May 28, 1963 I. A. ELLMAN 3,091,033

DENTAL CLEANING TOOL, APPARATUS, AND METHOD

Filed June 2, 1961

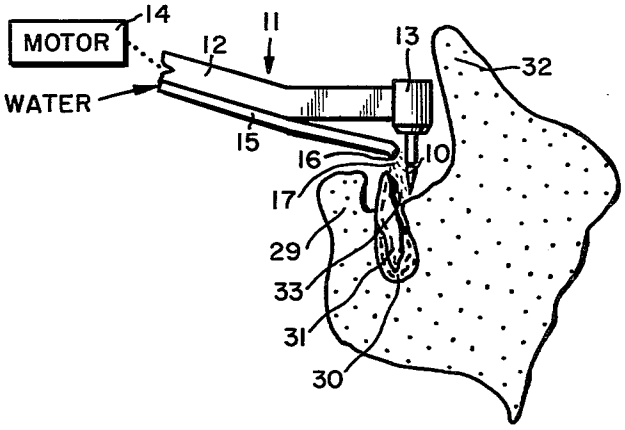

Fig. 1

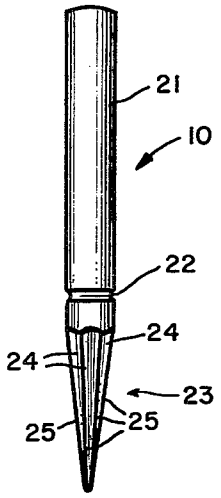

Fig. 2

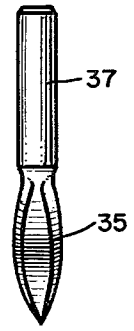

Fig. 4

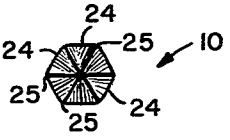

Fig. 3

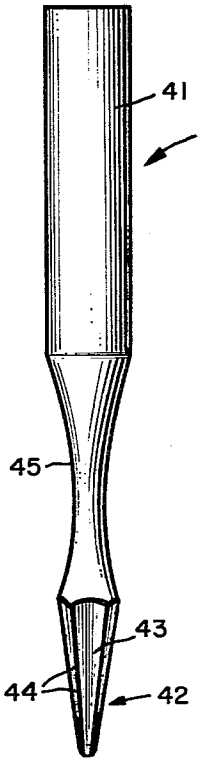

Fig. 6

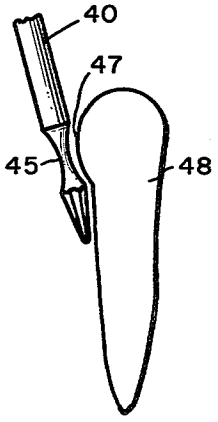

Fig. 7

Fig. 8

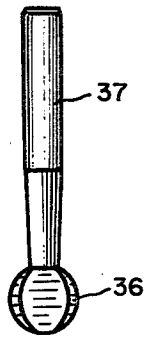

Fig. 5

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DENTAL CLEANING TOOL, APPARATUS, AND METHOD

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This invention relates to dental tools and apparatus for teeth cleaning and prophylaxis, and to a new method therefor. It relates, particularly, to tools, apparatus and a method for removing hard calculus deposits from and for polishing teeth. This application is a continuation-in-part of my prior copending application, Serial No. 830,272, filed July 29, 1959, and now abandoned.

It has been demonstrated that removal of calculus from teeth is essential in the prevention and treatment of periodontal disease. Until recently, hand instruments have been the sole means available to dentists for this purpose. These hand instruments have been generally referred to as scalers, and include the usual planes, chisels, hoes or curettes, which are hand reciprocated by the dentist over the tooth surfaces to scrape or chip off or dislodge the adherent calculus, commonly known as tartar. This technique, still widely used, exhibits many disadvantages. Firstly, it is very painful for the patient and is usually accompanied by considerable bleeding. Secondly, it is fundamentally unsound and inefficient, because, though the tooth surfaces are round, the scalers have essentially flat cutting edges that gouge, flatten or facet the rounded tooth surfaces. A third disadvantage is the difficulty in doing subgingival calculus removal, which requires insertion of the scaler in the periodontal pocket. Fourthly, it is slow and tedious. Finally, with this known technique it is impossible to polish the exposed root surfaces of the teeth, which many dental authorities have indicated to be a critical phase of proper gingivectomy.

