Feb. 6, 1968 C. H. FRAZIER 3,367,326

INTRA SPINAL FIXATION ROD

Filed June 15, 1965

FIG. 1.

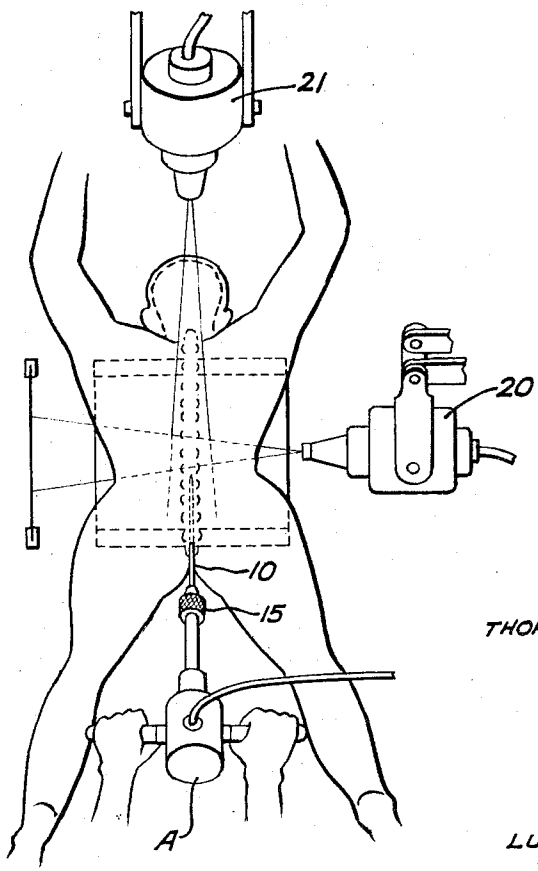
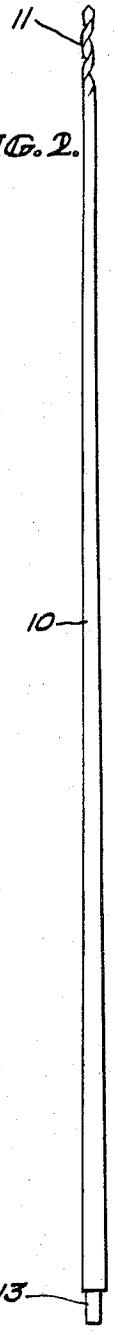


FIG. 2.



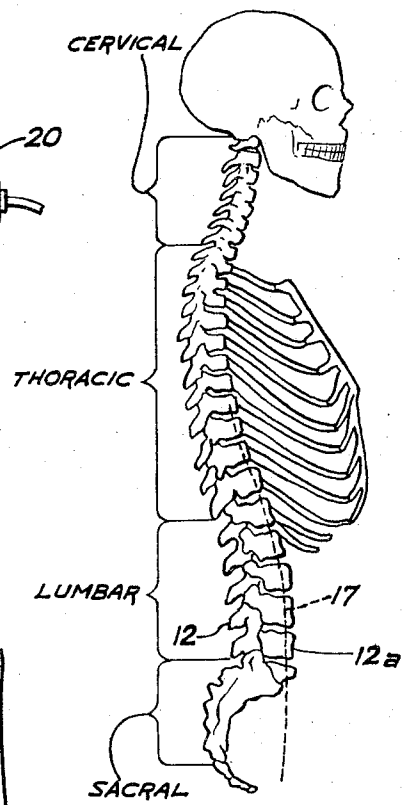


FIG. 4.

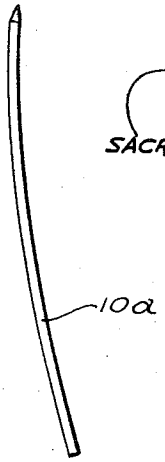


FIG. 3.

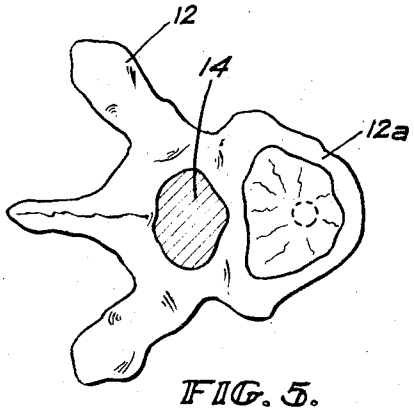


FIG. 5.

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INTRA SPINAL FIXATION ROD

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ABSTRACT OF THE DISCLOSURE

An improved tapered intra-medullary spinal fixation rod having a drill tip at the tapered end and the method of using the rod to support a human spine by drilling the rod through successive vertebrae.

The present invention relates to bone surgery, and pertains more particularly to a means for and method of positioning and supporting a spine.

In the case of a malformed spine, or one weakened by injury or disease, it frequently would be of inestimable value if the spine could be brought toward its normal or correct shape and maintained in that position. It is common practice in some bone breaks, for example, the neck of the femur, to insert a metal pin lengthwise through the two parts of the bone to secure them in properly set position. Prior attempts have been made to stabilize the spine by metal pins and plates embedded alongside the spine, and by various orthopedic harnesses strapped onto the body, but to date no known prior means or method has provided satisfactory, and if necessary permanent, positioning and stabilization for a malformed, weak or injured spine.

