

STABILIZATION OF THE LOWER THORACIC AND LUMBAR SPINE WITH THE INTERNAL SPINAL SKELETAL FIXATION SYSTEM AND A CROSS-LINKAGE SYSTEM FIRST RESULTS OF TREATMENT

D. MARTI GARIN, C. VILLANUEVA LEAL¹, J. BAGO GRANELL¹

Since 1986, 19 patients with 21 fractures of the thoracic and lumbar spine have been treated with the AO Internal Spinal Skeletal System. Of these fractures, 17 were burst fractures, 2 were seatbelt fractures and 2 were fracture-dislocations. All the patients in the series had a minimum follow-up of 12 months. There were 4 important losses of correction and two deep infections. In the majority of patients the postoperative reduction deteriorated during follow-up. The addition of 1 or 2 DTT appears to give the system more stability.

Keywords: burst fractures ; complications ; cross linkage ; internal fixation ; pedicle fixation ; spinal fractures.

Mots-clés: fractures avec déplacement postérieur ; ostéosynthèse ; dispositif de traction transsternale ; fixation pédiculaire ; fractures de colonne.

Modern surgical treatment of spinal fractures is aimed at achieving the best possible results through reconstruction of normal spinal anatomy in order to reduce intracanal fragments, and regain normal spinal alignment, without any postfracture deviations. The internal Spinal Fixator of Dick limits the area requiring instrumentation and so minimizes spinal dysfunction.

The AO Internal Spinal Skeletal Fixation System (ISSF) is a dynamic system that allows the performance of the manipulations necessary for the reduction of burst fractures, the correction of kyphosis and recuperation of vertebral body height by distraction. The system has also been suggested

for the treatment of horizontal instabilities such as dislocation fractures and seatbelt fractures.

The purpose of this study is to review the clinical and anatomical results of 21 lower thoracic and lumbar spinal fractures treated with the AO fixator since 1986 with a minimum follow-up of one year. There is also a discussion of the mechanical failures that occurred as well as alternative quadrangular assembly with DTT (4, 5) which in our cases appeared to improve the solidity of the assembly.

MATERIALS AND METHODS

Our department used the AO system for the instrumentation of unstable spinal fractures from 1986 to 1988, in 19 patients with 21 unstable thoracolumbar fractures. All the cases were treated by the second and third authors of this article, surgeons working exclusively in spinal surgery. All patients had a minimum follow-up of one year. The patients were evaluated using the clinical parameters of neurological variations and radiographic deformity. The radiographic valuation was performed using the Cobb technique for the evaluation of kyphosis and lordosis. The evaluation of the restoration of normal spinal anatomy was carried out by measuring the compression angle of Denis (8), the regional kyphosis, and the posterior and anterior vertebral body height. The adjacent vertebral body

¹ Hospital of Traumatology, Vall d'Hebron, Barcelona, Spain.

Correspondence and reprints : D. Marti Garin.

heights were used as a control. The fractures were catalogued according to the Denis classification (7) and the Frankel grades for evaluation of the neurological evolution. In 4 cases no system other than the AO system was used, in 13 cases it was associated with a double DTT system, and in 2 cases it was associated with only one DTT system.

RESULTS

Nineteen patients (12 males and 7 females) sustained 21 fractures of the lower thoracic and lumbar vertebrae. The average age was 26.6 years (range 16-56). The most frequent cause of injury was traffic accidents (10), followed by work-related injuries (5), suicide attempts (3) and sports injuries (2). The frequency of the level involved was T11 (1), T12 (4), L1 (10), L2 (5) and L3 (1). Two fractures were caused by seatbelts, 2 were fracture-dislocations and 17 were burst fractures. The preoperative neurological status according to the Frankel grades included 2 patients with grade A, no patients with grade B, 8 patients with grade C, 3 patients with grade D, and 7 patients with grade E. In follow-up this became 2 patients with grade A, no patients with grade B, 2 patients with grade C, 6 patients with grade D, and 9 patients with grade E (see table I).

