

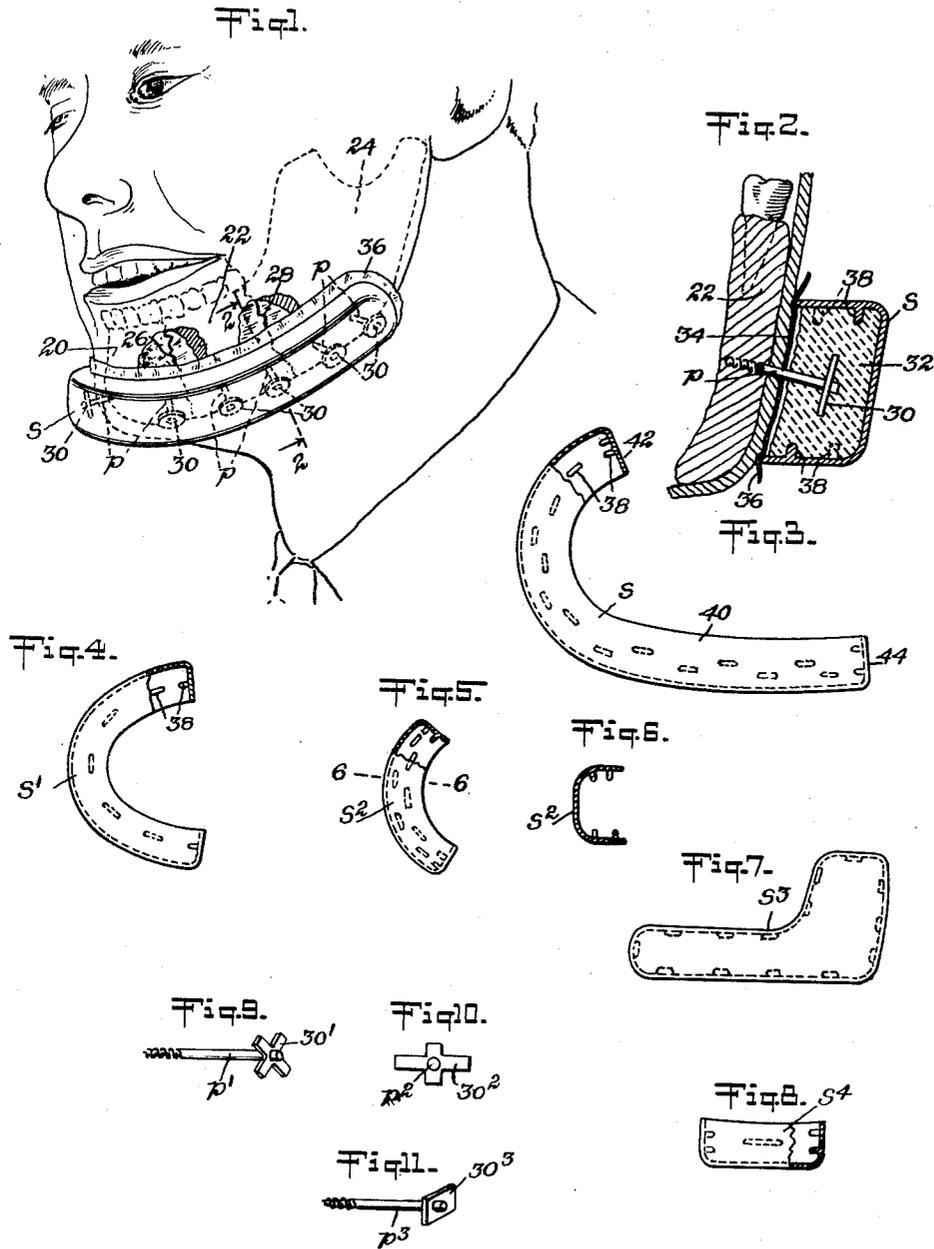
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J. D. BERKE

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EXTERNAL FIXATION OF BONE FRACTURES

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INVENTOR.

Joseph D. Berke

James T. Franklin

Attorneys

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## EXTERNAL FIXATION OF BONE FRACTURES

Joseph D. Berke, New York, N. Y.

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This invention relates to bone surgery and more particularly to the treatment of bone fractures.

