

[54] BONE BIOPSY INSTRUMENT AND METHOD

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[58] Field of Search **128/2 B, 2 R, 310**

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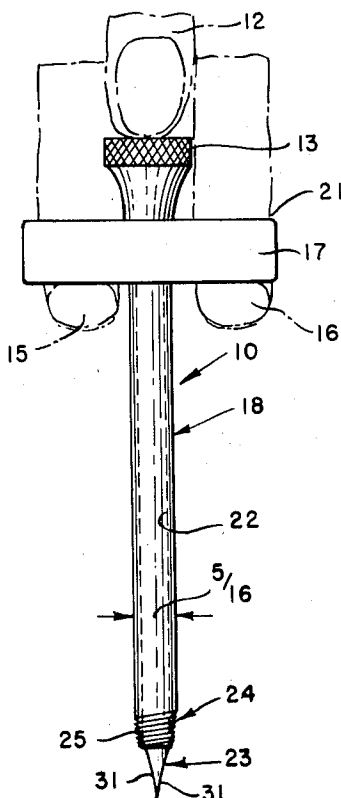
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[57] **ABSTRACT**

A bone biopsy instrument comprising an obturator in

the form of a rod-like member having an enlarged head at one end and a wedge shaped cutting and scraper blade at its opposite distal end slidably fitted into a tubular sheath of lesser overall length formed at its distal end to provide a conical tip converging toward the distal end to define an annular cutting edge in alignment with the passage defining wall and provided at its opposite proximal end with an enlarged head in end butting contact with the head of the obturator. The length of the tubular sheath is such that the bladed distal end of the assembled obturator protrudes from the distal end of the tubular sheath with the annular cutting edge of the tubular sheath surrounding the base of the wedge shaped cutting and scraper blade to provide an instrument the composite distal end of which may enter through a minimal length skin incision to pierce the soft subcutaneous tissue and dispose the bladed distal end of the obturator in contact with the underlying bone segment to be biopsied and permit the tubular sheath to be then advanced relative to the obturator to contact the bone severing the surrounded soft subcutaneous tissue and delimit a bone segment of finite diameter to be removed as a sample for pathological and diagnostic study. Upon removal of the obturator, the tubular sheath is rotated while applying a light axial forward pressure to advance the annular cutting edge into the bone to sever the delimited bone segment, a helical thread being preferably formed on the conical tip of the tubular sheath to feed the sheath cutting edge into the bone structure.

