

MOUTH PIECE FOR COOLING OF ORAL TISSUE
OF A PATIENT DURING CHEMOTHERAPY TREATMENT

CROSS REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Application No. 62/317,786, filed April 4, 2016, and U.S. Provisional Application No. 62/460,195, filed February 17, 2017, which are both hereby incorporated by reference.

FIELD OF THE INVENTION

The present invention relates to a mouth piece for cooling of oral tissue of a patient during chemotherapy treatment.

BACKGROUND OF THE INVENTION

One of the most limiting side effects associated with chemotherapy treatments of cancer patients is the condition characterized by severe inflammation of the oral mucous membrane tissues known as mucositis. This inflammation produces oral sores that are so painful for the patient that frequently the chemotherapy treatments must be weakened or even discontinued before they are completed. As a result, cancer patients oftentimes can not be given the necessary amount of chemotherapy to effectively treat their conditions.

It has been known, however, that keeping the oral tissues cold during chemotherapy treatments causes vasoconstriction of the associated blood vessels which reduces the amount of chemotherapy agent flowing into this tissue. The known method of cooling the oral tissues comprises periodically placing ice within the patient's mouth during the administration of the

chemotherapy agent. This method lessens the formation of oral sores for short treatment periods of less than about one hour.

Although the known method of cooling the oral tissues has been acceptable for short treatments, it is impractical for extended chemotherapy treatments that may continue for extended periods, for at least the following reasons. First, it is quite difficult for the patient to sleep because the rapidly melting ice must be constantly replaced. Second, and, more importantly, it fails to constantly and uniformly cool all of the oral tissues that are prone to form inflammation. The known method does not maintain the oral tissues at a constant desired temperature for the duration of extended treatments, and mucositis and oral sores inevitably form and become a limiting problem that forces the chemotherapy dose to be reduced or the treatment discontinued. Although the patient may be able to withstand the lessened chemotherapy treatment, its effectiveness is limited and the cancer may grow at an uncontrollable rate despite the treatment.

Thus, in view of the inadequacies of the known method, there has been a need for an oral therapeutic apparatus, and a method of using the device, for effectively cooling selected oral tissues to reduce absorption of the chemotherapy agent and the subsequent formation of inflammation and oral sores, throughout extended periods of chemotherapy treatment. Such a device would reduce or eliminate the problem that have not been overcome by the known method and have reduced the effectiveness of previous chemotherapy treatments. Furthermore, there has been a need for an oral device that remains comfortable to the patient throughout the length of any treatment so that relaxation and even sleep can be obtained.

The present invention provides a solution to the above problems.

SUMMARY OF THE INVENTION

The invention is directed to a mouth piece for cooling of oral tissue of a patient during chemotherapy treatment. The mouth piece includes a malleable top element configured to rest adjacent at least major surfaces of the upper gums and teeth of a patient's mouth in a close-fitting relationship. The mouth piece further includes a malleable bottom element configured to rest adjacent to at least major surfaces of the lower gums and teeth of a patient's mouth in a close-fitting relationship. The top element is integral with or connected to the bottom element to permit emplacement in the mouth as a one-piece unit. The mouth piece further includes an aperture positioned in a frontal location that permits a patient to breathe through the mouth when the mouth piece is emplaced within the mouth in said operative close-fitting relationship. The mouth piece further includes a cooling medium contained within the top element and the bottom element and able to retain a cooling environment within the mouth sufficient to reduce capillary blood flow to the patient's mouth.

