LUMBAR SPINAL OSTEOTOMY

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The correction of severe rigid spinal kyphosis was first done by Smith-Petersen in 1945 as a one-stage operation, and shortly afterwards in 1946 by La Chapelle who used two stages. Smith-Petersen performed his bone division posteriorly by oblique osteotomies (Fig. 1) and snapped the anterior longitudinal ligament by manipulation. La Chapelle carried out a more horizontal bone resection and divided the anterior ligament under direct vision by an additional surgical approach anteriorly.

This paper is based on an experience of operations on just over a hundred patients, of whom eighty were available for review. The hazards of operation are considered in relation particularly to the deaths and complications. Only six of the patients were women, and all the patients were in early adult or middle age. With two exceptions, the patients have all suffered from ankylosing spondylitis or rheumatoid spondylitis, and presented with a severe rigid kyphosis, mainly cervico-thoracic as a rule. Usually the normal lumbar lordosis has been lost, this region of the spine becoming flattened or involved in the general kyphotic curve.

The object of spinal osteotomy in nearly all these patients has been to provide a compensatory lumbar lordosis for the rigid thoracic or cervico-thoracic kyphosis, and the indications for the operation are therefore as follows: 1) To enable the patient to become erect, thereby counteracting the effects of gravity in persistently increasing the deformity; this correction enables him to see ahead for a much greater distance, and greatly improves his appearance (Figs. 2 to 11). 2) To improve respiration by lifting the thoracic cage upwards off the diaphragm, upon which breathing depends almost entirely in most of these patients.
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Case 1—Photographs showing the appearance of a patient with ankylosing spondylitis before operation.

Case 1. Figure 5—Before lumbar osteotomy. Figure 6—Radiograph after operation.

3) Similarly, by relieving pressure of the costal margin on the upper abdominal viscera, to improve gastrointestinal function; many patients have noticed both improved appetite and digestion. 4) Occasionally to enable the abdominal surgeon to have an adequate approach when major gastric or intestinal surgery is required.
Case 1—Appearance of patient after lumbar osteotomy.

Case 1. Figure 10—One year after operation. Figure 11—Five years after operation. There has been very little loss of correction.

DETAILS OF THE OPERATION

The Smith-Petersen method has been followed entirely, the correction being attained in a single operation. Difficulty in rupturing the longitudinal ligament was encountered only very occasionally. Slight differences in the detail have been developed as the series progressed, and on the whole a much greater correction has been planned and achieved than was ever conceived originally in osteotomy at a single level.
Combined local and general anaesthesia has been used, the former with adrenaline and
the latter with intratracheal intubation, which requires great care because of the danger of
cervical fracture-dislocation. More recently, fluthane low pressure anaesthesia has provided
an excellent operation field without any undue disturbance to the patient.

The prone position with suitable supporting pillows or sponge rubber cushions has been
used throughout the series in preference to the lateral one. The diaphragm must be allowed
to move freely and care taken with the position of the head, in addition to any necessary
upward tilting of the whole patient when fluthane is being used.

The operation has been performed where ossification or calcification in the anterior
longitudinal ligament is least; otherwise as high up the lumbar spine as possible. On the whole,
lumbar 2–3 has been the level of choice, lumbar 1–2 being followed by a greater tendency
to ileus, possibly from irritation of the splanchnic plexus. No apparatus has been used to
obtain correction, because manual control with the body weight of the patient has proved
easy, safe and quick, and avoids the danger of an excessive leverage, particularly in patients
who are ankylosed from head to foot.

Through the usual mid-line lumbar approach the muscles are stripped laterally by
subperiosteal dissection as far as the articular processes and the remains of the intervertebral
joints. Part of the spinous process at the lower limit of the intended osteotomy is removed, the
amount being judged to allow the required correction in a stable manner, enabling the superior
spinous process to hinge down on to the remainder of the inferior one. The ligamenta flava
and interspinous ligament are removed: these are usually ossified; so their removal has to be
done with fine gouges and bone-nibbling forceps. The theca and cord are thus exposed
centrally. It is difficult to avoid penetrating the subarachnoid space, because the theca is
often very adherent.

Osteotomies are then made on both sides across the line of the articular processes at an
angle of about 45 degrees to the frontal plane from a point just clear of the margin of the theca.
The completed osteotomy enters the intervertebral foramen above, and care has to be taken
not to damage the nerve root. The actual osteotomy line is made about 1–2 millimetres wide,
and the instruments most suitable for performing this important part of the operation are fine
straight osteotomes and narrow pointed bone-nibbling forceps. The depth of the bone both
here and in the ossified ligamenta flava is surprisingly great—often as much as one or two
centimetres.