Some of these disadvantages have been partially obviated by the introduction of an ultrasonic prophylaxis device. This is an electronic device comprising a handpiece containing a magnetostrictive body, which, when suitably energized, causes a tip to reciprocate up and down at an ultrasonic frequency. When employed in connection with a water spray, it has been found possible to remove calculus both supragingivally and subgingivally without substantial pain or bleeding. However, the device is quite expensive and thus few dentists make use of it. Further, care must be exercised during its use to prevent excessive damage to the gingival tissue and root gouging. Still further, it is still not possible with this device to obtain root polishing.

I have invented a new tool and apparatus and method for tooth prophylaxis that overcomes all of the disadvantages referred to above. My new cleaning tool comprises a smooth, non-abrasive, multisided, preferably tapered, symmetrical member having no cutting edges. It is adapted to be mounted in the usual rotary, highspeed handpiece and rotated at a speed generally in excess of 100,000 r.p.m. (revolutions per minute). The rotating tool is then brought into contact with the tooth surfaces, whereupon it is found that calculus deposits miraculously vanish, and in a short period of time all exposed calculus, both supragingivally and subgingivally is removed without any damage to the tooth enamel or the gingival tissue. An unexpected result of my invention is complete tooth prophylaxis without pain and without bleeding in virtually all cases. A further feature of my invention is a novel tool construction that enables the tool to reach exposed root surfaces permitting root polishing to be accomplished, which, it is believed, was never heretofore possible without curettage.

My invention will now be described in greater detail with reference to the accompanying drawing, in which:

FIG. 1 illustrates a portion of a human lower jaw including a tooth showing the dental tool and apparatus of the invention used in the treatment of the tooth;

FIG. 2 is a front view of a tool in accordance with the invention;

FIG. 3 is a bottom end view of the tool of FIG. 2;

FIGS. 4 and 5 are front views of modifications;

FIG. 6 is a front view of a preferred tool in accordance with the invention;

FIGS. 7 and 8 show the tool of FIG. 6 in use on teeth.

In FIG. 1 is illustrated the tool **10** of FIGS. 2 and 3 mounted in a high-speed dental handpiece **11** of a type well known in the dental art. The handpiece **11** comprises the usual handle **12** terminating in a chuck head **13** adapted to receive and hold the tool **10** for rotary movement therewithin. The mechanism for driving or rotating the tool **10** may include the usual belt and pulley system activated by an electric motor **14**, or it may include an air driven mechanism. The precise means is unimportant. All that is important is that the tool **10** can be rotated in the handpiece at a speed of the order of 100,000 r.p.m., generally between 80,000 and 250,000 r.p.m., 120,000 r.p.m. being an easily obtainable value. A water tube **15** extends along the underside of the handle **12**, its end terminating in a nozzle **16** or orifice directed toward the tool **10**. When water is directed through the tube **15**, it will emerge from the nozzle **16** in the form of a spray **17** impinging on the tooth then being treated. The handpiece **11** and associated water spray, being well known in the art and commercially available, have not been illustrated in detail and needn't be further described. The tool **10**, which is shown in greater detail in FIGS. 2 and 3, comprises a one-piece, straight, axially-symmetrical steel member having an upper cylindrical shank portion **21**, an intermediate annular recess **22**, and a tapering active or cleaning portion **23**, all symmetrical about a common central longitudinal axis. The shank portion **21** is adapted to be held in the chuck **13**. The recess **22** is provided as a gripping surface to enable the dentist to pick up the tool **10** with tweezers or the like to place into the chuck **13** where it is removably retained when the chuck is tightened. The active part of the tool **10** comprises the lower part **23**, which comprises six, smooth, flat, generally triangular surfaces **24** intersecting each other at an obtuse angle of 120° to form six corners **25**. The active part is therefore hexagonal in cross-section. Since the corners are formed by surfaces intersecting at an obtuse angle, no cutting edges are formed. In fact, the corners **25** may even be rounded off, but they must remain distinct as corners, in that their distance to the center axis of the tool should be at least 5% greater than the distance from the center of the flat surface **24** to the axis. While the surfaces **24** are preferably flat, they also may be slightly concave, which still, preferably, form obtuse angles with each other.