In another embodiment of the invention, the mouth piece includes an external chamber extending from the front of the mouth piece for storing a cooling medium comprised of a salt water solution. An aperture is positioned in a frontal location and extends through the external chamber that permits a patient to breathe through the mouth when the mouth piece is emplaced within the mouth in an operative close-fitting relationship. A series of bladders are positioned within the top element and the bottom element, wherein the bladders are connected to the external chamber for receiving the cooling medium which flows throughout the top element and the bottom element and for retaining a cooling environment within the mouth sufficient to reduce capillary blood flow to the patient's mouth.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings:

FIG. 1 is an illustrational view of a mouth piece in accordance with the invention located within the mouth of a patient undergoing chemotherapy treatment;

FIGS. 2-5 illustrate a first embodiment of the invention, wherein:

FIG. 2 is a cross-sectional view of a mouth piece taken in the direction of line 2--2 of FIG. 1, in accordance with the first embodiment;

FIG. 3 is a front top left perspective view of the mouth piece of FIG. 2, wherein the cooling medium bladders for the upper gums are shown;

FIG. 4 is a top view of the mouth piece of FIG. 2 illustrating a plurality of bladders housing the cooling medium;

FIG. 5 is a side elevation view of the inside surface of the right upper outer wall of the mouth piece of FIG. 2 illustrating two rows of bladders being separately by a row of air pockets;

FIGS. 6-10 illustrate a second embodiment of the invention, wherein:

FIG. 6 is a cross-sectional view of a mouth piece taken in the direction of line 2--2 of FIG. 1, in accordance with the second embodiment;

FIG. 7 is a front top left perspective view of the mouth piece of FIG. 6, wherein a single U-shaped bladder for insulating the upper teeth is shown;

FIG. 8 is a top view of the mouth piece of FIG. 2 illustrating the biting surface of the U-shaped upper insulation bladder;

FIG. 9 is a front top left perspective view of the mouth piece of FIG. 6, further comprising an expandable upper wall for contacting the roof of the mouth; and

FIG. 10 is a front top left perspective view of the mouth piece of FIG. 9, further comprising four flexible arms for contacting the corners of the mouth;

FIGS. 11-15 illustrate a third embodiment of the invention, wherein:

FIG. 11 is an illustrational view of a mouth piece located within the mouth of a patient undergoing chemotherapy treatment, wherein an external chamber extends from the front of the mouth piece;

FIG. 12 is a cross-sectional view of a mouth piece taken in the direction of line 12--12 of FIG. 11, in accordance with the third embodiment;

FIG. 13 is a front top left perspective view of the mouth piece of FIG. 12, wherein the cooling medium bladders for the upper gums are shown and are connected to the external chamber;

FIG. 14 is a top view of the mouth piece of FIG. 12 illustrating a series of connected bladders for receiving the cooling medium which flows throughout the top element and the bottom element;

FIG. 15 is a front top left perspective view of the mouth piece of FIG. 12, wherein the cooling medium bladders for the upper gums are shown and are connected to the external chamber, wherein the external chamber includes a salt water chamber and a pure water chamber that moves freely inside the salt water chamber.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention will now be described in detail with reference to the drawings.

FIG. 1 illustrates a mouth piece 10 in accordance with the present invention which is located within the mouth of a patient undergoing chemotherapy treatment. As depicted in FIGS.

2 and 6, the therapeutic device is engaged simultaneously by the upper teeth 201 and 202 and lower teeth 203 and 204 of the patient, and includes an aperture 70 in a frontal location that permits the patient to breathe through the mouth when the mouth piece is emplaced with the mouth in an operative close-fitting relationship. In one embodiment, a flexible tube (not shown) can be inserted through or otherwise connected with the aperture 70 and positioned inside the patient's mouth to assist the patient with inhaling air from outside the mouth while breathing comfortably. In another embodiment, this flexible tube can be used to supply oxygen to the patient if medically warranted.

FIGS. 2-5 illustrate a first embodiment of the invention, wherein the mouth piece 10 is composed of a material that is malleable and biocompatible with the patient's oral tissues and can be used to form the device according to the size and shape of the patient's mouth as will be described in greater detail below. Suitable materials include, for example, acrylic, plastic, silicon and rubber. Unlike the second embodiment of the invention described below, the material of the mouth piece itself is not intended to be a cooling medium, but rather forms a framework with which to house bladders or other elements that are configured to act as the cooling medium as will be discussed below.