When the osteotomies are completed a certain amount of instability is evident, and
the correction is then achieved by hinging the part of the spine above on that below, in
the course of which the anterior longitudinal ligament is both felt and heard to rupture with
a distinct thud, or a loud snap when it is entirely calcified or ossified. The wedge-shaped gap
closes down and this readily controls any bleeding that there may be from the raw bone
surfaces or perivertebral veins. The obliquity of the osteotomy lines gives lateral stability, and
the coaptation of the spinous processes prevents excessive angulation. A wire loop or suture is
inserted between the spinous processes, more as a marker than to give any real internal
fixation, and the surrounding bone surfaces are prepared for grafting by elevating osseous
flaps and inserting the bone chips obtained in the earlier part of the operation.

As a rule fusion occurs readily and consolidation in as short a time as three months,
though protection is essential for longer. The osteotomy lines must be cut cleanly, so that
they glide smoothly on one another. When they are uneven the vertebra above may be displaced
backwards on the vertebra below (Figs. 17 to 19). If the theca is inadvertently opened it is
wise to suture the hole to prevent excessive loss of cerebrospinal fluid, and before closure of
the wound haemostasis must be perfect.

The patient is immobilised in the corrected position in a plaster jacket, which includes
one thigh to give more complete fixation and to make nursing easier. After six weeks the
plaster is changed, the sutures are removed and an ambulatory plaster jacket is applied. For
Case 2—A patient with a severe thoracic kyphosis seen before and after operation.

Case 2—The radiographs of the patient before operation are shown in Figure 14, immediately afterwards in Figure 15 and three weeks later in Figure 16 when additional extension had occurred.
both these plasters the two-table technique is used to maintain the hyperextension, the head end of the patient being guarded very carefully, particularly if the cervical spine is ankylosed. If, in addition, the hips are ankylosed, even greater care has to be taken, as leverage can then be extreme. Usually, it has been found preferable to carry out hip arthroplasty for bilateral ankylosis with flexion deformity before spinal osteotomy, in spite of the necessity for a period of further immobilisation, and even plaster fixation of one leg for a period of six weeks. The correction of the hip flexion deformity enables a more accurate estimation of the intended spinal correction, and makes the spinal osteotomy safer, the patient being no longer a rigid pillar of bone. Recently internal fixation with metal plates has been employed in an effort to dispense with plaster immobilisation (Fig. 20). Experience has shown that after the first few days a posterior plaster shell makes nursing easier and the patient more comfortable.

In the lumbar region the degree of correction achieved at a single osteotomy site has usually been between 25 and 45 degrees, but in one case a correction of nearly 90 degrees was obtained at the lumbar 4-5 level without any nerve damage except a slight temporary peroneal weakness (Figs. 12 to 16). This marked correction was accidental and the result of not having the base of the spinous process above firmly embedded on the remaining portion of the spinous process below, too much of which had been resected. In the great majority of cases a good compensatory
lumbar lordosis from adequate lumbar correction has made cervical thoracic osteotomy unnecessary. Costo-vertebral ankylosis makes thoracic osteotomy extremely difficult.

During the last year cervical osteotomy has been performed successfully in cases of marked cervical kyphosis, but it will be described in a separate paper.

RESULTS AND COMPLICATIONS

Deaths—Eight patients died from complications of the operation. The causes were: accidental suffocation 1, perforated ulcer and peritonitis 1, acute gastric erosion 1, thrombosis of spinal cord—acute psychosis 1, cervical fracture and cord injury 1, amyloid disease and renal failure 1, anoxic encephalopathy, shock or cause unknown 2. The accidental suffocation resulted from turning a patient some twelve hours after operation and failing to realise the danger during sleep that the head might sink into the pillows and become buried because of cervical ankylosis. This was a nursing error and should be avoided. Possibly this patient should be included with the anoxic cases described later.

The acute abdominal complications of perforation and gastric erosion caused death four days and one day after operation respectively. The osteotomy site in the former patient is shown in Figure 21. The plaster made diagnosis difficult, but clearly if a patient has abdominal pain such complications must be considered and the plaster split with removal of the anterior shell to allow complete abdominal examination. Laparotomy could be performed if necessary with the patient in the posterior plaster shell. The level of the osteotomy in both patients was lumbar 2–3, and it is possible that pull on adhesions could be related to the abdominal complications.

Cord lesions occurred in two patients and led to death from terminal bronchopneumonia. In one, thrombosis of the spinal cord vessels may have been precipitated by forward displacement of the upper vertebra at the osteotomy site, with post-operative flaccid paralysis, partly relieved by manipulative correction; pressure sores on the upper part of the back and bronchopneumonia proved fatal four months after operation. This patient also had a severe acute maniacal psychosis, which made nursing very difficult, as at one stage he removed his own plaster and later refused to stay in a plaster bed.

