where the neck section is narrowed, too much deflection occurs, and, on the contrary, there is a possibility that too much deflection results in a problem in the operability. In addition, additional improvement is required also regarding strength. In particular, in a case of using a general purpose resin such as polypropylene (PP),
20 which is generally used in the toothbrush, more remarkable problems arise.

[0005]

An aspect of the present invention is made to solve the problem described above, and an object thereof is to provide a toothbrush including a thin head that can achieve good operability.

Solution to Problem

[0006]

In order to achieve the object, a toothbrush according to an aspect of the present invention includes: a bristle implanting portion configured of a plurality of bristle
 5 bundles; a head section provided with the bristle implanting portion on a bristle
 implanting surface; a neck section extending from the head section; and a handle section
 extending from the neck section. The head section has a thickness of 2.0 mm to 4.0 mm,
 and the neck section has a minimum width and a minimum thickness of 3.0 mm to 4.5
 mm. The neck section is provided with a curved surface on a side of the bristle
 10 implanting surface on a rear end side of the neck section, the curved surface having a
 center position disposed on the side of the bristle implanting surface and having a
 concave arc contour on the side of the bristle implanting surface in a side view. An
 angle formed between a plane that configures the bristle implanting surface and a straight
 line connecting a center point of the handle section in a thickness direction at a grip
 15 center position of the toothbrush and a center point of the head section in the thickness
 direction at a center position of the bristle implanting portion is 5.0° to 10.0°.

[0007]

In the toothbrush according to the aspect of the present invention, a
 configurational material of the neck section may have a flexural modulus of 1,000 MPa
 20 to 2,200 MPa.

[0008]

In the toothbrush according to the aspect of the present invention, the
 configurational material of the neck section may be a polypropylene resin.

25 Advantageous Effects of Invention

[0009]

According to an aspect of the present invention, it is possible to realize a toothbrush including a thin head section which can achieve good operability.

5 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.

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Description of Embodiments

[0011]

Hereinafter, embodiments of the present invention will be described with reference to FIGS. 1 and 2.

15

The following embodiment is an aspect of the present invention and does not limit the present invention thereto, and it is possible to perform any modification within a range of the technical idea of the present invention. In addition, in the following drawings, in order to show each configurational element in an easily understandable manner, a scale of dimension, the number of components, or the like is different

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depending on the configurational element.

[0012]

FIG. 1 is a plan view of a toothbrush according to an embodiment.

FIG. 2 is a side view of the toothbrush.

As shown in FIGS. 1 and 2, a toothbrush 1 of the embodiment includes a bristle

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implanting portion 11, a head section 12 provided with the bristle implanting portion 11,

a neck section 13 extending from a base end side of the head section 12, and a handle section 14 extending from a base end side of the neck section 13. In other words, the head section 12, the neck section 13, and the handle section 14 are integrally formed. Hereinafter, a member configured of the head section 12, the neck section 13, and the handle section 14, which are integrally formed, is referred to as a handle body 15. In FIG. 1, the bristle implanting portion 11 is omitted.

[0013]

Here, an upper surface of the head section 12, which is provided with the bristle implanting portion 11, is referred to as a bristle implanting surface 12a. As shown in FIGS. 1 and 2, a plane P (virtual plane) that configures the bristle implanting surface 12a is set as an XY plane, a direction in which the handle body 15 extends as a whole is set as an X-axis direction, and a direction orthogonal to the X axis is set as a Y-axis direction. A normal direction of the plane P is set as a Z-axis direction. In the following description, a dimension of each member in the Y-axis direction is referred to as a width of the member, a dimension of each member in the Z-axis direction is referred to as a thickness of the member, and a dimension of each member in the X-axis direction is referred to as a length of the member.

[0014]

The handle body 15 is integrally molded into an elongated shape as a whole and can be produced by injection molding with a resin as a material, for example. Examples of configurational materials of the handle body 15 includes polypropylene (PP), polyethylene terephthalate (PET), polybutylene terephthalate (PBT), polycyclohexylenedimethylene terephthalate (PCT), polyacetal (POM), polyethylene naphthalate (PEN), polystyrene (PS), acrylonitrile butadiene styrene resin (ABS), cellulose propionate (CP), polyarylate, polycarbonate, or acrylonitrile styrene copolymer

resin (AS). Of the resin materials, regarding high strength and easiness of thinning of the head section, a material such as POM, PBT, or PEN is preferably used.

