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Treatment of thoracolumbar burst fractures by vertebral shortening

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Abstract Burst fractures may be stable or unstable, so the choice of treatment may be controversial; almost all cases are surgical type. Deciding on the best method and approach is difficult, due to the many possible options and the fact that good results are achieved in only 60–70% of cases. The main problems to be resolved are the residual kyphosis or the recurrence due to loss of reduction. This is a prospective, observational, longitudinal and descriptive study of six patients – two men and four women, mean age 46 years – who scored 7 or more points according to the load distribution classification, and were treated with vertebral shortening by a posterior approach and transpedicular fixation with INO plates. Follow-up was for a period of 2 years, and included evaluating pre- and postoperative stability and kyphosis among other data. The results showed a reduction in the mean fracture angle from 17° preoperatively to 1° postoperatively. Full stability was achieved in five patients, and incomplete stability in one patient, who recovered with the use of a corset. There was evidence of arthrodesis in all six patients within 9 months. The use of an anterior approach to treat burst fractures is well recognized; however, treatment with vertebral shortening using a posterior approach has the advantages of less bleeding, shorter surgical time and less residual kyphosis, as a result of putting together two flat surfaces of healthy bone. The residual kyphosis in the present series, after the 2-year follow up, was less than 1°, which is lower than the 5°–10° reported in the literature.

Keywords Spine fracture · Spine surgery · Burst fracture · Spine classification · Anterior approach

Introduction

In surgical treatment of vertebral fractures, the most important aspects are the instrumentation system, which has to prevent movement along the three axes of the spine, and placing two surfaces of healthy bone together, or better yet, placing a very good construct with surgical coaptation of two plain surfaces [1, 2, 4, 5, 7, 9, 10,12].

Burst fractures may be stable or unstable [11]; that is why controversy exists as to the best approach (anterior or posterior) and stabilization system to use [8,12].

We know the following about burst fracture treatment

1. With a posterior approach, good results are achieved in only 60–70% of patients [2, 3, 5, 6,12].
2. An anterior approach is necessary in 20–30% of patients, as a complementary approach or as a primary indication [5, 7,12].
3. Fixation offers early physical therapy without the use of a brace [1, 3, 4, 11,12].
4. Careful arthrodesis with autologous bone graft is the most desirable procedure [8,12].

