This invention relates to novel methods and surgical instruments useful in performing tracheotomies.

The methods and instruments of this invention facilitate the provision of an opening in a patient's trachea to receive a trachea tube. Although the methods and instruments are not so limited, they are especially useful under emergency conditions, particularly where professional medical assistance is not available.

A number of methods and devices exist for use in preparing a patient's trachea for receiving a trachea tube. In accordance with all of those methods it is necessary to provide an incision or opening in the trachea itself, into which the trachea tube may be inserted. The methods and devices of this invention facilitate the very rapid preparation of an incision suitable for reception of a trachea tube by permitting easy removal of a portion of the tracheal tissue, including portions of the tracheal rings or cartilage.

In preparing a tracheotomy it is first necessary to expose the trachea itself. That is generally done by making a transverse incision in the patient's neck intermediate in the third and fourth cartilage rings. The edges of the tissue adjacent the incision are then spread so that the trachea itself is visible.

The preparation of the opening in the trachea can be very difficult at times, particularly where a portion of the trachea is to be removed. Under such circumstances great care must be exercised to anchor the tracheal rings or to hold them in a predetermined position while a portion of the tracheal tissue is being removed. And frequently when a portion of the tracheal tissue, such as portions of the tracheal rings, has been but partially severed, the areas from which the portion is being cut out may become covered with blood and foam and the face of the operator may become sprayed with blood, mucus and foam, thereby hampering his vision. That is particularly a problem under emergency circumstances where facilities for keeping areas upon which operations are being performed cleared of blood, mucus, and the like, are not available.

Difficulties may also be encountered in removing tracheal tissue from a patient's neck where the patient's trachea is located deep within his neck. Similarly, difficulties in preparing an opening in a patient's trachea may be encountered when the trachea, as it extends inferorly in the neck, is directed rapidly posteriorly. In such cases, particularly under emergency conditions, it is extremely hard to perform a safe and rapid tracheotomy.

With the methods and instruments of this invention the foregoing hardships are minimized and in many cases eliminated.

Therefore it is a principal object of this invention to provide novel and simple methods and surgical instruments for performing a tracheotomy.

It is another principal object of this invention to provide novel and simple methods and surgical instruments for removing a segment of tracheal tissue from a patient's trachea preparatory to inserting a trachea tube.

Also an object within the contemplation of this invention is the provision of a novel surgical punch especially adapted for removing a segment of tracheal tissue.

Yet another object of this invention is the provision of which portion is adapted to cooperate with another portion of the punch located exteriorly of the trachea to remove and to retain a segment of tracheal tissue. In accordance with this invention once the trachea has been exposed in any conventional manner, a transverse slit is made in the trachea, preferably between the third and fourth cartilage rings. As will be described in greater detail, a button end of the tracheal punch is first pushed through the slit superiorly and is then depressed inferorly. That places the button end completely within the trachea. A cooperating portion of the trachea punch of this invention is then pushed towards the trachea and the button end, sufficient force being exerted so that the sharpened cutting segment of the cooperating portion of the punch cuts through the trachea. When the button end and sharpened portion move into an overlapping relationship, a disc-shaped opening in the trachea is provided. The tracheal tissue, that is the portions of the third and fourth cartilage rings and the adjacent tissue, is trapped within the punch, thereby eliminating the possibility and danger of their being lost in the trachea itself. The opening in the trachea having been thus prepared, the trachea tube may be inserted in a routine manner.

Thus it will be appreciated that the punch and the method of using it are quite simple but very effective. Further objects and advantages of this invention will become apparent from the following description and drawings of which:

FIGURE 1 is a side elevation of a trachea punch of this invention;

FIG. 2 is a side view partially in section of the trachea punch of FIG. 1;

FIG. 3 is a side view, partially in section, of the trachea punch of FIG. 1 showing the punch element in its fully retracted position;

FIG. 4 shows a patient having had a transverse slit made in the trachea in accordance with the method of this invention;

FIG. 5 shows how the button end of the trachea punch is inserted into the slit in the trachea;

FIG. 6 shows the trachea punch with the button end fully inserted in the trachea;

FIG. 7 shows the sinuous cutting edge as it begins to sever the tracheal tissue; and

FIG. 8 shows the opening which has been provided in the trachea by the trachea punch.

FIGS. 1 to 3 illustrate a presently preferred embodiment of the trachea punch of our invention. The trachea punch 1 there shown consists of two main elements, the body 10 and the punch element 12. Body 10 comprises a generally elongated cylindrical hollow housing 14 having an opening 16 adjacent its upper end. A head 18 is connected to the upper end of housing 14 and has a generally convex top 20 of a diameter somewhat greater than the diameter of housing 14. At two diametrically opposed locations head 18 is provided with chamfered segments 21 to facilitate gripping head 18 and to prevent its rotation when in use.

