

DESCRIPTION

Title of Invention

TOOTHBRUSH

Technical Field

[0001]

The present invention relates to a toothbrush.

Priority is claimed on Japanese Patent Application No. 2016-211879, filed on 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 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 insufficient in some cases.

Citation List

Patent Literature

[0003]

[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 Publication No. 2011-200296

Summary of Invention

Technical Problem

[0004]

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 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), which is generally used in the toothbrush, more remarkable problems arise.

[0005]

The present invention is made with consideration for such problems, and an object thereof is to provide a toothbrush including a thin head with which it is possible to achieve good operability.

Solution to Problem

[0006]

According to a first aspect of the present invention, there is provided a toothbrush including a head section which is disposed at a front end side and in which a bristle bundle is implanted in a bristle implanting surface, a neck section extending from a rear end side of the head section, and a handle section extending from a rear end side of the neck section. The head section has a thickness of 2.0 to 4.0 mm. The neck section is formed such that a minimum value of a width of the neck section in a direction that is parallel to the bristle implanting surface and orthogonal to a length direction of the handle section is 3.5 mm to 4.5 mm, and the width is constant or gradually increases toward the rear end side from a position at which the neck section has the minimum value. When the width of the neck section is W mm, and a thickness of the neck section in the direction orthogonal to the bristle implanting surface is D mm, the position of the minimum value is set as an origin when the width of the neck section gradually increases toward the rear end side from the position of the minimum value, the position of the minimum value on the front-most end side is set as an origin when the width of the neck

section is constant toward the rear end side from the position of the minimum value, a value obtained by D/W at a position separated by 10 mm toward the rear end side in parallel with the bristle implanting surface is 0.7 to 2.5, a difference between a value obtained by D/W at a position of the origin, at which the minimum value of the width is measured, and a value obtained by D/W at a position separated by 20 mm from the position of the origin toward the rear end side is equal to or larger than 0.05, and D/W at the position separated by 20 mm from the position of the origin toward the rear end side is larger than 1.0. A deflection coefficient $M \text{ (mm}^4\text{)} = W \times D^3$ at the position separated by 10 mm toward the rear end side from the position of the origin, at which the minimum value of the width is measured, is 165 mm^4 to 625 mm^4 .

[0007]

In the toothbrush according to the aspect of the present invention, the neck section is formed by a resin material, and a flexural modulus of the resin material is 1,000 MPa to 2,200 MPa.

[0008]

In the toothbrush according to the aspect of the present invention, the neck section is formed by a polypropylene resin.

[0009]

In the toothbrush according to the aspect of the present invention, a change rate of the deflection coefficient at a position separated by 10 mm from a position of a reference toward the rear end side is 1.3 to 1.8 with the position separated by 10 mm toward the rear end side from the position of the origin, at which the minimum value of the width is measured, as the reference.

[0010]

In the toothbrush according to the aspect of the present invention, a difference between the value obtained by D/W at the position of the origin, at which the minimum value of the width is measured, and the value obtained by D/W at the position separated by 20 mm from the position toward the rear end side is equal to or smaller than 0.07.

Advantageous Effects of Invention

[0011]

According to the present invention, it is possible to provide a toothbrush with which it is possible to achieve good operability in an oral cavity even when a

general-purpose resin is used.

Brief Description of Drawings

[0012]

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

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

FIG. 3 is an enlarged plan view showing a front end side of the toothbrush 11.

FIG. 4 is an enlarged side view showing the front end side of the toothbrush 11.

Description of Embodiments

[0013]

Hereinafter, embodiments of a handle body of a toothbrush and the toothbrush of the present invention will be described with reference to FIGS. 1 to 4.

The following embodiment is an aspect of the present invention and does not limit the 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 configuration in an easily understandable manner, a scale, the number of components, or the like in each structure is different from that of an actual structure.

[0014]

FIG. 1 is a plan view of a toothbrush 11. FIG. 2 is a side view of the toothbrush 11. FIG. 3 is an enlarged plan view showing a front end side of the toothbrush 11. FIG. 4 is an enlarged side view showing the front end side of the toothbrush 11.

[0015]

The toothbrush 11 of the embodiment includes a head section 110 which is disposed on a front end and in which a bristle bundle 114 of bristles is implanted, a neck section 120 extending from a rear end side of the head section 110, and a handle section 130 extending from a rear end side of the neck section 120 (hereinafter, the head section 110, the neck section 120, and the handle section 130 are collectively referred to as a handle body 12).

[0016]

The handle body is integrally molded into an elongated shape as a whole and is produced by injection molding with a resin as a material, for example.

As a material of the handle body, a resin having a flexural modulus (JIS7171) of 1,000 MPa to 2,200 Mpa is used, and examples thereof include polypropylene resin (PP), polyacetal resin (POM), polystyrene resin (PS), polyethylene terephthalate resin (PET), polybutylene terephthalate resin (PBT), acrylonitrile butadiene styrene resin (ABS), polyarylate resin, polycarbonate resin, or acrylonitrile styrene resin (AS). Of the resins, with consideration for making effects of the present invention remarkable and costs, it is preferable to use polypropylene resin which is a general-purpose resin.

