CASE REPORT

Primary vertebral leiomyosarcoma masquerading as a nerve sheath tumour

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SUMMARY

A 47-year-old woman presented with symptoms of low back pain and weakness in bilateral lower limbs. MRI of the spine revealed a mass arising from T11 vertebra involving neural foramina at bilateral T11–12 and right T10–11 levels with extension to the right paravertebral region. Suspecting a nerve sheath tumour, she underwent posterior spinal decompression, stabilisation and debulking, following which her neurological symptoms resolved. Histopathological and immunohistochemical evaluation revealed a leiomyosarcoma. A month later she developed sudden paraparesis and MRI revealed an increase in size of the tumour with cord compression and displacement. She underwent a repeat spinal decompression and debulking procedure after which she received adjuvant radiotherapy via volumetric modulated arc therapy, to a total dose of 45 Gy in 25 fractions over 5 weeks. MRI performed 2 months later revealed complete response and she is disease free for the past 5 months.

BACKGROUND

Leiomyosarcomas are rare tumours, which are challenging to diagnose and treat appropriately. The most common site from which they arise is the corpus uteri. The prognosis of these tumours is poor (cure rate 20–60%) with most metastasising despite aggressive treatment.^{1 2} The spinal column is one such site where they may metastasise and in this situation the management usually consists of spinal stabilisation, palliative radiotherapy and achieving pain control.

On the other hand, a leiomyosarcoma arising de novo from the vertebra is exceedingly rare and so far only nine cases have been reported.^{3 4} Owing to its rarity, its management is not clearly defined and most cases have been managed with surgery and/or radiotherapy. Here, we describe another case of primary vertebral leiomyosarcoma and its successful management, followed by a review of the literature with emphasis on its radiological and immunohistochemical features, along with the treatment approaches used thus far.

CASE PRESENTATION

A 47-year-old woman without any comorbidities presented to her physician with symptoms of progressively worsening low back pain over a period of 3 months. The pain was insidious in onset, moderate in intensity, dull in character, aggravated by standing, partially relieved by rest and without radiation elsewhere. A week prior to presentation, she also developed weakness in bilateral lower limbs.

On examination her motor strength was reduced (2/5 in all muscle groups) in bilateral lower limbs, with consequent loss in her ability to ambulate. This was associated with loss of sensations in bilateral lower limbs as well as brisk knee and ankle reflexes. Babinski sign was positive. The patient was immediately admitted for further evaluation and a diagnostic workup was initiated. At the time of admission, there were no associated bladder or bowel symptoms, but 2 days later she developed retention of urine and complete paraparesis.

She had a significant history of uterine leiomyoma for which she had undergone a simple hysterectomy 4 years ago. Histopathological evaluation of that specimen did not show any evidence of sarcomatous degeneration of the leiomyoma.

The initial workup and management of the patient was undertaken at a different hospital and she was referred to our institution for further management.

INVESTIGATIONS

Routine blood investigations and plain radiography of the spine were normal. A contrast-enhanced MRI of the dorsolumbar spine ([figure 1](#)) revealed a mass lesion involving the posterior half of T11 vertebral body with heterogeneous contrast enhancement, appearing hypointense on T1 sequence and hyperintense on T2 and STIR sequences. The lesion was contiguous with an intensely enhancing extraosseous soft tissue component, measuring 7.2×2.2×1.3 cm (CC×TR×AP) with bilateral (right>left) epidural extension along the anterolateral aspect of the spinal canal and resulting in spinal cord compression at T11 and T12 levels with associated cord oedema at these levels without any evidence of invasion. The extraosseous lesion also involved bilateral T11–12 and right T10–11 neural foramina with associated compression of exiting nerve roots. The soft tissue component extended into the right paravertebral region through the right T10–T11 and the T11–12 neural foramina with widening of the right T11–T12 foramen. The paravertebral component measured 4.1×3.9×2.3 cm (CC×TR×AP) with peripheral enhancement, extension into right paraspinal muscle posteriorly and abutting the right crus of the diaphragm without any obvious involvement.

