A NEW APPROACH TO THE MANAGEMENT OF ACUTE DISLOCATIONS AND FRACTURE-DISLOCATIONS OF THE CERVICAL SPINE

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Over the past year internal fixation has been used in conjunction with intervertebral disc removal and anterior interbody fusion, in treating 4 patients with unstable cervical spines resulting from acute trauma. The results have been most promising.

During the last decade anterior disc removal followed by anterior intervertebral-body fusion has found its place in the treatment of cervical spondylosis and other discogenic disorders.[1-3] While others advocate it in isolated instances, Cloward has pioneered the treatment of all acute unstable fractures and dislocations by this method.[4-7] He has shown decided lessening of morbidity, with early rising and rapid rehabilitation compared with conventional conservative and posterior-fusion methods.

RATIONALE AND PRINCIPLES

In 50% of Cloward's cases sound fusion was accompanied by radiological evidence of anterior collapse.[5] While he found that this did not in any way mar his results, it could theoretically lead to such problems as kinking of the spinal cord or intervertebral foraminal narrowing. In performing the operation, I have felt a little dubious of the adequacy of the self-fixation of the graft, where marked instability is present.

When anterior interbody fusion is performed for cervical spondylosis, disc syndromes, or chronic subluxations, a graft is countersunk into the enucleated and prepared intervertebral space while head traction is applied. If traction is now released, self-locking of the graft under compression occurs. Provided forced hyperextension, which could physically extrude the graft, is avoided, immediate stability can be demonstrated at the operating table. I believe that the success in these cases depends on the presence of intact or relatively intact bony and soft tissue structures behind the axis of movement, which act as a check-rein against dynamic flexion forces over the bony block (Fig. 1A). After reduction of an acute subluxation or a dislocation with locked facets, there remains tearing of the posterior ligamentous attachments. An unprotected graft here, it is postulated, instead of acting as a stabili-

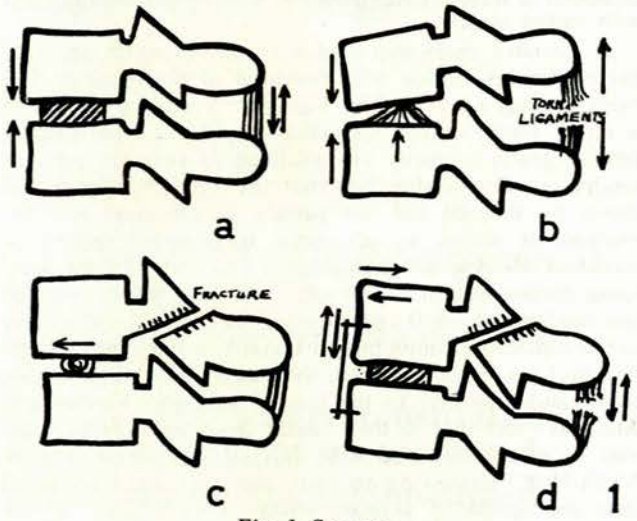


Fig. 1. See text.

zing block may act as the fulcrum of a first-class lever, so that upthrusts from behind, in the form of unchecked flexion strains, may cause toppling downward and forward of the upper cervical spine (Fig. 1B).

If the defect is bony in origin, such as in fracture-dislocations involving the facets and/or neural arches, in addition to this mechanism, the graft may now conceivably act as a 'roller' over which the anterior portion of the upper vertebra may be propelled forward when flexion strains are applied (Fig. 1C).

It is contended that anterior internal fixation, where practicable, should combat both tendencies by creating a

buffer, so that flexion forces would be at a decided mechanical disadvantage (Fig. ID). Humphries, Hawk and Berndt[3] showed that anterior internal fixation was feasible in the lumbar spine. Why should this therefore not pertain in the case of the cervical spine?

In practice, internal fixation combined with anterior fusion permits the patient with very unstable injuries to be out of bed within a day or two of operation, without external immobilization. To guard against violent unprotected strains, a light protective collar on discharge from hospital is usually provided.

The procedure is considered to be of particular value where irreversible paraplegia or quadriplegia is present. As sufficient innervation of the cervical musculature 'escapes' even in C4 - 5 lesions; internal fixation permits virtual disregarding of the neck lesion *per se*, and of mobilization of the patient with easier nursing and handling from the time of operation. Therefore, the earlier the operation is carried out, the better should be the anticipated results.

Internal fixation is not considered necessary in chronic subluxations or acute subluxations showing no marked deviation on flexion or extension radiological views. Internal fixation has not been found practical, where marked vertebral body comminution precludes adequate screw purchase. In these cases I have continued to undertake 'simple' anterior fusion with postoperative recumbency in the latter instance. However the problem may possibly be circumvented here by extending the fusion and fixation on both sides of the comminuted vertebra.