5 Claims, 5 Drawing Figures



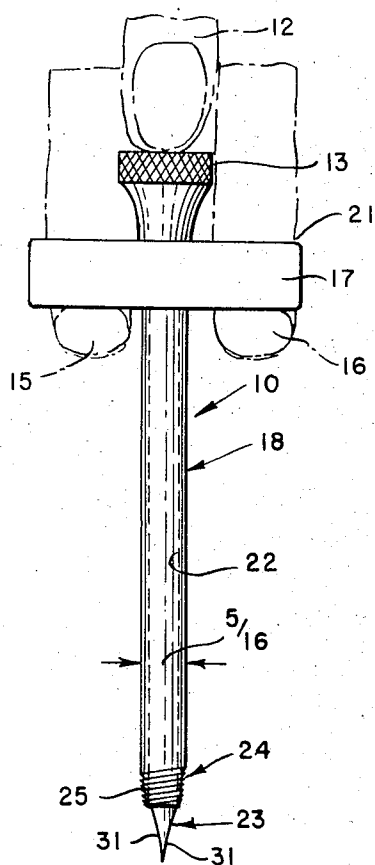


Fig. 1

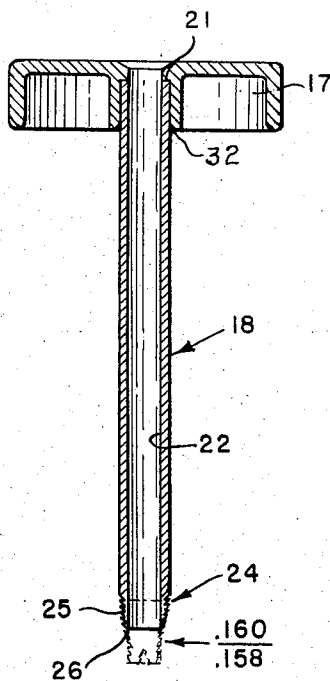


Fig. 3

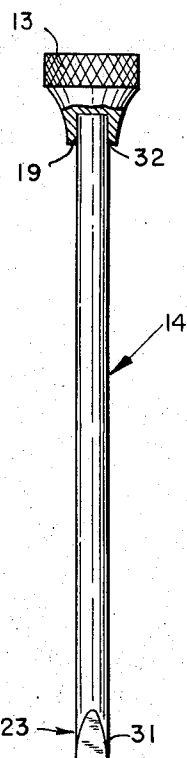


Fig. 4

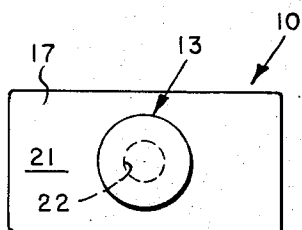


Fig. 2

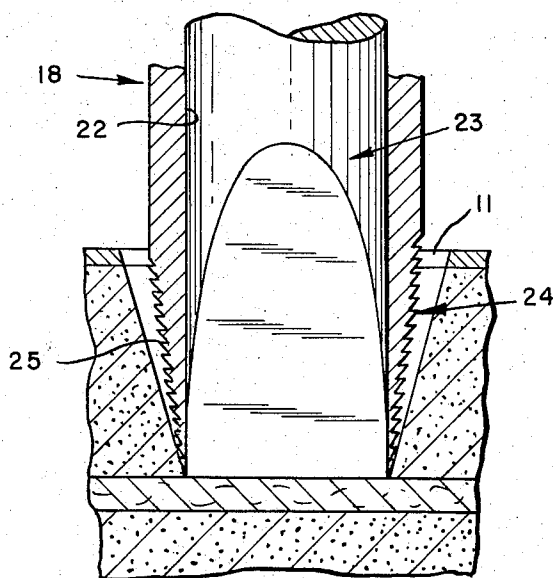


Fig. 5

BONE BIOPSY INSTRUMENT AND METHOD

BACKGROUND OF THE INVENTION

The present invention relates to biopsy instruments and more particularly to a method and apparatus for securing an optimal bone sample or specimen from human beings or animals for pathological examination and experimental purposes in making studies for diagnostic purposes. At the present time, such samples or specimens are only obtainable by use of needle type instruments which obtain very tiny and unsatisfactory samples or by major surgical procedures under general anesthesia which are time consuming, subject the human patient or animal to considerable discomfort and often objectionable trauma, and the obtaining of large samples, much more than are actually needed. In the present invention, a skin incision of minimal size is made over the area to be biopsied and the instrument of the present invention dimensioned to enter through the minimal size incision is employed to sever and remove an adequate yet minimal sized sample or specimen. The instrument is intended to be used under local anesthesia or during a surgical procedure. Its use results in only slight discomfort of the human patient or animal, objectionable trauma is avoided, and an optimal sample or specimen is obtained.

SUMMARY OF THE INVENTION

It is a primary object of the present invention to provide a bone biopsy instrument which is operative through a minimal length skin incision over the bone area to be biopsied to remove an optimal size bone sample or specimen or disk-like configuration for pathological and diagnostic study.

A further object of the present invention resides in the provision of a simple two part bone biopsy instrument made up of a rod-like obturator and a tubular outer sheath adapted for unitary entry through a small skin incision wherein the obturator distal end, in the form of a diametrically directed, wedge-like, scraping tip, protrudes axially beyond the distal end of the tubular sheath the outer wall of which converges axially to form a conical tip defining an annular cutting edge at the juncture of the base of the wedge-like scraping tip and the main body of the obturator adapting the tubular sheath, after contact of the bone by the obturator scraping tip, to be moved axially relatively to the obturator into contact with the bone to thereby cut through the soft tissue within the annular cutting edge freeing the severed tissue to be scraped free by rotation of the obturator, which is then removed by axial retraction of the obturator, freeing the sheath to be advanced by rotation into the bone to sever a disk-like bone sample or specimen of predetermined optimal size.

