

[DESCRIPTION]

[TITLE OF INVENTION]

TOOTHBRUSH

[Technical Field]

[0001]

The present invention relates to a toothbrush.

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

[Background Art]

[0002]

For preventing dental caries and periodontal diseases, it is important to remove plaque from the inside of the oral cavity by brushing using a toothbrush.

Conventionally, various toothbrushes have been proposed to enhance a plaque removing effect. For example, it is possible to cause bristles to reach a portion behind the back teeth (the pharynx side of the back teeth), which it is difficult for an ordinary toothbrush to reach, by reducing the thickness of the head portion and the width of the neck portion of the toothbrush. Patent Document 1 describes a toothbrush that has a head portion with a reduced thickness and exhibits excellent operability in the oral cavity.

Meanwhile, it is important for a consumer or the like who is suffering from a periodontal disease to remove plaque from periodontal pockets and to massage the dental gum through brushing using a toothbrush. For removing plaque from periodontal pockets and massaging the dental gum, appropriate deflection of the bristles is required, and a toothbrush in which bristles with a thin diameter are provided in a high density and a toothbrush using bristles with extremely thin tip ends have been proposed.

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[Citation List]

[Patent Literature]

[0003]

[Patent Document 1]

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

[Summary of the Invention]

[Technical Problem]

[0004]

However, if a thickness of a head portion of a toothbrush is simply reduced in order to enhance the cleaning power for a portion behind the back teeth, which is difficult for an ordinary toothbrush to reach, the bending strength resistance of the head portion and the pulling-out strength of bristle bundles are degraded, and the quality of the toothbrush is degraded. Also, if the thickness of the head portion is reduced, a user impression during use deteriorates, and for example, the head portion tends to be deflected during use, and the bristle bundles spread. Therefore, there is a limit in reducing the thickness of the head portion.

Also, it is possible to enhance the impression during use by increasing the deflection of the bristles to make a feeling of touch on the periodontal gum satisfactory. However, if the deflection of the bristles is excessively large, a property of the bristles entering the periodontal pockets is degraded, the cleaning power is thus degraded, bristle spreading increases, and problems such as a decrease in durability of the toothbrush occur.

[0005]

The present invention was made in view of the above circumstances, and an object thereof is to provide a toothbrush that provides superior cleaning power and an

excellent impression during use.

[Solution to Problem]

[0006]

The present invention has the following configurations.

[1] A toothbrush including: a handle body that includes a head portion, a neck portion that extends from the head portion, and a handle portion that extends from the neck portion, in which bristle bundles are implanted on a bristle implanted surface of the head portion by the metal piece-scheme bristle implanting, a material of the handle body is polypropylene resin, a thickness of the head portion is 2.0 to 4.0 mm, when an amount of deflection of the head portion which is measured by a method (α) described below is assumed to be A, and an amount of deflection of the neck portion which is measured by a method (β) described below is assumed to be B, a value X of an amount of deflection ($A/L2$) of the head portion per length L2 (mm) of the head portion is 0.015 to 0.045, and a ratio Y/X is 0.8 to 2.0 which is a ratio of a value Y of an amount of deflection ($B/(L2 + L3)$) of the neck portion per a sum of a length L2 (mm) of the head portion and a length L3 (mm) of the neck portion relative to the value X.

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

the head portion.

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

[2] A toothbrush including: a handle body that includes a head portion, a neck portion that extends from the head portion, and a handle portion that extends from the neck portion, in which bristle bundles are implanted on a bristle implanted surface of the head portion by the metal piece-scheme bristle implanting, a material of the handle body is polyacetal resin, a thickness of the head portion is 2.0 to 4.0 mm, when an amount of deflection of the head portion which is measured by a method (α) described below is assumed to be A, and an amount of deflection of the neck portion which is measured by a method (β) described below is assumed to be B, a value X of an amount of deflection ($A/L2$) of the head portion per length L2 (mm) of the head portion is 0.027 to 0.032, and a ratio Y/X is 1.0 to 1.4 which is a ratio of a value Y of an amount of deflection ($B/(L2 + L3)$) of the neck portion per a sum of a length L2 (mm) of the head portion and a length L3 (mm) of the neck portion relative to the value X.

Method (α): A height of a tip end of the handle body in a state in which the bristle implanted surface of the head portion is directed upward in the vertical direction and a

position of a boundary between the head portion and the neck portion is fixed is assumed to be a reference height, a 200 g spindle is further suspended at a position corresponding to $10 \pm 3\%$ from a tip end of the bristle implanted portion relative to a length in a longer axis direction of the bristle implanted portion at the head portion in the fixed state, and an amount of displacement (a unit is mm) of the height from the reference height of the tip end of the handle body 10 seconds later is assumed to be the amount of deflection A of the head portion.

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

[3] The toothbrush according to [1] or [2], in which the product of an amount of deflection A' of the head portion, which is measured by a method (α') described below, and the amount of deflection B of the neck portion is 2.5 to 12.

Method (α'): The height of the tip end of the handle body in a state in which the bristle implanted surface of the head portion is directed upward in the vertical direction and a position deviated from the position of the boundary between the head portion and the neck portion toward a side of the handle portion by 10 mm is fixed is assumed to be a reference height, a 200 g spindle is suspended at a position corresponding to $10 \pm 3\%$

from the tip end of the bristle implanted portion relative to the length in the longer axis direction of the bristle implanted portion at the head portion in the fixed state, and the amount of displacement (the unit is mm) of the height from the reference height of the tip end of the handle body 10 seconds later is assumed to be the amount of deflection A' of the head portion.

[4] A toothbrush including: a handle body that includes a head portion, a neck portion that extends from the head portion, and a handle portion that extends from the neck portion, in which bristle bundles are implanted on a bristle implanted surface of the head portion, and a product of an amount of deflection A' of the head portion, which is measured by a method (α') described below, and an amount of deflection B of the neck portion, which is measured by a method (β) described below is 2.5 to 12.

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

Method (β): The height of the tip end of the handle body in a state in which the bristle implanted surface of the head portion is directed upward in the vertical direction and the position of the boundary between the neck portion and the handle portion is fixed is

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

[5] The toothbrush according to any one of [1] to [4], in which the thickness of the head portion is 2.0 to 4.0 mm.

[6] The toothbrush according to any one of [1] to [5], in which the thickness of the head portion is 2.0 to 4.0 mm, and the smaller one of the minimum width and the minimum thickness of the neck portion is 3.0 to 4.5 mm.

[7] The toothbrush according to [6], in which the minimum width of the neck portion is 3.0 to 4.5 mm.

[8] The toothbrush according to any one of [1] to [7], in which the strength of bristle tips of bristles that form the bristle bundles is 1.7 to 3.0 N.

[9] The toothbrush according to any one of [1] to [8], in which the material of the handle body is polypropylene resin.

[10] The toothbrush according to any one of [1] to [9], in which in the method (β), a position corresponding to 42.4% from a tip end of the handle body relative to the length in a longer axis direction of the handle body is fixed.

[11] The toothbrush according to any one of [1] to [3] or [5] to [10], in which the amount of deflection A and the amount of deflection B satisfy $A < B$.