A whole body ¹⁸fluorodeoxyglucose positron emission tomography-CT (¹⁸FDG PET-CT; [figure 2A, B](#)) was performed to exclude the possibility of this lesion being a metastatic deposit from a primary elsewhere. There was no abnormal FDG uptake anywhere in the body and remarkably, no uptake in the lesion itself.

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Figure 1 Preoperative MRIs. (A and B) Images in T2 sagittal and coronal planes reveal marrow infiltration of T11 vertebra (black arrow). There is an extraosseous extension of the soft tissue mass into epidural (red arrow) and paravertebral space with extension in paraspinous region through right T10–11 and T11–12 neural foramina (blue arrows). Also note involvement of left T11–12 neural foramina (orange arrow). (C and D) Postcontrast images in sagittal and coronal planes reveal moderate-to-intense heterogeneous enhancement of the T11 vertebra (black star) and extraosseous soft tissue component. Epidural component of the soft tissue is compressing the spinal cord (green arrow).

DIFFERENTIAL DIAGNOSIS

A differential diagnosis of a nerve sheath tumour, malignant fibrous histiocytoma or fibroblastic osteosarcoma was considered.

TREATMENT

After initial evaluation, a working diagnosis of nerve sheath tumour was considered and she underwent posterior spinal decompression, stabilisation and debulking. Intraoperative findings revealed a vascular, firm, greyish-red mass which was of neoplastic origin on frozen section. Owing to difficulty in achieving haemostasis, gross total resection could not be performed and priority was placed on relieving cord compression by addressing the epidural component of the mass. Postsurgery her neurological function improved and she was able to ambulate with passive support.

Tumour tissue as well as bone fragments obtained from the surgery revealed a spindle cell neoplasm with moderate atypia, cigar-shaped nuclei, coarse chromatin, moderate amount of eosinophilic cytoplasm, 18–19 mitoses/hpf and <10% tumour necrosis. A diagnosis of primary vertebral leiomyosarcoma, grade 2 was made. Owing to the rarity of this diagnosis, another independent pathological review was performed, which confirmed the initial diagnosis. Additionally, immunohistochemistry (IHC) revealed diffuse positivity for smooth muscle actin (SMA) and desmin in tumour cells, whereas S-100 was negative.

Owing to subtotal resection of tumour tissue, a month later she again developed sudden complete paralysis of bilateral lower limbs. A repeat MRI revealed progressive disease, with an increase in the volume of disease predominantly in the paravertebral region and associated cord compression at T9–T11 levels with displacement to the left. She underwent a repeat tumour debulking with posterior decompression of T9–T10 vertebrae, right T9 pediculectomy and posterior stabilisation of T9–T12 vertebrae.

Figure 2 (A and B) Preoperative CT images from positron emission tomography-CT scan in axial and coronal planes reveals a mixed attenuation soft tissue mass lesion in spinal canal extending into bilateral neural foramina and paraspinal region with widening of neural foramina. (C and D) Postoperative treatment planning CT images in axial and coronal planes shows the clinical target volume (in green contour) and planning target volume (in red contour).

She was then referred to our institution for further management. At this point in time, her motor strength in lower limbs was 2/5 without any bladder or bowel symptoms. The case was discussed in our tumour board and she was planned for adjuvant radiotherapy with curative intent. The technique chosen was volumetric modulated arc therapy (VMAT) to a total dose of 45 Gray (Gy) in 25 fractions over 5 weeks.