Head 18 at its lower surface terminates in a shaft 22 having a reduced diameter segment 24 of substantially the same diameter as the inside diameter of housing 14. Reduced diameter segment 24 has a tapped hole 26 adapted to receive a lock bolt 28 when reduced diameter segment 24 resides in housing 14. An annular shoulder 30 at the base of shaft 22 limits the extent to which reduced diameter segment 24 of head 18 may be inserted inwardly of housing 14.

When tapped hole 26 is aligned with opening 16, lock bolt 28 may be screwed into tapped hole 26 to lock head 18 to housing 14.
At the end opposite the end to which head 18 is connected, housing 14 terminates in a sharpened sinus cutting edge 32, the purpose of which will become apparent hereinafter. Such housing 14 and head 18 are two diametrically opposed longitudinally disposed slots 34 communicating with the interior and with the exterior of the housing.

Although we do not intend to be so limited, housing 14 may be fabricated of non-magnetic stainless steel and head 18 of aluminum. So also may punch element 12 be fabricated of non-magnetic stainless steel.

Referring now to FIGS. 2 and 3, punch element 12 is seen to include an upper cylindrical guide portion 36. A first hole 38, circular in cross section, is provided therein. An axially disposed tapped hole 40, communicating with hole 38 and with the upper end 42 of guide portion 36 is adapted to receive a set screw for a purpose to be described.

The other end of guide portion 36 of punch element 12 terminates in a truncated conical segment 46. Guide portion 36 is sufficiently long so that when the punch element is in its fully extended position, the truncated conical segment 46 is disposed entirely outside of housing 14 thereby largely preventing accidental cutting by the sinus cutting edge 32. Extending downwardly from the truncated conical segment is an elongated cylindrical button 50, also circular in cross section. Button 50 is provided at the end of button carrying shaft 48.

Button 50 is itself circular in cross section throughout and comprises a cylindrical segment 52 of uniform diameter and a rounded convex end 54 in which it terminates. The diameter and the peripheral dimensions of the cylindrical segment 52 are substantially identical to those of housing 14 adjacent sinus cutting edge 32. It will be appreciated therefore that edge 56 of button 50 and sinus cutting edge 32 are adapted to cooperate to cut tissue when is interposed between them and they are drawn together in an overlapping relationship in the manner which will be described.

Punch element 12 also includes a bar 58 removably connected thereto. The dimensions of bar 58 are such that it is slidably received by hole 38 in which hole it is locked by set screw 44. Longitudinal slots 34 are also dimensioned so that they will slidingly receive bar 58.

To assemble trachea punch 1, punch element 12 is inserted into housing 14. Then bar 58 is passed through one of the longitudinal slots 34, through hole 38 in guide portion 36 of punch element 12, then outwardly through the longitudinal slot 34. When bar 58 has been properly centered with respect to punch element 12 and housing 14, set screw 44 is tightened thereagainst. Then the reduced diameter segment 24 of head 18 is disposed inwardly of the upper end of housing 14, opening 16 and tapped hole 26 are aligned, and lock bolt 28 is inserted and tightened to maintain the connection between head 18 and housing 14.

The peripheral dimensions of guide portion 36 and the internal peripheral dimensions of housing 14 have been predetermined to very close tolerances so that upon reciprocation of one part with respect to the other, sliding movement with substantially no wobble is obtained. Thus guide portion 36 serves to guide punch element 12 as it reciprocates within housing 14. The same close tolerances exist between the cylindrical segment 52 of button 50 and the inside of housing 14 adjacent the sinus cutting edge 32, the button being an effective cutting means similar in operation to a punch and die.

Punch element 12 is proportioned with respect to longitudinal slots 34 and housing 14 so that button 50 may extend forwardly and outwardly of cutting edge 32 about one inch. These elements have also been proportioned so that button 50 may be drawn outwardly of housing 14 as is best seen in FIG. 3, into an overlapping relationship. That is the instrument's retracted position.

The overall size of the trachea punch is not critical.

In one embodiment, one particularly useful for adults, in its extended position, the trachea punch is about 4½ inches long. In its retracted position, that is illustrated in FIG. 3, and with button 50 lying completely within housing 14, the instrument is approximately 3½ inches long. It is possible, and also desirable, to use a trachea punch which is of somewhat smaller dimensions for children and for babies. There are many suitable dimensions and the most suitable size of the segment to be removed from the trachea of a given patient will depend upon many factors, all of which will be apparent to those of ordinary skill in the art in view of the description herein given.