In performing the operation, as a general rule, slight controlled subluxation after reduction has been allowed to recur, to ensure the graft being placed under compression, which is believed to be a potent factor in attaining early fusion.[8, 9] Only then have the plate and screws been applied. An objection has been raised by colleagues against encouraging fusion in a subluxated position. I hold that, provided the integrity of the spinal canal and intervertebral foramina are restored this is of no moment, once fusion has occurred. However, in deference to these colleagues, in the last reported case full reduction has been maintained by a wedge-shaped graft.

Up to the present a two-holed Sherman plate with 2 half-inch screws have been the fixing agents. This is basically an unsound method of internal fixation and steps are being taken to have a more suitable appliance constructed.

TECHNIQUE

It is not proposed to detail the procedure, since the various basic techniques have been adequately described by the pioneers, but merely to chronicle the main steps and preferences.[1, 2, 7, 10] Depending on circumstances, reduction is either carried out pre-operatively by conservative measures, including where necessary the use of Crutchfield tongs, or on the table after anaesthetic induction and intubation. A halter is fashioned from stockinette. A traction cord is attached and passed over a pulley, which is fixed to a length of plank, in line with, and extending from the head of the table. To this the anaesthetist attaches and removes weights as required. The left-sided approach used is essentially that described by Robinson and associates.[7, 10]

Both oblique and transverse skin incisions have been used with equal facility. While the latter is cosmetically more acceptable, the procedure can be more easily demonstrated to bystanders through an oblique incision. The incision is deepened through the successive layers of fascia between the viscera and covering pretracheal muscles medially, and the sternomastoid and carotid sheath laterally. The prevertebral fascia is opened in the midline. The affected area is dissected clean and verified under radiological control, marker needles being inserted into the disc or discs. The intervertebral disc is removed and the vertebral bodies are dealt with as in Cloward's method except that no specialized instruments are employed.[11] A half-inch drill point on a hand-chuck is used to prepare the bed between the adjacent vertebral bodies.

As grafting material, in preference to a cored-out plug, I use a full-thickness block of autogenous iliac crest bone, with cortex on 3 sides, placed end on. The antero-posterior length of this is slightly greater than the cored-out distance between the vertebral bodies. The depth of the graft is slightly less than the antero-posterior depth of the prepared bed. Traction is applied by the anaesthetist to increase the intervertebral distance. The graft is tapped home and gently countersunk beyond the anterior margins of the vertebrae. Traction is released to entrap the graft and (except in one case) the neck is slightly flexed to lock the graft more securely. The plate and screws are applied. The screw holes are made with a fine bone-awl to allow maximal gripping of the threads by the cancellous bone. The wound is closed in layers, a small glove drain being left in for 24 hours. Sutures are removed after 5 days. As already indicated, early rising is encouraged.

During the period under review, 9 anterior cervical fusions were carried out following acute cervical trauma. Three of these fell into the 'relatively stable' group. One patient was fused before introduction of the internal fixation method, and 1 had severe vertebral-body comminution. The remaining 4 underwent the combined operation.

CASE HISTORIES

Case 1. E.T.

A Bantu labourer suffered a dislocation of C6 on C7 with 'jumped' facets when a weight fell onto his head on 22 April 1963. There were no objective neurological signs. Under local anaesthesia, Crutchfield tongs were inserted and increasing weight traction applied under radiological control. By 23 April reduction was complete, and the weight was reduced. On 16 May anterior spinal fusion combined with internal fixation was undertaken. By the 16th postoperative day movements were practically full. X-rays showed encroachment of 1 of the screws on the adjacent disc. Because of this, on 18 July when fusion was considered to be sound, the plate and screws were removed. On 15 August the patient was given permission to return to work. His subsequent progress has been uneventful.

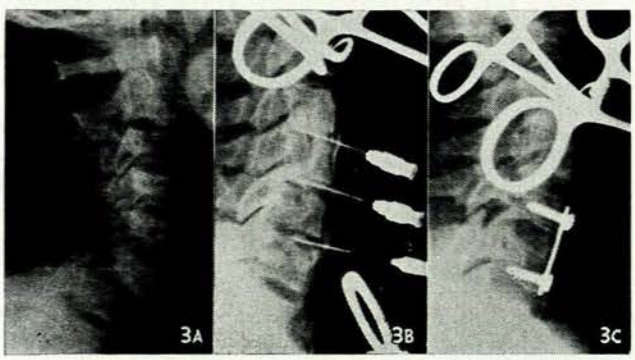
Case 2. G.L.

