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Surgical treatment of giant cell tumours of the thoracic and lumbar spine: report of nine patients

Received: 27 April 2000
Revised: 7 August 2000
Accepted: 9 August 2000
Published online: 9 December 2000
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Abstract Giant cell tumours involving vertebral bodies are still difficult to treat, though results are gradually improving. The object of this study was to assess the results of “complete excision”, both of previously untreated giant cell tumours and of recurrences, and to consider the possible effects of any tumour contamination during operation. Nine consecutive patients with giant cell tumours of the thoracic and lumbar spine were treated surgically between 1986 and 1995. Four of these patients were referred with recurrent tumours. All operations aimed at complete resection of the tumour; where possible an en-bloc approach was used. The spines were reconstructed with autografts and instrumentation. All patients were regularly reviewed as part of an on-going study. Following the five operations for previously untreated

tumours (“primary” operations), there were no local recurrences, but one patient died of pulmonary metastases. One of the four patients operated upon for a recurrence developed a further recurrence, which was excised 2 1/2 years ago. It would seem that giant cell tumours of the thoracic and lumbar spine, including recurrences, should be treated by complete excision. The en-bloc approach is the safest technique. Where an intralesional component is unavoidable, total removal of the (pseudo)capsule should be ensured by preliminary extralesional dissection. Any tumour spill should be meticulously removed. The use of frozen sections to check resection margins is advisable.

Key words Giant cell tumour · Spine · Surgery · Recurrences · Resection margins

Introduction

Giant cell tumours of the thoracic and lumbar spine are uncommon [6, 23,32].

In 1985, when the first patient in the present series was referred, it was known that the results of curettage were poor; three of the four patients documented by the Netherlands Bone Tumour Committee [30] developed local recurrences. However, there had been sporadic reports of successful complete, though usually intralesional, excision [19, 20, 21, 22, 28,34]. It was therefore decided to treat such patients by complete excision of the tumour, including its (pseudo)capsule; whenever possible the en-bloc approach

was used. With the addition of each patient, an ongoing study developed. During the course of the study, the basic concept of complete excision was supported by the recommendations of Sanjay et al. [27] and Hart et al. [14] that giant cell tumours of the spine be “completely removed” [27] or that “initial surgery should be as aggressive as possible” [14]; they reserved radiotherapy for recurrences and following incomplete excision. This paper reviews the results of the surgical treatment of a personal consecutive series of nine patients with giant cell tumours of the thoracic and lumbar spine, where the emphasis was on complete excision and where radiotherapy was not used, even for recurrences.

Table 1 Details of the nine patients with giant cell tumours of the thoracic and lumbar spine. Vertebrae in parentheses were partially resected (■ posterior rectangle)