The present invention is directed toward the positioning and stabilizing of a human spine.

A further object of the invention is to provide an improved intra-medullary spinal fixation rod for inserting through the centrum of each of a plurality of adjacent vertabrael processes of a human spine.

A further object of the invention is to provide an elongated, tapered rod with a drill tip thereon, the rod and drill tip being of a metal which will be tolerated by, and stable within, a human body, the rod and drill tip being formed for drilling into and through a plurality of successive spinal vertabrae to support, stabilize and the spine in which such vertebrae are located.

A further object of the invention is to provide an improved method for positioning and stabilizing a plurality of adjacent spinal vertebrae by inserting through the centrum of the vertebral process of each of such vertebrae a metal rod, and then, if the rod is to remain therein, severing the rod at a point below the spine which will be within the body upon healing.

A further object of the invention is to provide an improved method for positioning and stabilizing a human spine which comprises inserting a stabilizing rod through a plurality of successive vertebrae of such spine while observing by radiograph the forward tip of the rod as it proceeds along its course.

The foregoing objects and advantages of the invention will be apparent from the following description and the accompanying drawings, wherein:

FIG. 1 is a somewhat diagrammatic, perspective view showing the insertion of an intra-medullary spinal fixation rod in accordance with the present invention.

FIG. 2 is an enlarged, side elevational view of a preferred form of spinal fixation rod embodying the invention.

FIG. 3 is a similar view in reduced scale of a curved spinal fixation rod which can be employed where a slight curvature is desired.

FIG. 4 is a somewhat diagrammatic, side elevational view of a spinal column with the skull and a portion of the rib cage attached, the broken line showing the location of a spinal fixation rod inserted in accordance with the invention.

FIG. 5 is a plan view of a thoracic vertebra with the target location of the rod in the centrum indicated by the dotted line circle.

Briefly, in the illustrative form of the present invention, an intramedullary spinal fixation rod or pin **10** preferably is tapered as shown in FIG. 2 with the leading end thereof in the form of a drill tip **11**. The rear or driving end of the rod **10** is adapted to be chucked in a suitable drill, such as that A shown in FIG. 1.

The rod **10** preferably is inserted in the peri-anal region or through the colon and thence onto the lower end of the spine **12** (FIG. 4) by drilling through the sacrum. The rent in the colon can be repaired after the rod has been driven through it. The rod **10** is guided to course upwardly through the centrum of each successive vertebra until a desired penetration has been achieved. The lower end of the rod **12** may then be severed, and the portion which has penetrated the spine remains in position therein. During the insertion of the rod **10**, the progress of the leading end thereof preferably is followed by radiograph observations.

Referring to the drawings in greater detail, a presently preferred spinal fixation rod **10** (FIG. 2) is of suitable metal, which is relatively inert, and which will be well tolerated within the body, for example, a metal of the type used in the making of an intramedullary rod or nail of the type used for pinning broken bones, such as a bone of the leg or arm. The rod **10** is gradually tapered from the rear or driving end **13** toward the forward or leading tip end **11**, since the vertebral bodies **12***a*, forwardly of the spinal cord **14** (FIG. 5), through which the rod **10** is inserted are of smaller size toward the upper end of the spine than they are toward the lower end thereof.

The rear or driving end **13** of the rod **10** is adapted to be chucked in the chuck **15** of a suitable drill, such as the usual half-inch electric drill A (FIG. 1) having a conventional AC-DC motor and employing a well known type of electronic speed control mechanism (not shown) employing a silicon rectifier to change AC line current to half-wave DC and a potentiometer, and employing a feed-back circuit to provide adequate torque at low speeds.

The forward tip portion **11** of the tapered rod **10** is in the form of a drill, the specific type of drill not being a feature of the present invention provided it is suitable for drilling through bone. Most of the path of the drill, as is obvious from the dotted line **17** indicating such path in FIG. 4, is in comparatively soft, inner bone structure and cartilage, although at the zone of entry into the sacrum it is, of course, harder.

It is not always necessary that the rod **10** be stiff, and it may be desirable in some instances that it be quite bendable either in part or throughout its entire length. It is obvious from FIG. 4 that in order to insert the rod **10** into the spinal processes of the upper thoracic region, and thence, if necessary, on into those of the cervical region, a bending of the rod **10** will be essential. Such bending can be accomplished, for example, by employing a slightly bendable rod with a slightly offset tip thereon and drilling to the maximum distance wherein the spine can be manipulated into a sufficiently straight position to permit such drilling. From this point on the rod can be driven, the rod being turned to direct the offset tip toward either the front or back as required, by rotatively moving the rod through an angle of 180°.