Briefly, presurgery MRI and PET-CT images were rigidly registered to the simulation CT (with slice thickness of 2 mm, after immobilising the patient in the supine position, using a thermoplastic cast) and the extent of disease was contoured as gross tumour volume (GTV_{presurgery}). Next, postsurgery MRI was rigidly registered to the simulation CT and the extent of disease was again contoured as GTV_{postsurgery}. Both volumes were then combined and incorporated into the clinical target volume (CTV), which also included the T9–L1 vertebrae, and respective tissue boundaries (figure 2C, D). We also incorporated the entire postoperative bed into the CTV. A planning target volume margin of 5 mm was chosen as per institutional protocols. The high-density implant and image artefacts secondary to it were also contoured separately to allow inhomogeneity corrections to be applied. Though it would have been simpler to treat this patient with anteroposterior radiation fields, this would have led to a higher dose to the right kidney and hence VMAT was chosen (figure 3). Another consideration in choosing VMAT was to reduce treatment delivery time so as to minimise patient discomfort. Daily imaging verification prior to delivery (via either kV orthogonal planar imaging or cone beam CT) was performed to ensure accurate delivery.

Contouring and planning was performed on Eclipse V13.5 (Varian Medical Systems, Palo Alto, California, USA) using the Acuros XB dose calculation algorithm (Varian Medical Systems, Palo Alto, California, USA) and treatment was delivered on Varian TrueBeam V2.0 (Varian Medical Systems, Palo Alto, California, USA).

OUTCOME AND FOLLOW-UP

The patient completed treatment without experiencing any significant toxicity. On a follow-up MRI performed 2 months after

Figure 3 (A and B) Dose colour wash in axial and coronal planes with lower limit set to 95% of prescription dose. Only the superomedial region of the right kidney was enveloped at this dose level (black arrows). (C) Cumulative dose–volume histograms (DVH) of selected structures. 99.9% of the planning target volume (red line) received at least 95% of the prescribed dose. DVH of combined kidney volume (dotted yellow line), the right kidney (cyan arrow) and left kidney (white arrow). The mean dose (D_{mean} ; not shown here) of the combined kidney volume was 12.01 Gy, whereas the right and left kidney received a D_{mean} of 12.6 and 11.3 Gy, respectively.

completion of radiotherapy, there was no evidence of residual disease. At the time of her last follow-up visit, the patient is able to ambulate with passive support, her motor strength in lower limbs is 4/5 and she has been disease free for 5 months.

DISCUSSION

Leiomyosarcomas are a rare group of tumours arising from smooth muscle cells and most commonly occur in the uterus or gastrointestinal tract.⁵ They can be classified into three categories depending on site of origin: (1) intraperitoneal or retroperitoneal smooth muscle cells; (2) intracutaneous or subcutaneous smooth muscle cells; (c) vascular smooth muscle cells.⁶ Those arising in the retroperitoneum (predominantly uterus) are the most common, whereas those arising in the intracutaneous or subcutaneous smooth muscle cells are rarer and occur most commonly in the thigh. Leiomyosarcomas arising from the vascular smooth muscle are the rarest and can occur anywhere in the body. Superficially located tumours usually have a better prognosis than deep seated or retroperitoneal tumours owing to the ease of complete surgical removal with negative margins.⁷ Other prognostic factors are grade and tumour necrosis.⁸

Primary leiomyosarcoma arising from the bone are quite rare (0.1% of all pathologically proven primary bone tumours) and occur most commonly in long bones, whereas those arising from the vertebrae are even rarer.^{9–11} The putative cell of origin for primary leiomyosarcoma of the vertebra appears to be smooth muscle found in the intima of blood vessels of bone, dura or subarachnoid space but other possibilities include a multipotent mesenchymal stem cell or an intermediate cellular form (eg, myofibroblast) capable of smooth muscle differentiation.^{10 12–16}

A review of all cases of primary vertebral leiomyosarcoma is presented in [table 1](#). A single case was reported in a patient with

acquired immunodeficiency syndrome, 8 years postdiagnosis.¹⁷ A single case was reported as postradiation leiomyosarcoma, occurring 17 years after receiving 30 Gy to the lumbar vertebra for metastatic mediastinal seminoma.¹⁰ Leiomyosarcoma of osseous origin may also arise after treatment of haematogenous malignancies with chemotherapy alone.¹⁰ Other associations are with hereditary retinoblastoma and Paget's disease.^{10 16 18}

Radiological findings of vertebral LMS in the preceding nine cases are also presented in [table 1](#). Based on these reports, CT findings usually show an ill-defined lytic or permeative mass with varying amounts of bone destruction. On MRI, they appear isointense to hyperintense on T1 sequence and hypointense to hyperintense on T2, with homogeneous or heterogeneous contrast enhancement. However, these findings are non-specific and include many differential diagnoses.