[0017]

The resins described above may be individually used, or two or more kinds thereof may be used together.

In addition, in order to improve a grip property, the handle body may be partially or entirely coated with a flexible resin such as an elastomer, for example. In a case of using the flexible resin such as the elastomer, from a point of view of enhancing adhesiveness, polyolefin is preferable, and PP is more preferable, for example.

[0018]

The head section 110 has a bristle implanting surface 111 on one side (hereinafter, referred to as an upper surface side) in a thickness direction). The bristle implanting surface 111 is provided with a plurality of bristle implanting holes 112, and the bristle bundles 114 (refer to FIG. 2) of bristles are implanted into the bristle implanting holes 112. In FIGS. 1, 3, and 4, the bristle bundle 114 is omitted.

[0019]

In the embodiment, when L11 represents a distance from an outer edge of the bristle implanting hole 112 disposed on the front-most end side to a front end of the head section 110, an end portion of the head section 110 on the rear end side is defined as a position separated by the distance L11 from an outer edge of the bristle implanting hole 112 disposed on the rear-most end side toward the rear end side. In other words, as shown in FIG. 3, the head section 110 is disposed within a range 110A obtained by being separated by the distance L11 from outer edges of the bristle implanting holes 112 positioned on both ends in a length direction of the toothbrush. A position of the range 110A on the rear end side is a boundary between the head section 110 and the neck section 120.

[0020]

An end portion of the handle section 130 on a front end side is a finger rest

portion, and an end portion of the finger rest portion on the front end side is a boundary between the neck section 120 and the handle section 130. For example, the finger rest portion is demarcated by a ridge line formed by an intersecting portion between a surface of the neck section 120 on a side of the bristle implanting surface 111 on the rear end side and a surface of the handle section 130 on the side of the bristle implanting surface 111 on the front end side, or a ridge line formed by an intersecting portion between a surface of the neck section 120 on an opposite side of the bristle implanting surface 111 on the rear end side and a surface of the handle section 130 on the opposite side of the bristle implanting surface 111 on the front end side. In this case, the boundary between the neck section 120 and the handle section 130 is defined by the ridge lines.

[0021]

In addition, in a case where the surface of the neck section 120 on the side of the bristle implanting surface 111 on the rear end side is flush with the surface of the handle section 130 on the side of the bristle implanting surface 111 on the front end side such that the ridge line is not formed, the finger rest portion is demarcated by a ridge line formed by an intersecting portion between a side surface of the neck section 120 in a width direction on the rear end side and a side surface of the handle section 130 in the width direction on the front end side. Even in this case, the boundary between the neck section 120 and the handle section 130 is defined by the ridge line.

[0022]

For example, in a case where the handle body 12 of an example has an S shape in which, in a side view, the handle section 130 is formed into a substantially arc shape that is convex on the side of the bristle implanting surface 111, and the neck section 120 is formed into a substantially arc shape that is concave on the side of the bristle implanting surface 111, the boundary between the neck section 120 and the handle section 130 is defined as follows.

[0023]

The handle section 130 is provided with a curved surface 133 on the side of the bristle implanting surface 111 on the front end side of the handle section. The curved surface has a center position disposed on an opposite side (below the handle section 130 in FIGS. 2 and 4) of the bristle implanting surface 111 and has a convex arc contour on the side of the bristle implanting surface 111 in a side view. Similarly, the handle section 130 is provided with a curved surface 134 on the opposite side of the bristle

implanting surface 111 on the front end side of the handle section. The curved surface has a center position disposed on the opposite side of the bristle implanting surface 111 and has a convex arc contour on the side of the bristle implanting surface 111 in a side view.

[0024]

In addition, the neck section 120 is provided with a curved surface 123 on the side of the bristle implanting surface 111 on the rear end side of the neck section. The curved surface has a center position disposed on the side (above the handle section 130 in FIGS. 2 and 4) of the bristle implanting surface 111 and has a concave arc contour on the side of the bristle implanting surface 111 in a side view. Similarly, the neck section 120 is provided with a curved surface 124 on the opposite side of the bristle implanting surface 111 on the rear end side of the neck section. The curved surface has a center position disposed on the side of the bristle implanting surface 111 and has a concave arc contour on the side of the bristle implanting surface 111 in a side view.

[0025]

The curved surface 123 and the curved surface 133 have intersecting angles between tangential lines thereof and the bristle implanting surface 111 in a side view, the intersecting angles continuously changing as the curved surfaces proceed in a length direction of the handle section 130. However, an intersecting angle between the tangential lines in an intersecting portion between the curved surface 123 and the curved surface 133 is not 0° or 180° but is an angle θ_1 . Therefore, a ridge line 131 is formed in the intersecting portion between the curved surface 123 and the curved surface 133.

