June 4, 1946. E. CHAPMAN 2,401,548

METHOD AND APPARATUS FOR CRANIAL OPERATIONS

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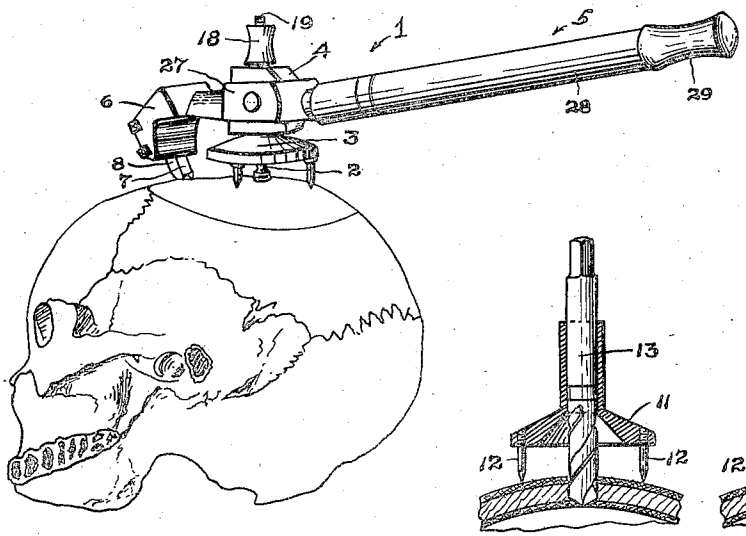

FIG. 1

FIG. 5

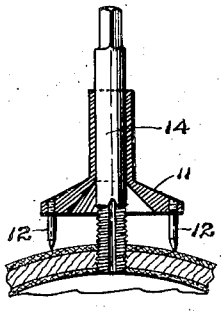

FIG. 6

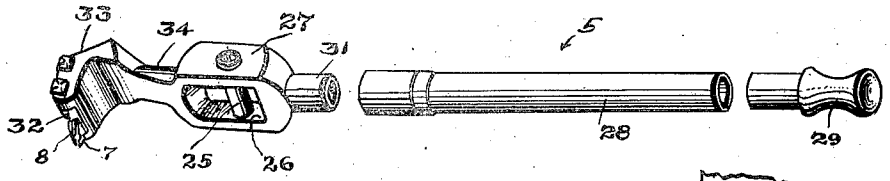

FIG. 2

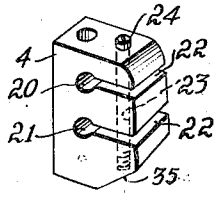

FIG. 7.

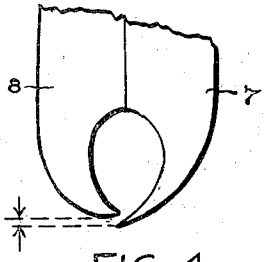

FIG. 4

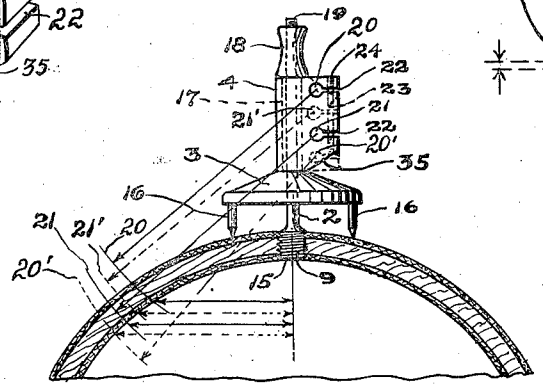

FIG. 3

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METHOD AND APPARATUS FOR CRANIAL OPERATIONS

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8 Claims. (Cl. 128—310)

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This invention, as indicated, relates to a method and apparatus for cranial operations. More particularly, it comprises a simplified procedure for removing an area of bone structure from the skull with a minimum of structural damage. It also includes a number of parts adapted to be assembled as an operative instrument at a selected point on the skull and adjusted for operation over a predetermined closed cutting path of very narrow width and under controlled range of cutting action. The invention includes means for precision mounting of the cutting implement and its parts so that no destructive strains will be imposed upon the instrument or the bone structure operated on. The invention also includes the method of exposing the bone area of the skull to a minimum degree and permitting the removal of a bone flap without extended injury to the scalp and associated muscular and other tissue during the operation.

Another feature of the invention comprises the provision of a knife and associated guide member whereby the depth of the cut may be maintained at a constant depth of a fractional amount, and thus prevents injury as the channel being cut approaches the inner table of the skull and avoids puncturing the dura.

