A TARGET DEVICE FOR PLACEMENT OF IMPLANTS IN THE THORACOLUMBAR PEDICLES

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Posterior spinal instrumentation with the placement of intrapedicular implants has become an important technique. We have designed a hand-held target device to facilitate the open or percutaneous location and penetration of the thoracolumbar pedicles. A cylindrical pin guide incorporates two metal rings and can be moved under image intensifier control until the rings are superimposed to show correct alignment. The radiation dosage for the surgeon is minimal; the device allowed accurate placement of 106 consecutive pedicle screws.

In spinal surgery, the use of posterior instrumentation with screws or pins placed in the thoracolumbar vertebral pedicles has become more important in the past decade (Magerl 1982; Louis 1983; Luque 1986; Roy-Camille, Saillant and Mazel 1986; Dick 1987). The placement of such screws or pins using anatomical landmarks was described by Roy-Camille and by Louis, but this method requires extensive soft-tissue dissection (Saillant 1976; Louis 1983; Roy-Camille et al 1986). There is also a significant incidence of misplaced implants despite the practically routine use of radiographic control (Robbins and Gertzbein 1988).

We have developed a hand-held target device for the accurate guidance of such implants.

TECHNIQUE

The device consists of an autoclavable cylindrical plastic block with a handle. At each end of the cylinder a metal ring is embedded, and a centrally placed 4 mm hole can hold a 160 mm long pin with a sharp tip (Fig. 1).

An image intensifier is moved and adjusted until the relevant pedicle is clearly visualised in end-on view. This positioning is helped by taking into account the known axis of the pedicle at different spinal levels (Saillant 1976; Louis 1983; Roy-Camille et al 1986; Zindrick et al 1987).

The sharp tip of the pin is then located at the centre of the image of the pedicle (Fig. 2), and the device is moved until the images of the two metal rings are superimposed on the image intensifier screen (Fig. 3). The pin is then in line with the axis of the pedicle; the cortex is penetrated and the pin inserted to a depth of about 5 mm (Fig. 4).

Fig. 1a

Fig. 1b

Target device showing the pin in place (a) and one of the metal rings (b).

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The pedicles are fully visualised and the device is brought into the beam with the tip of the pin placed at the centre of the pedicle.

Fig. 2a

Fig. 2b

Fig. 3a

Fig. 3b

When the two rings are superimposed, the pin is aligned to the axis of the pedicle and can be driven through the cortex.

Fig. 4

Lateral view to show the 5 mm depth of penetration of the pin.

The method can be used directly on exposed bone or for percutaneous placement of external fixation. For the latter purpose, a Schanz type screw can be placed in the hole in the cylinder and the centre of the image of the pedicle localised by placing the tip of the screw on the skin. A stab incision is made and the muscle and fascia are split to the bone using scissors. The alignment rings can then be used to insert the Schanz screw under repeated image intensifier control, gentle hammer blows being enough to penetrate the cortex until the self-tapping screw can be driven into the pedicle. A similar technique can be used with an appropriate needle for facet joint injections.

Its alignment can be checked repeatedly during insertion to ensure that the axis remains correct by reference to the images of the two metal rings. The pin is then replaced by a standard drill bit or a Kirschner wire which is used to further penetrate the pedicle. The appropriate implant can then be inserted.

RADIATION DOSAGE

We studied radiation doses using a hand-held dosimeter (Babyline 61, Nardeux-Loches, France) and a Siemens Siremobil automatic fluoroscopy unit. Dose rates were measured at the handle of the new device, patient backscatter being simulated by a plastic container with a

diameter of 16 cm filled with water. Calibration was performed against a secondary standard at the Eichamt Dortmund FRG.

The radiation exposure at the surgeon's hand was $16.7\mu\text{Gy}/\text{min}$ with a normal field. If a reduced beam was used the dosage only was $4.2\mu\text{Gy}/\text{min}$ (Table I). No

Table I. Dose rates at the surface of the surgeon's hand

	$\mu\text{Gy}/\text{min}$	mrad/min
Full beam	16.7	1.67
Narrow beam*	4.2	0.42

* 5 cm width at the patient's skin

radiation penetrated the surgeon's protective apron (0.25 mm lead equivalent). These results indicate that there is little radiation at the level of the surgeon's hand; in theory more than 22 000 procedures, with an estimated radiation time of 30 seconds each, could be carried out

over a three-month period before exceeding the maximum allowable dose rate for the hand.

RESULTS AND DISCUSSION

We have used this technique for the insertion of 106 consecutive pedicle screws for posterior instrumentation; no pedicle was missed. The main advantages are the precise and reproducible identification of the centre of the pedicle and the ability to check the axial alignment repeatedly with the aid of the two metal rings. The surgeon's hand can remain outside the radiation beam during each check of position and alignment; the exposure rate at the handle of the device is low enough to be safe.

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