Table I. — Neurologic assessment preoperatively and 12 months postoperatively in 19 patients with thoracolumbar fractures

Frankel Grade	Preoperative	Postoperative (12 months)
E	7	9
D	3	6
C	7	2
B	0	0
A	2	2
Total	19	19

Seventeen patients had injuries at only one level, requiring stabilization of 3 vertebrae, and another patient had injuries at two successive levels requiring instrumentation over 4 levels. An-

other patient had two fractures at T12 and L2, requiring instrumentation of T11-L1-L3, immobilizing 5 vertebral levels. Posterolateral bone grafts were used in all cases. Transpedicular bone grafts as described by Daniaux (6) were not employed. The anterior approach was not used in any cases. Two cases with severe technical defects have been excluded from the study, one case because the Schanz screws were not in the pedicles and the other because of incorrect placement of the clamps which secure the nuts and prevent loosening. These technical errors resulted in reoperation with new instrumentation (C.D. System in both); these results would doubtlessly confuse the results of this study.

The average preoperative kyphosis as measured by the Cobb method was 13.21°. This was reduced to 5.94° in the immediate postoperative period, to become 13.35° at 12 months' follow-up. The average anterior body height was 62.94% preoperatively, 81.16% in the immediate postoperative period, and 67.69% at follow-up. The average posterior vertebral height was 95.63% preoperatively, 96.94% during the immediate postoperative period and 94.23% at follow-up.

The results have been analyzed in three separate groups: the first group includes fractures without comminution of the posterior wall, fracture-dislocations and seatbelt fractures (4 cases); the second group is comprised of the burst fractures treated with simple ISSF (1 case, and the third group is made up of the remaining burst fractures treated with ISSF combined with 1 or 2 DTT (12 patients, 14 fractures).

In the group of fracture-dislocation and seatbelt fractures there were no important losses of correction. At admission the average local kyphosis was 20.5°, and at follow-up the average local kyphosis was 8.70°, the posterior vertebral height was 100% and the anterior height, 75%.

There was one case of burst fracture not associated with any other type of instrumentation; in this case there was an important loss of correction as shown in table II. Reoperation was performed after 6 weeks with the placement of 2 DTT systems which partially restored the loss of correction. In this classification two cases were