[0026]

The curved surface 124 and the curved surface 134 also have intersecting angles between tangential lines thereof and the bristle implanting surface 111 in a side view, the intersecting angles continuously changing as the curved surfaces proceed in the length direction of the handle section 130. However, an intersecting angle between the tangential lines in an intersecting portion between the curved surface 124 and the curved surface 134 is not 0° or 180° but is an angle θ_2 . Therefore, a ridge line 132 is formed in the intersecting portion between the curved surface 124 and the curved surface 134. Hence, the curved surfaces 133 and 134, which have the convex arc contour on the side of the bristle implanting surface 111 in a side view, on one side in the length direction, with the ridge lines 131 and 132 interposed between the neck section and the handle

section are continuous to the curved surfaces 123 and 124, which have the concave arc contour on the side of the bristle implanting surface 111 in a side view, on the other side in the length direction, with the ridge lines 131 and 132 interposed therebetween. In this manner, the neck section 120 and the handle section 130 are formed into a substantial S shape in a side view.

[0027]

The boundary of the neck section 120 on the rear end side is defined by the ridge lines 131 and 132. Hence, a range 130A, in which the handle section 130 is disposed, is provided on the rear end side from the ridge lines 131 and 132, and the neck section 120 is disposed in a range 120A between a range 110A in which the head section 110 is disposed and the range 130A in which the handle section 130 is disposed.

[0028]

An end portion (on the rear end side from the ridge line 131) of the handle section 130 on the side of the bristle implanting surface 111 on the front end side is the finger rest portion. A user holds the handle section 130 such that a thumb is placed on the finger rest portion, and thereby it is possible to stably operate the toothbrush 11. In addition, the ridge line 132 in the length direction of the handle section 130 is positioned on the rear end side from the ridge line 131. Therefore, compared with a case where the ridge line 132 is positioned on the front end side from the ridge line 131, the finger rest portion is thick, and thus it is possible to more stably operate the toothbrush 11.

[0029]

A length of the handle body 12 is not particularly limited; however, the length is 100 to 200 mm, for example.

A width of the head section 110, that is, a width in a direction that is parallel to the bristle implanting surface 111 orthogonal to the length direction of the handle section 130 (hereinafter, simply referred to as a width) is not particularly limited; however, the width is, preferably, 5 to 16 mm and, more preferably, 8 to 12 mm. As long as the width of the lower limit value described above or wider is secured, it is possible to ensure a sufficient area in which the bristle bundles 114 are implanted. In addition, as long as the width of the upper limit value described above or narrower is secured, it is possible to further enhance operability in an oral cavity.

A length of the head section 110 is not particularly limited; however, the length is, preferably, 10 to 33 mm and, more preferably, 12 to 28 mm, for example. As long as

the length of the lower limit value described above or longer is secured, it is possible to ensure a sufficient area in which the bristle bundles 114 are implanted. In addition, as long as the length of the upper limit value described above or shorter is secured, it is possible to further enhance the operability of the oral cavity.

A thickness of the head section 110 can be determined by considering a material or the like and is, preferably, 2.0 to 4.0 mm, for example. As long as the thickness of the lower limit value described above or larger is secured, it is possible to further enhance the strength of the head section 110. In addition, as long as the length of the upper limit value described above or smaller is secured, it is possible to enhance reachability to a back tooth, and it is possible to further enhance the operability in the oral cavity.

[0030]

For example, a length of the neck section 120 is preferably 25 to 70 mm such that the neck section 120 touches a lip when the head section 110 is inserted into an oral cavity.

The neck section 120 is formed to have a width that is constant or gradually increases toward the rear end side from a position at which the minimum value of the width is measured. In a case where the width of the neck section 120 is constant toward the rear end side from the position of the minimum value of the width, the position of the minimum value is defined as a position on the front-most end side. The neck section 120 according to the embodiment is formed to have a width that gradually increases toward the rear end side from a position 121 at which the minimum value of the width is measured. The width of the neck section 120 can be determined by considering a material or the like, and the minimum width of the neck section 120 is, preferably, 3.5 mm to 4.5 mm and, more preferably, 3.7 mm to 4.3 mm. As long as the width of the lower limit value described above or wider is secured, it is possible to further enhance the strength of the neck section 120. In addition, as long as the width of the upper limit value described above or narrower is secured, it is possible to enhance the reachability to the back tooth, and it is possible to further enhance the operability in the oral cavity.

[0031]

In addition, when the width of the neck section 120 is W mm, and the thickness thereof in the direction orthogonal to the bristle implanting surface 111 is D mm, a value obtained by D/W at a position 122 separated by 10 mm toward the rear end side in

parallel with the bristle implanting surface 111, with the position 121, at which the neck section 120 has the minimum value in width, as an origin, is preferably 0.7 to 2.5, more preferably 0.7 to 2.0, much more preferably 0.8 to 2.0, and particularly preferably 0.8 to 1.5.

[0032]

In a case where the minimum width of the neck section 120 is 3.5 mm to 4.5 mm, and the value obtained by D/W is smaller than the upper limit value described above, there is a possibility that the neck section 120 is likely to be deflected when brushing is performed, and the operability is degraded, and there is a possibility that the neck section 120 will be widened to impair the operability, and an impression of a product is also impaired, with thinness of the head section 110 being unnoticed, even regarding the external appearance of the toothbrush.

