

DESCRIPTION

TITLE OF INVENTION: DENTAL COMPOSITION, DENTAL
MILLING RESIN MATERIAL, AND METHOD OF PRODUCING
DENTAL MILLING RESIN MATERIAL

5

TECHNICAL FIELD

[0001]

The present invention relates to dental
compositions, dental milling resin materials, and
10 methods of producing dental milling resin materials.

BACKGROUND ART

[0002]

In recent years, prostheses, such as
15 crowns, bridges, or the like, are designed on-screen
using computers, and CAD/CAM devices that perform
milling to produce prostheses are used in production
of dental prostheses. Thus, dental prostheses with
consistent quality can be reliably supplied in a
20 short time.

[0003]

For milling performed by the CAD/CAM
devices, a dental milling resin material (also
referred to as a dental resin block or dental milling
25 blank), which is obtained by forming a dental resin

into a block, is used as a material before cutting
into a shape (see, for example, Patent Document 1).

CITATION LIST

5 PATENT DOCUMENT

[0004]

Patent Document 1: Japanese Patent No. 6739809

SUMMARY OF THE INVENTION

10 TECHNICAL PROBLEM

[0005]

As the above-described dental milling resin
material, a resin material having a higher mechanical
strength is desired in order to ensure stability of a
15 prosthesis in the oral cavity.

[0006]

An object of the present invention is to
provide a dental composition with which a dental
milling resin material having a high mechanical
20 strength can be obtained.

SOLUTION TO THE PROBLEM

[0007]

According to one aspect of the present
25 invention, a dental composition includes a

polymerizable monomer including only one group selected from the group consisting of a urethane group, a urea group, and a carbonate group; and an inorganic filler.

5

EFFECTS OF THE INVENTION

[0008]

According to one aspect of the present invention, a dental composition, with which a dental milling resin material having a mechanical strength can be obtained, is provided.

10

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0009]

Next, an embodiment for implementing the present invention will be described.

15

[0010]

<Dental composition>

The dental composition of the present embodiment includes a polymerizable monomer including only one group selected from the group consisting of a urethane group, a urea group, and a carbonate group (referred to as one urethane group or the like hereinafter); and an inorganic filler. In the present specification, the dental composition refers

20

25

to a composition used in the field of dentistry.

[0011]

The urethane group is a bonding group represented by -NHCOO-. The urea group is a bonding
5 group represented by -NHCONH-. The carbonate group is a bonding group represented by -OCOO-.

[0012]

The polymerizable monomer including only one urethane group or the like includes one urethane
10 group or the like, but does not include two or more urethane groups or the like.

[0013]

The polymerizable monomer including only one urethane group or the like is not particularly
15 limited. For example, the polymerizable monomer including only one urethane group or the like is (meth)acrylate including one urethane group or the like. In the present specification, the (meth)acrylate refers to a compound including a
20 methacryloyloxy group, an acryloyloxy group, or both (referred to as a (meth)acryloyloxy group hereinafter).

[0014]

The (meth)acrylate including only one
25 urethane group or the like is preferably

(meth)acrylate including two or more
(meth)acryloyloxy groups.

[0015]

The (meth)acrylate including only one
5 urethane group or the like is, for example,
represented by the following formula (1).

[0016]

[Chem. 1]



10 [0017]

In the formula (1), A₁ and A₂ are each
independently a (meth)acryloyloxy group or
(meth)acrylamide group that may include an alkyl
group having a carbon number of 3 or less in a side
15 chain; B is a urethane group; and R₁ and R₂ are each
independently an alkyl group having a carbon number
of 8 or less, in which a (meth)acryloyloxy group or a
(meth)acrylamide group may be included in a side
chain.

20 [0018]

The (meth)acrylamide group refers to a
methacrylamide group, an acrylamide group, or both.
The acrylamide group refers to a substituent
represented by -NHCO(CH=CH₂).

[0019]

In A₁ and A₂, it is preferable that the carbon number of the alkyl group included in the side chain of the (meth)acryloyloxy group or the (meth)acrylamide group is 2 or less, or the side chain of the (meth)acryloyloxy group or the (meth)acrylamide group does not include an alkyl group. In addition, in R₁ and R₂, the carbon number of the alkyl group is preferably 5 or less.