In operation, the tool **10** is rotated about its central axis within the handpiece at a speed, say, of 120,000 r.p.m. Then the dentist brings the rotating tool into contact with the calculus deposits on the tooth. When the rotating tool, which is travelling 2,000 r.p.s. (revolutions per second), is urged against the tartar, the tartar becomes impacted at a rate of $6 \times 2000 = 12{,}000$ times per second. Each second the tool makes 2,000 revolutions, and during each revolution, each of the six corners strikes the tartar in succession as the tool rides up from each flat side to the corner. These 12,000 impacts per second cause the tartar to vibrate at this rate, as a consequence of which it disintegrates or loosens, and thus can be readily removed by the patient rinsing or the dentist directing a jet of air

or water to remove the disintegrated or loosened tartar. Thus, cleaning can be effected without a simultaneous water spray, though the latter is preferred.

In the preferred technique, the water spray is turned on when the rotating tool is brought into contact with the tooth surfaces. The tool is preferably moved lightly back and forth over the surface to be cleaned. Used with a contrangle, it thus becomes possible to reach any and every surface of every tooth in all parts of the mouth. FIG. 1 shows the lower jaw portion of a patient including the lower lip **29**, the lower jaw bone **30** in which a tooth **31** is rooted and the tongue **32**. On the tooth **31** is an accumulation of hard calculus matter or tartar as at **33**. As will be noted in the figure, the water spray from the tube **15** impinges on the tooth and tartar and on the rotating tool. Hence, as the tool disintegrates or loosens the tartar, it immediately washes away under the action of the water jet. Further, the water itself impinging on the rotating tool becomes ultrasonically agitated which assists in the rapid and complete removal of the tartar.

The tool **10** is constructed so that the number of corners present multiplied by its speed of rotation will produce vibration of the tartar at a frequency in the ultrasonic range, from 10,000 c.p.s. (cycles per second) upward. This not only results in rapid break-up of the tartar into an easily removable powder, but, equally important, it is a frequency beyond the significant area of perception for most people. Thus, the patient does not sense any annoying rotation or vibration, but only feels that a round instrument is being passed gently over the tooth surfaces. Since the corners do not cut or in any way injure the gingival tissue, there is no pain and usually no bleeding. This makes it far more acceptable to the patient and should lead to more frequent prophylactic treatments and thus reduce the incidence of periodontal disease.

That the theory described above in explaining the operation of the invention is correct is confirmed by tests that have been conducted demonstrating that ultrasonic vibrations are indeed imparted to a surface against which is urged the rotating tool of the invention. Another confirmatory fact is the useful lifetime of the tool. It is found that after cleaning about 200 teeth, the wear of the corners tends to reduce the cross-section of the cleaning portion **23** of the tool to a circle. When almost a circle is reached the tool no longer is able to remove the tartar efficiently and replacement by a new tool becomes necessary. No cutting action occurs with the tool, not only because of its lack of sharp edges, but also because, being of ordinary tool steel, after its use on a few teeth, any sharp edges that might exist at the corners of a new tool become quickly worn or rounded off making it impossible for the tool to cut even the soft gingival tissue. Tests have also demonstrated that the tool is completely safe. It takes on the average less than 20 seconds to clean a tooth, yet the rotating tool has been held against extracted teeth for up to 300 seconds before a noticeable mark appeared. Rapid cleaning of the tooth is so readily obtained because a wide area of the tooth can be treated at one time. Since the tool rotates about an axis parallel to the tooth axis, it automatically provides complete coverage of the tooth when moved around the curvature of the tooth, producing a clean, smooth surface on the tooth that resists further accumulation of tartar.