On the other hand, in a case where the value obtained by D/W exceeds the upper limit value described above, a thickness D increases, and thus there is a possibility that it will be difficult to close the lip when brushing is performed on an occlusal surface. In addition, there is a possibility that an effect of improvement in operability which is achieved by the thin head section 110 will be impaired. Therefore, when the value obtained by D/W is 0.7 to 2.5, it is easy to perform the brushing with the lip closed while the improvement in operability which is achieved by the thin head section 110 is kept.

[0033]

In addition, a value obtained by D/W at a position separated by 20 mm toward the rear end side, with the position 121, at which the neck section 120 has the minimum value in width, as an origin, is larger than 1.0, preferably 1.3 or smaller, and more preferably 1.05 to 1.2. Similarly, a value obtained by D/W at a position separated by 30 mm toward the rear end side, with the position 121, at which the neck section 120 has the minimum value in width, as an origin, is larger than 1.0, preferably 1.5 or smaller, and more preferably 1.05 to 1.3.

[0034]

The thickness D is larger than the width W at the position separated by 20 mm toward the rear end side, with the position 121, at which the neck section 120 has the minimum value in width, as the origin. In this manner, it is possible to prevent the operability from being degraded due to the easiness of deflection of the neck section 120, and it is possible to prevent the operability from being damaged due to the wideness of

the neck section 120. As described above, as long as the value obtained by D/W at the corresponding position is within the range described above, it is possible to ensure the effect of improvement in operability without difficulty in closing the lip even when the corresponding position of the neck section 120 is inserted into the oral cavity. As long as the value obtained by D/W at the position separated by 30 mm toward the rear end side, with the position 121, at which the neck section has the minimum value in width, as the origin, is within the range described above, it is possible to ensure the effect of improvement in operability without considering the difficulty in closing the lip.

[0035]

In addition, a difference between the value obtained by D/W described above at the position 121 and the value obtained by D/W described above at the position separated by 20 mm toward the rear end side, with the position 121 as the origin, is preferably 0.05 to 0.07 and more preferably 0.06 to 0.07. In a case where the difference of the values obtained by D/W described above is smaller than the lower limit value described above and a case where the difference is larger than the upper limit value, there is a possibility that the same problems arise as those in a case where the value obtained by D/W is smaller than the lower limit value described above and a case where the value obtained by D/W exceeds the upper limit value described above. Therefore, as long as the difference between the value obtained by D/W described above at the position 121 and the value obtained by D/W described above at the position separated by 20 mm toward the rear end side, with the position 121 as the origin, is 0.05 to 0.07, it is easy to perform the brushing with the lip closed while the improvement in operability which is achieved by the thin head section 110 is kept.

In addition, the value obtained by D/W described above at the position separated by 30 mm toward the rear end side, with the position 121 as the origin, is larger than the value obtained by D/W described above at the position 121, and a difference between the values is preferably 0.1 to 0.2. In a case where the value obtained by D/W described above at the position separated by 30 mm toward the rear end side, with the position 121 as the origin, and the value obtained by D/W described above at the position 121 satisfy a relationship described above, it is easy to perform the brushing with the lip closed while the improvement in operability which is achieved by the thin head section 110 is kept.

[0036]

In addition, regarding a change rate of D/W described above at a position on the

rear end side, with a position on the front end side in the length direction of the handle section 130 as a reference, when R01 represents a change rate of D/W described above at the position separated by 10 mm toward the rear end side from the position 121, at which the neck section 120 described above has the minimum value in width, the change rate R01 is, preferably, higher than 1.00 and 1.2 or lower. When R02 represents a change rate of D/W described above at the position separated by 20 mm toward the rear end side from the position 121, the change rate R02 is, preferably, higher than 1.00 and 1.2 or lower. When R03 represents a change rate of D/W described above at the position separated by 30 mm toward the rear end side from the position 121, the change rate R03 is, preferably, higher than 1.00 and 1.3 or lower. It is preferable that the change rates R01, R02, and R03 satisfy a relationship of $R01 < R02 < R03$.

Consequently, the thickness D is already large on the front end side of the neck section 120 that is easier to enter the oral cavity, and thereby it is possible to avoid the difficulty in brushing with the lip closed. In addition, the thickness D is more significantly changed on a front end portion side of the neck section 120 to which a load due to the brushing is likely to be applied, and thereby it is possible to avoid a problem of operability due to too much deflection in a thickness D direction.

[0037]

In addition, when R12 represents a change rate of D/W described above at the position separated by 20 mm toward the rear end side, with the position 121 as the origin, from the position separated by 10 mm toward the rear end side, with the position 121 as the origin, the change rate R12 is, preferably, higher than 1.00 and 1.2 or lower. In addition, when R23 represents a change rate of D/W described above at the position separated by 30 mm toward the rear end side, with the position 121 as the origin, from the position separated by 20 mm toward the rear end side, with the position 121 as the origin, the change rate R23 is, preferably, higher than 1.00 and 1.3 or lower. It is preferable that the change rates R12 and R23 satisfy a relationship of $R01 \leq R12 \leq R23$. Additionally, it is preferable that at least one of the change rates R12 and R23 is higher than the change rate R01.