The mouth piece includes a top element 18 and a bottom element 19, which collectively provide total mouth coverage during chemotherapy treatment. The top element 18 is integral with or connected to the bottom element 19 to permit emplacement in the mouth as a one-piece unit. The top element 18 consists of a malleable material and is configured to rest adjacent at least major surfaces of the upper gums 211 and 212 and upper teeth 201 and 202 of a patient's mouth in a close-fitting relationship. The bottom element 19 consists of a malleable material and

is configured to rest adjacent at least major surfaces of the lower gums 213 and 214 and lower teeth 203 and 204 of a patient's mouth in a close-fitting relationship.

In one embodiment, the therapeutic device is formed by first making stone casts of the patient's teeth along with a bite registration. The casts are mounted on an articulator to simulate the patient's occlusal, and the articulator is adjusted to form a 4-6 mm vertical occlusal space.

Next, a buildup is initiated with the preferred therapeutic device. A wax pattern is fabricated and added to the buildup, which pattern defines the inner and outer walls of the mouth piece. The preferred material is added to enclose the wax pattern as well as the position of the aperture 70. The preferred material is allowed to harden or cure either at room temperature, or at an elevated temperature within a heating source such as a pressure pot.

The hardened device is then placed in boiling water or within a hot atmosphere such as in an oven to melt the wax pattern, and the wax is poured out to produce a hollow device. The device is then finished, shaped and contoured. Finally, to assure that the outer surface of the finished device properly conforms to the contour of the patient's mouth, it is placed therein to verify an accurate fit. The device must fit comfortably and not extend so far into the patient's mouth that it causes the patient to gag.

In another embodiment, the mouth piece material has sufficient malleability and is manufactured in a variety of sizes in order to fit the patient's mouth according to his or her size without the need for making a custom device each time from a stone cast as was described above. For example, the mouth piece can be offered in sizes small, medium, large, and extra-large. The mouth piece can include flexible inner and outer walls to self-adjust its configuration to the size and shape of a patient's mouth.

Referring to FIG. 2, a separate cooling medium is contained within the top element 18 and the bottom element 19 and is able to retain a cooling environment within the mouth sufficient to reduce capillary blood flow to the patient's mouth to prevent mouth sores and oral discomfort following chemotherapy treatment. The cooling medium can be housed in a plurality of bladders 81-88 located at predetermined locations along the inner cavities of the mouth piece. Prior to use, the mouth piece is stored in a freezer or other temperature controlled environment in order to cool the cooling medium to a desired temperature. Preferably, the cooling medium of the mouth piece is able to maintain the necessary temperature while the mouth piece is in the patient's mouth to cool the oral tissues throughout a portion of time of chemotherapy treatment, depending on the types of drugs being administered and their known effects on the gums and mouth of the patient. For example, during a two hour chemotherapy treatment session, only a fifteen minute portion of the treatment may cause adverse effects on the gums and mouth. Therefore, the mouth piece of the present invention can be inserted into the mouth of the patient during the time of the chemotherapy treatment when it is most needed, such that the cooling effect of the mouth piece can be maximized at the most effective time.

The cooling medium is positioned within the mouth piece in order to contact and cool selected oral tissues within the patient's mouth. The cooling medium also partially cools the mouth piece which functions as a heat sink for heat generated in the oral tissues. The cooling medium functions such that heat is continuously transferred away from the oral tissues and the device, to keep the oral tissues cold and prevent the device from significantly warming during the chemotherapy treatment. Significant warming of the therapeutic device would allow inflammation and oral sores to form and consequently force the treatment to be reduced or discontinued.

Preferably, the cooling medium is maintained at a temperature of approximately 0 degrees C. to approximately 5 degrees C. The cooling medium can be carried by the device in sealed chambers, and the device is cooled in a freezer or other cooling device to the proper temperature prior to use. The cooling medium may be a non-toxic gel or a like substance made by adding hydroxyethyl cellulose (CELLUSIZE (TM)), sodium polyacrylate, or vinyl-coated silica gel that can maintain its initial temperature.