Case no.	Age	Sex	Presentation	Previous operative treatment	Vertebra(e) involved	Tumour grade	WBB ^a staging	Resection	Contamination grade (see text)	Stabilisation	Complications	Postoperative management	Follow-up results
1	34	F	Progressive collapse T3; ingrowth left lung; minor pain	8 months prior to referral T2–5 laminectomies; partial tumour resection; radiotherapy 45 Gy	T3	I→II	4→9, A→D	T(2),3,(4), en bloc (metastasis in excised scar)	0	■ T1–T7, post. lat. + ant. autograft; ant. Zielke rod	None	Circle bed, 3 months; Milwaukee brace, 1 year	10 years: High thoracic kyphosis, no symptoms. Discharged
2	27	M	Pain; path. fracture	None	T12	I	4→10, A→D	T12, en bloc	I	■ T11–L1; post. lat. + ant. autograft; ant. Zielke rod	Unexpected contamination	Circle bed, 3 months; Boston brace, 1 year	5 years: Occasional backache. Emigrated
3	34	M	Pain→left thigh	12 months prior to referral; intralesional excision/curettage	L2	I→II	2→8, A→D	L(1),2,(3), extra/intra, lesional	II	■ L1–L3, post. lat. + ant. autograft; ant. Zielke rod	Loose Zielke screw at 2 weeks; replaced	Circle bed, 3 months; Boston brace, 1 year	12 years: No symptoms. Discharged
4	26	F	Pain	None	T12	II	5→9, A→C	T(11),12, en bloc	I	Steffee T11–L1; post. lat. + ant. autograft, + ant. vasc. rib	Unexpected contamination	Boston brace, 1 year	9 years: No symptoms. Metal removed at 3 years
5	27	F	Pain	None	T7,8,9; Anterior and right para-vertebral extension T5,6,10	I	4→9, A→D	T(6),7,8,9, Tumour dissected off T5,6,10, en bloc	I	Steffee T5–T10 (laminar wires cranially); post. lat. + ant. autograft; ant. Zielke rod	Intra-operative bleeding; unexpected contamination	Circle bed, 6 weeks; Boston brace, 2 years	10 years: Weak abdominal muscles. Post. metal removed at 6 1/2 years
6	22	F	Pain; paraparesis	4 years prior to referral, partial excision & chemo-therapy	T7,8,9; Left para-vertebral extension T10; Left lamina T9	II	12→10, A→D	T7,8,9(10), extra/intra lesional	II	Steffee T6–T11; post. lat. + ant. autograft	18 months follow-up: fracture of graft + cranial screws; re-operation including vascularised fibula (see text)	Circle bed, 3 months; Milwaukee brace, 6 years	9 year: Good (see text)
7	29	M	Pain; path. fracture; conus syndrome	None	T11; Right para-vertebral extension T10,12	II	5→12, A→D	T(10),11, (12), en bloc	I	Steffee T9–L1, Post. lat. + ant. autograft	Unexpected contamination; lung metastases (see text)	Circle bed, 3 months; Boston brace, 1 year	7 1/2 years: Died. Symptom-free spine, lung metastectomy, progression of other lung metastases (see text)

Table 1 continued

Case no.	Age	Sex	Presentation	Previous operative treatment	Vertebra(e) involved	Tumour grade	WBB ^a staging	Resection	Contamination grade (see text)	Stabilisation	Complications	Postoperative management	Follow-up results
8a	26	M	Follow-up: recurrence & referred	12+7 months prior to referral, intra-lesional excisions	T9,10	II	6→3, A→D	T9-T10, Extra/intralesional	II	Isola T7-12Post. lat. + ant. autograft	None	Boston brace, 1 year	4 1/2 years: at 2 years recurrence. Re-resection etc. See 8b
8b	26	M	Pain; swelling	See 8a	T11 + graft; II Right paravertebral extension T8-T11	II	6→11, A→D	T(11) (bone graft), posterior ends, R 8-11 ribs en bloc	I	Isola T7-L1, Ant. autograft (fibula)	Possible postero-superolateral contamination. Re-resection: no tumour (see text)	Boston brace, 1 year	2 1/2 years: Good
9	68	F	Pain neck→arms; weak left hand	2 months prior to referral, right anterior open biopsy	T1	II	4→9, A→D	T1, extra/intralesional (See text)	II	■ Songer cables, C5-T4, Replaced laminae C7-T1, Post. lat. + ant. autograft	Intra-thoracic haematoma. Evacuated collar, 6 months	Halo cuirasse, 6 weeks; Philadelphia collar, 6 months	5 years: Good, weakness in left hand unchanged

^aWeinstein, Boriani and Biagini [5,14] preoperative classification

Materials and methods

The nine patients were operated upon between January 1986 and July 1995. The minimum follow-up period is 4 1/2 years.

Details of the nine patients are given in Table 1. Regarding case 8, details of the last operation for the recurrence are included in Table 1 (8b), but the outcome of this operation is not included in the analysis of the results because of the short follow-up period of only 2 1/2 years.

Routine preoperative investigations included radiography, bone scan, computed tomography (CT), CT myelography in cases 1, 2 and 3 and magnetic resonance imaging (MRI) in the remainder, biopsy, selective angiography and embolization. A CT myelogram was also carried out in case 6, prior to referral.