[0015]

In particular, polypropylene has properties of broader utility, higher easiness in process and a more decrease in costs, but a lower flexural modulus than a resin such as polyacetal. For example, the flexural modulus of the polyacetal is substantially about 2,500 MPa, and the flexural modulus of polypropylene is substantially about 1,500 to 2,000 MPa. Therefore, according to the related art, polypropylene is a material that is unlikely to be used as a material of the toothbrush including a thin head section and a narrow neck section. However, the shape of the toothbrush of the embodiment to be described below is employed, and thereby it is also possible to use a resin such as polypropylene which has a relatively low flexural modulus.

[0016]

In the embodiment, the flexural modulus of a configurational material of the handle body 15, particularly, the neck section 13, is preferably 1,000 MPa to 2,200 MPa. When the flexural modulus is lower than 1,000 MPa, there is a concern that it is not possible to obtain sufficient strength when the neck section 13 is narrowed. In addition, the flexural modulus is higher than 2,200 MPa, there is a concern that hardness increases, but the handle body 15 becomes brittle.

[0017]

Regarding the resin, one kind of resin may be used alone, or two or more kinds of resins may be used together. In addition, the handle body 15 may have a configuration in which a part or an entirety of the handle section 14 is coated with a soft resin. A part or the entirety of the handle section 14 is coated with the soft resin, and thereby a fit feeling of hand when a user grips the handle section 14 improves, and it is

possible to prevent a gripping finger from sliding. For example, as the soft resin, a resin with Shore A 90 or lower is preferably used, and a resin with Shore A 10 to 40 is more preferably used. Examples of the soft resin include polyolefin-based elastomers, styrene-based elastomers, polyester-based elastomers, polyurethane-based thermoplastic elastomers, or silicon-based elastomers.

[0018]

The length of the entire handle body 15 can be determined regarding operability or the like. For example, the length of the entire handle body 15 is about 100 to 200 mm.

[0019]

The head section 12 has a substantially quadrangular flat plate shape of which four vertexes are subjected to corner cutoff into curved lines in a plan view. The bristle implanting surface 12a that is an upper surface of the head section 12 is provided with a plurality of bristle implanting holes 12h. A bristle bundle 17 having bundled bristles is implanted into the bristle implanting holes 12h, and thereby the bristle implanting portion 11 configured of the plurality of bristle bundles 17 is formed. Of the plurality of bristle implanting holes 12h, a distance d1 from a bristle implanting hole 12h that is positioned on the front end-most side of the head section 12 to a front end of the head section 12 is set to be equal to a distance d2 from a bristle implanting hole 12h that is positioned on the base end-most side of the head section 12 and a base end of the head section 12. In other words, a boundary position K1 between the neck section 13 to be described below and the head section 12 is a position separated by a distance equal to the distance d1, from the bristle implanting hole 12h that is positioned on the base end-most side of the head section 12 toward the side of the neck section 13.

[0020]

The dimension of the head section 12 is determined with consideration for a property such as the operability in the oral cavity. When the head section 12 is too wide in width, the operability in the oral cavity is impaired. When the head section is too narrow in width, the number of the implanted bristle bundles 17 is too small, and a
 5 cleaning effect is likely to be impaired. Therefore, the width of the head section 12 is set to about 5 mm to 16 mm, for example.

[0021]

When the head section 12 is too long in length, the operability in the oral cavity is likely to be impaired. When the head section is too short in length, the number of the
 10 implanted bristle bundles 17 is too small, and the cleaning effect is likely to be impaired. Therefore, the length of the head section 12 is set in a range of 10 mm to 33 mm, for example.

[0022]

The shape of the bristle implanting hole 12h is not particularly limited and may
 15 have a circular shape such as an ellipse or a polygonal shape such as a triangle or a quadrangle. The number of bristle implanting holes 12h is not particularly limited and is set in a range of 10 to 60 holes, for example. A diameter of the bristle implanting hole 12h is determined depending on the size of the bristle bundle 17 and is set in a range of 1 mm to 3 mm, for example. An arrangement pattern of the bristle implanting holes
 20 12h is not particularly limited, and any arrangement pattern such as a so-called grid shape or a zigzag shape may be employed.

[0023]

Examples of bristles that configure the bristle bundle 17 include a bristle
 (tapered bristle) that has a diameter gradually decreasing toward a bristle tip or a bristle
 25 (straight bristle) that has an outer diameter that is substantially constant except for a

round portion of a bristle tip. Examples of a material of the bristle can include a polyamide such as nylon 6-12 or nylon 6-10, polyester such as PET, PBT, polytrimethylene terephthalate (PTT), PEN, or polybutylene naphthalate (PBN), a polyolefin such as PP, or a synthetic resin material such as an olefin-based elastomer or a
5 styrene-based elastomer. The resin materials may be used individually or in a combination of two more kinds thereof. In addition, the bristle may have a multi-core structure having a core and at least one sheath provided on an outer side of the core.