FIG. 2 is a cross-sectional view taken in the direction of line 2--2 of FIG. 1. The patient's right upper teeth 201 and right upper gums 211 engage the top right walls 41, 51 and 61, which collectively form a U-shaped cavity. Bladders 81 and 82 are attached to the vertical walls 41 and 51, respectively, and house the cooling medium as described above. The bladders are dimensioned to rest adjacent at least major surfaces of the right upper gums 211, as shown in FIG. 2. Similarly, the other remaining quadrants of the patient's mouth are treated in the same manner as described above and therefore do not require further discussion.

FIG. 3 illustrates a front top left perspective view of the mouth piece, wherein the cooling medium bladders for the upper gums are shown. An aperture 70 is positioned in a frontal location that permits a patient to breathe through the mouth when the mouth piece 10 is placed within the mouth in the operative close-fitting relationship. Although the aperture 70 is illustrated as a single aperture, in other embodiments of the invention more than one aperture can be included. As illustrated, the top element 18 is integral with the bottom element 19 along their adjacent surfaces, collectively forming a single continuous side wall there between and permitting emplacement in the mouth as a one-piece unit. In other embodiments, the top element 18 can be hingedly connected to the bottom element 19 at the distal ends adjacent the joint of the

jaw bones. In this embodiment, the patient can open and close his mouth while maintaining the cooling medium in contact with the top and bottom gums and teeth.

FIG. 4 is a top view of the mouth piece illustrating the plurality of bladders housing the cooling medium. In the illustrated embodiment, several discreet cooling chambers (bladders) 81-84 are provided along the interior walls of the mouth piece 10. The distribution of the cooling medium between several discreet chambers provides a malleable surface for contacting the gums of the patient without interfering with the breathing hole 70. The number and sizes of the discreet chambers can vary depending on the overall size of the mouth piece and the particular patient being treated. Preferably, each chamber is fixedly attached to the mouth piece with an appropriate adhesive or other means to prevent its dislodgement during use. In another embodiment, the chambers are removably attached and can be interchanged with various size bladders to control the amount and timing of cooling; or to adjust the fit of the mouth piece for the user's unique dental anatomy. For example, patients may have one or more teeth that are recessed or crooked from the adjacent teeth and a smaller or larger bladder can be fitted in this location of the mouth piece to accommodate for this discrepancy and therefore create more of a custom fit.

FIG. 5 is a side elevation view of the inside surface of the right upper outer wall 41 of the mouth piece illustrating two rows of bladders being separated by a row of air pockets. A first row of bladders 801 is positioned near the bottom and is intended to sit near the right upper teeth 201 (see Fig. 2) of the patient. A second row of bladders 802 is positioned near the top and is intended to sit near the right upper gums 211 (see Fig. 2) of the patient. Different volumes and/or types of cooling materials can be positioned in the first and second rows, respectively, to provide various cooling zones for gums vs. teeth. For example, the first row of bladders 801 can

contain a cooling medium that warms up faster and removes less heat from the teeth (thus cooling the teeth less), as compared with the cooling medium that is contained within the second row of bladders 802. This can also be accomplished by utilizing a rubber or plastic material with a low specific heat. In general, it is preferred that the teeth are cooled less than the gums of the patient, especially if the patient has sensitive teeth for a variety of reasons.

In another embodiment, a row of air pockets 803 is positioned between the first and second rows of bladders. The air pockets act to thermally separate the first and second rows of bladders 801 and 802 and minimize thermal transfer between them. In other embodiments, the row of air pockets is not included with the device. Other thermal barriers can be utilized in place of the row of air pockets.

In another embodiment, the mouth piece includes a separate cooling medium (not shown) along the outer lateral surfaces of the sidewalls of the mouth piece to make contact with the patient's cheeks and cool the oral tissues thereof and also cool the gums along the upper and lower jaw.