A definite diagnosis can be reached only by histopathological evaluation and IHC analysis, which often reveals diffuse SMA positivity. All eight cases that used IHC reported this marker positive, followed by vimentin (6/8 cases) and desmin (4/8 cases).

In our case, even though histopathology of the hysterectomy specimen was unremarkable except for the presence of leiomyoma, it has been argued that sarcomatous degeneration in the leiomyoma may be missed due to limitations of histomorphological sampling and the sheer volume of leiomyomas diagnosed in routine clinical practice.¹³ A possibility also exists of the uterine leiomyoma metastasising (most frequently) to the lungs, the so-called 'benign metastasising leiomyomas' of which 54 cases have been reported so far.^{24–26} Only one of these cases was a low-grade leiomyosarcoma arising 15 years after hysterectomy.²⁶ Nevertheless, in our case the tumour was high grade, had a high mitotic index, showed aggressive clinical behaviour and was not located in the lungs, which supports its de novo origin from the spine.

The imaging features of our case also differed from those previously reported in that the lesion did not show a lytic pattern of bone destruction on plain radiography or CT. Another feature was the absence of FDG uptake in the lesion. While the lack of FDG avidity could represent a false-negative imaging result, absence of a lytic pattern of destruction is a variation that has not yet been observed.

A previously reported patient had developed a recurrence at the site of surgery, likely due to seeding at the time of initial surgery.²⁰ This prompted us to include the entire postoperative bed during radiotherapy planning. Another decision we took in the management of our patient was to limit the dose to 45 Gy, which is different from Tahara *et al*,⁴ who prescribed 70 Gy. Though they also used intensity-modulated radiotherapy, it would be difficult to limit the dose received by the spinal cord to <50 Gy, which is the threshold above which radiation myelopathy would ensue.²⁷ Nevertheless, due to limited cases, the role of adjuvant radiotherapy after surgical resection remains unclear.

The role of chemotherapy is also unclear and there are very few agents with significant activity against LMS of uterine origin.²⁸ Whether chemotherapy could have an impact in vertebral LMS is unknown at this time.

In conclusion, primary vertebral LMS is an extremely rare condition and patients should be managed with upfront maximal safe resection. Adjuvant radiotherapy should be considered for situations where the tumour excision is incomplete and should be limited to 45–50 Gy using standard fractionation.

Table 1 Clinicopathological characteristics of patients with primary vertebral leiomyosarcoma