Consequently, similarly to the description above, the thickness D is already large on the front end side of the neck section 120 that is easier to enter the oral cavity, and thereby it is possible to avoid the difficulty in brushing with the lip closed. In addition, the thickness D is more significantly changed on the front end portion side of the neck

section 120 to which a load due to the brushing is likely to be applied, and thereby it is possible to avoid the problem of operability due to too much deflection in the thickness D direction.

[0038]

In addition, in a case where the material is the same, a deflection amount of a stiff body is known to receive a significant influence of the "second moment of area". The deflection amount is proportional to the width W to the first power and the thickness D to the third power, and thus it is desirable that the width is minimized while the thickness D is maintained, in order to decrease the deflection amount.

For example, when a deflection coefficient $M \text{ (mm}^4\text{)} = W \times D^3$, the deflection coefficient M calculated from the width W and the thickness D at the position 121 of the neck section 120 is preferably 165 mm^4 to 625 mm^4 , more preferably 180 mm^4 to 525 mm^4 , and particularly preferably 200 mm^4 to 330 mm^4 . In addition, the deflection coefficient M calculated from the width W and the thickness D at the position 122 of the neck section 120 is preferably 165 mm^4 to 625 mm^4 , more preferably 180 mm^4 to 525 mm^4 , still more preferably 200 mm^4 to 330 mm^4 , and still more preferably 270 mm^4 to 310 mm^4 . The deflection coefficient M calculated from the width W and the thickness D of the neck section 120 at the position separated by 20 mm toward the rear end side in parallel with the bristle implanting surface 111 from the position 121 is preferably 350 mm^4 to 550 mm^4 . The deflection coefficient M calculated from the width W and the thickness D of the neck section 120 at the position separated by 30 mm toward the rear end side in parallel with the bristle implanting surface 111 from the position 121 is preferably 600 mm^4 to $1,500 \text{ mm}^4$.

When the deflection coefficient M at the position 122 is 165 mm^4 to 625 mm^4 , it is possible to contribute to improvement in brushing properties with the lip closed, and it is possible to prevent the operability from being degraded due to too much deflection.

[0039]

A change rate of the deflection coefficient M is, preferably, 1.0 to 1.3 between the position 121 and the position 122. In addition, a change rate of the deflection coefficient M between the position 122 and the position separated by 20 mm toward the rear end side from the position 121 is, preferably, 1.3 to 1.8. In addition, a change rate of the deflection coefficient M between the position separated by 20 mm toward the rear end side from the position 121 and the position separated by 30 mm toward the rear end

side from the position 121 is, preferably, 1.7 to 3.0 and, more preferably, 1.8 to 3.0. The change rate is a value obtained by dividing a deflection coefficient at a position on the rear end side by a deflection coefficient at a position on the front end side and a value calculated by M/M from the deflection coefficient M at the position 121 and the deflection coefficient M at the position 122 between the position 121 and the position 122, for example.

As long as the deflection coefficient M and the change rate thereof are within the range described above, it is easy to perform the brushing with the lip closed without causing the degradation of the operability.

[0040]

The bristle bundle 114 is a bundle of a plurality of bristles. A length (bristle length) from the bristle implanting surface 111 to a tip of the bristle bundle 114 can be determined with consideration for a bristle bending portion or the like that is necessary for the bristle bundle 114 and is set to 6 to 13 mm, for example. All of the bristle bundles 114 may have the same bristle length or may have different bristle lengths from each other.

[0041]

A size (bristle bundle diameter) of the bristle bundle 114 can be determined with consideration for the bristle bending portion or the like that is necessary for the bristle bundle 114 and is set to 1 to 3 mm, for example. All of the bristle bundles 114 may have the same bristle bundle diameter or may have different bristle diameters from each other.

[0042]

Examples of bristles that configure the bristle bundle 114 include a bristle (tapered bristle), which has a diameter gradually decreasing toward a bristle tip and has a sharpened bristle tip, or a bristle (straight bristle) that has an outer diameter that is substantially constant from the bristle implanting surface 111 toward the bristle tip. Examples of straight bristle include a bristle having a bristle tip with a flat surface that is substantially parallel with the bristle implanting surface 111 and a bristle having a bristle tip that is rounded into a hemispherical shape.

[0043]

Examples of a material of the bristle include polyamide such as nylon 6-12 (6-12NY) or nylon 6-10 (6-10NY), polyester such as PET, PBT, polytrimethylene

terephthalate (PTT), polyethylene naphthalate (PEN), or polybutylene naphthalate (PBN), polyolefin such as PP, or elastomer resin such as olefin-based elastomer or styrene-based elastomer. The resin materials can be used individually or in a combination of two or more of resins. In addition, examples of the bristle include a polyester bristle having a multi-core structure that has a core and at least one sheath provided on an outer side of the core.