Another object of the present invention resides in providing the conical tip of the sheath of the biopsy instrument of the preceding object with a helical thread extending from its tip to its base whereby upon rotation of the sheath the thread will engage in the bone structure surrounding the annular cutting edge to effect an axial self feeding of the annular cutting edge into the bone structure thereby diminishing the stresses on the bone sample severed during rotation of the tubular sheath to provide a disc-like sample or specimen of optimal size and thickness.

A further object of the present invention resides in the provision of a method of securing an optimal bone sample or specimen from human beings or animals for pathological and diagnostic studies while minimizing the resulting discomfort and trauma normally experienced in present day major surgical procedures employed to obtain adequate size samples or specimens.

BRIEF DESCRIPTION OF THE DRAWINGS

Further objects will appear from the following description and appended claims when read in conjunction with the accompanying drawings wherein:

FIG. 1 is a side elevational view of an assembled bone biopsy instrument constructed in accord with the present invention;

FIG. 2 is a top plan view of the assembled bone biopsy instrument of FIG. 1;

FIG. 3 is a longitudinal sectional view of the tubular outer sheath of the bone biopsy instrument illustrated in FIG. 1;

FIG. 4 is a side elevational view of the rod-like obturator and scraping member of the bone biopsy instrument illustrated in FIG. 1 as viewed from the right side of FIG. 1; and

FIG. 5 is a fragmental sectional view on an enlarged scale illustrating the relative positions of the distal ends of the tubular sheath and obturator and scraping member of the bone biopsy instrument of FIG. 1 after the instrument has been entered through the skin incision and subcutaneous tissues to a position to effect scraping of the surface of the bone sample or specimen to be obtained and subsequent removal of the obturator and rotation of the tubular sheath to sever the bone sample from the remainder of the bone structure.

DESCRIPTION OF THE PREFERRED EMBODIMENT

With continued reference to the drawings where the same reference numerals are employed throughout the several views to indicate the same parts, numeral 10 designates generally the bone biopsy instrument of the present invention. Referring for the moment to FIGS. 1 and 2, instrument 10 is illustrated in its fully assembled relation as held by the surgeon for inserting it through the skin incision 11 (FIG. 5). As will be clear from the dot-dash illustration of FIG. 1, instrument 10 is held by the surgeon with his thumb 12 in end butted engagement with the enlarged head 13 at one end of the obturator 14 (FIG. 4) and his index finger 15 and middle finger 16 engaged beneath the plate-like head 17 at the adjacently related end of tubular sheath 18 (FIG. 3). In this assembled relation, the inner annular shoulder 19 of head 13 (FIG. 4) will be firmly engaged with the opposed upper surface 21 (FIG. 3) of head 17 defining the upper end of the through passage 22 (FIGS. 1 to 3) of tubular sheath 18. The opposite distal end 23 of obturator 14, as will be clear from FIG. 1, will protrude beyond the conical distal end 24 of tubular sheath 18. When held in this manner, the two part biopsy instrument 10 is ready for use as will be presently described.

In order to perform its intended function, the two parts of bone biopsy instrument 10 should be constructed to reasonably close tolerances to assure proper entry through a small skin incision 11 located over the bone area to be biopsied and the distal ends 23 and 24

should be constructed to accomplish their respective obturating and scraping and cutting and self threading functions. For purposes of illustration and guidance, the parts of a bone biopsy instrument 10 for use on adult human beings should preferably be constructed of stainless steel heat treated, polished and pacivated to the following dimensions:

Tubular Sheath

Overall Length	3 3/4 inches $\pm$.010
Outer diameter	5/16 inch
Wall thickness	5/64 inch