FIGS. 4 and 5 show other tool shapes useful in accordance with the invention. The tool of FIG. 4 has a flame-shaped end **35** and that of FIG. 5 a ball-shaped end **36**. Both have six sides and a hexagonal cross-section, and the usual shank portion **37**. In general, the number of sides of the active portion will lie between four and eight, and preferably is six. If too few corners are provided, too high a rotational speed is necessary to produce the ultrasonic vibrations, which speeds may not be accessible to most dentists who now possess the usual high-speed handpiece. If too many corners are provided, they tend to lose their distinctness, which reduces the intensity of the vibration.

The tool of FIGS. 2 and 3 has proved satisfactory for all supragingival prophylaxis. A commercial tool now widely used has the following dimensions: an overall length of 7/8 inch, a tapered length of 5/16, a width at the top of the taper of 1/16 inch, and a width at the botom of the taper of about 1/100 inch, the taper being about 10°. The tool has also proved useful in subgingival calculus removal, since the slender end can be inserted into the periodontal pocket. However, for the latter purpose and also to perform root polishing, the tool shape illustrated in FIG. 6 is far superior.

The tool **40** illustrated in FIG. 6 comprises a shank portion **41** adapted to be detachably held by the chuck **13**, and a working end having two essential parts. At the bottom, similarly to the tool illustrated in FIGS. 2 and 3, there is provided a six-sided tapered body **42**. The tapered end **42** has smooth sides **43** forming six corners **44** and a hexagonal cross-section, and is symmetrical about a center longitudinal axis and thus adapted for rotary motion. The tapered end **42** is about one-third to one-half the length of the tapered part **23** of the tool shown in FIGS. 2 and 3, and the remaining two-thirds to one-half is smoothly recessed or contoured, as shown, to provide an annular concave portion **45**. For example, the radius of curvature may be about ½ inch, with a diameter at the top of the taper of about 1/16 inch, and the smallest diameter at the neck of the concave portion **45** being about 3/100 inch. Preferably, the tapered end has a larger taper than that of the tool of FIGS. 2 and 3, for example 15°.

FIG. 7 shows the manner in which the tool **40** is used. As usual, it is rotated at a high speed preferably between 100,000 and 200,000 r.p.m., so that the tooth surfaces are impacted and vibrated at a frequency of 10,000 to 20,000 c.p.s. When the rotating tapered end is placed in the gingival crevice or periodontal pocket, the contoured hegion **45** accommodates the bell-shaped tooth crown **47**, and thus the flat side of the tool is enabled fully to contact the root surfaces **48** in the deepest pocket. Complete removal of calculus present is quickly accomplished without pain or damage to soft tissue and with at most only very minor bleeding. Moreover, the rapid impacts by the tool surfaces polishes the roots rendering them smooth without any flats, grooves or concavities, a result not believed possible with any other known technique. Since the tool rotates about an axis essentially parallel to that of the tooth, cleaning of the root takes place over a large area as the tool is moved around the curvature of the tooth thus keeping the time consumption to a minimum. The absence of cutting edges and any cutting action prevents destruction of periodontal attachment or surrounding soft tissue. FIG. 8 shows how the special shape of the tool **40** enables it easily to reach deposits on the concave lingual surface of lower anterior teeth, which was not possible with the tool of FIG. 2.

