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A simplified Galveston technique for the stabilisation of pathological fractures of the sacrum

Received: 29 October 1999
Revised: 15 April 2000
Accepted: 25 April 2000

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Abstract Mechanical stabilisation of pathological fractures of the sacrum is technically challenging. There is often inadequate purchase in the sacrum, and stabilisation has to be achieved between the lumbar vertebrae and ilium. We present a simplification of the Galveston technique. We treated a total of six patients with this technique, four for metastatic disease and two for primary tumours. Our technique consists of the formation of a proximal stable construct using ISOLA pedicle screws linked distally using a modular system of connectors to threaded

iliac bolts with cross linkages. Neurological decompression and fusion was performed as appropriate. The benefits of this method are: ease of access to the ilium, a solid purchase to the ilium, less rod contouring and shorter operating time. We have had no operative complications from this procedure. All patients were discharged home mobile, with a reduced opiate requirement.

Key words Sacrum · Pathological fractures · Internal stabilisation · Galveston technique

Introduction

The aim of management in patients with metastatic spinal disease is to alleviate pain, maintain function and prevent neurological complications. Whilst tumour progression may be halted and even reversed by radiotherapy and chemotherapy, the pain produced by pathological fracture is best relieved by mechanical stabilisation [5].

In the lumbar spine, mechanical stabilisation may be accomplished via anterior or posterior approaches, but at the lumbar sacral level posterior surgery is technically easier. However, there is often insufficient bone remaining in the sacrum, when weakened by a destructive lesion, for adequate posterior fixation. The Galveston technique overcomes this problem by utilising the ilium for distal fixation.

We present the results we have obtained for a series of patients with pathological fractures of the lumbo-sacral junction, using a variant of the Galveston technique that comprises linking iliac screws via connectors to a pedicle screw and rod construct in the lumbar spine. This is technically less demanding than the Galveston technique.

Materials and methods

Patients

Over a 2-year period, six patients with pathological sacral fractures were referred to the regional spinal unit.

The patients had different primary pathologies; four had metastatic disease (phaeochromocytoma, breast, renal and transitional cell carcinoma of bladder) and two had primary bone disease (aneurysmal bone cyst and B cell lymphoma).

The principal indication for surgery was intractable pain. In four instances this was so severe that the patients were bed bound, whilst the remainder were housebound because of their pain. All had undergone various attempts to control their pain, including simple analgesia, non-steroidals, opiates, radiotherapy and epidural analgesia; none had been successful. In addition, four patients had symptoms and signs of cauda equina or root compression to varying degrees.

Surgical technique

Approach to the spine is via a posterior 'Mercedes Star' incision [4]. This utilises a midline incision over the lumbar spine for the insertion of the lumbar pedicle screws and bilateral extensions towards the posterior superior iliac spine to gain access for the inser-

Fig. 1 A, B Postoperative radiographs of the simplified Galveston technique using ISOLA screws

tion of the iliac screws. This incision can be reflected to expose the posterior aspect of the sacrum if sacrectomy is considered.

Pedicle screws should be firstly placed in the lumbar spine and thoracic spine if required. Then, the posterior superior iliac spine is identified and the outer wall of the ilium is dissected in a subperiosteal plane to reach the greater sciatic notch. This position acts as a reference for insertion of the iliac screws. It is important not to breach the walls of the ilium, so a tract is made with a guide wire or awl. The tract is directed approximately 1–2 cm anterior to the sciatic notch and aimed at the sourcil of the acetabulum; care should be taken not to enter the hip. Typically, to reach the sourcil of the acetabulum, bolts of approximately 85 mm are required in an adult. The tract can be tapped if desired.

Iliac crest bone graft was not harvested from the posterior ilium, due to the risk of weakening the iliac screw purchase. If grafting was required, allograft was used.

In three patients we utilised the ISOLA iliac screws, but later changed to the Synergy iliac screws. These screws have a lower profile, an improved couple for the rod, and a deeper pitch, theoretically improving the pull-out strength.

Postoperative radiographs of the technique using ISOLA screws are shown in Fig. 1.

Results

Details of the patients' instrumentation and outcome are presented in Table 1. There were two cases of isolated sacral disease, and therefore proximal fixation was with pedicle screws to L4 and L5. In the other four cases the disease extended up the spine, and therefore the construct was extended to two levels above the highest diseased vertebra.

All patients made an uneventful postoperative recovery. The duration of surgery ranged from 2 to 7 1/2 h, reflecting the amount of additional decompression and lumbar

stabilisation performed. Postoperatively, patients were encouraged to mobilise immediately, and no additional orthotic bracing was required.

Hospital stay averaged 10 days. Five of the six cases were able to walk out of hospital unaided, whilst the remaining patient was wheelchair bound because of persisting neurological deficit. Significant reduction in analgesic requirements was noted in all cases.

There were no instances of mechanical failure, implant loosening or infection. A single patient is still alive after 2 years, and has had his metal work removed to enable a further magnetic resonance imaging (MRI) investigation. At surgery the fusion mass was found to be solid.

