LIQUID JET APPARATUS AND METHODS FOR DENTAL TREATMENTS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit under 35 U.S.C. § 119(e) of U.S. Provisional Patent Application No. 61/261,293, filed November 13, 2009, entitled "APPARATUS AND METHODS FOR ROOT CANAL TREATMENTS," which is hereby incorporated by reference herein in its entirety and made part of this specification.

BACKGROUND

Field

[0002] The present disclosure generally relates to methods and apparatus for treatment of a tooth and, more particularly, methods and apparatus using liquid jets for removing organic matter from a tooth.

Description of the Related Art

[0003] In conventional root canal procedures, an opening is drilled through the crown of a diseased tooth, and endodontic files are inserted into the root canal system to open the canal spaces and remove organic material therein. The root canal is then filled with solid matter such as gutta percha or a flowable obturation material, and the tooth is restored. However, this procedure will not remove all organic material from the canal spaces, which can lead to post-procedure complications such as infection. In addition, motion of the endodontic file may force organic material through an apical opening into periapical tissues. In some cases, an end of the endodontic file itself may pass through the apical opening. Such events may result in trauma to the soft tissue near the apical opening and lead to post-procedure complications.

SUMMARY

[0004] Various non-limiting aspects of the present disclosure will now be provided to illustrate features of the disclosed apparatus and methods.

~~[0005] In one aspect, a dental instrument comprises a positioning member having a channel configured to deliver a high-velocity liquid jet to a cavity in a tooth. The positioning member may have a proximal end portion and a distal end portion. The distal end portion may be configured to direct the liquid jet into the cavity in the tooth. In one~~

~~embodiment, the positioning member may comprise an elongated member such as, e.g., a guide tube.~~

[0005] In a first aspect, there is provided a dental instrument comprising: a positioning member having a channel configured to deliver a high-velocity liquid jet to a cavity in a tooth, the positioning member having a proximal end portion and a distal end portion, the distal end portion configured to be disposed in, near, or on a portion of the tooth during treatment; an impingement member disposed near the distal end portion of the positioning member, the impingement member having an impingement surface, wherein the instrument is configured such that the high-velocity liquid jet impacts the impingement surface during operation of the high-velocity liquid jet; and a plurality of openings through the distal end portion of the positioning member, the openings configured to allow outflow of liquid from the liquid jet after impact with the impingement surface, wherein the impingement member comprises one or more angled or curved portions that angle or curve back towards the proximal end portion of the positioning member, wherein the one or more angled or curved portions extend distally beyond a distal end of the openings.

[0005a] In a second aspect, there is provided an apparatus for treating a tooth, the apparatus comprising: a pressure wave generator having a positioning member , distal portion of the positioning member having an impingement surface, the positioning member being arranged relative to the impingement surface so as to direct a beam of energy along a beam axis onto the impingement surface to produce acoustic pressure waves, wherein the impingement member comprises one or more angled or curved portions that angle or curve back towards a proximal portion of the positioning member, the one or more angled or curved portions being disposed symmetrically relative to the beam axis.

[0005b] In a third aspect, there is provided an apparatus for treating a tooth, the apparatus comprising: a pressure wave generator having a fluid beam forming portion including an orifice and an impact surface, the impact surface being spaced from the orifice and positioned such that an axis through the orifice extends to the impact surface, the impact surface being configured to be inserted into a tooth chamber in a tooth, wherein the impact surface comprises a concave surface facing the orifice, the concave surface substantially symmetric about the axis, wherein the impact surface comprises one or more angled or curved surfaces that angle or curve back towards a proximal portion of the pressure wave generator.

[0006] In another disclosure~~aspect~~, the dental instrument may include a backflow restrictor that is configured to be applied to the tooth. The backflow restrictor may be configured to inhibit backflow of fluid out of an opening in the tooth during operation of the liquid jet. At least a portion of the backflow restrictor may be disposed between the proximal end portion and the distal end portion of the positioning member.

[0007] Disclosed herein is~~In another aspect,~~ a method for treatment of a root canal of a tooth is described. The method comprises disposing an impingement member having an impingement surface, separate from a tooth, in a cavity in the tooth. The method also comprises generating a high-velocity, coherent, collimated liquid jet, and directing the jet through air toward the cavity such that liquid enters the cavity in the tooth and fills at least a substantial portion of the cavity. The method also comprises impacting the jet on the impingement surface, and passing the jet through at least a portion of the liquid filling the at least a substantial portion of the cavity prior to the impacting.

[0008] Disclosed herein is~~In another aspect,~~ a method for treatment of a root canal in a tooth is disclosed. The method comprises generating a high-velocity liquid beam with a nozzle disposed in an interior of a tooth, and impacting an impingement surface disposed in a fluid environment located in the interior of the tooth with the high-velocity liquid beam.

[0009] For purposes of this summary, certain aspects, advantages, and novel features of the inventions are summarized. It is to be understood that not necessarily all such advantages may be achieved in accordance with any particular embodiment of the invention. Thus, for example, those skilled in the art will recognize that the inventions disclosed herein may be embodied or carried out in a manner that achieves one advantage or group of advantages as taught herein without necessarily achieving other advantages as may be taught or suggested herein.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] FIGURE 1 is a cross-section view schematically illustrating a root canal system of a tooth.