In the other patient with a post-operative flaccid paralysis death occurred one week after operation, and a fracture-dislocation with spinal cord pulping at the cervical 6–7 level was found at necropsy. This may have occurred at one of several stages during the operation, such as during intratracheal intubation, placing the patient on the operation table, carrying out the spinal extension at the osteotomy, applying the plaster or finally lifting the patient on to the theatre trolley or bed. No force must be exerted on a rigid cervical spine.

Amyloid disease is a recognised complication of ankylosing spondylitis and was the cause of death from renal failure in one patient four months after operation who had made a good
initial recovery, and who had shown no previous signs of renal insufficiency. Before operation
these patients must be assessed for renal function as well as vital capacity.

Shock caused the death of two patients in less than twenty-four hours after operation, and
at necropsy nothing abnormal could be found. The term anoxic encephalopathy has been
used in such cases, implying that the head-down position may deprive the vital centres of
adequate oxygen supply, and if this is the case the operation table must be tilted so as to
keep the patient’s head level during the operation. The possibility of fat embolism was
also considered, but was not confirmed on detailed investigation. An absence of fatal chest
complications is to be noted, particularly as many of these patients had a vital capacity of
less than fifteen hundred cubic centimetres.

Non-fatal complications—Spinal cord irritation with some residual spasticity in the legs
occurred in one patient from haemorrhage around the cord in the lower thoracic region
well above the osteotomy site. The cord was decompressed by laminectomy with good
effect, but the patient required elbow crutches for weight bearing because weakness of the
lower limbs persisted.

Nerve root damage with temporary foot drop occurred in one patient, and in two others
paraesthesiae were noted. The probable cause was stretching of the nerve roots just above the
osteotomy site with a correction of more than 45 degrees.

High intestinal obstruction in a severe form occurred in one patient from strangulation by the
superior mesenteric vessels. This was relieved completely by duodeno-jejunostomy and a good
recovery was made. The level of the osteotomy was lumbar 2–3.

Ileus of a minor degree has occurred in several patients and was usually relieved quite quickly
by making a window in the plaster and by the appropriate medical measures. A slight
haematemesis probably from gastric erosion occurred in one patient with complete recovery.

Psychological upset in a less severe form than the acute mania already mentioned is
understandable when correction from very severe deformity is achieved suddenly and somewhat
dramatically. In only one patient has special medical treatment been required, but a sympathetic
approach to a patient’s altered outlook and to the reaction of the relations and friends can
be very important.

Recurrence of deformity, severe enough to warrant further correction, has been observed in
three patients. In two of these the angle at the osteotomy site decreased, probably because of
incomplete bone consolidation, after the patient had got up. It is not easy to determine
whether the posterior fusion is sound; so the use of a posterior spinal support for about a
year after operation is recommended, together with careful and regular follow-up examination.

In another case spinal deformity increased above the level of the osteotomy and called for a
second operation.

The low incidence, in ten years, of loss of correction after the operation has been
very satisfying. Usually a few degrees are lost in the course of consolidation, but not
enough to make further operation necessary. On the other hand, the mortality rate has
been high, and measures must be taken to reduce this in the future. Acute abdominal
complications are much less likely to prove fatal if they are anticipated, and nursing errors
can be avoided.

Many of the patients in this series had gross deformity, and the incidence of complications
is bound to be reduced if the operation is employed earlier in the disease. It has to be realised
that gross spinal deformity can occur in spite of conservative measures such as plaster beds
and spinal braces. The patient with ankylosing spondylitis involving the whole spine requires
regular observation, and the value of breathing exercises to maintain diaphragmatic excursion
and vital capacity must not be overlooked. It is doubtful whether the operation increases
vital capacity, because the thoracic cage is still rigid, but certainly the patients seem to benefit
from easier diaphragmatic excursion, and their mental as well as physical outlook is much
improved.
SUMMARY

1. The indications for correction of severe rigid kyphosis by lumbar osteotomy are described.
2. The fatal complications in a series of a hundred cases are listed. With more experience of this operation they should be considerably reduced.
3. Among the non-fatal complications the low incidence of recurrence of the deformity severe enough to require further operation is noteworthy.

A tribute must be paid to the anaesthetists, Dr G. P. Fox, Dr D. C. R. R. Jenkins and Dr G. B. Badock, who so skilfully performed intratracheal intubation in nearly every patient, and who have played a very important part in controlling the head end of the patient at the time of carrying out the spinal correction. Also the nursing and physiotherapy staffs at the London Hospital, the Robert Jones and Agnes Hunt Orthopaedic Hospital and the Orsett branch of the Tilbury Riverside Hospital have contributed much skilful work in the care of these patients after operation. My thanks are also due to many colleagues for so kindly referring their patients to me.

REFERENCES