Such positioning of the offset tip will cause a deflection of the tip along a desired path, the rod being sufficiently flexible to permit it to follow such gradually deflected path. Another means for inserting the rod along a curved path is to employ a flexible rod with a drill tip on the leading end thereof offset to one side slightly so as to cause the drill tip to drift in the direction in which the tip is offset when the rod is oscillated, and to follow a straight course when the rod is rotated.

Some changes in the alignment of successive vertebrae, at least those of the lumbar region is usually possible by manipulation of the body of the subject as the drill advances from one vertebra to the next, thereby to maintain the drill tip on its desired course. The requirement for a more or less flexible rod, and a curving or drifting course for the tip **11** becomes necessary only in cases of an uncorrectable curvature, or for advancement of the rod into the upper portions of the spine, where the presence of the rib cage restricts such manipulation.

A presently preferred method for inserting the rod **10** into a spine **12** is as follows:

The drill tip **11** is introduced in the peri-anal region, or through the colon. The progress of the tip **11** of the rod **10** is observed at required intervals throughout the insertion procedure by radiograph observation, preferably employing two X-ray machines **20** and **21** with their ray axes directed toward a desired point along the spine, and offset from each other through a selected transverse angle, preferably of approximately 90° as shown in FIG. 1.

The rod **10** is directed so that it passes through the sacrum and enters the centrum of the spinal process of the lowermost lumbar vertebra. Thence it is directed along a course through the centrum of each successive vertebra until a desired penetration has been attained, for example, when the zone of the spine which it is desired to straighten or stabilize has the rod inserted therein. The rod **10** is then released from the drill chuck **15**, and is cut off as by means of a bolt cutter (not shown) at a desired point, preferably a point which will be within the body after healing if the rod is to remain in place permanently. If the rod is to be removed after a spinal healing process has occurred, the rod is allowed to project so that it can be manipulated as required for its withdrawal.

If it is necessary to advance to rod **10** to a point in the spine which cannot be reached with a straight rod, a rod of suitable flexibility is employed, and is guided in its course from one vertebra to the next as required and as set forth previously herein. Also, in some cases, it might be desirable to insert a pre-formed rod such as that **10***a* shown in FIG. 3.

The invention provides a means and method for straightening and strengthening malformed, injured, diseased and weakened spines whereby it is possible to restore to almost normal condition and use, many persons who at present are suffering from such spinal conditions.

While I have illustrated and described a preferred embodiment of the present invention, it will be understood, however, that various changes and modifications may be made in the details thereof without departing from the scope of the invention as set forth in the appended claims.

Having thus described the invention, what I claim as new and desire to protect by Letters Patent is defined in the following claims:

1. The method of supporting a malformed, injured or diseased spine which comprises introducing into the anal-peri-anal region of a person whose spine is to be supported the tip of an elongated rod of material which will be tolerated within such spine, and thence inserting the rod through the centrum of the vertebral process of each of a selected plurality of successive vertebrae of such spine.

2. The method of supporting a malformed, injured or diseased spine which comprises introducing into the anal-peri-anal region of one whose spine is to be supported the rotating drill tip of an elongated rod of small diameter, and of a material which will be tolerated within such spine, and thence inserting the rod in such spine by drilling with the drill tip of the rod through the centrum of the vertebral process of each of a selected plurality of successive vertebrae of such spine.

3. The method of supporting a malformed, injured or diseased spine which comprises introducing a rotary drill into the anal-peri-anal region of one whose spine is to be supported, of drilling into and through the centrum of the vertebral process of each of a selected plurality of successive vertebrae of such spine, and of inserting into the holes thus drilled a small diameter rod of a material will be tolerated within such spine.

4. The method set forth in claim **3** wherein after insertion of the rod in the holes, the rod is severed below its point of entry into the lowermost vertebra at which it enters such spine.

5. An intramedullary spinal fixation rod comprising an elongated rod of round cross sectional shape and of a material which will be tolerated with a human spine, means for mounting one end of the rod in power driven chuck means for controlled rotation of the rod about its axis, the other end of the rod being in the form of a drill suitable for drilling in bone, the rod being tapered from said one end toward said drill end, and of a length for introduction at a selected zone of the anal and peri-anal region and insertion by drilling thence through the sacrum and the centrum of the vertebral process of each of a selected plurality of successive vertebrae of a human spine, one or more of which vertebrae is to be positioned and supported by the rod.

6. An intramedullary spinal fixation rod comprising an elongated rod of round cross sectional shape and of a material which will be tolerated with a human spine, power driven means operatively engaging the rod for controlled rotative movement of the rod about its axis, the leading end of the rod being in the form of a drill suitable for drilling in bone, the rod being tapered toward said drill end, and of a length for introduction at a selected zone of the anal and peri-anal region and insertion by drilling thence into and through the centrum of the vertebral process of each of a selected plurality of successive vertebrae of a human spine, one or more of which vertebrae is to be positioned and supported by the rod.

7. An arrangement according to claim **5** wherein a selected portion of the rod is sufficiently flexible to follow a curved course in a selected portion of its path into and through the selected vertebrae.

8. An arrangement according to claim **5** wherein the rod is formed to follow a curved course in its path into and through selected vertebrae.

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