[0024]

A cross-sectional contour of a bristle is not particularly limited, and examples of
10 the cross-sectional contour include a perfect circular shape, a circular shape such as an elliptical shape, a polygonal shape such as a triangular shape, a quadrangular shape, a pentagonal shape, or a hexagonal shape, a star shape, a three-leaf clover shape, or a four-leaf clover shape.

[0025]

15 The size of the bristle is not particularly limited. In a case where the cross-sectional contour is a circular shape, the size is 3 mil to 11 mil (1 mil = 1/1,000 inch = 0.025 mm), for example. The bristle bundle may be formed by bristles which all have the same size or may be formed by a combination of bristles having two or more different sizes. A bristle length is not particularly limited and is set to 6 mm to 12 mm,
20 for example.

[0026]

As shown in FIG. 2, the handle section 14 is provided with a curved surface 14a on a side of the bristle implanting surface 12a on a front end side of the handle section. The curved surface has a center position (curvature center) disposed on an opposite side
25 (below the handle section 14 in FIG. 2) of the bristle implanting surface 12a and has a

convex arc contour on the side of the bristle implanting surface 12a in a side view.

Similarly, the handle section 14 is provided with a curved surface 14b on the opposite side of the bristle implanting surface 12a on the front end side of the handle section.

The curved surface has a center position disposed on the opposite side of the bristle

5 implanting surface 12a and has a convex arc contour on the side of the bristle implanting surface 12a in a side view.

[0027]

In addition, the neck section 13 is provided with a curved surface 13a on the side of the bristle implanting surface 12a on a rear end side of the neck section. The curved

10 surface has a center position (curvature center) disposed on the side (above the handle section 14 in FIG. 2) of the bristle implanting surface 12a and has a concave arc contour on the side of the bristle implanting surface 12a in a side view. More specifically, a surface (curved or flat surface) of the neck section 13 on the side of the bristle implanting surface 12a in a thickness direction of the handle section 14 from a region on a front end

15 side to a region on the rear end side in a longitudinal direction intersecting the head section 12 is curved to form the curved surface 13a having the concave arc contour on the side of the bristle implanting surface 12a in a side view of being viewed from a width direction orthogonal to the longitudinal direction and the thickness direction. The curvature center of the curved surface 13a is disposed above the curved surface 13a in the

20 thickness direction. Similarly, the neck section 13 is provided with a curved surface 13b on the opposite side of the bristle implanting surface 12a on the rear end side of the neck section. The curved surface has a center position (curvature center) disposed on the side of (above) the bristle implanting surface 12a and has a concave arc contour on the side of the bristle implanting surface 12a in a side view.

25 [0028]

The curved surface 13a and the curved surface 14a have intersecting angles between tangential lines thereof and the bristle implanting surface 12a in a side view, the intersecting angles continuously changing as the curved surfaces proceed in a length direction of the handle section 14. However, an intersecting angle between the tangential lines in an intersecting portion between the curved surface 13a and the curved surface 14a is not 0° or 180° but is an angle α_1 . Therefore, a ridge line K2 is formed in the intersecting portion between the curved surface 13a and the curved surface 14a.

[0029]

Regarding the curved surface 13b and the curved surface 14b, intersecting angles between the bristle implanting surface 12a and tangential lines of the curved surfaces in a side view continuously change as the curved surfaces proceed in the length direction of the handle section 14. However, an intersecting angle between the tangential lines in an intersecting portion between the curved surface 13b and the curved surface 14b is not 0° or 180° but is an angle α_2 . Therefore, a ridge line K3 is formed in the intersecting portion between the curved surface 13b and the curved surface 14b.

Hence, the curved surfaces 14a and 14b, which have the convex arc contour on the side of the bristle implanting surface 12a in a side view, on one side in the length direction, with the ridge lines K2 and K3 interposed between the neck section and the handle section, are continuous to the curved surfaces 13a and 13b, which have the concave arc contour on the side of the bristle implanting surface 12a in a side view, on the other side in the length direction, with the ridge lines K2 and K3 interposed therebetween. In this manner, the neck section 13 and the handle section 14 are formed into a substantial S shape in a side view.

[0030]

A boundary of the neck section 13 on the rear end side is defined by the ridge

lines K2 and K3. Hence, a range, in which the handle section 14 is disposed, is provided on the rear end side from the ridge lines K2 and K3, and the neck section 13 is disposed in a range between a range in which the head section 12 is disposed and the range in which the handle section 14 is disposed.

5 [0031]

An end portion (on the rear end side from the ridge line K2 in a side view) of the handle section 14 on the side of the bristle implanting surface 12a on the front end side is a finger rest portion 19. The top of the finger rest portion 19 on the front end side is set by the ridge line K2. As shown in FIG. 1, such a top position (ridge line K2) is a
10 position of a top at the shortest distance with respect to the head section 12 in a front view. A user holds the handle section 14 such that a thumb is placed on the finger rest portion 19, and thereby it is possible to stably operate the toothbrush 1.

