Update on the Cloward procedure: new instruments

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A series of 283 patients who suffered from cervical spondylosis, herniated disc, or traumatic pathology of the cervical spine were operated on using an anterior approach. Intersomatic arthrodesis was performed in 350 cases; in every case, a threaded bone graft was screwed into the intervertebral orifice using the technique described by the author. Fusion was achieved within 6 months in 93% of cases with 92 autologous grafts and in 81% of cases with 258 heterologous grafts.

In addition to the use of threaded intervertebral holes and threaded bone grafts, the Cloward technique was modified by the introduction of a set of new instruments, which largely replaced the ones previously in use. These included a low-speed motor with different drills and trephines, a trephine guide retractor, and an intersomatic retractor.

KEY WORDS • threaded cylindrical bone graft • anterior cervical fusion • instrumentation

In 1985 our group published a paper that discussed techniques used as an alternative and complement to the Cloward technique. Since that time, we have improved our method by adding a new set of instruments that simplifies a process which offers an interesting alternative for achieving broader and more complete decompression of the cervical cord and roots.

Clinical Material and Methods

Between 1973 and 1984, we operated on 711 patients with cervical spine pathology using the Cloward technique. Based on the wide experience acquired by 1985, we began adding a series of new instruments and modifications to the technique until the end of 1991 and used these in 283 patients.

Low-Speed Motor

To create the intervertebral orifice, we designed a low-speed motor that drives cylindrical drills of various diameters at between 50 and 100 rpm. Operated at 12 V, with a power of 15 W, this motor affords the possibility of changing the direction of rotation. The electrical and mechanical components of the motor are isolated in stainless-steel housing, which facilitates gas sterilization.

The fusion process begins with the connection of a drill with a central pin applied to the middle of the disc so as to prevent displacement of the drill. When the burr hole has reached a depth of 4 to 6 mm, this drill is replaced by flat drill of the same diameter, which is used to complete the intervertebral bed. A variable-length nut-to-counternut safeguard always controls the depth of penetration of these drills, thus avoiding undesired penetration into the spinal canal. A set of drills with diameters of 10, 12, and 14 mm is available for introducing bones with diameters of 12, 14, and 16 mm, respectively, because the diameter of the bone must always be 2 mm greater than that of the receiving bed (Fig. 1A).

Trephine Guide Retractor

To facilitate the extraction of the graft from the iliac crest (a procedure that is also performed with the motor), we designed a trephine guide retractor, the function of which consists in isolating the musculocutaneous area from the osseous part of the crest to prevent traumatic contacts between the trephine and the skin. The retractor is first attached to the free edge of the crest by means of two pins on the back of the device; it simultaneously displaces the musculocutaneous tissue downward using the semicircular component of the instrument. Once the lateral surface of the
crest has been isolated and exposed in this way, the corresponding trephine (measuring 12, 14, or 16 mm in diameter) is attached to the motor, and an initial circular cut is made 3 to 4 mm in depth on the cortex of the crest. For this first cut, the central pin of the free edge of the trephine is intended to protrude slightly so as to prevent any possible displacement: the pin is then withdrawn 40 to 50 mm. The pronged crown of the trephine can thus be applied to the first cut until a total perforation of the crest has been completed. Once the bone has been reached, it is pushed out of the trephine by operating the motor in a clockwise direction (Fig. 1B).

**Intersomatic Retractor**

To facilitate access to the pathological osteophyte and disc structures once the intervertebral orifice has been made, we designed an intersomatic retractor with

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**Fig. 1.** Schematic illustration demonstrating the creation of an intervertebral orifice made with the low-revolution (50 to 100 rpm) electric motor.  
A: Creation of the intervertebral orifice with a drill equipped with a central pin which, when fitted to the center of the disc, prevents possible displacement. When the orifice has reached a depth of 6 to 8 mm, this drill is replaced by a flat drill of the same diameter which completes the hole. During this procedure, the depth of the drill is controlled by means of a nut-to-counternut safety mechanism which prevents its penetrating into the spinal canal.  
B: Illustration of the extraction of bone from the iliac crest using the trephine guide retractor. The retractor consists of a semicircular component at one end that exposes and isolates the external surface of the crest so that the musculocutaneous tissue of the crest is pushed downward. The surgical field is stabilized by attaching the instrument to the free edge of the crest by means of two pins situated on the back.  
C: Diagram of the exposure and enlargement of the intervertebral orifice using the intersomatic retractor with open edges and semicircular blades at right angles. The blades are attached to the spongy tissue of the vertebral bodies by means of a small pin inserted into their external surface. The retractor makes it possible to obtain a broader surgical field, better visibility, and improved handling of the instrument because unlike previous instruments, it is more open and has parallel branches. The powerful opening mechanism helps to raise the posterior cortex area of the vertebral bodies, which leads to a more complete removal of the pathological osteophyte and disc structures. This retractor avoids asymmetrical retraction from the orifice and iatrogenic fractures of the vertebral bodies.
parallel branches, at the end of which two semicircular blades are placed at right angles. These blades are introduced into the hole attached to the spongy tissue of the vertebral bodies by means of a small pin inserted into their external surface; from this position, the surgeon proceeds with the intersomatic retraction by operating a smooth but powerful antiblocking rack mechanism (Fig. 1C).