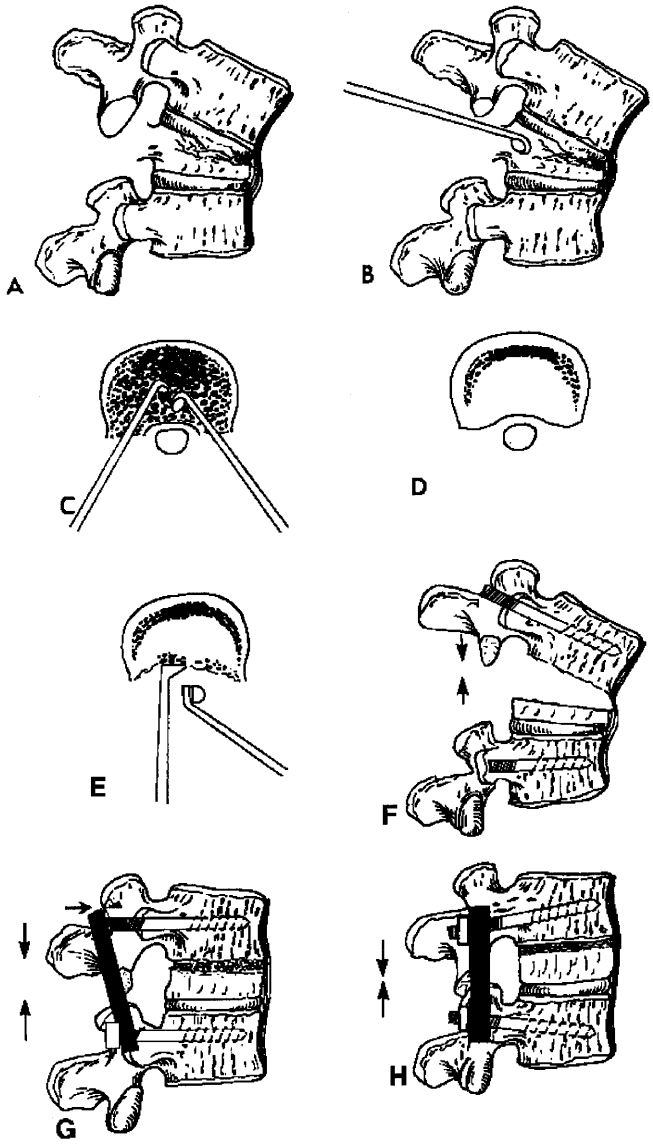

Fig. 1A–H Surgical technique. **A,B** Exposure of posterior elements, total resection of the neural arch and localization of the point of entry in the pedicles. **C–E** Emptying of two-thirds of the vertebral body, including retropulsed fragments, using the Heining technique and resection of all the upper disc to obtain anterior fusion to the cranially adjacent vertebra. **F** Total resection of both pedicles and placement of transpedicular screws in the upper and lower vertebra. **G,H** Vertebral shortening done by approximation of the screws and placing INO plates with a crossbar

5. Immobilization must be segmental and as short as possible [1, 10,12].

Actually, thanks to the load sharing classification, we know that 20–30% of fractures require an anterior or combined approach to avoid kyphosis, dislodgement and rupture of the implant [5, 8,11].

With all that in mind, we suggest the use of a posterior approach for burst fractures that might be seen as requiring an anterior one, as this means less bleeding and less surgical time, and offers a stronger possibility of stabilization on a structure created by two flat surfaces of healthy bone lying together.

Materials and methods

This is a prospective study of six burst fractures that scored 7 or more points on the McCormack load sharing classification [8], and were treated with vertebral shortening and a posterior approach. Patients ranged in age from 36 to 55 years; two were male and four female. Two patients had complete spinal cord injury and four of them had no neurological injury.

The fractures were located at T9 in one patient, T11 in one patient, T12 in two patients, L1 in one patient and L3 in one patient.

Surgical technique

We used a longitudinal medial posterior approach at the level of the fractured vertebra (Fig. 1). We exposed the transverse process by subperiosteal dissection, and then located the reference point of entry of the pedicles, drilling at the reference point as wide as possible. We then emptied two-thirds of the vertebral body, including retropulsed fragments (Fig. 2), through the pedicles, using the Heining technique, removing all the upper disc to obtain anterior fusion with the cranially adjacent vertebra. With total resection of the neural arch and both pedicles, transpedicular screws were placed in the superior and inferior vertebrae. Vertebral shortening

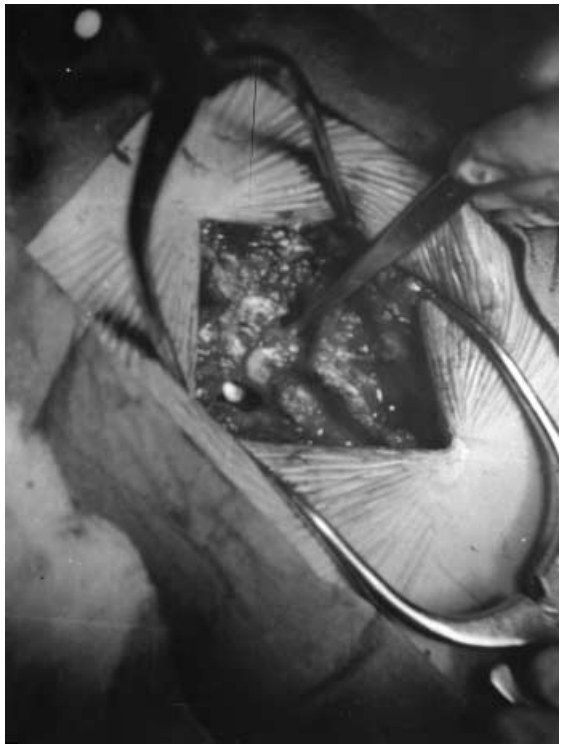

Fig. 2 Total liberation of the neural elements, with resection of the neural arch, both pedicles and two-thirds of the vertebral body