10 [0020]

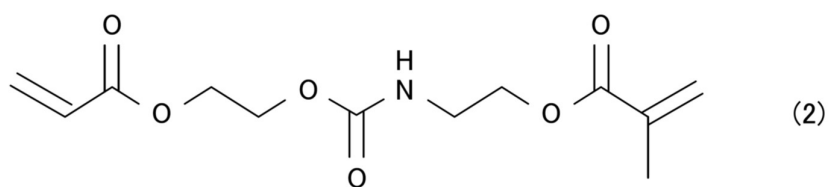
When the carbon number of the alkyl group is 9 or greater in R₁ and R₂, the polymerizable monomer including only one urethane group or the like is easily distorted, and a cured product obtained by curing a dental composition including such a polymerizable monomer cannot have a sufficient mechanical strength.

[0021]

The (meth)acrylate represented by the above formula (1) is not particularly limited. For example, (meth)acrylate represented by the above formula (1) is (meth)acrylate including only one urethane group (-NHCOO-) represented by any of the following formulae (2) to (6).

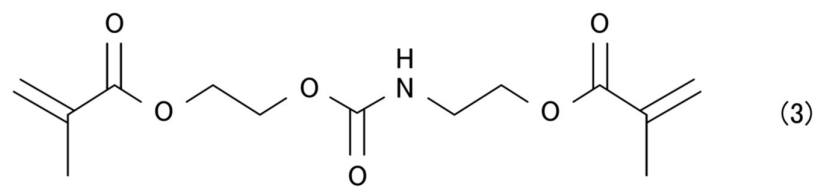
25 [0022]

[Chem. 2]



[0023]

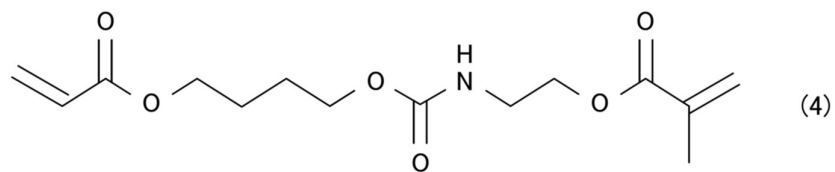
[Chem. 3]



5

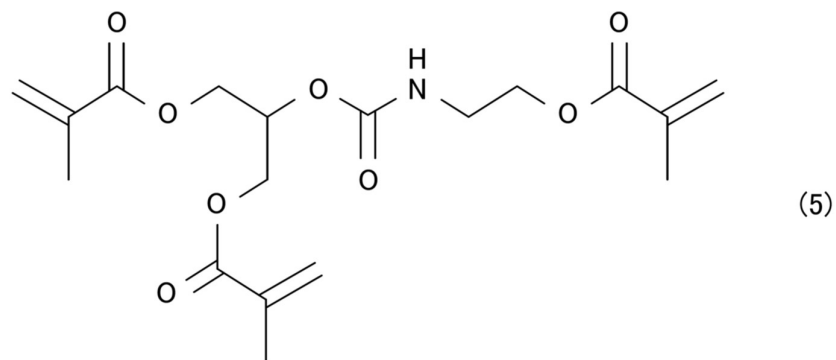
[0024]

[Chem. 4]



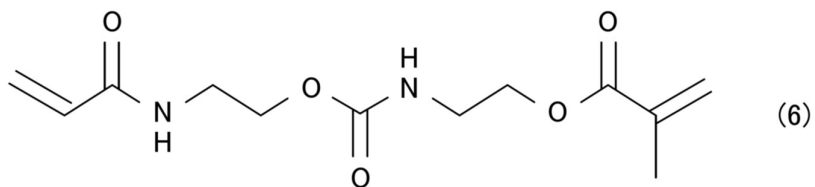
[0025]

10 [Chem. 5]



[0026]

[Chem. 6]



5 [0027]

An amount of the polymerizable monomer including only one urethane group or the like in the dental composition is not particularly limited, but is preferably 5 percent by mass or greater and 30 percent by mass or less, more preferably 10 percent by mass or greater and 28 percent by mass or less, and yet more preferably 15 percent by mass or greater and 25 percent by mass or less. When the amount of the polymerizable monomer including only one urethane group or the like is 5 percent by mass or greater and 30 percent by mass or less, a cured product of the

10

15

dental composition can maintain a high mechanical strength.

