DENTAL FILLING MATERIALS AND METHODS OF USE

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a divisional of U.S. application Ser. No. 10/914,057 filed Aug. 6, 2004, now U.S. Pat. No. 7,303,817 issued Dec. 4, 2007; which is a continuation-in-part of U.S. application Ser. No. 10/465,416 filed on Jun. 18, 2003, now U.S. Pat. No. 7,211,136 issued May 1, 2007; which is a continuation-in-part of U.S. application Ser. No. 10/304,371 filed on Nov. 26, 2002, now U.S. Pat. No. 7,204,875 issued Apr. 17, 2007, and a continuation-in-part of U.S. application Ser. No. 10/279,609, filed Oct. 24, 2002, now U.S. Pat. No. 7,204,874 issued Apr. 17, 2007; which claims priority to provisional Application Ser. No. 60/336,500 filed Oct. 24, 2001.

FIELD OF THE INVENTION

This invention relates to filling materials for use in filling dental cavities and for root canal treatments.

BACKGROUND OF THE INVENTION

Endodontics or root canal therapy is that branch of dentistry that deals with the diseases of the dental pulp and associated tissues. One aspect of endodontics comprises the treatment of infected root canals, the removal of diseased pulp tissues, followed by the biomechanical modification and the subsequent filling of the pulp cavity (root canal). Root canal therapy is generally indicated for teeth having sound external structures but having diseased, dead or dying pulp tissues. Such teeth may or may not generally possess intact enamel and dentin and are satisfactorily engaged with bony tissue. In such teeth, the pulp tissue and excised portions of the root should be replaced by a biocompatible substitute. One technique for the preparation of a root canal involves creating a coronal access opening with a conventional dental drill. A tool is used for gross removal of pulp material from the root canal through the coronal access opening. The void formed is enlarged with reamers and/or files to result in a fully excavated cavity. Debris is removed from this cavity by flushing and the cavity is cleansed to remove all diseased tissue. This process, while essential, results in a root canal that is weakened and susceptible to fracture. Following chemical antisepsis, the excavated canal is ready for filling.

A basic method involves inserting a filling cone into a root canal and cementing therein to obturate the canal. The common root canal filling cone material is made from gutta-percha. Lateral condensation is a method in which several filling cones, a primary cone and auxiliary cones, are inserted into a root canal. The primary cone is inserted and cemented to the seat of the root canal. Using a tapered spreader, the primary cone is then squeezed against the side of the root canal and a second cone is inserted and cemented into place. This process is continued until the root canal is completely obturated which can require up to 10 to 15 filling cones. Vertical condensation of warm or hot gutta-percha is yet another method of sealing root canals. After cementing a primary cone short of the apex of the root canal, heat application is alternated with a series of smaller and smaller pluggers until the gutta-percha is moved to the apex. This is often possible when the smallest plugger approaches the apex of the tooth within 3 to 5 millimeters. The space is then backfilled. Lateral canals are packed and sealed as a consequence of lateral expansion of a wave of heated gutta-percha. Alternatively, small segments of gutta-percha can be used in this method that are inserted into the root canal, heated in order that they can adhere to one another and each backfilled one at a time until the root canal is filled. All three of these methods, the single filling cone, lateral condensation and vertical condensation apply root canal cement or sealer around the individual cones or in between segments as a binding agent.

Another method employs an injection gun that injects warm or hot gutta-percha filling material into a root canal. The injector initially places heated gutta-percha at the apical area of the root canal through a needle-like canula tip and fills the gutta-percha into any surrounding voids/spaces under pressure or at the seat of the root canal which is then condensed with a plugger into the root tip. The injector then backfills the root canal by injecting additional gutta-percha into the root canal until it is obturated. A similar method involves heating gutta-percha on a flexible metal or plastic carrier used to insert the gutta-percha into the root canal. The carrier may be a solid rod, or a hollow rod, situated in the center of a master cone. The rod is connected to a handle which may be removed by slipping it out of the hollow rod, or cutting it off if it is a solid rod.

Most of the current methods employed in obturating a canal use a gutta-percha material that is inert in nature and will not be absorbed or degraded by the living tissue if the root canal is overfilled and extends beyond the apex. It has been a challenge for dentists to control the exact amount of the material within the border of the root canal to avoid overfilling. The cold core of gutta-percha is not malleable so that it cannot be molded to the canal walls, resulting in poor adherence. In addition, when heated gutta-percha cools to body temperature in the root, a uniform contraction takes place further reducing adherence to the walls of the canal. Moreover, gutta-percha material is a polyisoprene rubber material in nature, which does not have the capability to bond to most dental materials, especially when the root canal sealer is a polymer-based material. Due to poor adherence and bonding, existing bacteria in the root canal can multiply or leakage may result, causing bacteria to enter the canal from the mouth, which can lead to the persistence of an infection or other complications. Gutta-percha exhibits poor strength and brittleness. Dental gutta-percha points/cones tend to break in harsh conditions, e.g., sharply curved root canals, tight spaces during a root canal treatment, and the like.

It is desirable to provide a root canal filling material that bonds easily to sealants. It is preferable that the root canal filling material have proper strength and flexibility. It would be advantageous if the root canal filling material could be retrievable or dissolvable. It would be highly advantageous if the root canal filling material could reduce or eliminate bacterial leakage. It would be beneficial if the cavity filling material and root canal filling material could be bioactive. It would be further advantageous if the root filling material strengthened the root. It would be beneficial if the root filling material could be softened without effecting the overall strength and integrity of the filling material.

SUMMARY OF THE INVENTION

These and other objects and advantages are accomplished by the filling material of the present invention comprising a thermoplastic polymer. The thermoplastic polymer is preferably a biodegradable polymer. A bioactive substance may be combined with the biodegrable thermoplastic polymer. The thermoplastic polymer acts as a matrix for the bioactive sub-