The tool also can be used as a periodontal probe to measure or indicate the depth of the periodontal pocket. The dimensions previously indicated provide the multi-sided tip with a length of about 1/8 inch. By stopping the rotation of the tool, and probing the pocket, a rapid and fairly accurate estimate can be made of the pocket depth as determined by the location of the top of the tapered end. Also, indicia or markings can be provided at spaced locations along the length of the tool. The tool is also useful when rotated to remove excess cement from an area where a crown has been freshly cemented.

While I have described my invention in connection with specific embodiments and applications, other modifications thereof will be readily apparent to those skilled in this art without departing from the spirit and scope of the invention as defined in the appended claims.

What is claimed is:

1. A dental cleaning tool comprising a straight tool

bit having a shank portion at one end and a cleaning portion at the other end both having a common central axis, said cleaning portion comprising an elongated body symmetrical about said central axis and tapering substantially to a point at its end remote from the shank portion, said cleaning portion being constituted of between four and eight elongated smooth side portions symmetrically disposed about said central axis and forming at their junctions obtuse-angled corners, whereby when said tool bit is rotated about its axis at very high speeds and brought into contact with hard tooth deposits, ultrasonic vibrations are imparted thereto leading to their rapid disintegration and removal without injury to the tooth or surrounding soft tissue.

2. A dental cleaning tool as set forth in claim 1, wherein said cleaning portion has a hexagonal cross-section.

3. A dental cleaning tool as set forth in claim 1, wherein said shank portion has an annular recess at a region thereof adjacent the cleaning portion.

4. A dental cleaning tool comprising a straight tool bit having a shank portion at one end, a cleaning portion at the other end and an intermediate portion connecting the shank to the cleaning portion and all having a common central axis, said cleaning portion comprising an elongated body symmetrical about said central axis and tapering substantially to a point at its end remote from the shank portion and constituted of plural elongated smooth side portions symmetrically disposed about said central axis and forming at their junctions obtuse-angled corners, said intermediate portion having a recessed concave portion of a size and depth accommodating a tooth crown and extending from the shank to the larger end of the tapering portion, whereby when said tool bit is rotated about its axis at very high speeds and brought into contact with hard tooth deposits even at the base of the tooth, ultrasonic vibrations are imparted thereto leading to their rapid disintegration and removal without injury to the tooth or surrounding soft tissue.

5. A dental cleaning tool comprising a straight tool bit having a cylindrical shank portion at one end and a tapered cleaning portion at the other end and a contoured intermediate portion curving inward to provide clearance for a tooth crown, all having a common central axis, said cleaning portion comprising an elongated body symmetrical about said central axis and constituted of plural elongated adjoining smooth side portions symmetrically disposed about said central axis and forming at their junctions obtuse-angled corners, said cleaning portion having a hexagonal cross-section, whereby when said tool bit is rotated about its axis at very high speeds and brought into contact with hard tooth deposits, ultrasonic vibrations are imparted thereto leading to their rapid disintegration and removal without injury to the tooth or surrounding soft tissue.

6. The combination of a rotary-type, high-speed dental handpiece and a dental cleaning tool therefor, said dental cleaning tool comprising a straight tool bit having a shank portion at one end and a cleaning portion at the other end both having a common central axis, said cleaning portion comprising a solid elongated body symmetrical about said central axis and constituted of plural elongated smooth side portions symmetrically disposed about said central axis and forming at their junctions non-cutting corners, means in the dental handpiece for receiving and gripping the shank portion of the tool bit, and means operatively connected to the handpiece for rotating the tool bit in the handpiece about the tool axis at a high speed between 80,000 and 250,000 r.p.m. whereby when the said rotating tool is brought into contact with hard tooth deposits, ultrasonic vibrations are imparted thereto leading to their rapid disintegration and removal without injury to the tooth or surrounding soft tissue.