[12] The toothbrush according to any one of [1] to [3] or [5] to [11], in which a difference ($B - A$) between the amount of deflection A and the amount of deflection B satisfies $1 \leq (B - A) \leq 4$.

[13] The toothbrush according to any one of [1] to [3] or [5] to [12], in which the amount of deflection is 0.5 to 3.0.

[14] The toothbrush according to any one of [1] to [13], in which the amount of deflection is 2.1 to 5.0.

[15] The toothbrush according to any one of [1] to [3] or [5] to [14], in which the material of the handle body is polyacetal resin, a product of the amount of deflection A of the head portion and the amount of deflection B of the neck portion is 2 to 10, a thickness of the head portion is 2.0 to 4.0 mm, and the smaller one of the minimum width and the minimum thickness of the neck portion is 3.0 to 4.5 mm.

[16] The toothbrush according to any one of [1] to [15], in which the form in which bristle bundles are implanted on the bristle implanted surface of the head portion is metal piece-scheme bristle implanting.

[Advantageous Effects of Invention]

[0007]

The toothbrush according to the present invention provides superior cleaning power and an excellent impression during use.

[Brief Description of Drawings]

[0008]

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

Fig. 1B is a side view of the toothbrush according to the embodiment of the present invention.

Fig. 2A is an explanatory diagram of a method of measuring the amount of deflection of a head portion.

Fig. 2B is an explanatory diagram of the method of measuring the amount of

◦
deflection of the head portion.

Fig. 3 is an explanatory diagram of a method of measuring the strength of bristle tips.

[Description of Embodiments]

[0009]

[First invention]

Hereinafter, an embodiment of a toothbrush according to the first invention will be described with reference to Figs. 1A and 1B.

A toothbrush 1 in Figs. 1A and 1B includes a head portion 2 with a substantially rectangular shape in a plan view, a neck portion 4 that extends from the head portion 2, and a handle portion 6 that extends from the neck portion 4 (hereinafter, the head portion 2, the neck portion 4, and the handle portion 6 will be collectively referred to as a handle body 10). A bristle implanted portion (not shown) is provided at the head portion 2.

[0010]

The handle body 10 is integrally molded into a long shape as a whole and is obtained through injection molding using resin, for example, as a material.

Examples of the material of the handle body 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, acrylonitrile styrene resin (AS), and polyester resin (PCTA). From among these examples, PP, POM, and PBT are preferably used, and PP and POM are more preferably used in terms of high strength and excellent formability. In addition, PP is particularly preferably used as a material of the handle body since it is then possible to further obtain the effects of the present invention at lower cost.

One kind of the aforementioned resin may be used alone, or two or more kinds thereof may be used in combination.

A bending elastic modulus of the material of the handle body is preferably 1200 to 3000 MPa and is more preferably 1500 to 3000 MPa. If the bending elastic modulus of the material of the handle body is within the aforementioned range, it is possible to set the amount of deflection of the head portion to an appropriate value, which leads to an improvement in the cleaning power and the operability in the oral cavity and an improvement in an impression from use of the user. Note that the bending elastic modulus of the material of the handle body is measured in accordance with JIS K7171.

In addition, a part or the entirety of the handle portion 6 in the handle body 10 may be covered with soft resin. Gripping properties when the user grips the handle portion 6 are further enhanced by a part or the entirety of the handle portion 6 being covered with soft resin. Examples of the soft resin include elastomer resin such as polyolefin-based elastomer, styrene-based elastomer, polyester-based elastomer, and polyurethane-based thermoplastic elastomer, and silicon resin.

[0011]

A length L of the handle body 10 can be decided in consideration of operability and the like and is set to 150 to 200 mm, for example.

[0012]

The head portion 2 has a longitudinal direction in the length direction of the handle body 10 and has a substantially rectangular plate shape with four apexes cut along curved lines in a plan view. A plurality of bristle implanted holes 22 are formed on one surface (bristle implanted surface 20) of the head portion 2. Bristle bundles obtained by bundling bristles are implanted in the bristle implanted holes 22, and a bristle implanted portion including the plurality of bristle bundles is formed.

Note that a plan view in this specification means viewing the toothbrush from the side of the bristle implanted surface of the head portion. The direction that is parallel to the bristle implanted surface 20 and intersects the length direction of the handle body 10 perpendicularly is assumed to be a width, and the direction that intersects the bristle implanted surface 20 perpendicularly is assumed to be a thickness. In addition, the surface on the facing side of the bristle implanted surface 20 is assumed to be a front surface, and the side opposite to the facing side of the bristle implanted surface 20 is assumed to be a rear surface.

The head portion 2 expands in the width direction from a tip end 9 toward the neck portion 4, then extends with a constant width, then narrows in the width direction, and reaches a boundary P1 with the neck portion 4 in a plan view.

[0013]

In the embodiment, the boundary P1 corresponds to an end point of a curved line forming a cut corner, which is close to the neck portion 4, in a plan view shape of the head portion 2, that is, a position at which the curving direction of the curved line that forms the cut corner changes. That is, the boundary P1 between the head portion and the neck portion is a position at which curved lines or straight lines R1 that form both edges at which the width of the cut corner portion, which is close to the neck portion, of the head portion in a plan view change to curved lines or straight lines with an increased width therebetween or straight lines with a constant width therebetween. In addition, in a case of a toothbrush in which a neck portion that has a width increasing toward the handle portion in a plan view, the boundary P1 coincides with a position at which the widths of the head portion and the neck portion are the smallest in a plan view.

Note that there may be a case in which it is difficult to specify the position of the boundary P1 as in a toothbrush in which the head portion and the neck portion are

formed to have the same width, for example. In such a case, a position corresponding to 17.5% from the tip end 9 of the handle body 10 relative to a length L1 (a position corresponding to 31.5 mm from the tip end 9 of the handle body 10 in a case in which the length L1 is 180 mm, for example) is assumed to be the boundary P1.

[0014]

The size of the head portion 2 can be decided in consideration of operability in the oral cavity and the like.

If a maximum width W1 of the head portion 2 is excessively large, the operability in the oral cavity is degraded. If the maximum width W1 is excessively small, the number of bristle bundles able to be implanted becomes excessively small, and cleaning power tends to be degraded. Therefore, the width W1 is set to 5 to 13 mm, for example.

A thickness T1 of the head portion 2 is preferably 2.0 to 4.0 mm, is more preferably 2.0 to 3.5 mm, and is further preferably 2.5 to 3.2 mm. If the thickness T1 is equal to or greater than the lower limit value, sufficient strength tends to be secured at the head portion 2. Further, it becomes easier to form the bristle implanted holes 22 in the thickness direction, to fixedly implant the bristle bundles in the bristle implanted holes 22, and to prevent pulling-out of the bristle bundles. In addition, if the thickness T1 is equal to or less than the upper limit value, the operability of the toothbrush 1 in the oral cavity is further enhanced. Further, it is possible to cause the bristles to reach every corner in the oral cavity, such as a portion behind the back teeth, and the effect of removing plaque from the oral cavity is further enhanced.

Note that in a case in which the thickness of the head portion 2 is not constant, T1 means the minimum thickness of the head portion 2.