Obturator and Scraping Member

Overall length	4 1/2 inches
Outer diameter	5/32 inch

The distal end 24 of tubular sheath 18 is threaded externally as indicated at 25 (FIGS. 1, 3 and 5) to provide a self cutting thread adapted to thread into the bone structure surrounding the bone sample or specimen to be obtained and formed to provide an annular cutting edge 26 (FIG. 3) aligned with the inner wall of through passage 22. While this may be accomplished in any suitable manner, the following procedure is suggested to properly establish the initial cutting edge of the thread. A brass slug is press fitted into a tubular steel blank having the aforesaid dimensions to provide an axial protrusion of three/sixteenths of an inch and provided with a lathe tailstock centering aperture true to the machined surfaces of the blank. The opposite end of the tubular blank is apertured to receive in centering relation the lathe head stock center. The blank with the slug insert in place is mounted in a lathe fitted with a tool bit designed to cut a buttress thread and the lathe set to cut 20 threads per inch along a 7° tapering path. The tool bit is advanced into the brass slug at a point to begin the resulting 30° angle of the buttress thread at a distance of 0.158 to 0.160 inches from the free end of the brass slug to assure that the root of the thread pass uninterrupted from the brass slug to the steel tube. Threading is continued until the tool bit passes from the tubular sheath leaving a conical threaded distal end 24 terminating at its smaller free end in annular cutting edge 26. The opposite end of tubular sheath 18 is then completed by press fitting the generally rectangular enlarged head 17 of heat treated, polished and pacivated stainless steel thereon.

The obturator 14 is preferably formed by grinding distal end 23 to form a wedge shape tip defined by oppositely facing flats 31 (FIG. 1) inclined relative to a diametrical plane at 30° and press fitting a knurled knob-like member of heat treated and pacivated stainless steel on the opposite end to form enlarged head 13. To insure a permanent connection between sheath 18 and its enlarged head 17 and the rod-like obturator and its knob-like head 13, the receiving passages of each are preferably chamfered at their outer ends to provide an annular recess which is filled with a suitable solder, preferably silver solder 32 to minimize corrosion. Such a solder employed with the heat treated, polished and pacivated stainless steel of sheath 18 and obturator 14 assures an instrument which will withstand repeated sterilization and long useful life.

In practice, the biopsy instrument of this invention is intended to be used either under local anesthesia to obtain a bone sample or specimen or during a surgical

procedure to obtain such a sample or specimen. In either case, the method of use consists in making a minimal length skin incision over the bone area to be biopsied sufficient only to permit the assembled tool, held as shown in FIG. 1, to be inserted into the incision with the protruding flats 31 of the wedge shaped tip of the obturator extending lengthwise of the incision. As a result of this initial insertion, the sharp tips defined by flats 31 advances vertically through the soft subcutaneous tissue underlying the skin incision while the flats press the sidewall tissues and skin outwardly, particularly at and near the skin surface, clearing a path for subsequent entry of the cutting tip 26 of the surrounding sheath 18. Upon contact of the very tip of obturator 14 with the bone segment to be removed, the fingers 15 and 16 are removed from beneath enlarged head 17 and the head 17 is grasped by the surgeon's other hand and sheath 18 is advanced inwardly of the incision guided by the stationary obturator 14 to pass cutting edge 26 through the minimal area of subcutaneous tissue in its path into contact with the bone as illustrated in FIG. 3. This initial inward movement of sheath 18 severs the minimal area of subcutaneous tissue lying within the confines of the five-thirty seconds inch diameter circle defined by cutting edge 26 from the surrounding tissue freeing the severed subcutaneous tissue for removal from the bone sample to be obtained. Removal of the severed subcutaneous tissue is effected by lightly pressing cutting edge 26 against the bone and rotating obturator 14 to scrape the bone area within cutting edge 26 of sheath 18 to free the severed tissue. After the scraping action is completed, obturator 14 is removed by retracting it through the axial passage 22 of sheath 18 which is held lightly in contact with the bone.

Upon removal of obturator 14, the surgeon grasps head 17 of sheath 18 and applies a slightly greater axial inward pressure to sheath 18 while bodily rotating sheath 18. This rotation under slightly greater axial pressure causes cutting edge 26 and the leading cutting point of helical thread 25 to enter the bone structure initiating severance of the bone along a circular path defined by cutting edge 26 and entry of thread 25 into the bone structure radially outward of cutting edge 26. Upon continued rotation of sheath 18 with only slight inward axial pressure, thread 25 will self feed itself into the surrounding bone structure advancing cutting edge 26 deeper into the bone with minimal contact of thread 25 with the surrounding tissue of the incision sidewalls distended by its engagement with the base of conical tip 24. When sheath 18 has been advanced sufficiently into the bone, a determination readily made by the skilled surgeon predicated on the number of revolutions of head 17, the severed disc-like bone sample or specimen is freed from the underlying bone structure by a circular or criss-cross motion of sheath 18. When thus freed, the disc-like bone sample or specimen lodged within the distal end 24 of sheath 18 is removed intact by reverse rotation of sheath 18 to thread it outwardly of the surrounding bone structure and then withdrawing sheath 18 through the incision.