All of the tumours involved the vertebral bodies and the neural arches.

The tumours ranged in size from one similar to that shown in Fig. 1 to the largest – case 5 – which is shown in Fig. 2.

The tumours were histologically graded on a scale of I to III [16]. There were no sarcomas (grade III). However, the grade did not influence the surgical procedure, as grading of non-sarcomas has no practical value [6, 13, 15, 29]. The resected tumours were subjected to routine macroscopic and microscopic examination, with inking of suspicious areas. All diagnoses were confirmed by the Netherlands Bone Tumour Committee.

For possible future reference, the Weinstein, Boriani and Biagini (WBB) [5,14] preoperative classification was retrospectively included for each case.

Postoperatively, routine radiographs of the spine were made after a few days, 2 and 6 weeks, 3, 6 and 9 months, and radiographs of the spine and chest at 1, 2, 3, 4, 5, 7 and 10 years, depending on the follow-up period. Particularly to search for a possible local recurrence, these radiographs were supplemented by myelography/tomography in the early years and, thereafter, by CT and MRI examinations. Recently, with the advent of titanium instrumentation, there has been a shift from CT to MRI examinations. MRI rather than CT was used routinely following removal of instrumentation. Sporadic bone scans were also carried out in cases 3–9.

All pre- and postoperative control imaging studies were also examined by Dr. W. K. Taconis, radiologist of the Netherlands Bone Tumour Committee.

Operative techniques

The aim of each operation was complete removal of the tumour including its (pseudo)capsule.

Whenever possible (cases 1, 2, 4, 5, 7), the aim was to resect the tumour by the combined posterior and anterolateral en-bloc extralesional technique [9]. For this to be possible, part of the vertebral arch and the underlying epidural space must be free of tumour so that, with the patient prone, a segment of the vertebral arch can be removed, the dura mobilized and, in the final stage of the operation with the patient in the lateral position, the diseased segment of the spine rolled away from the dural tube, all without transgressing tumour (Fig. 1).

When such an en-bloc resection was clearly impossible, for example when the tumour extended around one or both sides of the dura to its posterior surface (anterior-lateral-posterior tumour; cases 6, 8a, Fig. 3), the posterior part of the tumour including its (pseudo)capsule was first completely exposed by an extralesional (see Surgical Margins) dissection and then removed piecemeal to expose the dura and nerve roots, whilst the edges of the wound were protected with gauze soaked in Dakin's solution. This preliminary extralesional dissection ensured removal of the periphery of the tumour, parts of which could easily have been left behind if one had curetted the capsule from inside after an initial debulking procedure. The remaining exposed cut surface of the tumour was protected and avoided in an effort to prevent or limit further cont-

Fig. 1A,B Tumour suitable for en-bloc resection (based on case 4). A tumour-free segment of the vertebral arch is removed from 1 to 1 (or 2 where possible). The dura is mobilized and any involved nerve root divided. Subsequently, with the patient in the lateral position, the dissection is completed and the diseased segment of the spine is rolled out in the direction of the arrow (**B** in Fig. 1A shows the transpedicular biopsy track)

Fig. 2 Case 5. Computed tomography (CT) scan. Large giant cell tumour of the thoracic spine

Fig. 3 Case 6. CT myelogram. Anterior-lateral-posterior tumour. The spinal cord (arrow) is almost surrounded by tumour

amination. The operation was then continued as for the en-bloc resection.

In case 3, because of difficulty in mobilizing the inferior vena cava during the second stage of the operation, the left side of the vertebral body, including part of the tumour, was first removed piecemeal to ensure safe access. Finally, the whole vertebra, tumour and its (pseudo)capsule were removed.