If a length L2 of the head portion 2 is excessively long, the operability in the

oral cavity tends to be degraded. If the length L2 is excessively short, the number of bristle bundles to be implanted becomes excessively small, and the cleaning effect tends to be degraded. Therefore, the length L2 is appropriately decided within a range of 10 to 40 mm, for example.

[0015]

The shape of each bristle implanted hole 22 is not particularly limited, and examples thereof include circular shapes such as a perfect round shape and an elliptical shape and polygonal shapes such as a triangular shape and a rectangular shape.

The number of bristle implanted holes 22 is not particularly limited and is set to be 10 to 60, for example.

The diameter of each bristle implanted hole 22 is determined in accordance with the required thickness of each bristle bundle and is set to be 1 to 3 mm, for example.

The alignment pattern of the bristle implanted holes 22 is not particularly limited and may be any alignment pattern such as a so-called grid shape or a staggered shape.

[0016]

Examples of the bristles that form the bristle bundles include bristles with diameters that gradually decrease toward the bristle tips (tapered bristles), bristles with substantially a constant outer diameter except for rounded portions at the bristle tips (straight bristles), and bristles that have bristle tips with a shape such as a paddle shape, a spherical shape, or a tip-split shape.

Tapered bristles are preferably used as the bristles. It is possible to enhance the effect of removing plaque from periodontal pockets and the like by employing tapered bristles as the bristles. Further, an effect of massaging the dental gum is then enhanced, and the impression from use is further improved.

[0017]

Examples of the bristles include polyamide such as 6-12 nylon and 6-10 nylon, polyester such as PET, PBT, polytrimethylene terephthalate (PTT), polyethylene naphthalate (PEN), and polybutylene naphthalate (PBN), polyolefin such as polypropylene, and synthesized resin such as olefin-based elastomer and styrene-based elastomer. One of these resin materials may be used alone, or two or more of these resin materials may be used in combination.

In addition, the bristles may have a multicore structure that has a core portion and at least one sheath portion layer that is provided outside the core portion.

[0018]

Although a cross sectional shape of each bristle is preferably a perfect round shape, the cross-sectional shape is not necessarily limited to a perfect round shape and may be an arbitrary shape in accordance with a purpose of use of the toothbrush 1. For example, the cross-sectional shape may be an elliptical shape, a polygonal shape (for example, a triangular shape, a rectangular shape, a pentagonal shape, or a hexagonal shape), a deformed shape (for example, a star shape, a three-leaf clover shape, or a four-leaf clover shape), or the like.

[0019]

The thickness of each bristle is not particularly limited, and in a case in which the cross-sectional shape is a perfect round shape, for example, the thickness is preferably 4 to 8 mil (1 mil = 1/1000 inches = 0.025 mm). If the thickness is equal to or greater than the lower limit value, autonomy is improved, and cleaning properties are further enhanced. If the thickness is equal to or less than the upper limit value, bristle elasticity of the bristle bundles 11 becomes appropriate, and a more satisfactory feeling of touch is achieved.

All the bristles that form the bristle bundles 11 may have the same thickness, or

bristles with two or more different thicknesses may be used in combination.

[0020]

The height of the bristles is preferably 8 mm to 15 mm for adults and is preferably 6 mm to 12 mm for children, for example. In addition, it is preferable to further reduce the height of the bristles as the selected diameter of the bristles becomes smaller in terms of usability and an impression from use in the oral cavity. In addition, a plurality of bristles with different thicknesses may be used in combination in accordance with purposes such as impression from use, a feeling of cleanliness, a cleaning effect, and durability.

[0021]

The neck portion 4 connects the head portion 2 and the handle portion 6.

In the embodiment, the neck portion 4 extends with substantially a constant diameter from the boundary P1 toward the handle portion 6, then increases in diameter, and reaches a boundary P2 with the handle portion 6. The boundary P2 corresponds to an end point of the increase in diameter of the neck portion 4, that is, an end point of straight lines that form both edges of a portion with an increasing width or a position at which bending of curved lines that form both edges of the portion with an increased width changes, in a plan view. In Fig. 1A, the boundary P2 between the neck portion and the handle portion is a position at which the straight lines or curved lines R2 that form both edges of a portion with an increased width at the neck portion changes to curved lines with a gradually reducing width therebetween in a plan view.

Note that there may be a case in which it is difficult to specify the position of the boundary P2 as in a toothbrush in which the neck portion and the handle portion are formed to have the same width. In this case, a position corresponding to 42.2% from the tip end 9 of the handle body 10 relative to the length L1 (a position corresponding to

76.0 mm from the tip end 9 of the handle body 10 in a case in which the length L1 is 180 mm, for example) is assumed to be the boundary P2.

[0022]

A width W2 of the neck portion 4 is preferably 3.0 to 4.5 mm and is more preferably 3.0 to 4.2 mm. If the width W2 is equal to or greater than the lower limit value, sufficient strength in terms of bending resistance and the like of the neck portion 4 tends to be secured. Further, the toothbrush 1 does not become excessively soft and weak, and a satisfactory impression from use due to appropriately deflection tends to be obtained. In addition, if the width W2 is equal to or less than the upper limit value, the operability of the toothbrush 1 in the oral cavity is enhanced. Further, it is possible to cause the bristles to reach every corner in the oral cavity, and the effect of removing plaque in the oral cavity is further enhanced.

Note that in a case in which the width of the neck portion 4 is not constant, the width W2 means the minimum width of the neck portion 4.

[0023]

A thickness T2 of the neck portion 4 is preferably 3.0 to 4.5 mm and is more preferably 3.0 to 4.2 mm. If the thickness T2 is equal to or greater than the aforementioned lower limit value, sufficient strength in terms of bending resistance and the like of the neck portion 4 tends to be secured. Further, the toothbrush 1 does not become excessively soft and weak, and a satisfactory impression from use due to appropriate deflection tends to be obtained. In addition, if the thickness T2 is equal to or less than the upper limit value, operability of the toothbrush 1 in the oral cavity is enhanced. Further, it is possible to cause the bristles to reach every corner in the oral cavity, and the effect of removing plaque in the oral cavity is further enhanced.

Note that in a case in which the thickness of the neck portion 4 is not constant,

the thickness T2 means the minimum thickness of the neck portion 4.

[0024]

The minimum diameter of the neck portion 4 is preferably 3.0 to 4.5 mm and is more preferably 3.0 to 4.2 mm. If the minimum diameter of the neck portion 4 is equal to or greater than the aforementioned lower limit value, sufficient strength in terms of bending resistance and the like of the neck portion 4 tends to be secured. Further, the toothbrush 1 does not become excessively soft and weak, and a satisfactory impression from use due to appropriate deflection tends to be obtained. In addition, if the minimum diameter of the neck portion 4 is equal to or less than the aforementioned upper limit value, operability of the toothbrush 1 in the oral cavity is enhanced. Further, it is possible to cause the bristles to reach every corner in the oral cavity, and the effect of removing plaque in the oral cavity is further enhanced.