In another embodiment, the mouth piece includes cooling medium (not shown) along an optional upper wall 29 (see Fig. 2) which contacts the roof of the mouth, and along an optional lower wall 30 (see Fig. 2) which contacts the base of the mouth, and a portion of the interior walls contacting the tongue. These wall portions can be utilized to cool the surrounding roof and base of the mouth, and the tongue as well as the adjacent gums.

FIGS. 6-10 illustrate a second embodiment of the invention, wherein the mouth piece 10 itself is composed of a material that is not only malleable and biocompatible with the patient's oral tissues and can be used to form the device according to the size and shape of the patient's mouth, but wherein the material forming the mouth piece itself is intended to act as the cooling

medium as will be described in greater detail below. The material forming the mouth piece may include a non-toxic gel or a like substance made by adding hydroxyethyl cellulose (CELLUSIZE (TM)), sodium polyacrylate, or vinyl-coated silica gel that can maintain its initial temperature.

The mouth piece includes a top element 18 and a bottom element 19, which collectively provide total mouth coverage and cooling during chemotherapy treatment. The top element 18 is integral with or connected to the bottom element 19 to permit emplacement in the mouth as a one-piece unit. The top element 18 consists of a malleable material and is configured to rest adjacent at least major surfaces of the upper gums 211 and 212 and upper teeth 201 and 202 of a patient's mouth in a close-fitting relationship. The bottom element 19 consists of a malleable material and is configured to rest adjacent at least major surfaces of the lower gums 213 and 214 and lower teeth 203 and 204 of a patient's mouth in a close-fitting relationship.

FIG. 6 is a cross-sectional view taken in the direction of line 2--2 of FIG. 1. The patient's right upper teeth 201 and right upper gums 211 engage the top right walls 41, 51 and 61, which collectively form a U-shaped cavity. Because the mouth piece itself is the cooling medium, the additional bladders described with reference to FIGS. 2-5 above are not necessary and are not included. A U-shaped insulation bladder 91 is attached between the vertical walls 41 and 51, respectively, and is composed of a material that becomes warm very quickly after removing the mouth piece from its cooling storage device. The U-shaped insulation bladder 91 thereby substantially prevents the teeth from cooling during use of the mouth piece. The U-shaped bladder 91 is dimensioned to rest adjacent at least major surfaces of the right upper teeth 201, as shown in FIG. 6. Similarly, the other remaining quadrants of the patient's mouth are treated in the same manner as described above and therefore do not require further discussion.

FIG. 7 illustrates a front top left perspective view of the mouth piece, wherein a single U-shaped bladder 90 for insulating the upper teeth is shown as described above. In other embodiments, the U-shaped bladder can be comprised of multiple sections.

FIG. 8 is a top view of the mouth piece illustrating the biting surface of the U-shaped upper insulation bladder 90 as described above. The material forming the U-shaped insulation bladder can be malleable and provide a comfortable biting surface during insertion in the patient's mouth.

FIG. 9 is a front top left perspective view of the mouth piece of FIG. 6, further comprising an expandable upper wall for contacting the roof of the mouth. In particular, the upper wall is formed by a first section 29a that extends vertically from the right upper inner wall 51 (see FIG. 6) and by a second section 29b that extends vertically from the left upper inner wall 52 (see FIG. 6) respectively of the mouth piece. The first section 29a slides over the second section 29b to form a generally continuous top surface for contacting the roof of the patient's mouth thereby also cooling this area during chemotherapy treatment. The first section 29a and second section 29b are composed of a similar cooling material as the rest of the mouth piece and can also include additional material and/or internal structural reinforcement to ensure that the top portion maintains suitable structural integrity and generally have an upward biasing force to maintain contact with the roof of the mouth. The top portion includes the ability to widen and narrow because of the overlapping arrangement of the first section 29a and second section 29b. Accordingly, the mouth piece can accommodate various size mouth widths while maintaining the ability to cool the roof of the patient's mouth.