Cleansing of the wound made by the incision and removal of the bone sample or specimen is then effected in well known manner and, if necessary, suturing of the incision is effected to assure proper healing of the wound.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by Letters Patent is:

1. A biopsy instrument for securing optimal samples of bone for pathological and diagnostic studies comprising an elongated, tubular sheath defining a cylindrical, axial through passage, said tubular sheath at its proximal end having a head portion and at its opposite distal end having an external conical wall portion converging toward the distal end to define with the axial passage wall an annular cutting edge; and a rod-like obturator slide fitted into said sheath passage, said obturator at its proximal end having a head portion engaging the opposed end face of said sheath head portion and a distal end protruding beyond the distal end of said sheath and comprising oppositely facing flats extending from said annular cutting edge and converging toward the distal end of the obturator to define a diametrically directed wedge shaped blade.

2. The bone biopsy instrument of claim 1 wherein the conical wall portion of said tubular sheath is provided with a helical screw thread the lead end of which is co-terminous with said annular cutting edge and adapted to enter the bone outwardly of said annular cutting edge when said sheath is advanced relative to said obturator to initiate entry of said annular cutting edge into the bone and thereafter, upon rotation of said sheath, to self thread into the surrounding bone to advance the annular cutting edge into the bone and sever an annular bone segment of the desired thickness to be removed.

3. The method of securing an optimal sample of bone from human beings and animals for use in pathological and diagnostic studies using an instrument comprising a cylindrical rod-like obturator the distal end of which is formed to provide a wedge shaped cutting edge extending diametrically fitted into a cylindrical sheathing the distal end of which is externally tapered to define an annular cutting edge encircling the base circle of the wedge shaped obturator distal end, comprising the steps of making a small skin incision over the area to be biopsied; entering into the incision the wedge shaped, cutting blade end of the obturator; advancing

the obturator and sheathing as a unit through said incision until the tip of said wedge shaped cutting blade engages the bone thereby cutting through and parting the subcutaneous soft tissue overlying the bone area to be biopsied to permit entry of the sheathing distal end; slidingly advancing the sheathing relative to said obturator to advance the annular cutting edge through the parted soft tissue subtended by the annular cutting edge thereby severing the soft tissue within the annular cutting edge; rotating the obturator to scrape the bone area within the annular cutting edge and free the severed soft tissue from said bone area; retracting the obturator from the sheathing; applying axial pressure to the sheathing while rotating the sheathing to enter the annular cutting edge into the bone to a desired depth thereby severing the bone segment within the annular cutting edge from the surrounding bone structure; applying a rocking movement to the sheathing to free the severed bone segment from the underlying bone structure; and retracting the sheathing through the incision with the dislodged and severed bone segment therein.

4. The method of claim 3 wherein the tapered distal end of the cylindrical sheathing is provided with a helical thread and the axial pressure is applied momentarily to the sheathing to initiate entry of the thread into the surrounding bone structure and thereafter rotation of the sheathing is continued to effect threaded self feeding of the annular cutting edge through the bone to minimize splintering of the bone and bone sample as the annular cutter completes its bone cutting action.

5. The steps of obtaining an optimal bone biopsy sample comprising the steps of making a line incision of finite length through the skin layer into the subcutaneous soft tissue; piercing the subcutaneous soft tissue to a depth inward to the bone along the full length of the incision while spreading the pierced tissue defining the sides of the incision by a wedging action to form an inverted truncated opening defining at the entrance of the incision a circle the diameter of which equals the original incision length; severing the subcutaneous soft tissue subjacently related to said circle to the bone in a circular area to form a cylindrical opening having a diameter equal to said circular area; removing the severed soft tissue from the bone by a rotating scraping action; cutting through the bone by a rotating cutting action to smoothly sever in situ a bone disc biopsy sample of said finite diameter; breaking the bone disc sample loose from the subjacent bone structure; and retracting the intact bone disc sample from the incision.

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