Note that the minimum diameter of the neck portion 4 means a smaller one of the aforementioned width W2 and the thickness T2, that is, a smaller one of the minimum width and the minimum thickness of the neck portion 4. It is preferable that the minimum thickness and the minimum width be the same or that the minimum width be smaller than the minimum thickness and the minimum width be 3.0 to 4.5 mm, in the neck portion.

[0025]

A length L3 of the neck portion 4 can be decided in consideration of the length L2 of the head portion and the like, is a length of 30 to 90 mm, and is more preferably 30 to 60 mm, for example. If the length L3 is equal to or greater than the aforementioned lower limit, it becomes easier to cause the bristles to reach every corner in the oral cavity, and the effect of removing plaque in the oral cavity is further enhanced. If the length L3 is equal to or less than the aforementioned upper limit value, the operability of the

toothbrush 1 in the oral cavity is further enhanced.

[0026]

(Amount of deflection A of head portion 2)

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

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

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

In a case in which the width of a portion, which is close to the head portion, of the neck portion is the constant in a plan view, for example, the width is measured at gradually changing positions toward the head portion in a portion, which is close to the head portion, of the neck portion, and a position of change between a portion with a constant width and a position at which the width starts to increase is assumed to be the boundary P1. In addition, in a case in which the width of a portion, which is close to the head portion, of the neck portion narrows toward the head portion in a plan view, the

width is measured at gradually changing positions toward the head portion in the portion, which is close to the head portion, of the neck portion, and the position at which the width reaches a minimum width is assumed to be the boundary P1.

[0027]

In the present invention, the amount of deflection A of the head portion 2 is measured as follows.

As shown in Fig. 2A, the toothbrush 1 is fixed by using a jig 100 at a position (boundary P1) of the thinnest portion of the neck portion such that the bristle implanted surface 20 is directed upward. At this time, the height of the tip end 9 of the handle body 10 is assumed to be a reference height H_0 .

Then, as shown in Fig. 2B, a 200 g spindle 102 is suspended at the position of S, the height of the tip end 9 of the handle body 10 ten seconds later is measured, and this height is assumed to be H_1 . S described above is a position corresponding to $10 \pm 3\%$ from the tip end of the bristle implanted portion relative to the longer axis direction of the bristle implanted portion. In a case in which the bristle implanted portion has a length of 19 mm, for example, S is a position corresponding to 2.0 mm from the tip end.

Then, the absolute value of a difference between H_1 and H_0 is obtained as a (the unit is mm). a described above may be measured by a height gauge, for example. The measurement is performed at a room temperature of $25 \pm 3^\circ\text{C}$.

The measurement was performed five times, and an average value of a described above is assumed to be the amount of deflection A of the head portion 2.

[0028]

The amount of deflection A is preferably 0.4 to 3.0, is more preferably 0.4 to 2.5, and is further preferably 0.4 to 2.0. Also, the amount of deflection A is preferably 0.5 to 3.0, is more preferably 0.5 to 2.5, and is further preferably 0.5 to 2.0. If the amount of

deflection A is within the aforementioned ranges, the head portion 2 itself is appropriately deflected, flexibility of the bristle implanted portion implanted at the head portion 2 is exhibited, and a more satisfactory feeling of touch on the dental gum, that is, a more satisfactory impression from use is achieved. In addition, if the amount of deflection A is equal to or greater than the lower limit, a satisfactory impression from use is achieved. If the amount of deflection A is equal to or less than the aforementioned upper limit value, sufficient strength of the head portion 2 tends to be secured. Further, the toothbrush 1 does not become excessively soft and weak, and satisfactory operability in the oral cavity and cleaning power tend to be obtained.

Note that the amount of deflection A is adjusted by adjusting the bending elastic modulus of the material of the head portion 2 (that is, the material of the handle body 10) and the thickness, the width, and the like of the head portion 2.

[0029]

(Amount of deflection B of neck portion 4)

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

Method (β):

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

10 seconds later is assumed to be the amount of deflection B of the neck portion.

[0030]

In the invention, the amount of deflection B of the neck portion 4 is measured similarly to the amount of deflection A of the head portion 2 other than that a position at which the toothbrush 1 is fixed to the jig 100 (the boundary P1) and a position S from which the spindle 102 is suspended are different from those in the method of measuring the amount of deflection A of the head portion 2.

The position at which the toothbrush 1 is fixed to the jig 100 in the measurement of the amount of deflection B of the neck portion 4 is the boundary P2. In addition, S is a position corresponding to $50 \pm 3\%$ from the tip end of the bristle implanted portion relative to the length in the longer axis direction of the bristle implanted portion. In a case in which the bristle implanted portion has a length of 19 mm, for example, S is a position corresponding to 9.5 mm from the tip end.

Then, the absolute value (the unit is mm) of a difference between the reference height H_0 before the spindle 102 is suspended and a height H_1 ten seconds after the spindle 102 is suspended is obtained similarly to the method of measuring the amount of deflection A of the head portion 2. The measurement is performed at a room temperature of $25 \pm 3^\circ\text{C}$. The measurement is performed five times, and the average value thereof is assumed to be the amount of deflection B of the neck portion 4.

[0031]

The amount of deflection B is preferably 2.1 to 5.0, is more preferably 2.3 to 4.5, and is further preferably 2.5 to 4.0. If the amount of deflection B is within the aforementioned ranges, the neck portion 4 is appropriately deflected, appropriate cushioning properties appear, and a feeling of touch of the bristle implanted portion on the dental gum becomes more satisfactory. In addition, if the amount of deflection B is

equal to or greater than the aforementioned lower limit value, it is possible to cause the bristles to reach every corner in the oral cavity, such as a portion behind the back teeth, and to enhance the power of cleaning inside the oral cavity. Further, a property of the bristles entering periodontal pockets is enhanced, and the power of cleaning inside periodontal pockets is further enhanced. If the amount of deflection B is equal to or less than the aforementioned upper limit value, it is easy to secure sufficient strength of the neck portion 4. Further, the toothbrush 1 does not become excessively soft and weak, and a satisfactory impression from use tends to be obtained.

Note that the amount of deflection B is adjusted by adjusting the bending elastic modulus of the material of the neck portion 4 (that is, the material of the handle body 10), the minimum diameter of the neck portion, the cross sectional shape of the boundary P2, and the like.

[0032]

The product ($A \times B$) of the amount of deflection A of the head portion and the amount of deflection B of the neck portion is 0.8 to 10, is preferably 1 to 10, is further preferably 1 to 6, and is further preferably 1 to 3.5. Moreover, ($A \times B$) is preferably 2 to 10. If ($A \times B$) is within the aforementioned ranges, appropriate deflection with which the head portion 2 and the neck portion 4 cooperate can be obtained. In this manner, the flexibility and cushion properties of the bristle implanted portion appear when the bristle implanted portion is made to slide along sites to be cleaned (the teeth, dental gum, and the like), and a feeling of touch of the bristle implanted portion becomes satisfactory. In addition, the lower limit value of ($A \times B$) is equal to or greater than 0.8 and is preferably equal to or greater than 1. Moreover, the lower limit value is preferably equal to or greater than 2. A satisfactory feeling of touch on the dental gum and an excellent

massaging effect for the dental gum are obtained, and an impression from use is improved by $(A \times B)$ being equal to or greater than the lower limit value, which leads to appropriate deflection. The upper limit value of $(A \times B)$ is equal to or less than 10, is preferably equal to or less than 6, and is more preferably equal to or less than 3.5. It is possible to suppress excessive deflection of a region formed by the head portion 2 and the neck portion 4, degradation of operability, and degradation of cleaning power by $(A \times B)$ being equal to or less than the upper lower limit value. In addition, it is possible to prevent a decrease in massaging effects on the dental gum due to excessive deflection and a user's feeling that the toothbrush 1 is too soft and weak during the use. Further, the strength of the toothbrush 1 is enhanced, and durability is improved.