Fig. 3 Vertebral shortening is done by pulling the screws towards one another and then placing the INO plates. The fixation is completed using a crossbar

was done by pulling the screws towards one another and placing the INO plates, finishing the fixation with a crossbar (Fig. 3).

Myelography was used during surgery to confirm the free transit of the raquis conduct. A lateral posterior fusion was performed, and walking was permitted 48 h after surgery.

Postoperative evaluation was carried out every 3 months, with a final follow-up at 2 years. It consisted of neurological assessment, and measurement of spine alignment, stability, postoperative kyphosis and pain.

Table 1 Results of postoperative alignment after 2 years of follow-up

Case	Age	Sex	Level of fracture	Preop. fracture angle	Postop. fracture angle	Final fracture angle
1	36	M	T11	15°	0°	0°
2	40	M	L1	22°	4°	3°
3	55	F	T9	10°	0°	0°
4	43	F	T12	22°	0°	0°
5	39	F	T12	12°	2°	2°
6	47	F	L3	22°	0°	0°

Results

The vertebral shortening obtained in all cases was 2 cm. No patient presented scoliosis. There was no disturbance of the topographic anatomic alignment of the spine.

The two patients with previous complete neurological injury showed no improvement. The four patients without spinal cord injury showed no neurological change.

One patient presented medullar discharges, secondary to a non-sufficient stability, which was corrected using a TLSO cast brace for 3 months. The remaining five patients did not present pain 1 month after surgery.

Fusion was evident at 6 months in four patients and at 9 months in the remaining two. Mean blood loss was 300 cc and the mean surgical time was 2 h 40 min.

Overall results regarding the anatomic alignment of the spine after a follow-up of 2 years are shown in Table 1.

Discussion

There is no doubt that a complete spinal injury will not show improvement with this technique, but the fact that it maintains neurological stability in patients without spinal cord injury provides assurance that this is a trustworthy technique [6], avoiding damage to the patient in spite of the 2-cm vertebral shortening.

Fig. 4 Burst fracture of L1, with retropulsion and kyphosis of more than 50%

Fig. 5 Normal alignment on anteroposterior plain radiograph

Fig. 7 Final result, showing consolidation and good alignment

Fig. 6 Myelogram taken during the shortening procedure for confirmation of total liberation

Our treatment is feasible, with less surgical damage and without neurological damage, and provides an excellent topographic anatomic alignment of the spine (Fig. 4, Fig. 5, Fig. 6, Fig. 7). The residual kyphosis in our patients averaged 1°, without alteration of the spine dynamics, and a prompt improvement in their work, sports and social activities was observed.

Using a posterior approach results in less bleeding and shorter surgical time than using an anterior or combined approach [9].

However, we observed that the INO plates are not the ideal implant for vertebral shortening, because of their limited (26-mm) distance between each hole, which elevates the pressure against the pedicles and risks causing them to fracture. The ideal implant has to be precise, which is why we recommend a rod-transpedicular screw or a hook-rod system.

It is essential to leave 1 cm of shortened vertebral body, or to retain intact the inferior vertebral disc, in order to permit an adequate intersomatic foramen diameter, allowing a free neural root at the same level.

Conclusions

1. Burst fractures scoring 7 or more points on the McCormack load sharing classification may be treated with vertebral shortening.

2. With this procedure, residual kyphosis with a follow-up of 2 years is less than 1°.
3. Vertebral shortening does not alter spine dynamics.
4. Complete neurological spine injury does not improve with vertebral shortening.
5. There were no neurological complications attributed to vertebral shortening.
6. INO plates are not the ideal implant to achieve a vertebral shortening.

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