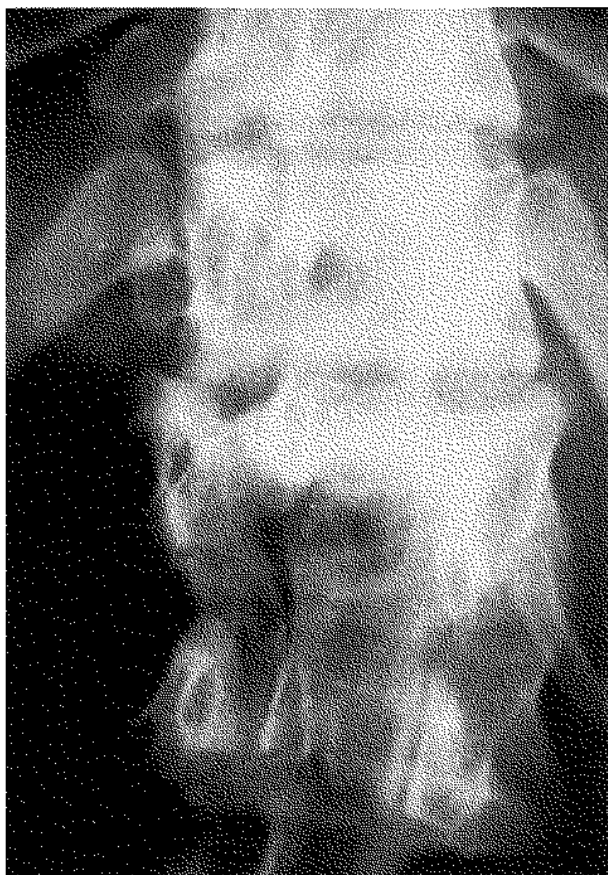


Fig. 1

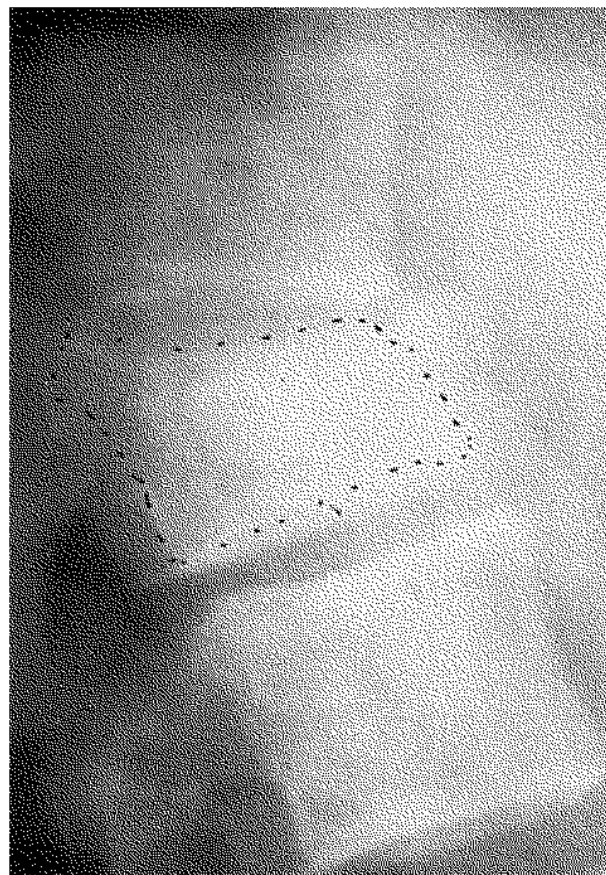


Fig. 2

Fig. 1 and Fig. 2. — Preoperative x ray films of burst fracture.

Table II. — Measurements of the local kyphosis after Cobb, the anterior compression angle as well as the anterior or posterior vertebral height

Measurements	(Average values)		Follow-up
	Admission	Postop.	
Anterior compression angle (°)	18.8	12.9	15.25
Local kyphosis (°)	13.2	5.9	13.35
Anterior vertebral height (%)	62.9	81.1	67.69
Posterior vertebral height (%)	95.6	96.9	94.23