An understanding of the method of this invention and the manner in which the trachea punch of this invention is used will be facilitated by referring to FIGS. 4 to 8 particularly.

FIGURE 4 shows a patient whose trachea has first been exposed in a conventional manner. Then a transverse slit "S" is made in the trachea, preferably between the third and fourth cartilage rings with a scalpel such as a #11 stab knife. That slit should be very slightly longer than the diameter of the cylindrical segment 52 of button 50 of the trachea punch to be used for preparing the opening.

As shown in FIG. 5, button 50 of the trachea punch is inserted into the trachea through the slit "S." The button is held in its extended position by the operator's thumb and index finger, the housing being held back by the operator's grip upon head 18. Then, much like one inserts a button on a shirt into a button-hole, one side of button 50 is inserted into slit "S." The inserted segment of button 50 is then disposed against the inside of the trachea adjacent the slit, thereby serving as a fulcrum so that as the operator moves his hand downwardly as indicated by the arrow in FIG. 5., the convex top 54 pushes against the outer lower side of slit "S" until the entire button 50 is forced into the trachea. With the insertion having thus been completed, as best seen in FIG. 6, the punch is positioned to remove the desired segment of tracheal tissue.

By placing his third and fourth fingers beneath bar 58, as best seen in FIG. 7, and by squeezing downwardly upon head 18 the operator causes sinus cutting edge 32 to contact and penetrate the tracheal tissue surrounding slit "S." Edge 56 of button 50 cooperates with sinus cutting edge 32 as edge 32 completes its penetration of the trachea and its severance of the tracheal tissue.

Finally edge 56 and button 50 are disposed inwardly of housing 14 as is best seen in FIG. 8. When the instrument is in the manner the tracheal tissue severed is retained within the housing, between the inside wall of housing 14, button 50 and truncated conical segment 46.

The tracheal segment removed is generally disc-like in shape as can be appreciated from FIG. 8 which shows the opening "O" provided in the trachea in accordance with the method of this invention. As shown in FIG. 8, the trachea is ready for the insertion of the trachea tube.
same peripheral dimensions as the inside dimensions of said hollow body adjacent the knife-edge, said button being adapted to be retracted inwardly of said body and to be extended outwardly of said body, and means connected to said punch element at a location removed from the button end for freely slidably reciprocating said punch element with respect to said body.

2. The hand operable surgical punch of claim 1 wherein said body has an enlarged head connected to the end opposite the knife-edge and for facilitating reciprocation of said punch element with respect to said body.

3. The hand operable surgical punch of claim 1 wherein said blade edge is a sinuous knife-edge.

4. The hand operable surgical punch of claim 1 wherein said body is cylindrical, and wherein said punch element includes an enlarged cylindrical portion remote from the button end of substantially the same diameter as the inside diameter of said body thereby serving to slidably guide the punch element as the button travels between its retracted and extended positions.

5. The hand operable surgical punch of claim 4 in which said punch element further includes a truncated conical segment integral with said punch element and terminating and merging in said enlarged cylindrical portion, said truncated conical segment being so located on said punch element that when said button is in its extended position said truncated conical portion is disposed outwardly of said body thereby preventing accidental cutting by said knife-edge when said button is being inserted into a trachea.

6. The hand operable surgical punch of claim 4 wherein when said button is in its retracted position, said punch element and said body cooperate to form a chamber.

7. The hand operable surgical punch of claim 6 wherein said body includes longitudinal slots, and said means for freely slidably reciprocating said punch element extend outwardly of said body through said slots, said slots and said means cooperating to limit the extent to which said button may be retracted inwardly of said body and may be extended outwardly of said body.

8. A surgical instrument adapted to remove tracheal tissue comprising an elongated cylindrical hollow body, a head connected to one end of said body, said head having a segment of greater diameter than said body, a sinuous knife-edge integral with the other end of said body, longitudinal slots in said body, an elongated punch element freely slidably mounted in said body, said punch element having a button circular in cross section at one end and a guide section circular in cross section at a location removed from said button, both said button and said guide section being of substantially the same diameter as the inside diameter of said body, said button being adapted to extend outwardly of said knife-edge end of said body, a bar connected to said punch element and extending outwardly of said body through said longitudinal slots for slidably reciprocating said punch element and said body with respect to each other, said slots and said bar being located so that said button may be extended outwardly of the knife-edge end of said body and may be inserted through a slit in a patient's trachea and so that said knife-edge and said button may retract into an overlapping relationship whereby a segment of tracheal tissue may be removed and retained by said surgical instrument.

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