[0028]

The amount of the polymerizable monomer including only one urethane group or the like varies depending on the intended use of the dental composition. In the case where the intended use of the dental composition is a dental milling resin material, the amount of the polymerizable monomer including only one urethane group or the like is preferably 5 percent by mass or the like and 30 percent by mass or less, and more preferably 10 percent by mass or the like and 25 percent by mass or less.

15 [0029]

The inorganic filler is formed of an inorganic material, and the inorganic filler is included in a resin composition in a form of particles. The inorganic filler is not particularly limited. Examples of the inorganic filler include barium glass, strontium glass a silica powder, and the like.

[0030]

As the inorganic filler, an inorganic filler subjected to a hydrophobic treatment is

25

preferably used. For the hydrophobic treatment of the inorganic filler, for example, a silane-coupling agent is used. Examples of the silane-coupling agent include 3-methacryloyloxypropyltrimethoxysilane, 8-
5 methacryloyloxyoctyltrimethoxysilane, and the like.
[0031]

A usage amount of the silane-coupling agent is preferably 0.1 percent by mass or greater and 15 percent by mass or less, more preferably 0.5 percent
10 by mass or greater and 10 percent by mass or less, and yet more preferably 1 percent by mass or greater and 5 percent by mass or less, relative to 100 percent by mass of the inorganic material constituting the inorganic filler.
15 [0032]

A particle size of the main inorganic filler is, for example, preferably 0.1 μm or greater and 100 μm or less, more preferably 0.1 μm or greater and 70 μm or less, and yet more preferably 0.1 μm or
20 greater and 50 μm or less. The particle size refers to an average particle diameter defined by a median diameter (d50).
[0033]

An amount of the inorganic filler in the
25 dental composition is not particularly limited, but

is preferably 70 percent by mass or greater and 90 percent by mass or less, more preferably 72 percent by mass or greater and 85 percent by mass or less, and yet more preferably 75 percent by mass or greater
5 and 82 percent by mass or less. When the amount of the inorganic filler is less than 70 percent by mass, a sufficient mechanical strength cannot be obtained. When the amount of the inorganic filler is greater than 90 percent by mass, a viscosity of the dental
10 composition is significantly increased, and therefore a problem may be caused, such that air bubbles are included in a cured product at the time when the dental composition is cured.

[0034]

15 An amount of the inorganic filler in the dental composition varies depending on the intended use of the dental composition. In the case where the intended use of the dental composition is a dental milling resin material, the amount of the inorganic
20 filler is preferably 70 percent by mass or greater and 90 percent by mass or less, and more preferably 75 percent by mass or greater and 85 percent by mass or less.

[0035]

25 The dental composition of the present

embodiment may further include polymerizable monomers other than the polymerizable monomer including only one urethane group or the like (referred to as other polymerizable monomers hereinafter).

5 [0036]

As other polymerizable monomers, (meth)acrylate that does not include a urethane group, and (meth)acrylate including two or more urethane groups can be used.

10 [0037]

Examples of other polymerizable monomers include 2,2-bis(4-methacryloyloxypropyl)propane (Bis-MPEPP), glycerol dimethacrylate (GDMA), neopentyl glycol dimethacrylate (NPGDMA), triethylene glycol dimethacrylate (TEGDMA), bisphenol A glycidyl methacrylate (Bis-GMA), tricyclodecane dimethanol dimethacrylate (DCP), trimethylolpropane trimethacrylate (TMPT), dipentaerythritol hexaacrylate (A-DPH), and the like.

[0038]

Examples of the (meth)acrylate including two or more urethane groups include di-2-methacryloyloxyethyl-2,2,4-trimethylhexamethylene dicarbamate (UDMA), and the like.

25

[0039]

As other polymerizable monomers, one polymerizable monomer may be used alone, or two or more polymerizable monomers may be used in
5 combination.

[0040]

An amount of other polymerizable monomers in the dental composition is not particularly limited, but is preferably 1 percent by mass or
10 greater and 70 percent by mass or less, more preferably 5 percent by mass or greater and 60 percent by mass or less, and yet more preferably 10 percent by mass or greater and 50 percent by mass or less. When the amount of other polymerizable
15 monomers is 1 percent by mass or greater and 70 percent by mass or less, a cured product of the dental composition can maintain a high mechanical strength.