[0044]

A cross-sectional shape of the bristle is not particularly limited, and examples of the cross-sectional shape include a perfect circular shape, a circular shape such as an elliptical shape, a polygonal shape, a star shape, a three-leaf clover shape, or a four-leaf clover shape. All of the bristles may have the same cross-section shape or may have different cross-sectional shapes from each other.

[0045]

The size of the bristle can be determined with consideration for the material or the like. In a case where a cross sectional of the bristle is a circular shape, the size is 6 to 9 mil (1 mil = 1/1,000 inch = 0.025 mm), for example. In addition, by considering usability, a toothbrushing feeling, a cleaning effect, durability, or the like, a plurality of bristles having different sizes from each other may be combined to be used.

[0046]

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

Subsequently, the bristle bundles 114 are implanted in the head section 110 of the obtained handle body 12. Example of methods for implanting the bristle bundles 114 include flat-bristle implantation of placing a flat wire into the bristle implanting hole 112, with the bristle bundle 114 folded in half and the flat wire being interposed therebetween, and thereby implanting the bristle bundle 114, a thermal bonding method of press-fitting and fixing a lower end of the bristle bundle 114 in molten resin which is a bristle implanting portion, or an in-mold process of heating the lower end of the bristle bundle 114, forming a molten ingot, then injecting molten resin in a die, and forming the bristle implanting portion.

[0047]

As described above, according to the toothbrush 11 of the embodiment, the minimum width of the neck section 120 is 3.5 mm to 4.5 mm. In this manner, the value

obtained by D/W is 0.7 to 2.5 while a state in which it is easy to perform the brushing, with the lip closed, is maintained. Consequently, it is needless to say that engineering plastic such as polyacetal is used, and it is possible to avoid degradation of the operability even in a case of using a general-purpose resin such as polypropylene.

[0048]

In a case of employing the flat-bristle implantation, the placement of flat bristles into the head section 110 results in applying stress. The strength is low with respect to deformation when the head section 110 is thin and a force is applied. On the other hand, in a case where the neck section 120 is thick, and the strength is high, stress is concentrated on the head section 110 when a tooth is brushed, folding of the head section 110 increases, and the usability is degraded, in some cases. By contrast, according to the toothbrush 11 of the embodiment, the neck section 120 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 120 from the head section 110 when the tooth is brushed, and thus the usability improves. Therefore, in a case of the flat-bristle implantation, it is possible to achieve particularly remarkable effects of the present invention.

[0049]

[Examples]

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.

[0050]

[Table 1]

	Neck section thickness [D]				Neck section width [W]				Material
	Minimum	+10	+20	+30	Minimum	+10	+20	+30	
Example 1	3.97	4.15	4.60	5.48	4.02	4.08	4.38	4.99	PP
Example 2	4.03	4.20	4.84	6.37	4.03	4.11	4.63	5.40	PP
Example 3	4.03	4.10	4.51	5.26	4.03	4.03	4.23	4.69	PP
Example 4	3.99	4.13	4.63	5.60	4.00	4.10	4.42	5.00	PP
Example 5	3.99	4.16	4.65	5.48	4.02	4.09	4.40	5.01	PP
Comparative Example 1	4.09	4.51	4.80	5.38	4.97	5.42	6.00	6.62	PP
Comparative Example 2	3.88	3.97	4.34	5.06	4.92	5.32	5.84	6.39	PP
Comparative Example 3	3.78	4.75	5.41	5.92	6.73	6.39	8.45	10.95	Saturated polyester
Comparative Example 4	5.04	5.12	5.56	6.73	5.01	5.16	5.27	5.44	PP
Comparative Example 5	4.97	5.01	5.20	5.82	4.96	5.04	5.13	5.19	PP
Comparative Example 6	4.79	4.93	5.04	5.59	4.97	5.06	5.13	5.19	PP
Comparative Example 7	5.14	5.23	5.57	6.44	5.56	5.92	6.23	6.70	PP

[0051]

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

Toothbrushes of Examples 1 to 5 and Comparative Examples 1 to 7, in which the neck section 120 is formed, were produced in accordance with specifications shown in [Table 1] described above. All of the head sections and handle sections had the same width, length, thickness, and shape. PP resin was used in the injection molding such that an integral molding object of the head section and the handle body described in FIGS. 3 and 4 was obtained (the 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 handle body, the width of the head section was 10 mm, the length thereof was 25 mm, the thickness thereof was 3.0 mm, the length of the handle body was 110 mm, and the length of the neck section was 48 mm). The bristle bundles of tapered

bristles (7.5 mil) made of PBT filaments were implanted in the head section by flat-bristle implantation such that the toothbrush was prepared.