[0032]

The neck section 13 integrally connects the head section 12 and the handle
15 section 14. The neck section 13 is narrowest at a position that is separated from a boundary position K1 (front end of the neck section 13) between the head section 12 and the neck section 13 slightly toward the handle section 14, has a small sectional area at the position, extends toward the rear end side without a change in sectional area, and is formed into a shape with a diameter that gradually increases to the boundary K2 with the
20 handle section 14 on the rear end side. In this manner, the neck section 13 gradually increases in diameter from the side of the head section 12 toward the side of the handle section 14, and thereby, deflection of the neck section 13 is absorbed even when the toothbrush 1 is used in various gripping methods or polishing methods. Hence, good usability is achieved. However, from the viewpoint of usability, the neck section 13
25 needs to have elasticity and to be appropriately bent.

[0033]

The length of the neck section 13 is preferably 25 mm to 70 mm such that the neck section 13 touches a lip when the head section 12 is inserted into an oral cavity.

[0034]

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

[0035]

As a method of holding the toothbrush, a "palm grip" of placing a thumb near
10 the finger rest portion and holding the handle section with the whole palm and a "pen grip" of placing the thumb near the finger rest portion and holding the toothbrush in a state of holding a pen are known. The present inventors have intensively studied a position to which a force is applied when the toothbrush is operated in a case various types of toothbrushes are held by the holding methods. As a result, the following is
15 clarified. A part of a finger touches a position of 37 mm on average from the top (position of the ridge line K2) of the finger rest portion, and thus the position becomes one of a center of an operation point. Hence, the position is defined as a grip center. The following is also clarified. The position is substantially coincident with a gravity center of many common toothbrushes.

20 [0036]

As shown in FIG. 2, when a straight line N represents a virtual straight line that connects a center point G2 of the handle section 14 in the thickness direction at the grip center position G1 of the toothbrush 1 and a center point S2 of the head section 12 in the thickness direction at a center position S1 (refer to FIG. 1) of the bristle implanting
25 portion 11, the straight line N is positioned above (+Z direction) the plane P. In other

words, the handle body 15 has a bent shape such that the handle section 14 having the grip center position G1 is positioned closer to the side of the bristle implanting portion 11 than to the bristle implanting surface 12a of the head section 12.

[0037]

5 The present inventors have found that, when a toothbrush in the related art, which has a handle body that extends in a substantially straight line shape, includes a thin head section and a narrow neck section, the head section or the neck section is deflected, and a bristle implanting portion is likely to be displaced toward a back side (-Z-axis direction in FIG. 2) of the head section. In particular, when brushing is performed, and
10 the neck section is bent, the bristle implanting portion is displaced toward the back side (that is, in a direction of being separated from a tooth or a gingiva) of the head section from a normal position, and it is difficult for a force applied to the handle section to be sufficiently transmitted to the bristle implanting portion. As a result, the following is found. The operability of the handle section is remarkably impaired.

15 [0038]

As a result of an intensive study, the present inventors have found that, similarly to the toothbrush 1 of the embodiment described above, when the side of the handle section 14 of the handle body 15 is curved closer to the side of the bristle implanting portion 11 than to the plane P that configures the bristle implanting surface 12a, and
20 further a parameter such as the angle θ between the straight line N and the plane P is optimized, curvedness of the handle body 15 can compensate for deflection of the head section 12 or the neck section 13. As described above, according to the toothbrush 1 of the embodiment, even when the head section 12 or the neck section 13 is bent in a case where the head section 12 is thin and the neck section 13 is narrow, it is possible to
25 maintain good handle operability, and it is possible to realize the toothbrush 1 that can

have both good operability in the oral cavity and good handle section operability.

[0039]

Hereinafter, a characteristic design parameter in the toothbrush 1 of the embodiment will be described.

5 [Thickness t of Head Section]

As a thickness t of the head section 12 decreases, the operability in the oral cavity can be enhanced. However, when the head section is too thin, strength of the head section 12 is likely to be insufficient. Therefore, the thickness t of the head section 12 can be determined with consideration for a configurational material, a flexural
10 modulus, or the like of the handle body 15. The thickness t of the head section 12 is set in a range of 2.0 mm to 4.0 mm. The thickness t of the head section 12 is preferably 2.5 mm to 3.5 mm.