The tumour of the last patient (case 9, Fig. 4) had destroyed the vertebral body and extended posteriorly between the left C8 and T1 nerve roots, one or both of which would have had to be sacrificed, with considerable loss of function of the hand, if an en-bloc resection had been carried out. The laminae of C7 and T1 were removed by the technique previously described [10] and, being tumour free, were subsequently replaced. The dura and nerve roots were mobilized and the posterolateral tumour was removed as far as possible with the aid of the CUSA (Cavitational Ultrasound Surgical Aspirator; Auto Suture Nederland – a subsidiary of United

Fig. 4 Case 9. Magnetic resonance (MR) image. The tumour has destroyed the vertebral body of T1 and extends anterolaterally and posterolaterally on the left side

States Surgical Corporation, Boulder, Colo.). The spine was stabilized and grafted posteriorly. The patient was then repositioned for the anterior exposure of C7, T1 and T2, employing a left-sided version of the approach described by Birch et al. [3], and the remaining tumour including its (pseudo)capsule was removed piecemeal after extralesional exposure. The walls of the cavity were checked by multiple frozen sections. One was positive; this area was resected further and re-biopsied. An anterior non-vascularized iliac crest graft was inserted.

Each spine was reconstructed with posterior instrumentation and anterior and postero-lateral autografts; a single anterior Zielke rod was added in cases 1, 2, 3 and 5. In the expectation that the patients would have a normal life expectancy, instrumentation was kept as short as possible to preserve adjacent motion segments. Rigid posterior instrumentation in combination with a sound anterior bone graft allowed early mobilization. Otherwise, to avoid unnecessary risks, prolonged recumbency was frequently necessary. Recently, titanium rather than stainless steel implants have been used. Rigid pedicle screw instrumentation has been removed following sound consolidation in young patients (Fig. 5).

Surgical margins

An extralesional resection had a wide [8] margin where this could be safely obtained and otherwise a marginal [8] margin, e.g. where the tumour was separated from the dura. Where the tumour involved the cortex of a thoracic vertebral body, the adjacent parietal pleura was always included in the resection. When an intralesional approach was necessary, the (pseudo)capsule of the extraosseous portion of the tumour was always dissected extralesionally to ensure its complete removal. Liberal use was made of frozen sections to check the margins.

Contamination

The degree of contamination during these operations was graded and recorded in each case:

Fig. 5 Case 4. **A** Antero-posterior and **B** lateral radiographs following removal of the Steffee instrumentation show consolidation of the anterior non-vascularized iliac crest graft, the anterior vascularized rib graft and the postero-lateral grafts

- *Grade I.* Theoretical or minimal contamination during an en-bloc resection when, for example, a small fissure occurred in the (pseudo)capsule or the tumour was inadvertently penetrated, but where this was immediately recognised and there was no obvious tumour spill into the wound

- *Grade II.* Contamination that was associated with an intentional combined extralesional/intralesional excision, with part or all of the tumour being removed piecemeal, but with meticulous removal of tumour spill

During and at the completion of contaminated operations, the wound was repeatedly rinsed with Dakin's solution.

Results

Contamination

The contamination grades for the nine patients are shown in Table 1.

Grade I contamination occurred in case 2 when the involved pedicles were osteotomized. In case 4, tumour was encountered when the right side of the T11–12 disc was incised. An osteotomy was therefore performed above the vertebral end plate of T11. In case 5, a fissure occurred in the (pseudo)capsule as the tumour was being rolled out. In case 7, when tumour overhanging the dura posteriorly was elevated, a fissure developed in the (pseudo)capsule.

In cases 3, 6, 8a and 9, with grade II contamination, one must assume residual microscopic contamination even though, in each case, there was no macroscopic tumour remaining in the wound and multiple frozen sections from the walls of the resulting cavity were all negative.