Although not shown in perspective view, the bottom of the mouth piece includes a similar lower portion (see FIG. 6) configured to contact the bottom/floor of the patient's mouth,

while not interfering with the frenulum of the tongue (also known as tongue web, lingual frenulum, or frenulum linguae) which is the small fold of mucous membrane extending from the floor of the mouth to the midline of the underside of the tongue.

FIG. 10 is a front top left perspective view of the mouth piece of FIG. 9, further comprising four flexible arms 301-304 configured to contact the corners of the mouth during use. Each flexible arm is attached at a proximal end near the aperture 70 positioned at the front of the mouth piece and extends out in a radial direction when the mouth piece is not positioned inside the patient's mouth. The flexible arms 301-304 are composed of a similar cooling material as the rest of the mouth piece and can also include additional material and/or internal structural reinforcement to ensure suitable structural integrity. For example, a resilient longitudinal core can be housed inside each flexible arm to provide the proper structural integrity and the proper flexibility. During use, the mouth piece 10 is inserted into the patient's mouth. Then each flexible arm is inserted and positioned into each corner of the patient's mouth. The flexible arms thereby provide additional cooling zones in the hard to reach areas located in the corners of the patient's mouth near the wisdom teeth. Accordingly, in this embodiment the mouth piece can accommodate various size mouths while maintaining the ability to cool the corners of the patient's mouth, including the gums and cheeks adjacent these areas of the mouth.

The therapeutic device in accordance with the present invention constantly and uniformly cools the patient's cheeks, gums, tongue, and roof and floor of the mouth. Because it closely conforms to the contour of the patient's mouth, it can be used for extensive treatments without causing discomfort. Furthermore, its uniform cooling action reduces or prevents the formation of inflammation and oral sores throughout extended chemotherapy treatments.

In another embodiment of the invention, a system for cooling of oral tissue of a patient during chemotherapy treatment is disclosed. The system includes a plurality of mouth pieces which are simultaneously cooled. During use, a first mouth piece is selected and inserted into the patient's mouth, while the remaining mouth pieces continue to be stored in a temperature controlled cooled environment. After a preselected time or after a preselected temperature of the mouth is reached, the first mouth piece is removed and replaced by a second mouth piece to regain the desired cooling effect that began to fade from the first mouth piece. In this way, a constant supply of cooled mouth pieces is available for the patient for use during chemotherapy treatment. For example, the plurality of mouth pieces can be stored in a refrigerator, freezer, cooling tub with ice, and the like and available to access within close proximity of the patient.

FIGS. 11-15 illustrate a third embodiment of the invention, wherein an external chamber 300 extends from the front of the mouth piece 10. An insulation wall 301 surrounds the external chamber 300 to help maintain a cold temperature of the liquid contents. The external chamber 300 preferably includes a salt water chamber 303 and a pure water chamber 304. A separation wall 302 provides a barrier between the salt water chamber 303 and the pure water chamber 304. In one embodiment, the salt water chamber 303 and the pure water chamber have surfaces that lie adjacent to each other, along the separation wall 302. The separation wall can be made of a flexible material, such as a thin rubber or plastic material. In another embodiment, the separation wall can be made of aluminum or other type of highly conductive material.

Although salt water and pure water are preferred because of their safety and ready availability, other materials which, like salt water, have a freezing point well below 0 degrees C. and pure water with a freezing point of 0 degrees C., other solutions in which the freezing point

of one solution is close to 0 degrees C. and the other of which has a freezing point below 0 degrees C. can be substituted either for the salt water, pure water or both.

The mouth piece includes a top element 18 and a bottom element 19, which collectively provide total mouth coverage and cooling during chemotherapy treatment. The top element 18 is integral with or connected to the bottom element 19 to permit emplacement in the mouth as a one-piece unit. The top element 18 consists of a malleable material and is configured to rest adjacent at least major surfaces of the upper gums 211 and 212 and upper teeth 201 and 202 of a patient's mouth in a close-fitting relationship. The bottom element 19 consists of a malleable material and is configured to rest adjacent at least major surfaces of the lower gums 213 and 214 and lower teeth 203 and 204 of a patient's mouth in a close-fitting relationship.