[0040]

[Minimum Width $W1$ of Neck Section]

15 As a minimum width $W1$ of the neck section 13 decreases, the operability in the oral cavity can be enhanced. However, when the neck section is too narrow, strength of the neck section 13 is likely to be insufficient. Therefore, the minimum width $W1$ of the neck section 13 can be determined with consideration for the configurational material, the flexural modulus, or the like of the handle body 15. The minimum width $W1$ of the
20 neck section 13 is set to 3.0 mm to 4.5 mm. The minimum width $W1$ of the neck section 13 is preferably about 3.5 mm to 4.3 mm.

[0041]

[Minimum Thickness $D1$ of Neck Section]

A minimum thickness $D1$ of the neck section 13 can be set to be the thickness of
25 the neck section 13 at a position at which the neck section 13 has the minimum width in

the X-axis direction. In other words, in the toothbrush 1 of the embodiment, a cross-sectional shape of the neck section 13 has a cross section that is orthogonal to an extending direction of the neck section, and a shape of the cross section is a substantially circular shape. Hence, a position at which the neck section 13 has the minimum width is coincident with a position at which the neck section has the minimum thickness in the X-axis direction. However, the shape of the cross section of the neck section 13, which is orthogonal to the extending direction thereof, may not need to be a circular shape and may be a polygonal shape, for example. In addition, the shape of the cross section of the neck section 13, which is orthogonal to the extending direction of the neck section, may be different depending on a position in the X-axis direction, and the position at which the neck section 13 has the minimum width may not be coincident with the position at which the neck section has the minimum thickness in the X-axis direction.

[0042]

Similarly to the minimum width W1 of the neck section 13, as the minimum thickness D1 of the neck section 13 decreases, the operability in the oral cavity can be enhanced. However, when the neck section is too narrow, strength of the neck section 13 is likely to be insufficient. Therefore, the minimum thickness D1 of the neck section 13 can be determined with consideration for a condition such as the configurational material, the flexural modulus, or the like of the handle body 15. The minimum thickness D1 of the neck section 13 is set to 3.0 mm to 4.5 mm. The minimum thickness D1 of the neck section 13 is preferably about 3.5 mm to 4.3 mm. In a case of the embodiment, since the shape of the cross section of the neck section 13, which is orthogonal to the extending direction, is a substantially circular shape, the width and the thickness are the same as each other. In other words, the minimum diameter of the neck section 13 is, preferably, 3.0 mm to 4.5 mm and, more preferably, 3.5 mm to 4.3 mm.

[0043]

Here, shape factors of a front end region and a rear end region of the neck section 13 are described.

The front end region (region between the boundary position K1 with the head section 12 and a position separated by 10 mm from the boundary position K1 toward the rear end side) of the neck section 13 is a region that enters the oral cavity and often physically interferes with the periphery of a cleaning site. Hence, from the viewpoint of the operability in the oral cavity, it is preferable that the head section 12 in the region in a side view on the bristle implanting surface 12a may be shaped to have the same flat surface as (to be flush with) the bristle implanting surface 12a or have a parallel relationship. Hence, when D represents the thickness of the neck section 13, D11 represents a thickness of the neck section 13 on an upper side of the plane with the plane including the bristle implanting surface 12a as a boundary in a side view, D12 ($D = D11 + D12$) represents a thickness on a lower side, it is desirable that $D12 > D11$ always in a neck front end region, and a ratio of D12 and D11 remains constant (a change of D11/D12 in the front end region described above being in a range of 1.0 ± 0.15).

[0044]

The rear end region (region between the ridge line K2 and a position separated by 20 mm from the ridge line K2 toward the front end side) of the neck section 13 is different from the front end region described above, and the rear end region enters the oral cavity in small cases. In order to limit too much deflection by the thin head or the narrow neck (that is, in order to enhance the operability in the oral cavity and the handle section operability, the rear end region plays a role of applying a shape change for establishing an appropriate grip center point angle θ and a grip center point height h. In particular, a shape (on an upper side) of the rear end region on the side of the bristle

implanting surface 12a mainly depends on setting of the grip center point angle θ , and thus a shape thereof in a side view is set to an arc shape steeper (large curvature) than the front end region. Further, since the thickness increases depending on the change in shape, it is possible to perform bending control on a root of the neck section 13 on which
 5 a load due to brushing is likely to be concentrated.

On the other hand, although the same arc shape is formed depending on the change in shape in a side view of the upper side on the back side (lower side) in the rear end side, it is necessary to increase the thickness in order to limit the deflection, and thus a gentler arc shape (having small curvature) is formed than that on the upper side. In
 10 this case, when the thickness D11 (20) represents the thickness D11 at the position moved by 20 mm from the ridge line K2 toward the side (front end side) of the head section 12, the thickness D11 (10) represents a case of moving by 10 mm from the ridge line K2 toward the front end side, the thickness D11 (0) represents a case of the ridge line, and the thickness D12 is represented in the same way, the following relationship is
 15 established.