The prime object of the invention centers about the provision of an improved method of and a splint for the external fixation of bone fractures.

In the current practice or technique of external fixation of bone fractures, threaded anchor pins are screwed into drill holes formed in the bone fragments, and, after reducing the fracture and bringing the bone fragments into corrected relative position, the protruding ends of the anchor pins are bridged and joined or connected together by a mechanical linkage splint comprising interconnected bars and clamps. This technique and the mechanical splints employed therewith suffer a number of severe drawbacks, particularly where the fracture is on a visible part of the body and especially on a part difficult to immobilize, such, for example, as the mandible or lower jaw of the head. The mechanical splint is difficult to use, requires exceptional surgical skill to apply and adjust, and is, for such exposed parts of the body, markedly obtrusive and unsightly. The prime object of my present invention relates to improving the technique of external fixation of bone fractures and to the provision of a novel splint that eliminates all of these disadvantages.

In the method of my present invention, the anchor pins, preferably of a special and suited structure, are inserted into the bone fragments, and, after the fracture is reduced and the bone fragments are brought into corrected relative position, the outwardly protruding ends of the anchor pins are encased in a shell mold containing a settable plastic material, and the plastic material is thereupon permitted to set and harden. The shell mold, preferably made out of a plastic material, is preshaped to fit the body local to the fracture. In obviating the disadvantages of the external mechanical splints of prior practice, this improved technique and appliance is characterized by the following advantages:

(1) The shell mold with its contained settable plastic is readily manipulated and applied to the anchor pins; no exceptional surgical skill is required for its efficient use;

(2) The shell mold forms a holder or casing for the plastic in both its unset and set condition; there results cleanliness in its application and use and a strong, bone fragment uniting splint;

(3) The shell mold being preshaped to fit the body local to the fracture, and the shell and the contained plastic combining to form the pin

uniting structure, a splint is produced which does not undesirably project or protrude from the body but which on the contrary is confined in volume and locus to produce a not unattractive or unsightly appearance, thus causing least disfigurement to the patient;

(4) The shell provides a smooth external surface completely surrounding the wounded or affected part of the body, which may, therefore, at all times be kept thoroughly clean and aseptic; and

(5) The devices making up the splint are simple in design and construction and thus producible at a low manufacturing cost.

To the accomplishment of the foregoing objects and such other objects as may hereinafter appear, my invention relates to the method and the splint sought to be defined in the appended claims, described in the following specification taken together with the accompanying drawing in which:

Fig. 1 is a perspective view showing the splint of the present invention applied for external fixation of a fracture of the mandible;

Fig. 2 is a view shown on an enlarged scale and taken in cross-section in the plane of the line 2—2 of Fig. 1;

Fig. 3 is a plan view with a part broken away of the shell mold as used for the mandible fracture shown in Fig. 1;

Fig. 4 is a similar view of a shell mold preshaped to fit the chin and opposite lateral jaws of the patient;

Fig. 5 is a similar view of a shell mold preshaped to fit the chin of the patient;

Fig. 6 is a view thereof taken in cross-section in the plane of the line 6—6 of Fig. 5;

Fig. 7 is a face view of a shell mold shaped to fit a mandible having a double fracture on one side;

Fig. 8 is a view of another and smaller shell mold;

Fig. 9 is a perspective view of one form of structure of the anchor pins that may be used for the splint;

Fig. 10 is a view of a modification thereof featuring a different form of head thereon; and

Fig. 11 is a perspective view of a modified form of anchor pin.

Referring now more in detail to the drawing and having reference first to Figs. 1 to 3 thereof, I show the technique or method and the appliance or splint of the invention applied to a double fracture of the mandible. As aforesaid, the method and the splint of the present inven-

tion is particularly advantageous when used with a visible part of the body and especially a part normally difficult to immobilize, such, for example, as the mandible or lower jaw of the head. As applied for the treatment of such a fracture, the method of the present invention consists in inserting, exteriorly, the anchor pins *p, p* into the bone fragments 20, 22 and 24 shown fractured in the two regions 26 and 28, and, after reducing the fracture and bringing the bone fragments into their corrective relative position by any approved means, encasing the outwardly protruding ends 30, 30 of the anchor pins in a shell mold *s* containing a settable plastic material 32, and in then permitting the plastic material 32 to set and harden. The shell mold *s* is preshaped to fit the body local to the fracture. This shell mold *s* not only encases all of the protruding parts 30, 30 of the anchor pins *p, p*, but forms a casing for the settable and set plastic material 32, the said shell *s* being open only at its anchor screw receiving side and being otherwise closed to completely encase and surround the treated or affected part of the body as well as the protruding portions of the anchor pins. The plastic material 32 in the shell casing may be plaster of Paris or cement mixed with any desirable filler such as asbestos or the like.