Local recurrence

Case 8 was the only one to develop local recurrence. Prior to referral, posterior and transthoracic intralesional operations had been carried out twice (12 months and 7 months previously). At the time of referral there was an anterior-lateral-posterior tumour for which a posterior extra/intralesional and anterior en-bloc type resection was carried out. All the peripheral control frozen sections and subsequent paraffin sections were negative. Even so, 2 years later the patient developed a further recurrence. The instrumentation was removed to facilitate imaging. An en bloc excision of the MRI-visible tumour along with part of the previously inserted bone graft was carried out, though with grade I contamination. The contamination occurred when division of the eleventh rib unexpectedly revealed tumour in its marrow cavity. The rib was redivided 3 cm further laterally, and this resection plane was tumour free. During the reconstruction, an anterior fibula graft was added to the remainder of the previous graft. Frozen sections from the walls of the cavity were negative, but subsequent histological examination of the specimen revealed a minor intralesional area. This was probably caused by a fissure in the (pseudo)capsule and had probably not caused any actual contamination. However, it may have indicated a residual piece of viable tumour, still attached to the neighbouring muscle and to its blood supply. Accordingly the wound was re-opened and the

suspect area resected, but no tumour was identified. The present follow-up has lasted 2 1/2 years and the patient is still tumour free.

None of the other patients has developed a local recurrence.

Pulmonary metastases

Case 7 developed pulmonary metastases. Histological examination of the resected specimen revealed buds of tumour present in its veins. Within 6 months, the patient developed numerous pulmonary metastases, too numerous for resection. The metastases gradually enlarged. Two years following operation, the patient sustained severe road traffic injuries. Treatment included large doses of steroids. All the metastases regressed until 3 years following the accident, when one began to grow. This was resected along with several other neighbouring small metastases. The lung metastases were histologically identical to the spinal lesion. During the last year there was inoperable progression of the remaining lung metastases. Chemotherapy was ineffective and the patient was treated palliatively with steroids until he died.

Neurological sequelae

Cases 5, 6 and 9 experienced neurological sequelae. In case 5, there was some weakness of the abdominal wall musculature due to bilateral division of the 7, 8, 9 intercostal nerves. Preoperative paraparesis in case 6 improved satisfactorily following surgery to Frankel grade D [12]. In case 9, pre-operative weakness of the small muscles of the left hand remained unchanged following surgery.

The remaining patients have either no or only minor symptoms due to division of segmental nerves where oncologically necessary.

One patient (case 2) complained of occasional backache at the site of the operation.

There were no infections.

Multifocal tumour

One patient (case 5) developed a second giant cell tumour 2 years later in the sacrum [18]. This tumour was also successfully removed.

Complications

Bleeding

As a result of prolonged bleeding from the epidural veins in one patient (case 5), it was necessary to postpone the thoracotomy stage of the operation.

In case 9, a postoperative intrathoracic haematoma had to be evacuated on the 1st postoperative day.

Graft fracture

Graft fracture occurred in case 6, 1 1/2 years postoperatively, and was associated with screw breakage, increasing kyphosis and paraparesis. Although the graft had been a "vascularized" one, the flow had been mediocre. Re-operation in three phases consisted of redecompression of the spinal cord, improvement of the kyphosis, re-instrumentation and insertion of an anterior well vascularized fibula graft, and was successful.

Difficult mobilization of the aorta

In case 7, in the presence of a fairly large tumour, an attempt was made to mobilize the aorta via a right-sided thoracotomy, but it was too obscured by the tumour for this manoeuvre to be carried out safely. The aorta was subsequently mobilized from the tumour via a left thoracotomy prior to re-opening the right side for tumour removal and completion of spinal reconstruction.

Contamination

Unexpected theoretical or minimal (grade 1) contamination occurred in cases 2, 4, 5 and 7.

Technical complications

In case 3, a nut became loose, and this was noted on the radiographs taken 2 weeks postoperatively. The nut was replaced.

Discussion

Giant cell tumours of the spine usually involve the vertebral body with or without extension into the neural arch [27]. In the present series, all of the tumours involved the vertebral bodies and the neural arches.