[0045]

(1) At the position separated by 20 mm from the ridge line K2 toward the front end side:

The ratio of the thickness D11 on the upper side to the thickness D at the
 20 position is $40 \pm 10\%$.

At the position separated by 10 mm from the ridge line K2 toward the front end side:

The ratio of the thickness D11 on the upper side to the thickness D at the position is 40% or higher and 90% or lower and, preferably, 60% or higher and 80% or
 25 lower.

At the position of 0 mm (ridge line K2):

The ratio of the thickness D11 on the upper side to the thickness D at the position is 45% or higher, preferably 75% or higher, more preferably 80% or higher, and still more preferably 85% or higher. The upper limit value is, preferably, 95% or lower and, more preferably, 90% or lower.

[0046]

The ratio of the thickness D11 increases as the angle θ increases. In addition, when a thin type of head section 12 is formed, the thickness is small as is, and thus the ratio of the thickness D11 on the upper side further increases in order to obtain a predetermined angle θ .

In a case where the ratio of the thickness D11 is equal to or lower than the lower limit value, almost a straight shape is formed, and thus a predetermined grip center point angle is not obtained. In addition, even when an angle is formed, the thickness D12 increases more than necessary at the root of the neck section 13, and thus an effect as a narrow neck is degraded. When the thickness D12 is larger than the upper limit value, curvature of the neck section 13 starts at an early stage, and thus it is difficult for the appropriate grip center point angle to be formed, and the operability in the oral cavity is degraded.

[0047]

(2) A change $(D11(10)/D11(20))$ of the thickness D11 at the position separated by 20 mm from the ridge line K2 toward the front end side and at the position separated by 10 mm from the ridge line K2 toward the front end side is 1.2 or larger, preferably 1.4 or larger, and more preferably 1.7 or larger. In addition, an upper limit of the change $(D11(10)/D11(20))$ of the thickness D11 is 2.5.

In a case where the change $(D11(10)/D11(20))$ of the thickness D11 at the

position separated by 20 mm from the ridge line K2 toward the front end side and at the position separated by 10 mm from the ridge line K2 toward the front end side is smaller than the lower limit value, the straight shape is continuous to the root of the neck section 13, and thus the predetermined grip center point angle is not obtained. In a case where the change ($D11(10)/D11(20)$) of the thickness D11 at the position separated by 20 mm from the ridge line K2 toward the front end side and at the position separated by 10 mm from the ridge line K2 toward the front end side is larger than the upper limit value, the curvature of the neck section 13 starts at the early stage. Hence, it is difficult to form the predetermined grip center point angle, and the operability in the oral cavity is degraded.

The change of the thickness D11 at the position of 10 mm and at the position of 0 mm from the ridge line K2 toward the front end side is 1.4 or larger, preferably 1.8 or larger, and more preferably 1.9 or larger. The upper limit of the change of D11 at the position of 10 mm and the position of 0 mm toward the front end side is 3.0.

In a case where the change of D11 at the position of 10 mm and at the position of 0 mm from the ridge line K2 toward the front end side is smaller than the lower limit value, the straight shape is continuous to the root of the neck section 13, and thus the predetermined grip center point angle is not obtained. In a case where the change of D11 at the position of 10 mm and at the position of 0 mm from the ridge line K2 toward the front end side is larger than the upper limit value, the curvature of the neck section 13 starts at the early stage. Hence, it is difficult to form the predetermined grip center point angle, and the operability in the oral cavity is degraded.

[0048]

A change ratio ($D12(20)/D12(10)$) of the thickness D12 at the position separated by 20 mm from the ridge line K2 toward the front end side and at the position

separated by 10 mm from the ridge line K2 toward the front end side is 1.3 or larger and, preferably, 1.4 or larger.

The change of the thickness D12 at the position of 10 mm and at the position of 0 mm from the ridge line K2 toward the front end side is 1.3 or larger and, preferably 1.4
5 or larger.

In a case where the change ratio is equal to or smaller than the lower limit value, the curvature is not formed on the lower side depending on the change in shape on the upper side. Thus the finger rest portion is unnecessarily thick, and it is difficult to hold the portion. The upper limit value is not particularly set, the change is preferably not
10 larger than the change on the upper side in the same zone.

The range of a thickness (D11 (0) + D12 (0)) of the position of the ridge line K2 is preferably 7 mm or larger and 15 mm or smaller, more preferably 8.4 mm or larger and 13.5 mm or smaller, and still more preferably 8.8 mm or larger and 10 mm or smaller.