Discussion

Sacral involvement occurs in less than 2% of spinal malignancies [5], and surgical stabilisation can be challenging. The Galveston technique was originally described for cases of pelvic obliquity associated with neuromuscular scoliosis [1]. Research has shown the importance of accurate placement of the rods in order to prevent early loosening and implant failure. The rods should be inserted to the maximum possible depth and be entirely intraosseous throughout their length [1, 2]. This is technically demanding and time consuming, since considerable expertise is required to bend the distal end of the rods, which are a continuation of the lumbar construct. This necessitates accurate operative planning to determine the angle to which the rods must be shaped and the length of rod required.

Table 1 Clinical details of the six patients operated using the simplified Galveston technique

Tumour	Age	Pre-op. neurology	Postop. Neurology	Instrumentation level	Duration of surgery	Blood transfused	Post-op. length of stay	Mobility: preop./postop.	Survival
Metastatic breast cancer	53	Left S1 power 4/5 & sensory disturbance	Normal	T12–ilium. Decompression: S1	4 h	6 units	11 days	Bed bound/mobilising	18 months
Malignant phaeochromocytoma	32	Bilat. L4–S1 power 0/5. Left-side perianal anaesthesia	No Change	L2–ilium. Laminectomy: L4–S1	6 1/2 h	10 units	10 days	Bed bound/able to sit	5 months
Metastatic renal cancer	49	Normal	Normal	T10–ilium. Decompression: S1–2	7 1/2 h	4 units	10 days	Bed bound/mobilising	12 months
Metastatic transitional cell cancer of the bladder	44	Normal	Normal	L4–ilium	2 1/2 h	3 units	8 days	House bound/mobilising	3 months
B cell non-Hodgkin's lymphoma	78	Right L5 power 4/5	Normal	L2–ilium. Decompression: L4–S1	2 h	2 units	14 days	House bound/mobilising	2 months
Aneurysmal bone cyst of S1	14	Absent ankle jerks	Right L5 power 4/5	L4–ilium. Laminectomy: S1	3 1/4 h	None	6 days, transferred to local hospital	Bed bound/mobilising	Alive after 2 years

Literature on spinal instrumentation into the ilium is concerned with the correction of pelvic obliquity in neuromuscular scoliosis, and there are very few articles that address the problem of stabilising pathology in the sacrum.

Apart from the Galveston technique, other methods include sacral bars passed between both posterior iliac wings and connected to spine with Harrington rods [4]; Steinman pins inserted in a similar manner and connected to the spine with Cotrel-Dubousset instrumentation [6]; and dynamic hip screws (DHS) passed into the ilium and connected together with the DHS plate and then coupled to the spinal instrumentation [3].

None of the above systems provide the purchase to the pelvis that the Galveston technique provides, with its rods or screws inserted between the inner and outer table of the ilium. Blatter et al. [3] have described a method utilising the principles of fixation with threaded screws by using a DHS implant. However, the width of the screws appears too great to fit entirely between the table of the ilium, which presumably explains why the intraosseous length of these 65-mm screws is less than the screws we describe. In addition, the DHS plates are prominent under the skin in an area that is very prone to ulceration.

Strange-Vognsen et al. [7] describe the technique of passing two iliac screws through the posterior ilium, the upper screw laterally and the lower screw more anteriorly in the transverse bar of the ilium, for unstable sacral fractures. They do not mention the diameter or length of the screws, and they also utilised the sacrum for purchase, which was not possible in our series. They reported on three patients with a good outcome, but there is very little detail on the follow-up.

The advantage of the technique we describe, using iliac screws, is that the screws are relatively easy and rapid to insert. As they are connected to the rods, via modular connectors, minimal rod bending is required to achieve a stable fixation and this allows for a low-profile construct. Also, the iliac screws provide an improved pelvic purchase in comparison to the smooth Galveston rods. This technique has reduced intra-operative blood loss and operative time. Its use is recommended in the management of these difficult sacral tumours.

References

1. Allen BL Jr, Ferguson RL (1982) The Galveston technique of L-rod instrumentation of the scoliotic spine. *Spine* 7:276–284
2. Allen BL Jr, Ferguson RL (1984) The galveston technique of pelvic fixation with L-rod instrumentation of the spine. *Spine* 9:388–393
3. Blatter G, Halter Ward EG, Ruflin G, Jeanneret B (1994) The problem of stabilization after sacrectomy. *Arch Orthop Trauma Surg* 114:40–42
4. Katsuro T, Tsuchiya H (1990) Total sacrectomy and reconstruction for huge sacral tumors. *Spine* 15:1223–1227
5. Krikler SJ, Marks DS, Thompson AG, Merriam WF, Spooner D (1994) Surgical management of vertebral neoplasia: who, when, how and why? *Eur Spine J* 3:342–346
6. Santi MD, Mitsunga MM, Lockett JL (1993) Total sacrectomy for a giant sacral schwannoma. A case report. *Clin Orthop* 294:285–289
7. Strange-Vognsen HH, Kiær T, Tøndevold E (1994) The Cotrel-Dubousset instrumentation for unstable sacral fractures. Report of 3 patients. *Acta Orthop Scand* 65:219–220