[0033]

The amount of deflection A and the amount of deflection B preferably satisfy $A < B$. If $A < B$, the operability of the toothbrush 1 is further enhanced.

In addition, a difference $(B - A)$ between the amount of deflection A and the amount of deflection B is preferably equal to or greater than 1, is preferably equal to or greater than 1.5, and is further preferably equal to or greater than 2. If $(B - A)$ is equal to or greater than the lower limit value, the amount of deflection of the neck portion 4 can be maintained to be large with respect to the head portion 2, cushioning properties are enhanced, a feeling of touch on the dental gum becomes satisfactory, and the user tends to feel massaging effects on the dental gum.

In addition, $(B - A)$ is preferably equal to or less than 4 and is more preferably equal to or less than 3. If $(B - A)$ is equal to or less than the upper limit value, the amount of deflection of the neck portion 4 does not become excessively large with respect to the head portion 2, and the operability in the oral cavity tends to be enhanced. Further, the user's feeling that the toothbrush 1 is too soft and weak during the use tends

to be prevented.

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

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

[0034]

(Amount of deflection A' of head portion 2)

An amount of deflection A' of the head portion is measured by a method (α') described below.

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

[0035]

In the present invention, the amount of deflection A' of the head portion 2 is measured similarly to the amount of deflection A of the head portion 2 other than the position (boundary P1) at which the toothbrush 1 is fixed with the jig 100 is different from that in the method of measuring the amount of deflection A of the head portion 2.

In the measurement of the amount of deflection A' of the head portion 2, the position at which the toothbrush 1 is fixed with the jig 100 is a position P3 deviated from

the position of the boundary P1 toward the side of the handle portion by 10 mm in the longer axis direction.

Then, an absolute value (the unit is mm) of the difference between the reference height H_0 before the spindle 102 is suspended and the height H_1 ten seconds after the spindle 102 is suspended is measured similarly to the method of measuring the amount of deflection A of the head portion 2. The measurement is performed at a room temperature of $25 \pm 3^\circ\text{C}$. This measurement is performed five times, and the average value thereof is assumed to be the amount of deflection A' of the head portion 2.

[0036]

The amount of deflection A' is preferably 1 to 5, is more preferably 1 to 4, and is further preferably 1 to 3. If the amount of deflection A' is within the aforementioned range, the head portion 2 itself is appropriately deflected, flexibility of the bristle implanted portion implanted at the head portion 2 appears, and a satisfactory feeling of touch to the dental gum, that is, a satisfactory impression from use is achieved. In addition, if the amount of deflection A' is equal to or greater than the aforementioned lower limit value, a satisfactory impression from use is achieved. If the amount of deflection A' is equal to or less than the aforementioned upper limit value, sufficient strength tends to be secured at the head portion 2. Further, the toothbrush 1 does not become excessively soft and weak, and satisfactory operability in the oral cavity and satisfactory cleaning power tend to be obtained.

Note that the amount of deflection A' is adjusted by adjusting the bending elastic modulus of the material of the head portion 2 (that is, the material of the handle body 10), and the thickness, the width, and the like of the head portion 2.

[0037]

A product ($A' \times B$) between the amount of deflection A' of the head portion and

the amount of deflection B of the neck portion is preferably 2.5 to 12, is more preferably 3 to 12, is further preferably 3 to 10, and is further preferably 3 to 7. If $(A' \times B)$ is within the aforementioned range, appropriate deflection with which the head portion 2 and the neck portion 4 cooperate tends to be obtained. In this manner, flexibility and a cushion property of the bristle implanted portion appear when the bristle implanted portion is caused to slide along sites to be cleaned (teeth, dental gum, and the like), and a more satisfactory feeling of touch of the bristle implanted portion is achieved. In addition, $(A' \times B)$ is equal to or greater than 2.5 and is preferably equal to or greater than 3. A more satisfactory feeling of touch to the dental gum is achieved, a high effect of massaging the dental gum is obtained, and an impression from use is further improved by $(A' \times B)$ being equal to or greater than the aforementioned lower limit value, thereby obtaining appropriate deflection. $(A' \times B)$ is equal to or less than 12, is preferably equal to or less than 10, and is more preferably equal to or less than 7. It becomes easier to suppress degradation of the operability and degradation of the cleaning power due to excessive deflection of a region formed by the head portion 2 and the neck portion 4 by $(A' \times B)$ being equal to or less than the aforementioned upper limit value. In addition, it is possible to suppress degradation of the effect of massaging the dental gum due to the excessive deflection and a user's feeling that the toothbrush 1 is too soft and weak during the use. Further, the strength of the toothbrush 1 is enhanced, and durability is further improved.

[0038]

A ratio (B/A') between the amount of deflection B and the amount of deflection A' is preferably 0.8 to 2.5 and is more preferably 0.9 to 2.0.

[0039]

(Strength of bristle tips of bristles)

Strength of bristle tips of the bristles that form the bristle bundles is measured as follows.

An ISO bristle elasticity strength testing machine is used as a measurement device. An ISO bristle elasticity strength testing machine 200 shown in Fig. 3 includes a reference surface 202 and a ladder 204 disposed above the reference surface. The ladder 204 includes a plurality of cylindrical bar-like bodies (made of stainless steel; diameter of 3 mm). The bar-like bodies are aligned in parallel with each other at constant intervals (10 mm intervals between centers of the bar-like bodies).

First, the toothbrush 1 is installed on the aforementioned testing machine 200. At that time, the tip ends of the bristles implanted at the head portion 2 of the toothbrush 1 is brought into contact with the reference surface 202 of the aforementioned testing machine 200. Then, the maximum resistance value when the head portion 2 is caused to horizontally slide relative to the reference surface 202 is obtained, and this is assumed to be the strength of the bristle tips of the bristles. The sliding direction of the head portion 2 is a direction in which the longitudinal direction of the toothbrush 1 and the longitudinal direction of the bar-like bodies perpendicularly intersect each other. The sliding speed of the head portion 2 is set to be 10 mm/minute.

[0040]

The strength of the bristle tips of the bristles is preferably 1.7 to 3.0 N and is more preferably 1.9 to 2.8 N. If the strength of the bristle tips of the bristles is within the aforementioned preferable range, power of removing plaque is further enhanced, a more satisfactory feeling of touch of the bristles to the dental gum is achieved, and usability is further enhanced.