The success of operations for spinal giant cell tumours is judged primarily in terms of local recurrence, assuming an acceptable and appropriate surgical morbidity. In general, any local recurrence of a giant cell tumour usually occurs within 3 years [6], though Sanjay et al. [27] and Hart et al. [14] have recorded recurrent spinal tumours at up to 5 years. The first six and the ninth patients in the present series are free of local recurrence at 5–12 years, and probably are locally cured. The seventh patient was also free of local recurrence when he died. The remaining

patient (case 8) had his last recurrence resected 2 1/2 years ago, and this gives grounds for cautious optimism. The results in the present series, where all operations were directed at complete resection of the tumour, compare favourably with those of curettage as reported by Schrijver [30] – three recurrences following four operations – and of intralesional surgery reported by Sanjay et al. [27] – 7 recurrences following 15 operations for lesions involving the vertebral body – and by Hart et al. [14] – 4 recurrences following 23 operations in a tertiary centre. This progressive improvement in the results is in keeping with treatment in specialized centres and with continually improving facilities, which allow increasingly effective surgery ranging from the early curettage operations to the present concept of complete excision.

A local recurrence usually arises as a result of incomplete excision of a micro extension of the tumour, or from tumour contamination. The most secure way of avoiding these possibilities is by an extralesional en-bloc resection, which was attempted whenever possible (cases 1, 2, 4, 5, 7). Failing this, recourse was made to a combined extra- and intralesional excision including extralesional resection of all of the (pseudo)capsule and a meticulous removal of any tumour spill. As a further safeguard, the margins were subjected to biopsy and frozen section; in case 9, a positive biopsy led to an immediate extension of the resection and probably spared the patient a recurrence. This approach proved successful in all five of the "primary" operations and in three of the four operations for a recurrence, despite varying degrees of contamination.

The role of tumour contamination in the pathogenesis of a recurrence of a giant cell tumour is uncertain. Grade I contamination occurred in four of the five patients in whom an en-bloc resection was attempted, but there were no recurrences. With the aid of modern CT and MRI and better preoperative planning it should now be possible to avoid grade I contamination, as occurred in cases 2 and 4. In particular (case 4), if there is any doubt about the integrity of the vertebral end plate, the whole of the neighbouring disc and a slice of the neighbouring healthy vertebral body are now included in the en bloc resection. In cases 5 and 7 it is doubtful whether the fissures in the (pseudo)capsules could have been avoided. Potentially more serious was the grade II contamination that occurred in four patients. However, there was only one recurrence, and this in a patient (case 8a) being treated for a recurrence. Where possible, removal of the posterior part of the tumour in one piece, as described by Tomita et al. [35], rather than piecemeal, may help to reduce this type of contamination, especially where the anterior tumour can also be removed in one piece. On the basis of this, albeit limited, series, it seems unlikely that grade I contamination, localized and without obvious tumour spill, will lead to a recurrence; following grade II contamination, a recurrence is possible.

Another cause of potential contamination is the preoperative biopsy, but neither the anterior open biopsy in case 9 nor postero-lateral needle biopsies, the tracks of which were not excised, have given rise to recurrences. However, at present, a transpedicular biopsy with subsequent excision of the track is the preferred method [11,26].

An operation to remove a recurrence (or obvious remnant) is always hazardous, in particular because of the danger of leaving behind part of a fine tendril of tumour that has spread along tissue planes or between muscle fibres opened up by previous dissections and which continues to grow. The present recurrence rate of 25% (one patient in four) following operations for the removal of recurrences is similar to the 20% (one patient in five) of Hart et al. [14], who employed "aggressive" surgery supplemented in two cases by radiotherapy. These recurrence rates can be considered good, especially when compared to those following "primary" operations at the same centres, namely 0% (none of five) and 20% (4 of 20) respectively.

In the present series, apart from the somewhat increased chance of local recurrence, an operation to remove a recurrent vertebral body tumour was technically more difficult than a "primary" operation, with an associated increased risk of complications. One should therefore strive for complete removal of the giant cell tumour at the time of the initial operation.