[0041]

20 The dental composition of the present embodiment may optionally include other ingredients as long as other ingredients do not adversely affect the object of the present invention. Examples of other ingredients included in the dental composition
25 include a polymerization initiator, a polymerization

accelerator, a polymerization inhibitor, a chain transfer agent, a filler (excluding the above inorganic filler), a coloring material, a pigment, a fluorescent agent, an antibacterial agent, and the like.

[0042]

Examples of the polymerization initiator include organic peroxide, such as benzoyl peroxide and the like. As the polymerization initiator, one polymerization initiator may be used alone, or two or more polymerization initiators may be used in combination.

[0043]

An amount of the polymerization initiator in the dental composition is not particularly limited, but is, for example, 0.005 percent by mass or greater and 10 mass or less, preferably 0.01 percent by mass or greater and 5 percent by mass or less, and yet more preferably 0.1 percent by mass or greater and 3 percent by mass or less. When the amount of the polymerization initiator in the dental composition is 0.005 percent by mass or greater and 10 mass or less, a polymerization efficiency at the time when the dental composition is cured is improved.

[0044]

Examples of the filler include: inorganic fillers other than the above inorganic filler, such as silica zirconia, silica alumina, and the like; organic-inorganic hybrid fillers; cluster fillers; and the like. As the filler, a filler subjected to a hydrophobic treatment is preferably used. For the hydrophobic treatment of the filler, for example, a silane-coupling agent, such as 3-methacryloyloxypropyltrimethoxysilane or the like, can be used.

[0045]

Examples of the pigment include iron oxide, titanium oxide, and the like.

15 [0046]

Examples of the fluorescent agent include diethyl-2,5-dihydroxyterephthalate, and the like.

[0047]

As described above, the dental composition of the present embodiment includes the polymerizable monomer including only one urethane group or the like. The polymerizable monomer including only one urethane group or the like tends to have a relatively low viscosity compared to a polymerizable monomer including two or more urethane groups. Therefore, as

the dental composition includes the polymerizable monomer including only one urethane group or the like, an amount of the inorganic filler in the dental composition can be increased compared to a dental composition of a related art so that a mechanical strength (e.g., flexural strength) of a polymerization cured product of the dental composition can be improved.

[0048]

The dental composition of the present embodiment can be used for various dental materials because an effect of improving a mechanical strength of a polymerization cured product can be obtained as described above.

[0049]

Examples of the dental materials include dental milling resin materials, composite resins for dental filling, dental hard resins, dental temporary restorative materials, dental fillers, dental cements, dental adhesives (including primers for crown restoration adhesion), dental primers, tooth surface coating materials, dentifrices, and the like. Among the above dental materials, the dental composition of the present embodiment is suitably used for a dental milling resin material.

[0050]

<Dental milling resin material>

The dental milling resin material of the present embodiment can be formed by curing the above-
5 described dental composition through polymerization. Specifically, the above-described dental composition is used in the dental milling resin material of the present embodiment.

[0051]

10 An embodiment of curing the dental composition through polymerization is not particularly limited. Examples of the embodiment include polymerization methods, such as thermal polymerization, chemical polymerization,
15 photopolymerization, and the like.

[0052]

Since the dental composition of the present embodiment is used in the dental milling resin material of the present embodiment, the effects of
20 the dental composition can be obtained as they are. Specifically, a mechanical strength of the dental milling resin material obtained as a cured product can be improved by curing the dental composition, which includes the polymerizable monomer including
25 only one urethane group or the like, and the

inorganic filler, through polymerization.

[0053]

<Method of producing dental milling resin material>

5 The method of producing the dental milling resin material according to the present embodiment includes curing the above-described dental composition through polymerization. Specifically, the above-described dental composition is used in the
10 method of producing the dental milling resin material according to the present embodiment.

[0054]

 An embodiment of curing the dental composition through polymerization is not
15 particularly limited, and the same polymerization method (e.g., thermal polymerization, chemical polymerization, photopolymerization, or the like) as the polymerization method used for the above-described dental milling resin material when the
20 dental composition is polymerized and cured is used.

[0055]

 The polymerization conditions for curing the dental composition through polymerization are arbitrary. For example, the polymerization
25 temperature is 50°C or higher and 200°C or lower,

preferably 80°C or higher and 180°C or lower, and more preferably 110°C or higher and 150°C or lower. In addition, the duration of the polymerization is 20 minutes or longer and 360 minutes or shorter, preferably 60 minutes or longer and 240 minutes or shorter, and more preferably 100 minutes or longer and 180 minutes or shorter.