The anchor pins *p, p* are applied by now well known and approved methods. After piercing the skin and dividing the muscles and subcutaneous tissue, suitable holes are drilled into the jaw fragments. The pins *p, p* are then screwed or skewered into the drill holes to effect the desired anchoring of these anchor pins to the shell *s* and its contained set plastic 32. The protruding ends of the threaded pins *p, p* are preferably provided with enlarged heads which may be round as shown in Fig. 1 or which may be given a special crossed or angular configuration such as shown by the heads 30', 30<sup>2</sup> and 30<sup>3</sup> of the pins *p', p<sup>2</sup>* and *p<sup>3</sup>* shown in Figs. 9, 10 and 11 of the drawing. When the anchor pins or screws are inserted and anchored in the jaw fragments, the fracture is reduced and the bone fragments are brought into corrective relative position by any approved means, as, for example, by wiring the teeth or by the use of suitable ligatures. The skin surface 32 may then be treated to render the same aseptic and the shell mold *s* previously preshaped to fit the affected part of the chin and jaw and into which the plaster of Paris or other plastic 32 has been placed, is then applied in position to encase all of the protruding parts of the pins *p, p*, a suitable membrane such, for example, as a sheet of Cellophane 36, being preferably placed over the skin and interposed between the same and the edges of the shell opening as clearly depicted in Fig. 2 of the drawing for preventing any contact of the plastic medium with the skin and also for effectively sealing the shell mold or casing. The thus applied shell and contents is held in position until the plaster of Paris or other cement has set.

The resulting splint as best shown in Figs. 1 and 2 of the drawing possesses the following characteristics:

(1) The shell mold with its contained plastic is readily manipulated and applied and, therefore, requires no exceptional surgical skill for its effective use.

(2) The shell mold *s* forms a casing for the contained plastic 32 in both its unset and set condition. The plastic as it is formed and poured or placed into the shell mold may, there-

fore, be handled with operative convenience. When the plaster of Paris or other contents sets to a hardened condition, both the shell mold *s* and its plastic contents 32 form the mechanical bond or union for the anchor pins, thus producing a strong bone fragment uniting splint. The preferably irregular shape of the heads of the anchor pins and also the provision of the internally projecting studs 38, 38 preferably formed in the shell mold, help to securely anchor and unite together the anchor pins, the shell and the set plastic therein.

(3) The shell mold preshaped to fit the body, and the shell and its contained plastic combining to form the uniting structure, a splint is produced which is confined both in volume and locus producing a not unsightly result and thus causing the least disfigurement to the patient.

(4) The shell mold *s* completely surrounds the affected part of the body and particularly when made out of a plastic material, such as from a thermoplastic or thermosetting resin, provides a smooth and even polished surface which may at all times be kept thoroughly clean and aseptic.

(5) The shell mold *s* is preferably all enclosed except for the opening for receiving the plaster of Paris fill and the anchor pins, the same being made preferably of a U-shaped cross-section as best shown in Fig. 2 of the drawing. With this construction and in addition to the advantages above recited, there is provided an all enclosed shell mold closed and sealed at its open side by the body of the patient. The splint, therefore, lends itself to keeping the affected part of the body in the aseptic state.

(6) The devices used to make up the splint are simple in design and construction and are thus producible at a low manufacturing cost.

(7) Additional important advantages compared with the described prior art splint are that there is no movement of the parts of the splint once applied, there is no electrolytic action possible between the anchor pins or screws and the connecting bars as used in the prior art, the device permits of immediate application with simple implements and thereby helps reduce facial disfigurement caused by loss of bone fragments, the weight of the splint may be considerably reduced by the use of a lightening filler such as asbestos rendered possible by the employment of the encasing shell mold, etc.