A 52-year-old White male suffered a very unstable type of fracture-dislocation of C6 on C7 on 17 May 1963 (Fig. 2a). There were fractures of the neural arch and facets of C6 with compression of C7. Root pains were present with slight weakness of the hands, and pain in the lower limbs. Within a few hours of injury, operation was carried out. In case skull traction became necessary, the head was shaved, but reduction under anaesthetic was easily carried out (Fig. 2b). The routine operation was performed (Fig. 2c). His movements on the 15th postoperative day were as shown in Fig. 2(d - g). Sound fusion has since occurred. He is back at work, but complains of slight weakness of the left hand. Slight wasting of the first dorsal interosseous muscle is present on the left.

Fig. 2(a). Case 2. Fracture-dislocation of C6 on C7 before reduction. *2(b).* On operating table after reduction marker needle *in situ*. *2(c).* After insertion graft, plate and screws. *2(d - g).* Movements on 15th day following injury.

Case 3. F.K.

A Coloured male, aged 25, was admitted to hospital on 26 November 1963, having fallen over a fence and injured his neck 36 hours before admission. He had a dislocation of C6 on C7 with 'jumped' facets except for C6 and C7 'escape' (Fig. 3a), and almost complete quadriplegia (Fig. 3a). Mr. K. G. Kling, under whose care the patient was, found reduction to be easily obtained by halter traction and extension, but found gross instability; the slightest flexion causing redislocation (Fig. 3b). I first saw the patient on 6 December 1963 when anterior fusion and internal fixation were carried out (Fig. 3c).



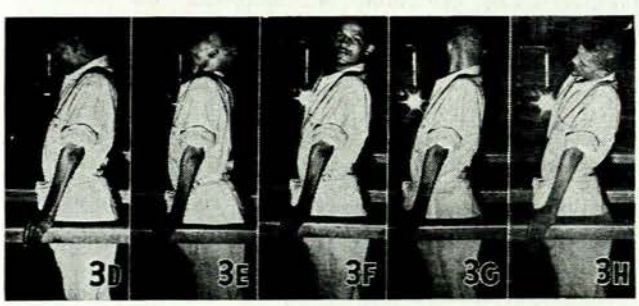


Fig. 3(a). Case 3. Dislocation of C6 on C7 with quadriplegia. *3(b).* Reduced position at operation. *3(c).* Graft, plate and screws *in situ*. *3(d - h).* Degree of rehabilitation in quadriplegic patient within 6 months.

The most early postoperative change was the facility in nursing the patient and the apparent increase in power of the movements which had been retained.

On 23 December he was transferred to the Paraplegic Unit at the Conradie Hospital. Except for weakness of digital flexion and extension and wrist extension, upper-limb power and sensation were found to be very good by 18 February 1964. Radiologically, lateral-flexion and extension views at this stage showed the cervical spine to be stable. Below the first dorsal level, paralysis remains complete. Rehabilitation has proceeded rapidly and movements of the cervical spine at the parallel bars on 28 May were as shown in Figs. 3(d - h).

Case 4. E.S.

A Coloured male, aged 27, fell over the handle-bars of his bicycle. He was hospitalized on 25 January 1964 with forward subluxation of C4 on C5 with a 'jumped' facet and unilateral root pain, but no neurological deficit. Reduction was easily accomplished by traction followed by extension. On 30 January anterior cervical fusion and internal fixation were carried out, (Fig. 4) a wedge-shaped graft being used to maintain full reduction. He was discharged from hospital on the 6th postoperative day, with good cervical movements. He returned to duty on 30 March 1964.

Fig. 4. Case 4. Full reduction with wedge-shaped graft, plate and screws *in situ*.

SUMMARY

Internal fixation, where practicable, combined with anterior intervertebral-body fusion is advised for acute unstable fractures and dislocations of the cervical spine. Early rising and rehabilitation are possible instead of weeks or months of morbidity as compared with conventional management. Where irreversible cord damage is present, the operation is considered to be of particular value.

I wish to express my indebtedness to Prof. C. E. L. Allen, Head of the Department of Orthopaedic Surgery, University of Cape Town, for his permission to operate on the second case cited; to Mr. K. G. Kling, for referring the patient (case 3) and his assistance; to Dr. J. G. Burger, Superintendent of Groote Schuur Hospital, as well as the Superintendent of the Conradie Hospital, Dr. Cormack, for their permission to report this case; and to Dr. P. Oates and the staff of the Paraplegic Unit, for their cooperation in after-care and allowing me follow-up access. For permission to report the last case, I wish to thank Dr. F. L. S. Visser, Superintendent of the Victoria Hospital, Wynberg. I also am most grateful to the staff of the Groote Schuur Hospital Department of Clinical Photography, for their help with the printing of the negatives.

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