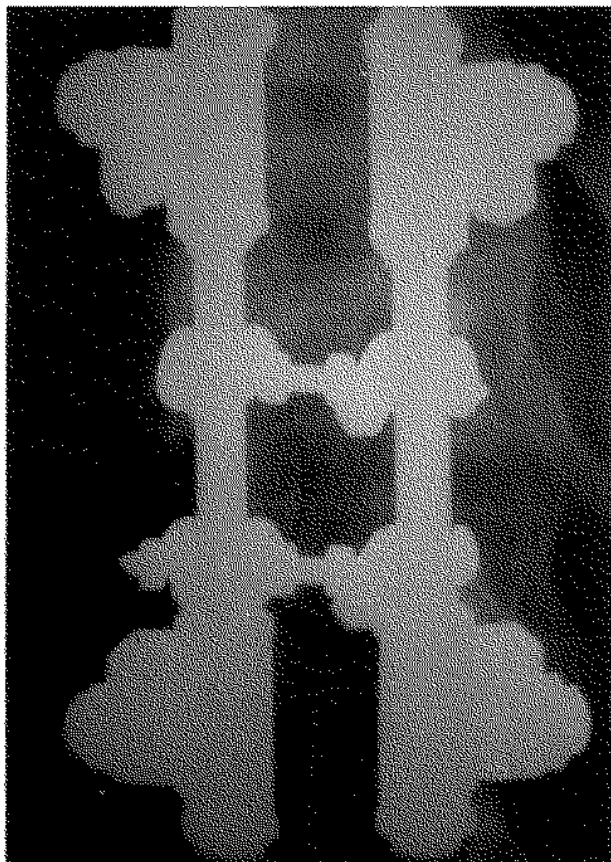


Fig. 3

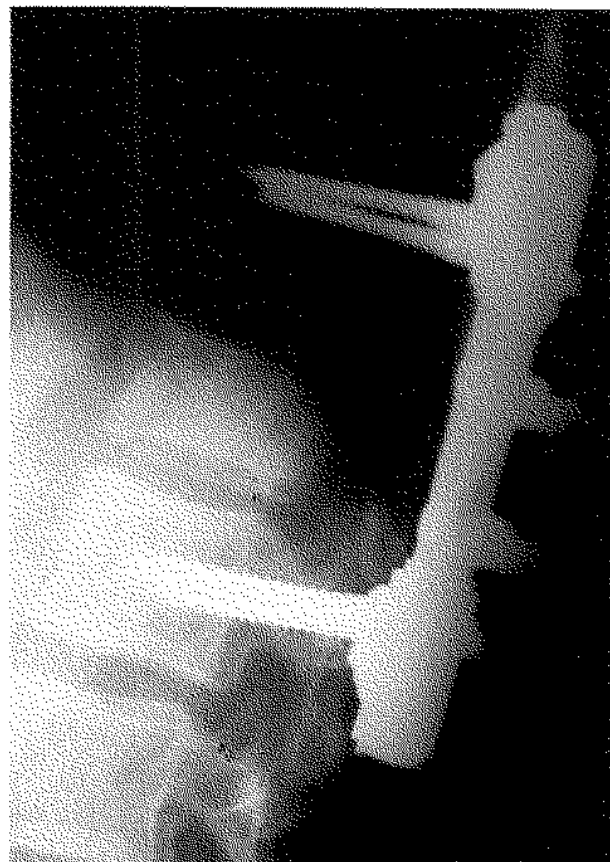


Fig. 4

Fig. 3 and Fig. 4. — Postoperative x ray films. Dick-DTT instrumentation.

excluded because of technical defects. In the group of burst fractures associated with other assembly systems (14 fractures in 12 patients), 1 DTT was used in 2 cases and 2 DTT's were used in 12 cases. The average preoperative kyphosis was 12.9° , reduced to 6.85° in the postoperative period and 12.4° at follow-up. The average posterior vertebral height was 92.85%, becoming 95.71% in the postoperative period and 94.5% at follow-up. The average anterior height was 59.35%, becoming 78.28% in the postoperative and 70.00% at follow-up.

COMPLICATIONS

There was no breakage of the Schanz screws, not any increase in neurological deficiencies. There were 3 cases of superficial seromas (15.8%).

In the first group the only complication worth mentioning was a postoperative seroma that healed spontaneously in 3 weeks. There were 2 important losses of correction (10.25%). In the first case there was a loss of lateral reduction caused by the windshield wiper effect that needed further surgery to place two DTT's. This resulted in a partial recuperation of the reduction. The second case was treated for a deep infection, with significant loss of correction requiring the removal of the ISSF without placement of any other type of instrumentation.

There were 2 deep infections (10.50%), the first being the case described above. The second case of deep infection ran its course without loss of reduction and required only surgical cleaning. The ISSF was left in place, and the patient had a satisfactory postoperative period.

DISCUSSION

Classical systems require at least four levels of instrumentation. According to some authors, the classical Harrington method has a kyphotic effect under distraction (2, 12, 13), whereas others believe that the kyphotic effect only occurs on the anchor vertebrae and that this method does nonetheless provide correction of all the spinal curves instrumented for distraction (18). Segmental instrumentation such as that of Luque does not achieve a distraction effect and, at the same time, requires long instrumentation. Plates with pedicle screws of the Roy-Camille type (16) also require long instrumentation and they are static systems incapable of reducing the fractures.

The introduction of the AO external pedicle fixator (14) involves instrumentation of the three Denis columns as well as reduction of the instrumented levels, and it achieves a distraction effect as well. The internal fixator (9, 10), avoids the problems of the external fixator and attains greater

correction of spinal lordosis. If the posterior common spinal ligament is intact, the distraction reduces the protruding fragments (1, 11, 15), and the canal recuperates its dimensions without further surgical intervention. The level of correction attained with the ISSF is shown in table II. There is good postoperative reduction but significant loss after 12 months' follow-up.