The apparatus also includes means for adjusting the device for cutting circular areas of various sizes without changing the knives which, of course, must be ground on a radius, since the feed of the cut is around a pivot.

The principal object of the present invention is to provide an improved procedure for the removal of an area of the bone structure from the skull with a minimum of structural damage and within a reduced period of time.

Another object of the invention is to provide an apparatus for carrying out the procedure of removing an area of bone structure from the skull under conditions imposing no harmful strains upon the area to be removed or the adjacent skull structure, and at the same time restricting the quantity of bone structure removed to extremely low limits.

Another object of the invention comprises the provision of means for preparing an anchorage for an operative instrument which means and instrument correspond precisely in their points of contact with and angular relations to, the skull, thus insuring exact registry of the preparatory and final operative units.

Another object of the invention is to provide a stationary pivot point having a relatively wide base of support on the skull, providing a pivot for a blade supporting member having free movement toward and away from the skull.

Another object of the invention is to provide a pivot point of the character stated upon which a member is freely rotatable and carries a plurality of adjustment bearings for cutting circular

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areas of various diameters with a single cutting instrument.

Another object of the invention is to provide a cutting unit with a guide unit which restricts the action of the cutting unit to the removal of a predetermined fractional amount of bone structure with a constant depth of cut.

Another object of the invention is to provide a cutting implement freely rotatable about a fixed pivot point and movable toward and away from the skull and having a plurality of bearings permitting the removal of skull areas of various diameters.

Another object of the invention is to provide an apparatus for the various purposes above stated which may be readily assembled, adjusted and removed without causing injury to the structure operated on.

Another object of the invention is to provide an instrument of the character above set forth which is simple to manufacture, and which at the same time is extremely precise in its operative functions and easily maintained and of long service life.

Other and further objects of the invention will appear in the course of the following description.

To the accomplishment of the foregoing and related ends, said invention, then, consists of the means and method hereinafter fully described and particularly pointed out in the claims, the annexed drawing and the following description setting forth in detail certain structures and means embodying the invention, such disclosed means and method constituting, however, but several of various forms in which the principle of the invention may be used.

In said annexed drawing:

Fig. 1 is a perspective view showing an instrument embodying the principles of the invention as applied to the top surface of a human skull;

Fig. 2 is a perspective view of the cutter-bar or lever and showing the cutting blade and guide member in clamped engagement at one end;

Fig. 3 is a diagrammatic view showing the pivot unit of the instrument held in completely rigid relation to the skull and supporting a trunnion block provided with a plurality of bearings for different radial cutting adjustments.

Fig. 4 is an enlarged fragmentary view showing the cutter blade and guide member in their predetermined spaced relation;

Fig. 5 is a central vertical sectional view of a tripod jig showing a drill in position to drill an opening in the skull along an axial line precisely normal to the skull relative to the tripod position;

Fig. 6 is a view similar to Figure 5 showing a tap replacing the drill in the tripod jig; and

Fig. 7 is a perspective view of the trunnion block.

As is clearly shown in Figures 1, 2 and 3, the strument 1 comprises a tensioning rod or tie-bar 2, a tripod tubular pivot member 3, a trunnion block 4, a cutter-bar or lever 5 provided with a cutter clamping terminal 6 carrying a cutter blade 7, and a guide bar or "sled-runner" guide 8.

The instrument, as has been indicated, is adapted for work of great precision and provides for safety and security of support with a minimum of destruction of bone tissue to provide an anchorage, and to produce the circular or oval channel defining and separating the area of the skull to be removed. This operation may be designated as severing the "bone flap."

The location and forming of the anchorage recess 9 and the mounting of the anchoring rod therein require preparatory steps to insure absolute registry of the instrument pivot therewith to avoid imposing injurious or destructive strains on the adjacent bone structure. The bone is exposed at the place for the recess, and a tripod jig 11 as shown in Figures 5 and 6 is positioned thereover, the tripod points 12 being located precisely and the indentations formed later receiving the corresponding tripod points of the substantially identical pivot member tripod 3 of the instrument above referred to. With the tripod jig in position the recess is formed through the use of a drill 13, and is then threaded through the use of a suitable tap 14. The recess is of restricted depth and both the drill and the tap may be provided with adjustable stop-members (not shown) to limit their downward movement. The tap and jig are then removed.

After forming the recess the tie-bar or tensioning rod 2 is mounted in position by screwing its enlarged screw-threaded terminal 15 into the recess. The tubular pivot member 3 is then telescopically engaged over the tie-bar and the points 16 of its tripod are seated in the indentations made by the points 12 of the tripod jig 11, as above explained.