[0049]

15 [Distance a from base end of Head Section to Finger Rest Portion]

As the distance a from the base end (boundary position K1 between the neck section 13 and the head section 12) of the head section 12 to a front end (boundary K2 between the neck section 13 and the handle section 14) of the finger rest portion 19 increases, the bristle implanting portion 11 reaches a deep position in the oral cavity.
20 Hence, it is possible to enhance the cleaning effect to every corner in the oral cavity, whereas the deflection of the neck section 13 increases. On the other hand, as the distance a decreases, it is possible to decrease the deflection of the neck section 13; however, the bristle implanting portion 11 is difficult to reach a deep position in the oral cavity. The distance a depends on the condition of the configurational material, the
25 flexural modulus, or the like of the handle body 15; however, the distance is set to about

25 mm to 70 mm, for example.

[0050]

[Grip Center Point Angle θ]

An angle θ formed between the plane P that configures the bristle implanting surface 12a and the straight line N connecting the center point G2 of the handle section 14 in the thickness direction at the grip center position G1 of the toothbrush 1 and the center point S2 of the head section 12 in the thickness direction at the center position S1 of the bristle implanting portion 11 is referred to as the grip center point angle θ .

[0051]

When the grip center point angle θ is too large, a difference between an extending direction of the handle section 14 and an extending direction of the head section 12 increases, and thus the operability of the handle section 14 is degraded. In addition, when the grip center point angle θ is too small, the handle body 15 has a linear shape, and thus an original effect of the embodiment is not achieved. In this respect, the grip center point angle θ is set to 5.0° or larger and 10.0° or smaller. The grip center point angle θ is, more preferably, 6.0° or larger and 8.0° or smaller.

[0052]

[Grip Center Point Height h]

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

[0053]

The grip center point height h is set to 6.0 mm or larger and 15.5 mm or smaller. The grip center point height h is preferably 7.0 mm or larger at the lower limit, preferably

15.0 mm or smaller at the upper limit, more preferably 14.5 mm or smaller, still more preferably 13.5 mm or smaller, still more preferably 12.0 mm or smaller, and particularly more preferably 11.0 mm or smaller. As upper and lower ranges, the grip center point height is preferably 7.0 mm or larger and 15.0 mm or smaller, more preferably 7.0 mm or larger and 14.5 mm or smaller, still more preferably 7.0 mm or larger and 13.5 mm or smaller, still more preferably 7.0 mm or larger and 12.0 mm or smaller, and particularly more preferably 7.0 mm or larger and 11.0 mm or smaller.

[0054]

[Examples]

10 Hereinafter, the present invention will be described in detail with Examples; however, the present invention is not limited to the following Examples, and it is possible to perform appropriate modifications in a range without departing from the gist of the present invention.

[0055]

15 Toothbrushes of Examples 1 to 10 and Comparative Examples 1 to 4 were prepared by an injection molding method in accordance with specifications shown in Table 1. In the toothbrushes described above, the entire handle section had the same width, length, thickness, and shape. Injection molding was performed with the kinds of resins described in Table 1 such that an integral molding object of the head section, the neck section, and the handle section described in FIGS 1 and 2 was obtained. The
20 bristle implanting holes were arranged with one row of three holes, six rows of four holes, and one row of three holes from the front end of the head section toward the neck section. The width and length of the head section are shown in Table 1. The bristle bundles of tapered bristles (7.5 mil) made of PBT filaments were implanted in the head section by
25 flat-bristle implantation such that the toothbrush was prepared.

[0056]

Evaluation items of samples included two items of the operability in the oral cavity and the handle operability. Regarding the operability in the oral cavity, "◎" (double circle mark) represented "very good", "○" (circle mark) represented "good",
5 "△" (triangle mark) represented "slightly bad", and "×" (cross mark) represented "very bad". Similarly, regarding the handle operability, "◎" represented "very good", "○" represented "good", "△" represented "slightly bad", and "×" represented "very bad".

[0057]

[Table 1]