As aforestated, the shell mold *s* is preferably made of a plastic material preshaped to fit the body which is local to the fracture. The shell molds may be manufactured in different units to meet the different conditions met with in operative service. This is illustrated by the different forms or configurations which the shell molds may take as shown in Figs. 3 to 8 of the drawing. When made from a thermoplastic material, the preshaped shell molds may be given their final shape by the surgeon, by further heat treating the same. The configurations are, moreover, such that the surgeon may cut a mold to shape and fill in the cutaway sides with closing partitions. The forms shown in Figs. 3 to 8 of the drawing are illustrative of what may be accomplished to effectuate these ends.

The shell mold *s* shown in Figs. 1 to 3 is preformed to fit the chin and one lateral jaw. The shell for this purpose comprises the generally J-shaped mold shown having a generally U-shaped section body 40 with its opposite ends closed by the walls 42 and 44. When made from a thermoplastic material, this shell may be further shaped

to more closely fit the patient's body, and if desired the end may be cut away such as the end having either the wall 42 or 44, in which event a suitable partition will be used to replace the cut-away portion. Fig. 4 of the drawing shows a shell mold *s'* having the same general construction as the shell mold *s* of Fig. 3, shaped, however, to fit the chin and both lateral jaws of the mandible. Figs. 5 and 6 show a shell mold *s*<sup>2</sup> of similar construction, except that the same is made to fit the chin only of the body. Fig. 7 shows a shell mold *s*<sup>3</sup> of similar construction, except that it is made to fit the chin and a double fracture on one side of the jaw. Fig. 8 shows a smaller shell mold *s*<sup>4</sup> designed to fit a small fracture or one of limited area.

Reverting to Figs. 9, 10 and 11 of the drawing, it will be noted that the shanks of the anchor pins have diameters much smaller than the anchor pins used in the prior described technique. This is made possible by virtue of the secure lodgment and anchoring obtained by the use of the shell mold *s* and its contained set plastic, the irregular shaped heads on the anchor screws contributing to this secure lodgment and anchoring effect. These smaller shanked anchor pins also enable a decided improvement in the operative technique of applying and inserting the anchor screws into the bone fragments. According to prior technique and because of the large diametered anchor screws which had to be employed, drilling of the holes in the bone fragments had to be resorted to. With the use of the anchor pins employed in the technique of the present invention, it becomes possible to eliminate the drilling as an operative step. Accordingly in the described technique, the anchor pins may be inserted without any previous operative step by using the anchor pins first to pierce the skin and subcutaneous tissue, after which the anchor pins are directly screwed or skewered into the bone fragments.

The method of external fixation of bone fractures of my present invention and the splint thereof and the many advantages involved in the operative practice therewith will in the main be fully apparent from the above detailed description thereof. It will be further apparent

that while I have shown the invention applied to the exterior fixation of a fracture of the mandible, this is given by way of exemplification and not by way of limitation since the method and appliance of the present invention are generally adapted and intended for external fixation of bone fractures. It will be further apparent that changes may be made in the method and in the appliance used without departing from the spirit of the invention defined in the following claims.

I claim:

1. The method of external fixation of bone fractures which consists in inserting anchor pins into the bone fragments, and, after bringing the bone fragments into corrected relative position, encasing the outwardly protruding ends of the anchor pins in a shell mold containing a settable plastic material, and permitting said plastic material to set and harden.

2. The method of external fixation of bone fractures which consists in inserting anchor pins into the bone fragments, and, after bringing the bone fragments into corrected relative position, encasing the outwardly protruding ends of the anchor pins in a plastic shell mold containing a settable plastic material, the said plastic shell mold being preshaped to fit the body local to said fracture, and permitting said plastic material to set and harden.

3. The method of external fixation of bone fractures which consists in inserting headed anchor screws into the bone fragments, and, after bringing the bone fragments into corrected relative position, encasing the outwardly protruding heads and ends of the anchor pins in a shell mold containing a settable plastic material, and permitting said plastic material to set and harden.

4. The method of external fixation of mandible bone fractures which consists in inserting anchor pins into the bone fragments of the jaw, and, after bringing the jaw bone fragments into corrected relative position, encasing the outwardly protruding ends of the anchor pins in a shell mold containing a settable plastic material, and permitting said plastic material to set and harden.

JOSEPH D. BERKE.