The tubular pivot portion 17 of the tripod member 3 receives the trunnion block 4 in swiveling engagement and a locking knob 18 screw-threadedly engaged on the threaded upper end 19 of the tie-bar seats firmly against the upper of the tubular pivot portion 17 without interfering with the free rotation of the trunnion block.

In order to provide for accurate positioning of the cutter blade against the bone structure for a predetermined size of bone area to be severed, the trunnion block 4 is provided with a plurality of transverse bearing openings, shown as two in number, in Figure 3, the upper opening 20 being closely adjacent the squared end of the trunnion block and the other opening 21 being approximately in a central position transversely of said block. Each of the openings may be intersected by a slotted transverse channel 22 opening through the rearward face of the trunnion block, and these slots, in turn, are intersected by a longitudinal tubular passageway 23 within which a clamping or adjusting bolt 24 may be engaged to insure accuracy of fit of the bearing pin 25 of the cutter-bar 5 within the selected bearing, as is shown more clearly in Figure 7.

One end 35 of the trunnion block 4 is preferably beveled to prevent confusion in selecting the bearing opening providing the desired radius for the cutter-bar movement. As will be noted from the diagrammatic lines in Figure 3, the shortest radius is provided with the beveled end 35 of the trunnion block in its lower position and the bearing opening 20 in use for the bearing pin 25. The longest radius 20' is obtained by using the same bearing opening 20 with the block 4 in reversed position with the beveled end 35 in its upper position. The bearing opening 21 with the beveled face 35 of the block downward provides the second longest radius and with the opening 21' at the reversed position provides the second shortest radius 21'.

In a specimen instrument of the character shown in the drawing the four adjustments provided, served to remove flaps of 3¼, 3⅛, 4⅛ and 4½ inches, in their major dimensions, respectively.

In order that the blade 7 may be prevented when breaking through the inner table of the skull from puncturing the dura, a guide member 8 is provided with a predetermined clearance fraction for the cutting action of the blade. A practical limit for the depth of cut is ten thousandths of an inch and the curvature of the guide member in the shape of a sled-runner prevents inward movement of the cutter edge in the event of a sudden breakthrough, while the body of the cutter blade immediately above the cutting edge serves as an abutment or stop to prevent forward movement.

The bearing pin 25 extends across a somewhat rectangular opening 26 in an enlarged portion 27 of the cutter-bar unit 5, the opening being elongated sufficiently to prevent contact with the trunnion block 4, and the bearing pin 25 passing through the trunnion block at a position rearwardly of the tubular pivot portion 17 of the pivot tripod member 3. The cutter-bar unit 5 may be made as an integral member, but is preferably formed with a telescopic tubular lever portion 28 terminating in a suitably shaped hand-grip 29 engaged in the free end thereof. The lever when formed as a telescopic unit engages frictionally with a stud 31 formed on the enlarged central portion 27. The cutter blade 7, and its guide member 8, are carried between clamping members 32 at the edge of a terminal head 33 on the end of the short lever section 34 extending from the enlarged portion 27 opposite the position of the stud.

From what has been above stated the method of procedure will be understood. However, it must be kept in mind that this procedure should be carried out as a precision operation, and that the formation of the recess in the skull, through the use of the tripod jig 11, and the mounting of the tension bar after such recess is formed must be at an identical axial angle and coaxial with the central tubular area of the pivot tripod which engages over the tensioning rod. The steps of the method when thus carrying through the operation consist in exposing the bone at the point where the tension rod is to be mounted and drilling a small hole in the bone structure along an axial line normal to the plane established by the tripod for a three-point contact with the skull and thereafter tapping the hole and removing the tap and jig, then mounting a tension rod having a threaded lower end in the tapped hole with the tension rod registering with the axial angle established by the drill and tap and thereafter mounting a tubular pivot member provided with a tripod base of three-point contact with the skull identical with that of the tripod used for the drill and tap whereby the pivot member will be exactly held with the body thereof co-axial with the line referred to and securing the same through tension applied to the tension rod and mount-

ing a trunnion block on the pivot member for free rotation with the bar carrying a cutter for free rotation toward and away from the skull interior along a predetermined radial path and thereafter moving the cutter around the radial path to cut a channel through the bone structure to provide a removable bone area.

Other modes of applying the principle of my invention may be employed instead of those explained, change being made as regards the means and steps herein disclosed, provided the means stated by any of the following claims or the equivalent of such stated means be employed.