[0052]

Values obtained by D/W at positions of 10 mm, 20 mm, and 30 mm toward the rear end side from a position of a minimum width, the position at which the neck section is minimum in width in examples, and values obtained by $W \times D^3$ are shown in [Table 2]. In addition, change rates calculated from deflection coefficients at positions as described above of the values obtained by $W \times D^3$ in examples are shown in [Table 3]. In addition, the change rates of the values calculated by D/W in examples are shown in [Table 4].

[0053]

(Evaluation Method)

Regarding the toothbrushes in the examples, the "operability of toothbrush in oral cavity (easiness of moving in mouth)" was evaluated by the following method.

<Operability of Toothbrush>

The operability of the toothbrush was evaluated with the "operability in oral cavity" based on the following evaluation criteria with toothbrushes of the examples which are used by ten professional panelists. "◎" (double circle mark) represents an average point of 2.5 points or higher by the ten professional panelists, "○" (circle mark) represents an average point of 2.0 points or higher and lower than 2.5 point, "△" (triangle mark) represents an average point of 1.5 points or higher and lower than 2.0 points, and "×" (cross mark) represents an average point of lower than 1.5 points.

[0054]

<<Evaluation Criteria>>

Three points: Easiness of moving in mouth is very well felt.

Two points: Easiness of moving in mouth is felt.

One point: Easiness of moving in mouth is not much felt.

Zero points: Easiness of moving in mouth is not felt.

[0055]

[Table 2]

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

[0056]

[Table 3]

Change rate of Width $\times$ Thickness³ [W $\times$ D³]

	Position of +10 mm from minimum position	Position of +20 mm from minimum position	Position of +30 mm from minimum position	Evaluation
Example 1	1.16	1.46	1.93	◎
Example 2	1.15	1.72	2.66	○
Example 3	1.05	1.40	1.76	◎
Example 4	1.14	1.52	2.00	◎
Example 5	1.15	1.50	1.86	◎
Comparative Example 1	1.46	1.33	1.55	△
Comparative Example 2	1.16	1.43	1.73	×
Comparative Example 3	1.88	1.95	1.70	×
Comparative Example 4	1.08	1.31	1.83	△
Comparative Example 5	1.04	1.14	1.42	△
Comparative Example 6	1.11	1.08	1.38	△
Comparative Example 7	1.12	1.27	1.66	×

[0057]

[Table 4]

Change rate of D/W

	Change rate R01 (position of +10 mm from minimum position)	Change rate R02 (position of +20 mm from minimum position)	Change rate R03 (position of +30 mm from minimum position)	Change rate R12 (position of +20 mm from +10 mm)	Change rate R23 (position of +30 mm from +20 mm)	Evaluation
Example 1	1.03	1.06	1.11	1.03	1.05	◎
Example 2	1.02	1.05	1.18	1.02	1.13	○
Example 3	1.02	1.07	1.12	1.05	1.05	◎
Example 4	1.01	1.05	1.12	1.04	1.07	◎
Example 5	1.02	1.06	1.10	1.04	1.04	◎
Comparative Example 1	1.01	0.97	0.99	0.96	1.02	△
Comparative Example 2	0.95	0.94	1.00	1.00	1.07	×
Comparative Example 3	1.32	1.14	0.96	0.86	0.84	×
Comparative Example 4	0.99	1.05	1.23	1.06	1.17	△
Comparative Example 5	0.99	1.01	1.12	1.02	1.11	△
Comparative Example 6	1.01	1.02	1.12	1.01	1.10	△
Comparative Example 7	0.96	0.97	1.04	1.01	1.08	×

[0058]

As shown in Table 2, the width of the neck section was 2.0 to 4.0 mm. The minimum value of the width of the neck section was 3.5 mm to 4.5 mm. The value obtained by D/W at the position separated by 10 mm toward the rear end side from the position at which the neck section has the minimum value in width was 0.7 to 2.5. The difference between the value obtained by D/W at the position 121 at which the minimum value of the width was measured and the value obtained by D/W at the position separated by 20 mm toward the rear end side from the position 121 was equal to or larger than 0.05. The deflection coefficient $M \text{ (mm}^4\text{)} = W \times D^3$ was 165 mm^4 to 625 mm^4 . The value obtained by D/W at the position separated by 20 mm toward the rear end side from the position 121 was larger than 1.0. The value obtained by D/W at the position separated by 30 mm toward the rear end side from the position 121 was larger than the value obtained by D/W at the position 121, and the difference between the values was equal to or larger than 0.1. In this case, it was possible to check that good operability was achieved.

[0059]

In addition, as shown in Table 4, in a case where the change rates R01, R02, R03, R12, and R23 are each higher than 1.00 and satisfy the relationship of $R01 < R02 < R03$ and the relationship of $R01 \leq R12 \leq R23$, it was also possible to check that the good operability was achieved.

[0060]

As described above, the preferred embodiments according to the present invention are described with reference to the accompanying drawings; however, it is needless to say that the present invention is not limited to the examples. The shape, the combination, or the like of the configurational members described in the above examples is an example, and it is possible to perform various types of modifications based on a design requirement or the like within a range without departing from the gist of the present invention.