[0041]

The toothbrush 1 according to the embodiment is manufactured in accordance with a conventionally known method of manufacturing a toothbrush. For example, hard resin is injected to a mold, and the handle body 10 is molded. Then, the bristle bundles are implanted on the bristle implanted surface 20 of the obtained handle body 10, thereby obtaining the toothbrush 1. As a method of implanting the bristle bundles, metal piece-scheme bristle implanting in which bristle bundles are folded into two, metal pieces pinched therebetween are driven into the bristle panting holes 22, thereby implanting the bristle bundles, a thermal fusion method in which lower ends of the bristle bundles are press-fitted into and fixed to melted resin to serve as the bristle implanted portion, an in-mold method in which lower ends of the bristle bundles are heated to form a melted lump, and melted resin is then injected to a mold, thereby molding the bristle implanted portion, and the like are exemplified.

The toothbrush according to the first invention is effective when the toothbrush is obtained by implanting the bristle bundles by the metal piece-scheme bristle implanting, in particular. In the case in which the metal piece-scheme bristle implanting is employed, a load due to the driving of the metal pieces is applied to the head portion. Therefore, the strength against deformation when power is applied decreases as the thickness of the head portion decreases. In the toothbrush 1 according to the embodiment, it is possible to disperse the force applied to the head portion when the teeth are brushed, for example, from the head portion to the entire neck portion by providing an appropriate deflection property to the neck portion. Therefore, it is possible to significantly obtain the effects of the present invention in the case of the metal piece-scheme bristle implanting, in particular.

In a case of a toothbrush obtained by the metal piece-scheme bristle implanting employing polypropylene resin with low strength as a material of the handle body, in

particular, and when a value X of an amount of deflection (A/L_2) of the head portion per length (L_2) of the head portion is assumed to be 0.015 to 0.045, a ratio Y/X between a value Y of an amount of deflection ($B/(L_2 + L_3)$) of the neck portion per a sum ($L_2 + L_3$) of the lengths of the head portion and the neck portion and X described above is preferably set to 0.8 to 2.0. X described above is preferably set to 0.018 to 0.45, is more preferably set to 0.018 to 0.040, and at this time, Y/X is preferably set to 0.9 to 2.0 and is more preferably set to 0.9 to 1.9.

In addition, in a case of a toothbrush obtained by metal piece-scheme bristle implanting employing polyacetal resin with high strength as a material of the handle, and when X described above is set to 0.027 to 0.035 or is preferably set to 0.029 to 0.032, Y/X described above is preferably set to 1.0 to 1.4 and is more preferably set to 1.0 to 1.3.

[0042]

A method of using the toothbrush 1 according to the embodiment will be described.

First, the handle portion 6 is gripped. A form in which the handle portion 6 is gripped is not particularly limited and may be a palm gripping scheme or a pen gripping scheme. Since cleaning is typically performed while a pressure is applied to a target site, a thumb or the like is placed on the vicinity of the boundary P2 at the rear end of the neck portion, and the handle portion 6 is gripped in any of the gripping schemes.

Then, the head portion 2 is inserted into the oral cavity, and the bristle implanted portion is caused to slide along the site to be cleaned while the handle portion 6 is pressurized. The force applied to the handle portion 6 is delivered to the head portion 2 via the neck portion 4, and is further delivered from the head portion 2 to the bristle implanted portion, and the bristle implanted portion thus cleans the site to be cleaned

while applying a pressure thereto. Since a product ($A \times B$) between the amount of deflection A of the head portion and the amount of deflection B of the neck portion is 0.8 to 10 at this time, appropriate deflection with which the head portion and the neck portion cooperate is obtained. As a result, it becomes easier to cause the bristles implanted at the head portion 2 of the toothbrush 1 to reach every corner in the oral cavity, such as a portion behind the back teeth, and the power of cleaning inside the oral cavity is enhanced. Further, it becomes easy to cause the bristles to enter the periodontal pockets, and power of cleaning the periodontal pockets is enhanced. In addition, flexibility and a cushion property of the bristle implanted portion are improved by obtaining appropriate deflection, a satisfactory feeling of touch of the bristle implanted portion to the dental gum is achieved, a satisfactory effect of massaging the dental gum is obtained, and an impression from use is enhanced.

In addition, if a product ($A' \times B$) between the amount of deflection A' of the head portion and the amount of deflection B of the neck portion is 2.5 to 12, it becomes further easier to obtain the appropriate deflection with which the head portion and the neck portion cooperate. In this manner, the power of cleaning the portion behind the back teeth, the periodontal pockets, and the like in the oral cavity is further enhanced, it becomes easier to obtain a satisfactory effect of massaging the dental gum, and the impression from use is further enhanced.

[0043]

In addition, if the thickness T1 of the head portion 2 is 2.0 to 4.0 mm, and the minimum diameter of the neck portion 4 is 3.0 to 4.5 mm, it becomes further easier to cause the bristles implanted at the head portion 2 to reach every corner in the oral cavity, such as the portion behind the back teeth, and the power of cleaning inside the oral cavity is further enhanced. Further, operability of the toothbrush 1 is further enhanced.

Further, if the strength of the bristle tips is 1.7 to 3.0 N, it becomes easier to cause the bristles to enter the periodontal pockets, and the power of cleaning the periodontal pockets is further enhanced. Further, a more satisfactory feeling of touch to the dental gum is achieved, and an impression from use is further enhanced.

[0044]

[Second invention]

The toothbrush according to the second invention is a toothbrush, which includes a head portion at which bristle bundles are plated, a neck portion that extends from the head portion, and a handle portion that extends from the neck portion, in which a product ($A' \times B$) between the amount of deflection A' of the head portion and the amount of deflection B of the neck portion is 2.5 to 12. For the toothbrush according to the second invention, it is possible to employ a mode that is similar to the toothbrush according to the first embodiment other than that it is essential that the product ($A' \times B$) between the amount of deflection A' of the head portion and the amount of deflection B of the neck portion be 2.5 to 12, and preferred mode is also the same.

$A' \times B$ is as described above in the first invention.

[0045]

Since the product ($A' \times B$) between the amount of deflection A' of the head portion and the amount of deflection B of the neck portion is 2.5 to 12 in the toothbrush according to the second invention, appropriate deflection with which the head portion and the neck portion cooperate is obtained. As a result, it becomes easier to cause the bristles implanted at the head portion of the toothbrush to reach every corner in the oral cavity, such as the portion behind the back teeth, and the power of cleaning the inside of the oral cavity is enhanced. Further, it becomes easier to cause the bristles to enter the

periodontal pockets, and the power of cleaning the periodontal pockets is enhanced. In addition, flexibility and a cushion property of the bristle implanted portion are improved by obtaining the appropriate deflection, a satisfactory feeling of touch of the bristle implanted portion to the dental gum is achieved, a satisfactory effect of massaging the dental gum is obtained, and an impression from use is enhanced.

[0046]

Although the present invention will be described below in further detail with reference to examples, the present invention is not limited to these examples.

Materials used in the examples are as follows.