I therefore particularly point out and distinctly claim as my invention:

1. A method for removing a portion of the skull which comprises exposing the bone structure at a restricted central point and forming a narrow circumscribed area having such point as a center, thereafter drilling a small hole in the bone structure along an axial line normal to the plane established by a tripod jig having a three-point contact with said skull, then mounting a tensioning rod firmly in said hole, said tensioning rod registering with said axial line, then mounting a tubular pivot member upon said tension rod with the base of said pivot member in identical three-point contact with the skull and the body thereof co-axial with said line, anchoring said pivot member to the skull through tension applied to said tensioning rod and mounting a hinged angularly movable single edge rotatable cutting unit on said pivot member for producing a channel around an area of skull structure to be removed from the skull.

2. A method for removing a portion of the skull which comprises exposing the bone structure at a restricted central point and forming a narrow circumscribed area having such point as a center, thereafter drilling a small hole in the bone structure along an axial line normal to the plane established by a tripod jig having a three-point contact with said skull, and tapping the hole, then mounting a tension rod registering with said axial line, then mounting a tubular pivot member upon said tension rod with the base of said pivot member in identical three-point contact with the skull and the body thereof co-axial with said line, anchoring said pivot member to the skull through tension applied to said tension rod, mounting a trunnion block on said pivot member for free rotation thereon, securing a bar, carrying a single edge cutter, to said trunnion block for free movement toward and away from said skull adjusted to a predetermined path of movement around said pivot member, and thereafter moving said cutter around said path to cut a channel through the bone structure to provide a removable bone area.

3. An apparatus of the character described having in combination a stationary vertical pivot member firmly secured to the skull, a trunnion block, provided with at least two selective positions for mounting the transverse trunnion bearing pin, engaged for free rotation on said pivot member, a cutter-bar mounted in a selected trunnion bearing for free movement toward and away from the skull with a cutting radius, intersecting the skull structure, determined by the position of the selected bearing member in said trunnion block, and a cutter blade secured on the end of said cutter-bar.

4. An apparatus of the character described having in combination a stationary vertical pivot member firmly secured to the skull, a trunnion block, provided with at least two selective positions for mounting the transverse trunnion bearing pin, engaged for free rotation on said pivot member, a cutter-bar mounted in a selected trunnion bearing for free movement toward and away from the skull with a cutting radius, intersecting the skull structure, determined by the position of the selected bearing member in said trunnion block, a cutter blade secured on the end of said cutter-bar, and a guard member fixed in closely spaced relation in advance of said cutter blade to restrict the depth of cutting action to a uniform predetermined fraction, and to limit forward movement of the cutter blade upon the completion of the cutting operation.

5. An instrument for cranial operations having in combination a vertical pivot member firmly anchored to the bone structure of the skull with a wide area of the contact with the skull, a cutting unit in the form of an elongated bar and central pivot block having free pivoted vertical and horizontal movement mounted on said pivot member and having a clamping terminal adjacent one end, a removable blade and guide member secured within said clamping terminal with said blade restricted to a fractional projection beyond said guide member to limit the depth of cut, said guide member providing a stop to limit forward movement of the cutter blade upon the completion of the cutting operation, and a handle member adapted to be attached to the opposite end of said cutter unit for controlling the cutting action of said blade.

6. A cutting unit adapted to be secured to the skull structure by an anchoring member engaging said skull, comprising a central pivot member, a trunnion block suitably mounted on said pivot member and reversibly engageable therewith, a plurality of transverse trunnion bearings in said trunnion block offset from the upper and lower marginal edges of said block in different amounts to provide variable spacing for said trunnion bearings, and a cutting-bar having an intermediate opening and a trunnion pin engageable within a preselected trunnion bearing for cutting a predetermined area of bone structure from the skull along an arcuate path determined by the distance of the cutting edge from the pivot point.

7. An apparatus of the character described having in combination a stationary pivot member firmly secured to the skull at approximately a right-angle thereto, a reversible trunnion block, provided with at least one offset transverse bearing, mounted for free rotation on said pivot member, a cutter-bar mounted in a selected trunnion bearing for free movement toward and away from the skull with a radius intersecting the skull structure, determined by the position of the selected bearing member, and a cutter blade secured on the end of said cutter-bar.

8. An apparatus of the character described having in combination a stationary pivot member firmly secured to the skull at approximately a right-angle thereto, a trunnion block, provided with at least two transverse trunnion bearings, engaged for free rotation on said pivot member, a cutter-bar mounted in a selected trunnion bearing for free movement toward and away from the skull with a cutting radius, intersecting the skull structure, determined by the position of the selected bearing in said trunnion block, and a cutter blade secured on the end of said cutter bar.

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