**Threaded Cylindrical Graft**

To create fusion of the vertebral bodies, the surgeon will decide on the type of bone to be inserted, choosing either a standard, smooth cylindrical bone (autologous, homologous, or heterologous) or, as in our case, a threaded cylindrical bone which we have been systematically implanting in patients treated at our hospital over the past 7 years. When using a threaded cylindrical bone at the iliac crest, the method involves applying threaded molding tongs on the crest’s spongy surface. To enhance displacement before introducing the threaded bone, an inner thread is made on the walls of the intervertebral orifice with a screw tap 2 mm larger than the initial hole and similar in size to the bone. The dowel is threaded in by means of an instrument fixed at its base that allows for smooth and constant implantation and permanent control of the depth of penetration (Fig. 2). A heterologous graft of bovine origin with the thread included is presented in sterile form and is placed in the same way, as has been previously described.16

**Results**

We have used 92 autologous threaded bones in 78 patients, most of whom had very unstable or traumatized cervical spines, and 258 heterologous threaded bones of bovine origin in 205 other patients.

**Clinical Follow-Up Evaluation**

The clinical evolution in the long-term progress of the 283 patients who have undergone surgery that used this technique has not differed in general from that observed in other studies.10,13,14,20,22,26 Nevertheless, we have confirmed an almost total absence of postoperative radicular pain (four cases: 1.41%) or neurological deficits related to implantation of the dowel.

**Radiological Follow-Up Studies**

Radiological follow-up studies were obtained in every case. Anteroposterior and lateral plain x-ray films were obtained in the immediate postoperative course, and dynamic radiology (flexion-extension) and computerized tomography scans were performed 6 months after surgery (Fig. 3).

The radiologically evident fusion rate obtained in our 283 patients was achieved in 93% of the autologous bone grafts and in 81% of the heterologous bone grafts. No bone fracture through displacement was observed. Intersomatic angulation (more than 5 degrees) caused by the collapsing of bone was
observed in only 7% of the cases and no appreciable clinical repercussions were found.

Discussion

Anterior cervical interbody fusion is a common and gratifying surgical procedure performed by many neurosurgeons as part of the treatment of patients with a variety of spinal disorders, particularly traumatic and degenerative ones. We have modified the Cloward technique by introducing new instruments which have been used on 283 patients during the last 7 years. These include a low-speed motor, a trephine guide retractor, an intersomatic retractor, and a threaded cylindrical retractor.

Use of the low-speed motor reduces the operative time and effort required by the surgeon and eliminates the use of much complex instrumentation. The motor can be used both for driving the cylindrical drills that create the intervertebral hole and for extracting the graft from the iliac crest, if the surgeon decides to remove the bone from the patient. In these cases, the operation is facilitated by the trephine guide retractor, which separates the skin and muscles from the crest, thus avoiding any possible injury to the soft tissues (ecchymosis) by the trephine without excessive retraction.

The intersomatic retractor allows better access to the spinal canal and better exposure of the deepest area of the intervertebral hole. Its powerful retraction, which is basically carried out on the upper third of the vertebral bodies, elevates the plane of the posterior cortex of the vertebral bodies and facilitates the removal of the osteophytes and disc structures. The semicircular blades placed at right angles with arms opened in a parallel fashion provide an excellent surgical field while eliminating the risk of vertebral fractures because the blades keep a wide surface of contact and provide asymmetrical intersomatic retraction.

The threaded cylindrical bone graft, whether autologous, homologous, or heterologous in origin, offers considerable advantages over bones of other shapes. It is screwed in in an atraumatic fashion, thus avoiding possible neural contusions, postoperative pain, and extrusion. The threaded cylindrical bone graft has a receiving orifice, and the threading helps to eliminate the size of the diameter, being 2 mm larger than that of the graft used. The resistance of the bone helps to eliminate the iliac osteotomy, which is always painful, and reduces the patient’s stay in the hospital.

Disclosure

The author has no financial interest in either the instrumentation or the methodology being advanced in this study.

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Manuscript received July 21, 1993.
Accepted in final form March 3, 1994.
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