FIG. 12 is a cross-sectional view taken in the direction of line 12--12 of FIG. 11. The patient's right upper teeth 201 and right upper gums 211 engage the top right walls 41, 51 and 61, which collectively form a U-shaped cavity. Bladders 181 and 182 are attached to the vertical walls 41 and 51, respectively, and house the cooling medium as described above. The bladders are dimensioned to rest adjacent at least major surfaces of the right upper gums 211, as shown in FIG. 12. Similarly, the other remaining quadrants of the patient's mouth are treated in the same manner as described above and therefore do not require further discussion.

FIG. 13 illustrates a front top left perspective view of the mouth piece, wherein the cooling medium bladders 181, 189, 183, and 190 for the upper gums are shown. An aperture 70 is positioned in a frontal location and extends through the external chamber 300 that permits a patient to breathe through the mouth when the mouth piece 10 is emplaced within the mouth in the operative close-fitting relationship. Although the aperture 70 is illustrated as a single aperture, in other embodiments of the invention more than one aperture can be included. The

interior wall of the aperture 70 is made from a rigid or semi-rigid material, such as plastic, hard rubber, etc., in order to maintain its shape under the weight of the external chamber 300 without crimping. As illustrated, the top element 18 is integral with the bottom element 19 along their adjacent surfaces, collectively forming a single continuous side wall there between and permitting emplacement in the mouth as a one-piece unit. In other embodiments, the top element 18 can be hingedly connected to the bottom element 19 at the distal ends adjacent the joint of the jaw bones. In this embodiment, the patient can open and close his mouth while maintaining the cooling medium in contact with the top and bottom gums and teeth.

FIG. 14 is a top view of the mouth piece illustrating the plurality of bladders housing the salt water solution which flows from the salt water chamber 303 via one or more channels 305 and 306. The mouth piece and external chamber are kept in a freezer before use so that the water that is stored in the pure water chamber 304 is frozen. The pure water chamber 304 will provide a cooling effect for the salt water flowing through the bladders in the mouth piece as illustrated by the arrows in the drawing. In the illustrated embodiment, a series of cooling chambers (bladders) 181-184 are provided along the interior walls of the mouth piece 10. The distribution of the cooling medium between several connected chambers provides a malleable surface for contacting the gums of the patient without interfering with the breathing hole 70. The number and sizes of the discreet chambers can vary depending on the overall size of the mouth piece and the particular patient being treated. The series of bladders form a completely connected network. For example, bladder 189 is positioned at the rear surface of the mouth piece and connects bladder 181 to bladder 182. Similarly, bladder 190 is positioned at the rear surface of the mouth piece and connects bladder 183 to bladder 184. Preferably, each bladder is fixedly attached to the mouth piece with an appropriate adhesive or other means to prevent its dislodgement during

use. In another embodiment, the chambers are removably attached and can be interchanged with various size bladders to control the amount and timing of cooling; or to adjust the fit of the mouth piece for the user's unique dental anatomy. For example, patients may have one or more teeth that are recessed or crooked from the adjacent teeth and a smaller or larger bladder can be fitted in this location of the mouth piece to accommodate for this discrepancy and therefore create more of a custom fit.

FIG. 15 is a front top left perspective view of the mouth piece of FIG. 12, wherein the cooling medium bladders for the upper gums are shown and are connected to the external chamber, wherein the external chamber includes a salt water chamber 303 and a pure water chamber 304 that moves freely inside the salt water chamber. In the example illustrated, the pure water chamber 304 is spherically-shaped, but other shapes can be employed. Furthermore, more than one water chamber 304 can be included with this embodiment of the invention.

The outer insulation wall of the external chamber 303 is selected to maintain its shape, yet also provides elasticity to allow a user to periodically squeeze the contents and assist the flow of the salt water solution through the series of bladders of the mouth piece.

In another embodiment (not shown), there is only a salt water chamber 303 and there is no pure water chamber 304. The size of the salt water chamber 303 can be adjusted depending on the amount and length of time that the cooling effect is required, without the need for a pure water (frozen) chamber.