Radiotherapy to supplement surgery has been used in the treatment of local recurrences and following incomplete excision but, as in case 1 of the present series, it was not always successful and there is always the long-term risk of a radiation-induced sarcoma [1, 7, 14,27]. Surgery alone, aimed at complete excision of a recurrence or a remnant, is free from this risk and has a good chance of success. Furthermore, if unsuccessful it can usually be repeated, as in case 8b. It would therefore seem that, as for previously untreated tumours, the current treatment of choice for a local recurrence or remnant should be complete excision, and that radiotherapy should be reserved for situations where this is really not possible.

Metastases from giant cell tumours in general are usually confined to the lung, as in case 7. Lung metastases occur in some 4% of cases and at up to 24 years, with a mean of approximately 4 years, following removal of the primary tumour. They should be resected whenever technically possible, though spontaneous regression has been recorded [2, 17, 24,31]. In case 7, the lung metastases appeared relatively early, at 6 months postoperatively. Blood flow through the tumour had been reduced by preoperative embolisation and, apart from elevation of its postero-lateral edge, the tumour had not been manipulated prior to removal, by which time it had been completely devascularised. Considering the presence of buds of tumour inside the veins within the tumour, it is probable that tumour cells had been shed prior to surgery and that small metastases were present in the lungs, though not visible on the chest radiographs. Although lung metastases are rare, it is

therefore probably advisable to include CT examination of the lungs in the preoperative investigation.

Because of the possibility of local recurrence or the development of pulmonary metastases, it is the intention to follow up all patients for 10 years.

Giant cell tumours of the thoracic and lumbar spine can be removed either by a purely posterior approach [25, 33, 34,35] or by the combined approach [4,9]. The purely posterior operation has the advantage that the patient does not need to be repositioned, whereas the author's favoured combined approach has the advantage of safety both for mobilizing major blood vessels and for dissecting free the tumour with an oncologically adequate margin under direct vision and of facilitating the insertion of an anterior vascularized bone graft. Because of their size, shape, position and/or involvement of neighbouring structures, none of the tumours in this series would have been suitable for resection by the purely posterior approach.

Although the most important goal of the operation is complete removal of the tumour, stabilization and reconstruction of the spine are also necessary. The most recent advances are the use of vascularized anterior grafts to promote early and durable spinal reconstruction, and titanium rather than stainless steel to improve postoperative imaging. Also, better instrumentation now allows earlier mobilisation.

Conclusions

On the basis of the present study and the cited literature, it would seem that giant cell tumours of the thoracic and lumbar spine, including recurrences, should be treated by complete excision. Grade I contamination is probably unimportant, whereas grade II might lead to local recurrence. Where possible an en-bloc approach, even with grade I contamination, is the most secure technique for achieving complete removal of the tumour. Failing this, one should opt for a combined extra- and intralesional excision including complete excision of the (pseudo)capsule along with a meticulous removal of any tumour spill. Margins should be assessed by frozen section. Recurrent tumours are more difficult to remove than untreated tumours and have a somewhat worse prognosis.

Just as Jaffe wrote in 1953 [15], a giant cell tumour can still be "a rather treacherous lesion".

Acknowledgements I am most grateful to the radiologists, in particular to Dr. W. K. Taconis, radiologist to the Netherlands Bone Tumor Committee, for checking all the imaging studies, and Dr. C. de Vries for carrying out the preoperative angiograms and embolisations, to the surgeons who participated in various operations: Dr. K. Bloemendaal, Prof. L. Eysman, Prof. A. Moulein, cardiothoracic surgeons; Dr. C. Daantje, Dr. H. Kroes, Dr. J. Luitse, general surgeons; Dr. H. Been, Dr. G. v. Norel, Dr. C. Plasmans, Dr. G. Slot, orthopaedic surgeons; Dr. M. Sobotka, vascular surgeon; to the anaesthetists and to the intensive care doctors, in particular to Dr. D. Zandstra and Dr. H. Oudemans. My thanks are also due to Mr B. Walman and Mr J. Maeijer for the illustrations.

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