[0061]

For example, in the toothbrush 11 of the embodiment described above, a configuration in which the neck section 120 has the width that gradually increases toward the rear end side from the position of the minimum width is an exemplary example; however, the toothbrush is not limited to the configuration and may have a configuration

in which the neck section extends with the same width toward the rear end side. Even in the configuration in which the neck section 120 extends with the same width toward the rear end side, it is preferable that the value obtained by D/W at the position separated by 10 mm toward the rear end side from the position of the minimum width is 0.7 to 2.5.

Reference Signs List

[0062]

11: toothbrush

12: handle body

110: head section

111: bristle implanting surface

120: neck section

130: handle section

What is claimed is:

1. A toothbrush comprising:
 - a head section which is disposed at a front end side and in which a bristle bundle is implanted in a bristle implanting surface;
 - a neck section extending from a rear end side of the head section; and
 - a handle section extending from a rear end side of the neck section,
 wherein the head section has a thickness of 2.0 to 4.0 mm,

 wherein the neck section is formed such that a minimum value of a width of the neck section in a direction that is parallel to the bristle implanting surface and orthogonal to a length direction of the handle section is 3.5 mm to 4.5 mm, and the width is constant or gradually increases toward the rear end side from a position at which the neck section has the minimum value,

 wherein, when the width of the neck section is W mm, and a thickness of the neck section in the direction orthogonal to the bristle implanting surface is D mm,

 the position of the minimum value is set as an origin when the width of the neck section gradually increases toward the rear end side from the position of the minimum value, the position of the minimum value on a front-most end side of the neck section is set as an origin when the width of the neck section is constant toward the rear end side from the position of the minimum value, a value obtained by D/W at a position separated by 10 mm toward the rear end side in parallel with the bristle implanting surface is 0.7 to 2.5,

 a difference between the value obtained by D/W at a position of the origin, at which the minimum value of the width is measured, and a value obtained by D/W at a position separated by 20 mm from the position of the origin toward the rear end side

is equal to or larger than 0.05,

wherein a deflection coefficient $M \text{ (mm}^4\text{)} = W \times D^3$ at the position separated by 10 mm toward the rear end side from the position of the origin, at which the minimum value of the width is measured, is 165 mm^4 to 625 mm^4 ,

wherein a change rate of the deflection coefficient M between the position separated by 10 mm from the position of the origin toward the rear end side and the position separated by 20 mm from the position of the origin toward the rear end side is 1.3 to 1.8, and

wherein a change rate of the deflection coefficient M between the position separated by 20 mm from the position of the origin toward the rear end side and the position separated by 30 mm from the position of the origin toward the rear end side is 1.8 to 3.0.

2. The toothbrush according to claim 1,

wherein a change rate of the deflection coefficient M between the position of the origin and the position separated by 10 mm from the position of the origin toward the rear end side is 1.0 to 1.3.

3. The toothbrush according to claim 1,

wherein a change rate of D/W from the position separated by 10 mm from the position of the origin toward the rear end side to the position separated by 20 mm from the position of the origin toward the rear end side is higher than 1.00 and 1.2 or lower.

4. The toothbrush according to any one of claims 1,
wherein a change rate of D/W from the position separated by 20 mm from the position of the origin toward the rear end side to the position separated by 30 mm from the position of the origin toward the rear end side is higher than 1.00 and 1.3 or lower.

5. The toothbrush according to any one of claims 1,
wherein the deflection coefficient M at the position separated by 20 mm toward the rear end side from the position of the origin, is 350 mm^4 to 550 mm^4 .

6. The toothbrush according to any one of claims 1,
wherein the deflection coefficient M at the position separated by 30 mm toward the rear end side from the position of the origin, is 600 mm^4 to 1500 mm^4 .

7. The toothbrush according to any one of claims 1,
wherein a value obtained by D/W at a position separated by 10 mm from the position of the origin toward the rear end side is 0.8 to 1.5.

8. The toothbrush according to any one of claims 1,
wherein the deflection coefficient M at the position separated by 10 mm toward the rear end side from the position of the origin, is 180 mm^4 to 330 mm^4 .

9. The toothbrush according to claim 1,
wherein the neck section is formed by a resin material, and

wherein a flexural modulus of the resin material is 1,000 MPa to 2,200 MPa.

10. The toothbrush according to claim 1,

Wherein a length of the head section is 10 to 33 mm.

11. The toothbrush according to claim 1,

Wherein a length of the neck section is 25 to 70 mm.

12. The toothbrush according to claim 1,

Wherein the head section, the neck section, and the handle section are collectively constitute a handle body,

the handle body is composed of any of polypropylene resin, polyacetal resin, polystyrene resin, polyethylene terephthalate resin, polybutylene terephthalate resin, acrylonitrile butadiene styrene resin, polyarylate resin, polycarbonate resin, or acrylonitrile styrene resin.

13. The toothbrush according to claim 12,

wherein the handle body is formed by a polypropylene resin.

14. The toothbrush according to claim 1,

Wherein the bristle bundle is implanted by flat-bristle implantation.