[0056]

The polymerization of the dental composition may be performed under pressure. In this case, the pressure is 1.0 MPa or greater and 10.0 MPa or less, preferably 2.0 MPa or greater and 8.0 MPa or less, and more preferably 3.0 MPa or greater and 5.0 MPa or less.

[0057]

Since the dental composition of the present embodiment is used in the method of producing the dental milling resin material according to the present embodiment, the effects of the dental composition are obtained as they are. Specifically, a mechanical strength of the dental milling resin material obtained as a cured product can be improved by curing the dental composition, which includes the polymerizable monomer including only one urethane group or the like, and the inorganic filler, through

polymerization.

[0058]

In the method of producing the dental milling resin material according to the present embodiment, a dental milling resin material can be produced merely by using the polymerizable monomer including only one urethane group or the like as a polymerizable monomer to be included in a dental composition. Specifically, a dental milling resin material can be produced using only a single monomer in the production method of the present embodiment.

[0059]

In the case where monomers are mixed and blended, instead of use of a single monomer, there is a risk such that a variation in quality is concerned depending on the purity of other monomers (the risk increases the number of monomer increases). In addition, in the case where monomers are mixed and blended, instead of use of a single monomer, monomers may not be homogeneously mixed (the risk of decreasing the homogeneousness of the quality increases).

[0060]

Conversely, a dental milling resin material can be producing using only a single monomer in the

method of producing the dental milling resin material according to the present embodiment, and therefore a risk of contamination with foreign matter can be reduced because of reduction in the number of
5 production steps. In addition, since the dental milling resin material is produced using only a single monomer, the production process can be simplified so that the production cost can be reduced in terms of materials, facilities, or the like.

10

Examples

[0061]

Examples of the present invention will be described hereinafter, but the present invention is
15 not limited to Examples. Numerical values without units are based on mass (percent by mass), unless otherwise specified.

[0062]

<Production of dental milling resin
20 material (resin block)>

As a dental composition, a dental milling resin material (resin block) was produced. First, a curable polymerizable monomer (monomer) and a polymerization initiator (BPO) were mixed at a
25 composition ratio presented in Tables 1 and 2 to

prepare a monomer liquid.

[0063]

The ingredients presented by symbols or abbreviations in Tables 1 and 2 are as follows.

- 5 mUDMA: (meth)acrylate represented by the above
formula (3)
mUA/MA-1: (meth)acrylate represented by the above
formula (2)
mUA/MA-2: (meth)acrylate represented by the above
10 formula (4)
mUTMA: (meth)acrylate represented by the above
formula (5)
mUAA/MA: (meth)acrylate represented by the above
formula (6)
15 UDMA: di-2-methacryloyloxyethyl-2,2,4-
trimethylhexamethylenedicarbamate
D-2.6E: 2,2-bis(4-methacryloyloxy
polyethoxyphenyl)propane, in which the average number
of moles of the ethoxy group added is 2.6
20 GDMA: glycerol dimethacrylate
NPGDMA: neopentyl glycol dimethacrylate
TEGDMA: triethylene glycol dimethacrylate
BPO: benzoyl peroxide (polymerization initiator)

[0064]

- 25 The monomer liquid and the inorganic filler

(silica powder + silane-treated glass) were mixed at a blending ratio [percent by mass] presented in Tables 3 and 4 by a planetary centrifugal mixer (or a double planetary mixer) to prepare a paste. A
5 molding container was filled with the resultant paste, and the paste was then polymerized and cured in a nitrogen gas at the pressure of 1.0 MPa to 5.0 MPa for 60 minutes to 180 minutes at 100°C to 130°C to obtain a cured block (Examples 1 to 16 and
10 Comparative Examples 1 to 5).
[0065]

The ingredients presented by symbols or abbreviations in Tables 3 and 4 are as follows.
Silica powder: AEROSIL (manufactured by NIPPON
15 AEROSIL CO., LTD., AEROSIL is a registered trademark)
Silane-treated glass: a barium glass powder surface-treated with 8-methacryloyloxyoctyltrimethoxysilane (average particle diameter: 0.7 μm)
[0066]