<Handle body>

- POM-1 (bending elastic modulus: 2600 MPa)
- PP-1 (bending elastic modulus: 1900 MPa)
- PP-2 (bending elastic modulus: 1400 MPa)

<Bristles>

- PBT

[0047]

(Examples 1 to 3 and Comparative Examples 1 and 2)

Toothbrushes similar to those in Figs. 1A and 1B were produced. The length L1 of the handle body was 180 mm, the thickness T1 of the head portion, the length L2 of the head portion, the width W1 of the head portion, the minimum diameter T2 of the neck portion, the length L3 of the neck portion, the width of the boundary P2, and the thickness of the boundary P2 of the toothbrush in each example were set to the dimensions shown in Table 1. Twenty-three bristles (made of PBT) were bundled as each bristle bundle, and the bristle bundles were implanted at the head portion in the bristle implanted pattern shown in Fig. 1A, thereby providing the bristle implanted

portion. The length and the thickness of each bristle in each example were set to the dimensions shown in Table 1.

Materials of the toothbrush in each example were as shown in Table 1.

In addition, the amount of deflection A of the head portion, the amount of deflection B of the neck portion, and the strength of the bristle tips of the toothbrush in each example were measured by the aforementioned methods (the position of the boundary P1: 31.5 mm from the tip end 9 of the handle body 10, the position of the boundary P2: 76.0 mm from the tip end 9 of the handle body 10).

The amount of deflection A, the amount of deflection B, $A \times B$, and the strength of the bristle tips of the toothbrush in each example are shown in Table 1.

[0048]

(Examples 4 to 9 and Comparative Examples 3 to 7)

Toothbrushes similar to those in Figs. 1A and 1B were produced. The length L1 of the handle body was 180 mm (Examples 4 to 9 and Comparative Examples 3 to 7), the thickness T1 of the head portion, the length L2 of the head portion, the width W1 of the head portion, the minimum diameter T2 of the neck portion, the length L3 of the neck portion, the width of the boundary P2, and the thickness of the boundary P2 of the toothbrush in each example were set to the dimensions shown in Tables 2 and 3.

Twenty-three bristles (made of PBT) were bundled as each bristle bundle, and the bristle bundles were implanted at the head portion in the bristle implanted pattern shown in Fig. 1A, thereby providing the bristle implanted portion. The length and the thickness of each bristle in each example were set to the dimensions shown in Tables 2 and 3.

Materials of the toothbrush in each example were as shown in Tables 2 and 3.

In addition, the amount of deflection A of the head portion, the amount of deflection A' of the head portion, the amount of deflection B of the neck portion, and the

strength of the bristle tips of the toothbrush in each example were measured by the aforementioned methods. The position of the boundary P1 and the position of the boundary P2, at which the toothbrush was fixed, were decided as described above for the toothbrush in each example.

The amount of deflection A, the amount of deflection A', the amount of deflection B, $A \times B$, $A' \times B$, and the strength of the bristle tips of the toothbrush in each example are shown in Tables 2 and 3.

[0049]

In addition, cleaning power, impressions from use, and operability of the toothbrushes in the respective examples were evaluated as follows.

The respective evaluation results will be shown in Tables 1 to 3.

[0050]

[Cleaning power for portion behind back teeth (on the side of the pharynx of the back teeth)]

Ten monitors cleaned oral cavities with the toothbrushes in the respective examples, and cleaning effects for portions behind back teeth at that time were evaluated with the following evaluation criteria. The average point of the ten monitors that was equal to or greater than 4 points was evaluated as "O", an average point that was equal to or greater than 2 points and less than 4 points was evaluated as "Δ", and the average point that was less than 2 points was evaluated as "X".

<Evaluation criteria>

5 points: There was a significantly strong feeling that plaque was removed from the portion behind the back teeth.

4 points: There was a strong feeling that plaque was removed from the portion behind the back teeth.

3 points: There was a feeling that plaque was removed from the portion behind the back teeth.

2 points: There was little feeling that plaque was removed from the portion behind the back teeth.

1 point: there was no feeling that plaque was removed from the portion behind the back teeth.

[0051]

[Evaluation of impression from use]

Ten monitors cleaned the inside of the oral cavities with the toothbrushes in the respective examples, feelings of touch to the dental gum at that time were evaluated with the following evaluation criteria, and impressions from use of the toothbrushes were evaluated. The average point of the ten monitors that was equal to or greater than 4 points was evaluated as “O”, the average point that was equal to or greater than 2 points and less than 4 points was evaluated as “Δ”, and the average point that was less than 2 points was evaluated as “X”.

<Evaluation criteria>

5 points: A significantly soft feeling of touch was obtained with no pain in the dental gum.

4 points: A very soft feeling of touch was obtained with no pain in the dental gum.

3 points: A soft feeling of touch was obtained with no pain in the dental gum.

2 points: A weak pain was felt in the dental gum.

1 point: A strong pain was felt in the dental gum.

[0052]

[Operability in oral cavity]

Ten monitors cleaned the inside of the oral cavities and evaluated operability of

the toothbrushes in the respective examples. The operability was evaluated in seven grades from 1 point to 7 points, and the operability that was felt to be more satisfactory was evaluated with a higher point. Average points of the ten monitors were classified into the following determination criteria, and the operability in the oral cavities were determined.

<Determination criteria>

O: An average point is equal to or greater than 5 points.

Δ: An average point is equal to or greater than 3 points and less than 5 points.

X: An average point is less than 3 points.

[0053]

[Table 1]

		Example 1	Example 2	Example 3	Comparative Example 1	Comparative Example 2
Amount of deflection A of head portion		0.87	0.89	1.77	0.18	3.11
Amount of deflection B of neck portion		2.90	2.60	3.90	2.00	6.30
A × B		2.50	2.30	6.90	0.40	19.6
Thickness T1 of head portion (mm)		2.6	3.0	2.6	4.5	2.6
Length L2 of head portion (mm)		31.5	31.5	31.5	31.5	31.5
Width W1 of head portion (mm)		10.5	10.5	10.5	10.5	10.5
Minimum diameter T2 of neck portion (mm)		3.5	4.0	3.5	5.0	3.5
Length L3 of neck portion (mm)		44.5	44.5	44.5	44.5	44.5
Width of P2 (mm)		7.5	7.5	7.5	7.5	7.5
Thickness of P2 (mm)		9.2	9.2	9.2	9.2	9.2
Strength of bristle tips (N)		2.5	2.15	2.57	2.51	2.1
Material of handle body		POM-1	PP-1	PP-1	PP-2	PP-2
Material of bristles		PBT	PBT	PBT	PBT	PBT
Length of bristles (mm)		29	29	29	31	29
Thickness of bristles (mil)		7.5	7.5	7.5	7.5	7.5
Depth of bristle implanting (mm)		2.2	2.5	2.2	3.8	2.2
Power of cleaning behind back teeth	Average point	4.8	4.4	4.6	1.2	1.9
	Evaluation	O	O	O	X	X
Impression from use	Average point	4.2	4.3	4.2	3.2	4.2

	Evaluation	O	O	O	Δ	O
Operability in oral cavity	Average point	6.6	6.2	4.9	2.7	2.1
	Evaluation	O	O	Δ	X	X

[0054]

[Table 2]