7. The combination of claim 6, wherein the said cleaning portion has a hexagonal cross-section.

8. The combination of a rotary-type, high speed dental handpiece and a dental cleaning tool therefore, said dental cleaning tool comprising a straight tool bit having a shank portion at one end and a cleaning portion at the other end both having a common central axis, said cleaning portion comprising a solid elongated body symmetrical about said central axis and constituted of plural elongated smooth side portions symmetrically disposed about said central axis and forming at their junctions between four and eight obtuse-angled corners, means in the dental handpiece receiving and gripping the shank portion of the tool bit, means operatively connected to the handpiece for supplying a liquid to the vicinity of the cleaning portion, and means operatively connected to the handpiece for rotating the tool bit in the handpiece about the tool axis at a high speed generally of the order of 100,000 r.p.m. whereby when the said rotating tool is brought into contact with hard tooth deposits in the presence of the liquid, ultrasonic vibrations in excess of 10,000 c.p.s. are imparted thereto leading to their rapid disintegration and removal without injury to the tooth or surrounding soft tissue.

9. The combination of a rotary-type, high-speed dental handpiece and a dental cleaning tool therefor, said dental cleaning tool comprising a straight tool bit having a shank portion at one end and a cleaning portion at the other end both having a common central axis, said cleaning portion comprising a solid elongated body symmetrical about said central axis and tapering substantially to a point at its end remote from the shank portion, said cleaning portion being constituted of plural elongated adjoining smooth side portions symmetrically disposed about said central axis and forming at their junctions obtuse-angled corners, said cleaning portion having a hexagonal cross-section, means in the dental handpiece receiving and gripping the shank portion of the tool bit, means attached to the handpiece for supplying a liquid spray to the vicinity of the cleaning portion, and means operatively connected to the handpiece for rotating the tool bit in the handpiece about the tool axis at a high speed generally of the order of 2000 r.p.s .whereby when the said rotating tool is brought into contact with hard tooth deposits in the presence of the liquid spray, ultrasonic vibrations are imparted thereto leading to their rapid disintegration and removal without injury to the tooth or surrounding soft tissue.

10. The combination set forth in claim 9 wherein the tool has a concave intermediate portion, connecting the shank portion to the cleaning portion, to accommodate a tooth crown.

11. A method of tooth treatment, comprising the steps of providing a cleaning tool having smooth sides forming n non-cutting corners, rotating said tool about its axis at a high speed in revolutions per second which when multiplied by n equals a value of at least 10,000, and bringing the sides of the rotating tool into contact with the tooth surfaces thereby rapidly cleaning them without pain or damage to the tooth or surrounding soft tissue.

12. A method of tooth calculus removal, comprising the steps of providing a cleannig tool having between four and eight smooth sides symmetrical about a central axis and forming non-cutting corners, rotating said tool about its axis at a high speed between 80,000 and 250,000 revolutions per minute, and bringing the sides of the rotating tool into contact with the tooth surfaces with calculus thereon thereby imparting ultrasonic vibrations thereto and rapidly cleaning it without pain or damage to the tooth or surrounding soft tissue.

13. A method of tooth treatment, comprising the steps of providing a cleaning tool having smooth sides forming non-cutting corners and tapering to a point located on the longitudinal axis of the tool, rotating said tool about its axis at a high speed in revolutions per second which when multiplied by the number of corners equals a value of at least 10,000, and bringing the sides of the rotating tool into contact with the tooth surfaces and moving it

thereabout parallel to the tooth axis thereby rapidly cleaning the tooth without pain or damage to the tooth or surrounding soft tissue.

14. A method as set forth in claim 13, wherein the tool has a recessed portion above the tapered sides, and the rotating tool is brought into contact with exposed root surfaces, the recessed portion accommodating the tooth crown, to polish the root.

15. A dental cleaning tool as set forth in claim 4, wherein the cleaning portion has an axial length about one-third to one-half the combined axial length of it and the adjacent intermediate portion.

16. A dental cleaning tool as set forth in claim 5, wherein the corners on the cleaning portion are spaced a distance from the axis at least 5% greater than the corresponding distance from the center of the smooth side portions.

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