In another embodiment (not shown), an adjustable support band is attached to the external chamber for wrapping around the users head to help support the weight of the external chamber. The support band can be secured via hook-and-loop fasteners, buckles, snaps, and the like.

The foregoing description of the preferred embodiment of the invention has been presented to illustrate the principles of the invention and not to limit the invention to the particular embodiment illustrated. It is intended that the scope of the invention be defined by all of the embodiments encompassed within the following claims, and their equivalents.

CLAIMS

1. A mouth piece for cooling of oral tissue of a user during therapeutic treatment comprising:

a malleable top element configured to rest adjacent at least major surfaces of the upper gums and teeth of the user's mouth in a close-fitting relationship;

a malleable bottom element configured to rest adjacent at least major surfaces of the lower gums and teeth of the user's mouth in a close-fitting relationship;

wherein the top element is integral with or connected to the bottom element to permit emplacement in the mouth as a one-piece unit;

an aperture positioned in a frontal location of the mouthpiece and configured to permit the user to breathe through the mouth when the mouth piece is emplaced within the mouth in said operative close-fitting relationship;

a cooling medium contained within the top element and the bottom element and able to retain a cooling environment within the mouth sufficient to reduce capillary blood flow to the user's mouth;

wherein the cooling medium includes a first coolant and a second coolant, the first coolant is positioned within the mouth piece in areas configured to rest in proximity to the teeth creating a first cooling zone, the second coolant is positioned within the mouth piece in areas configured to rest in proximity to the gums creating a second cooling zone; and wherein the first cooling zone has a lower specific heat than the second cooling zone, such that the area in proximity to the teeth is cooled less than the area in proximity to the gums.

2. The mouth piece according to claim 1, wherein the mouth piece has flexible inner and outer walls and is adapted to self-adjust its configuration to the size and shape of the user's mouth.

3. A mouth piece for cooling of oral tissue of a user during therapeutic treatment, the mouthpiece being insertable into the user's mouth and comprising:

a malleable top element configured to rest adjacent at least major surfaces of the upper gums and teeth of the user's mouth in a close-fitting relationship;

a malleable bottom element configured to rest adjacent at least major surfaces of the lower gums and teeth of the user's mouth in a close-fitting relationship;

wherein the top element is integral with or connected to the bottom element to permit emplacement in the mouth as a one-piece unit;

a first chamber extending directly from the front of the mouth piece for storing a cooling medium comprised of a first solution having a first freezing temperature;

a second chamber positioned inside the first chamber and containing a second solution having a second freezing point above the first freezing point temperature of the first solution to assist in cooling the first solution; and

one or more bladders positioned within the top element and the bottom element, wherein the one or more bladders are fluidly connected to the first chamber for receiving the cooling medium which flows throughout the first chamber, the top element and the bottom element to cool the oral tissue in the user's mouth.

4. The mouth piece according to claim 3, in which the first solution is salt water.
5. The mouth piece according to claim 3, in which the second solution is water.
6. The mouth piece according to claim 3, further comprising a separation wall positioned between the first chamber and the second chamber.
7. The mouth piece according to claim 3, in which the second chamber is smaller than the first chamber.
8. The mouth piece according to claim 7, wherein the second chamber is configured to move freely inside of the first chamber.
9. The mouth piece according to claim 7, in which the second chamber is spherically-shaped.
10. The mouth piece according to claim 3, in which the first chamber includes an outer insulation wall.
11. The mouth piece according to claim 10, in which the outer insulation wall provides elasticity to allow the user to squeeze the contents and assist the flow of the cooling medium.

12. The mouth piece according to claim 3, wherein the first freezing temperature of the first solution is below 0 degrees Celsius.

13. The mouth piece according to claim 3, further comprising an aperture positioned in a frontal location and extending through the first chamber that permits the user to breathe through the mouth when the mouth piece is emplaced within the mouth in said operative close-fitting relationship.