20 <Paste viscosity>

The viscosity of the paste was measured at 25°C at the shear rate of 1 [1/s] by a rheometer (MCR 302e, manufactured by Anton Paar Japan K.K.).
[0067]

25 <Flexural strength test>

A specimen in the size of 1.2 mm × 4.0 mm × 14.0 mm was cut out from the cured block by a diamond cutter, and each surface of the specimen was finished with water-resistant abrasive paper of P2000. A
5 three-point flexural strength test was performed by a universal testing machine (AG-Xplus, manufactured by Shimadzu Corporation) under the conditions such that a distance between supporting points was 12 mm and a cross head speed was 1.0 mm/min, to measure a three-
10 point flexural strength and flexural modulus.
[0068]

The three-point flexural strength was calculated according to the following equation (7).
[0069]

15 [Math. 1]
$$[MP_a] = 3FS/(2bh^2) \quad (7)$$

[0070]

In the equation (7), F is the maximum load [N] measured in the flexural strength test, S is the
20 distance [mm] between supporting points, b is a width [mm] of the specimen measured immediately before the test, and h is a thickness [mm] of the specimen measured immediately before the test. As the
evaluation of the three-point flexural strength, the
25 result was determined as good when the three-point

flexural strength was 310 MPa or greater, and the result was determined as not good when the three-point flexural strength was less than 310 MPa.

[0071]

5 The flexural modulus was calculated from a strain-stress curve obtained in the three-point flexural strength test according to the secant method. As the evaluation of the flexural modulus, the result was determined as good when the flexural
10 modulus was 8 GPa or greater, and the result was determined as not good when the flexural modulus was less than 8 GPa.

[0072]

<Milling processability>

15 Contact processability when the cured block was milled by a milling machine (Aadva Harmony WET, manufactured by GC Corporation) was examined. The contact processability was evaluated based on whether the contact processability of the cured block was
20 comparable to contact processability of a dental milling resin material of a related art (cured block of a related art).

[0073]

[Table 1]

[illegible]

[0074]

[Table 2]

Monomer liquid composition	Comparative Example				
	1	2	3	4	5
mUDMA					
mUA/MA-1					
mUA/MA-2					
mUTMA					
mUAA/MA					
UDMA	100		60	85	60
D-2.6E		100	30		30
GDMA			10	10	
NPGDMA				5	
TEGDMA					10
BPO	1.5	1.5	1.5	1.5	1.5
Total	101.5	101.5	101.5	101.5	101.5

[0075]

5 [Table 3]

[0076]

[Table 4]

	Comparative Example				
	1	2	3	4	5
Monomer liquid	29.4	29.4	22.8	20.5	21.2
Inorganic filler (silica powder + silane-treated glass	70.6	70.6	77.2	79.5	78.8
Total	100	100	100	100	100
Paste viscosity [Pa·s]	123	162	201	255	194
3-point flexural strength [MPa]	244	219	305	307	296
Flexural modulus [GPa]	7.7	7.1	10.7	11.8	11.0
Milling processability	Good	Good	Good	Good	Good

[0077]

With reference to Tables 1 and 3, in Examples 1 to 16, the resin block obtained using the dental composition including the polymerizable monomer including only one urethane group and the inorganic filler had the desired results in both the three-point flexural strength and the flexural modulus.

[0078]

Conversely, with reference to Tables 2 and 4, in Comparative Examples 1 to 5, the resin block obtained using the dental composition that did not include the polymerizable monomer including only one urethane group had the undesirable result in the three-point flexural strength. In addition, in Comparative Examples 1 to 2, the result of the flexural modulus was not good.

[0079]

Although the embodiments of the present invention have been described above, the present invention is not limited to the specific embodiments, and various modifications and changes can be made within the scope of the invention described in the claims.

[0080]

The present application is based on and
claims priority to Japanese Patent Application No.
2023-068578, filed on April 19, 2023, the entire
contents of which are incorporated herein by
5 reference.

CLAIMS

[Claim 1]

A dental composition comprising:

5 a polymerizable monomer including only one
group selected from the group consisting of a
urethane group, a urea group, and a carbonate group;
and
 an inorganic filler.

10

[Claim 2]

A dental milling resin material, obtained
by curing the dental composition according to claim 1
through polymerization.

15

[Claim 3]

A method of producing a dental milling
resin material, the method comprising:
 curing the dental composition according to
20 claim 1 through polymerization.