		Example 4	Example 5	Example 6	Example 7	Example 8	Example 9
Amount of deflection A of head portion		0.72	0.51	1.26	0.70	0.78	0.93
Amount of deflection B of neck portion		2.58	2.43	2.45	2.44	2.33	2.52
Amount of deflection A' of head portion		1.68	1.22	2.70	1.73	1.86	2.12
$A \times B$		1.86	1.24	3.09	1.71	1.82	2.34
$A' \times B$		4.33	2.96	6.62	4.22	4.33	5.34
Thickness T1 of head portion (mm)		3.0	3.0	3.0	3.0	3.0	2.6
Length L2 of head portion (mm)		28.9	25.3	33.7	28.7	30.0	28.7
Width W1 of head portion (mm)		9.1	10.6	10.3	10.3	10.5	10.3
Minimum diameter T2 of neck portion (mm)		4.0	4.0	4.0	4.0	4.0	3.0
Length L3 of neck portion (mm)		42.0	45.4	37.3	42.2	40.3	42.2
Width of P2 (mm)		7.8	7.8	7.8	7.8	7.8	7.8
Thickness of P2 (mm)		9.4	9.4	9.4	9.4	9.4	9.4
Strength of bristle tips (N)		1.41	1.87	2.37	1.89	3.58	1.89
Material of handle body		PP-1	PP-1	PP-1	PP-1	PP-1	POM-1
Material of bristles		PBT	PBT	PBT	PBT	PBT	PBT
Length of bristles (mm)		29	27	29	29	25	29
Thickness of bristles (mil)		5.5	7.0	7.5	7.5	9	7.5
Depth of bristle implanting (mm)		2.5	2.5	2.5	2.5	2.5	2.5
Power of cleaning behind back teeth	Average point	4.8	4.8	4.2	4.4	4.4	4.9
	Evaluation	O	O	O	O	O	O
Impression from use	Average point	4.8	4.6	4.4	4.5	4.1	4.5
	Evaluation	O	O	O	O	O	O
Operability in oral cavity	Average point	5.7	6.6	5.9	6.2	6.2	6.7
	Evaluation	O	O	O	O	O	O

[0055]

[Table 3]

	Comparative Example 3	Comparative Example 4	Comparative Example 5	Comparative Example 6	Comparative Example 7
Amount of deflection A of	0.29	0.38	0.19	0.33	0.35

head portion						
Amount of deflection B of neck portion		1.70	1.79	2.20	1.97	1.79
Amount of deflection A' of head portion		0.77	1.17	0.52	0.76	0.61
A × B		0.49	0.68	0.42	0.65	0.63
A' × B		1.31	2.09	1.14	1.50	1.09
Thickness T1 of head portion (mm)		4.5	4.5	4.5	4.5	4.5
Length L2 of head portion (mm)		28.0	34.0	24.8	28.0	32.2
Width W1 of head portion (mm)		8.8	10.3	10.6	10.3	10.5
Minimum diameter T2 of neck portion (mm)		5.0	5.0	5.0	5.0	5.0
Length L3 of neck portion (mm)		42.7	37.0	45.9	42.7	39.8
Width of P2 (mm)		7.8	7.8	7.8	7.8	7.5
Thickness of P2 (mm)		9.4	9.4	9.4	9.4	9.0
Material of handle body		PP-2	PP-2	PP-2	PP-2	PP-1
Material of bristles		PBT	PBT	PBT	PBT	PBT
Length of bristles (mm)		31	31	31	31	27
Thickness of bristles (mil)		7.5	7.5	7.5	7.5	7.5
Depth of bristle implanting (mm)		3.8	3.8	3.8	3.8	3.8
Power of cleaning behind back teeth	Average point	1.6	1.0	1.9	1.2	1.2
	Evaluation	X	X	X	X	X
Impression from use	Average point	3.8	3.5	3.1	3.2	2.9
	Evaluation	Δ	Δ	Δ	Δ	Δ
Operability in oral cavity	Average point	2.9	2.1	3.5	2.7	2.7
	Evaluation	X	X	Δ	X	X

[0056]

As shown in Table 1, the toothbrushes in Examples 1, 2, and 3, to which the present invention was applied, exhibited excellent cleaning power inside the oral cavities and satisfactory impressions from use. Further, excellent operability in the oral cavities was obtained.

In contrast, the toothbrush in which $A \times B$ was less than 0.8 (Comparative Example 1) and the toothbrush in which $A \times B$ was greater than 10 (Comparative Example 2) did not exhibit sufficient cleaning power for the portions behind the back teeth, and satisfactory operability in the oral cavities was also not obtained.

[0057]

As shown in Table 2, the toothbrushes (Examples 4 to 9), to which the present invention was applied, exhibited excellent cleaning power inside the oral cavities and satisfactory impressions from use. Further, excellent operability in the oral cavities was obtained.

In contrast, at least one of the cleaning power for the portions behind the back teeth, the cleaning power for the periodontal pockets, the impressions from use, and the operability in the oral cavities was insufficient in the toothbrushes in which $A \times B$ was less than 0.8 and $A' \times B$ was less than 3 (Comparative Examples 3 to 7) as shown in Table 3.

It was confirmed from the above results that the toothbrushes, to which the present invention was applied, provided superior cleaning power inside the oral cavities and excellent impressions from use.

[Reference Signs List]

[0058]

1 Toothbrush

2 Head portion

4 Neck portion

6 Handle portion

10 Handle body

[CLAIMS]

What is claimed is:

[Claim 1]

A toothbrush comprising:

a handle body that includes a head portion, a neck portion that extends from the head portion, and a handle portion that extends from the neck portion,

wherein bristle bundles are implanted on a bristle implanted surface of the head portion by the metal piece-scheme bristle implanting,

a material of the handle body is polypropylene resin,

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

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

a value X of an amount of deflection (A/L_2) of the head portion per length L_2 (mm) of the head portion is 0.015 to 0.045, and

a ratio Y/X is 0.8 to 2.0 which is a ratio of a value Y of an amount of deflection ($B/(L_2 + L_3)$) of the neck portion per a sum of a length L_2 (mm) of the head portion and a length L_3 (mm) of the neck portion relative to the value X;

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

amount of displacement (a unit is mm) of the height from the reference height of the tip end of the handle body 10 seconds later is assumed to be the amount of deflection A of the head portion; and

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

[Claim 2]

A toothbrush comprising:

a handle body that includes a head portion, a neck portion that extends from the head portion, and a handle portion that extends from the neck portion,

wherein bristle bundles are implanted on a bristle implanted surface of the head portion by the metal piece-scheme bristle implanting,

a material of the handle body is polyacetal resin,

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

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

a value X of an amount of deflection ($A/L2$) of the head portion per length L2

(mm) of the head portion is 0.027 to 0.032, and

a ratio Y/X is 1.0 to 1.4 which is a ratio of a value Y of an amount of deflection ($B/(L2 + L3)$) of the neck portion per a sum of a length $L2$ (mm) of the head portion and a length $L3$ (mm) of the neck portion relative to the value X ;

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

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

[Claim 3]

The toothbrush according to claim 1 or 2,

wherein a width at a position where a width is the smallest in the neck portion is 3.0 to 4.5 mm.

[Claim 4]

The toothbrush according to claim 3,
wherein a thickness at a position where a thickness is the smallest in the neck portion is 3.0 to 4.5 mm.