The results have been analyzed by groups according to the type of fracture and the instrumentation used (table II). When the posterior wall is intact there is no significant loss of reduction whatever the instrumentation used. In the other groups, a considerable loss of reduction is noted at the expense of the collapse of the anterior part of the vertebral body.

Contrary to the results obtained by other authors (1, 10) for burst fractures, those of our series, in spite of showing acceptable reductions during the postoperative period, also show progressive deterioration during the first year of follow-up (table III).

Table III. — Group measurements of the local compression angle (ACA), the local kyphosis (CL) in degrees (°), the anterior height (HA) and posterior height (HP) expressed as a percentage of adjacent vertebral bodies
Averages

	Admission				Postoperative				Follow-up			
	ACA	CL	HA	HP	ACA	CL	HA	HP	ACA	CL	HA	HP
Fractures without comminution of the posterior wall (4).	25,4	20,5	85	105	14,2	4,8	88,2	100	15,7	8,7	75	100
Fractures with comminution of the posterior wall.												
ISSF* (1)	± 4	12,0	100	97	0	- 5	105,0	105	14,0	37,0	30	80
ISSF + DTT (14)	18,6	12,9	59,3	92,8	13,4	6,8	78,3	95,7	15,1	12,4	70	94,5

* 2 cases excluded due to erroneous surgical technique.

Nevertheless, the stability of the assembly could be precarious in cases of great instability and could produce a windshield wiper effect as described for other, similar, assemblies (3, 17). Quadrangulation of the assembly appears necessary in these cases in order to avoid mechanical complications.

CONCLUSIONS

The Internal Spinal Skeletal Fixator (ISSF) System achieves spinal rigidity through pedicle fixation, a limit on the instrumented space, and early mobilization of the patient as well as reduc-

tion in the length of hospitalization. It also results in postoperative recuperation of the vertebral dimensions and reduction of fragments located in the spinal canal. The system may deteriorate and cause correction losses in fractures with extensive comminution of the vertebral body. The results of this study are significantly different from those published by other authors (1, 10). The authors suggest associating DTT with this system in order to provide greater stability. The treatment of a larger number of cases may give more conclusive results regarding this instrumentation system, which does not alter the instrumentation indications for unstable fractures.

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SAMENVATTING

D. MARTI GARIN, C. VILLANUEVA LEAL en J. BAGO GRANELL. Stabilisatie van de lage thoracale en lumbale wervelkolom door middel van osteosynthese met een dwars fixatiesysteem. Eerste resultaten.

Sedert 1986 werden 19 patiënten met 21 fracturen van de thoracale en lumbale wevelkolom behandeld met het A.O. instrumentarium. Bij 17 fracturen was er een verplaatsing van een fragment in het mergkanaal, 2 waren van het veiligheidsgordel type en 2 waren fracturen-luaties.

Al de patiënten werden gedurende minstens 12 maanden gevolgd. Er waren 4 belangrijke verliezen aan correctie en 2 diepe infecties. Bij de meerderheid van de patiënten gebeurde een geleidelijke deterioratie van de peroperatief bekomen repositie. Meer stabiliteit werd aan het systeem gegeven door 2 aanvullende dwarse tractie systemen.

RÉSUMÉ

D. MARTI GARIN, C. VILLANUEVA LEAL et J. BAGO GRANELL. La stabilisation de la colonne dorsale basse et de la colonne lombaire par ostéosynthèse à l'aide d'un dispositif transversal. Premiers résultats.

Depuis 1986, 19 patients présentant 21 fractures de la colonne dorsale et lombaire furent traités à l'aide

du matériel de synthèse vertébrale A.O. Dix-sept fractures présentaient un fragment postérieur déplacé dans le canal médullaire, 2 étaient des fractures de type «ceinture de sécurité» et 2 étaient des fractures-luxations. Ces patients furent suivis pendant au moins 12 mois. On observa 4 pertes de correction importantes et 2 infections profondes. Dans la majorité des cas, on nota une détérioration de la réduction obtenue initialement. L'addition d'un ou deux systèmes de traction transversale donne plus de stabilité au montage.