Sample	Specifications										Evaluation item	
	Material	Head section			Neck section			Handle section				
		Thickness t [mm]	Width [mm]	Length [mm]	Minimum width W1 [mm]	Minimum thickness D1 [mm]	Distance a from base end of head section to finger rest portion [mm]	Grip center point angle θ [°]	Grip center point height h [mm]	Operability in oral cavity	handle operability	
Example 1	PP	3.0	9.1	23.0	4.0	4.0	45	6.3	9.5	○	◎	
Example 2	PP	3.0	10.3	29.7	4.0	4.0	42	6.5	7.2	○	◎	
Example 3	PP	3.0	10.6	19.5	4.0	4.0	50	6.5	9.5	◎	◎	
Example 4	PP	3.0	10.5	22.0	4.0	4.0	47	7.0	10.0	○	◎	
Example 5	PP	3.0	10.3	22.0	4.0	4.0	46	7.5	10.5	○	◎	
Example 6	PBT	3.5	9.8	23.0	3.5	3.5	53	5.1	8.0	○	◎	
Example 7	PP	3.0	10.3	22.0	4.0	4.0	56.0	7.5	11.8	○	◎	
Example 8	PP	3.0	10.3	22.0	4.0	4.0	56.0	8.5	13.5	○	○	
Example 9	PP	3.0	10.3	22.0	4.0	4.0	66.0	8.5	15.0	○	○	
Example 10	PP	3.0	10.3	22.0	4.0	4.0	58.0	9.5	15.5	○	○	
Comparative Example 1	Saturated polyester	3.5	9.2	25.0	6.3	3.5	38	1.2	0.0	×	×	
Comparative Example 2	PP	4.7	10.3	29.7	5.1	5.0	43	6.3	7.0	△	○	
Comparative Example 3	PP	3.0	10.3	22.0	4.0	4.0	61.0	9.5	15.9	△	△	
Comparative Example 4	PP	3.0	10.3	22.0	4.0	4.0	56.0	10.5	16.8	×	×	

[0058]

As shown in Table 1, in the toothbrush of Comparative Example 1, the grip center point angle θ and the grip center point height h are both out of a number range of the present invention. In other words, in the toothbrush of Comparative Example 1, the handle body has a shape approximate to a relatively linear shape. Therefore, the toothbrush of Comparative Example 1 was verified to have the bad operability in the oral cavity and the bad handle operability. Further, in the toothbrush of Comparative Example 2, the thickness t of the head section, the minimum width $W1$ of the neck section, and the minimum thickness $D1$ of the neck section are out of the number range of the present invention. Therefore, the toothbrush of Comparative Example 2 was verified to have the bad operability in the oral cavity. In addition, the toothbrush of Comparative Example 3 had the grip center point height h out of the number range of the present invention and was verified to have the bad operability in the oral cavity and the bad handle operability. The toothbrush of Comparative Example 4 had both the grip center point angle θ and the grip center point height h out of the number range of the present invention and was verified to have the bad operability in the oral cavity and the bad handle operability.

[0059]

In this respect, the toothbrushes of Examples 1 to 10 have all parameters of the thickness t of the head section, the minimum width $W1$ of the neck section, the minimum thickness $D1$ of the neck section, the grip center point angle θ , and the grip center point height h within the number range of the present invention. Consequently, even when the neck section was bent, the toothbrushes were verified to have both good operability in the oral cavity and good handle operability.

[0060]

In general, in a case of employing the flat-bristle implantation, the placement of flat bristles into the head section results in applying stress. In a case of thin head section, strength is low with respect to deformation when a force is applied. On the other hand, when the neck section is thick, and the strength is high, stress is concentrated on the head section when a tooth is brushed, the deflection of the head section increases, and the usability is degraded, in some cases. In this case, similarly to the toothbrush 1 of the embodiment, the neck section is narrowed, and a certain degree of deflection is achieved. In this manner, it is possible to distribute the stress to the entire neck section from the head section when the tooth is brushed, and thus the usability improves.

Therefore, in a case of the flat-bristle implantation, it is possible to achieve the particularly remarkable effects of the present invention.

Reference Signs List

[0061]

- 15 1: toothbrush
- 11: bristle implanting portion
- 12: head section
- 12a: bristle implanting surface
- 13: neck section
- 20 14: handle section
- 17: bristle bundle

CLAIMS

What is claimed is:

1. A toothbrush comprising:

a bristle implanting portion configured of a plurality of bristle bundles;

5 a head section provided with the bristle implanting portion on a bristle
implanting surface;

a neck section extending from the head section; and

a handle section extending from the neck section,

wherein the head section has a thickness of 2.0 mm to 4.0 mm,

10 wherein the neck section has a minimum width and a minimum thickness of 3.0
mm to 4.5 mm,

wherein the neck section is provided with a curved surface on a side of the
bristle implanting surface on a rear end side of the neck section, the curved surface
having a center position disposed on the side of the bristle implanting surface and having

15 a concave arc contour on the side of the bristle implanting surface in a side view, and

wherein an angle formed between a plane that configures the bristle implanting
surface and a straight line connecting a center point of the handle section in a thickness
direction at a grip center position of the toothbrush and a center point of the head section
in the thickness direction at a center position of the bristle implanting portion is 5.0° to

20 10.0°.

2. The toothbrush according to claim 1,

wherein a configurational material of the neck section has a flexural modulus of
1,000 MPa to 2,200 MPa.

3. The toothbrush according to claim 1 or 2,
wherein the configurational material of the neck section is a polypropylene resin.