	Author, year of publication	Age/sex/presenting symptom	Location	IHC markers	Findings on CT	Findings on MRI	Treatment	Follow-up
1	Lo <i>et al</i> , 1995 ¹⁹	39/M/loss of sensation over lower half of body	T8 vertebra	SMA, vimentin	Narrowed spinal canal, compressed spinal cord	Intermediate signal on T1 and high signal on T2 with expansion of the posterior vertebral elements and cortical disruption into the spinal canal	Embolisation, subtotal resection followed by spondylodesis and osteosynthesis	NED
2	Antonescu <i>et al</i> , 1997 ¹⁰	36/M/pain	L2 vertebra	SMA, vimentin	NR	NR	Resection followed by adjuvant RT to 45 Gy	Died of metastatic disease at 6 months
3	Ritter <i>et al</i> , 2000 ¹⁷	35/F/bilateral lower limb weakness	T3–4 vertebrae	SMA, desmin, EBNA2	ND	Isointense on T1 with heterogeneous contrast enhancement and expansion of the vertebral body, lamina and pedicle	Gross total resection followed by adjuvant RT (dose not reported)	NR
4	Ochiai <i>et al</i> , 2000 ²⁰	69/M/neck pain and numbness in bilateral upper limbs	C7 vertebra	SMA, vimentin, desmin	Compression fracture of C7 with narrowing of C7-T1 neural foramen	Compression fracture of C7 vertebral body, hypointense on T1 and T2 with contrast enhancement at margin of crushed vertebral body	Open biopsy followed by RT to 50 Gy. Subsequently progressive disease detected in T3–4 vertebra treated by RT. Recurrence detected at site of initial biopsy, treated by resection	Died of disease (massive pleural effusion) at 6 months
5	Nishida <i>et al</i> , 2002 ²¹	47/F/low back pain	L2 vertebra	SMA, vimentin, muscle-specific actin (HHF-35)	Ill-margined permeative lesion with destruction of the anterior cortex of L2 vertebral body	Hypointense tumour on T1 and T2 with extension into the prevertebral soft tissue	Neoadjuvant RT (dose not mentioned) followed by total spondylectomy of L2 and osteosynthesis of L1–3	NED at 25 months
6	Krepler <i>et al</i> , 2002 ²²	45/M/NR	T7 vertebra	ND	ND	NR	Total spondylectomy	Died of disease at 24 months
7	Sasaguri <i>et al</i> , 2004 ²³	75/F/lumbago and lower back pain	T12 vertebra	SMA, vimentin, muscle-specific actin (HHF-35), desmin	Compression fracture of T12 with anterior wedge formation	Isointense retropulsed mass lesion with irregular enhancement and canal stenosis	Subtotal resection of tumour	NED at 4 months
8	Potsi <i>et al</i> , 2012 ³	57/F/lower back pain with bilateral lower limb weakness	T11 vertebra	SMA, vimentin	Ill-defined lytic mass involving the T11 vertebral body, left pedicle and lateral recess with destruction of cancellus and cortical bone. Infiltration of posterior cortex of vertebral body with infiltration of left neural foramen and spinal cord compression	Isointense mass on T1 and T2 with diffuse infiltration of collapsed vertebral body along with invasion of the paravertebral soft tissue	2 stage spondylectomy and fixation with subtotal resection of tumour	NED at 6 months
9	Tahara <i>et al</i> , 2016 ⁴	61/F/back pain	T9 vertebra	SMA, desmin, h-caldesmon, calponin and oestrogen receptor	Ill-defined lytic mass involving T9 vertebra with heterogeneous contrast enhancement and extension to the posterior elements, right ninth rib and paravertebral region	Hypointense on T1 and T2 with homogeneous contrast enhancement and extension to the epidural space leading to spinal cord compression	Preoperative embolisation followed by partial surgical resection of the tumour and adjuvant RT to 70 Gy	NED at 6 months
10	Present case	47/F/low back pain and bilateral lower limb weakness	T11 vertebra	SMA, desmin	Right-sided paravertebral mass at T10–12 level with contagious extension through T11–12 neural foramen into the spinal canal with destruction of the T12 pedicle	Hypointense on T1 and hyperintense on T2 with heterogeneous contrast enhancement and significant epidural component compressing the spinal cord. Contiguous extension to paravertebral space through right T10–11, T11–12 foramina (with widening) and encasement of exiting nerve roots	Partial surgical resection. Subsequently, progressive disease, treated with debulking and adjuvant RT to 45 Gy	NED at 5 months

F, female; IHC, immunohistochemistry; M, male; NED, no evidence of disease; ND, not done; NR, not reported; SMA, smooth muscle actin; RT, radiotherapy.

Learning points

- ▶ Primary vertebral LMS is a rare tumour and should be kept as one of the rare differential diagnosis of a localised mass lesion involving the vertebra.
- ▶ Owing to the rarity of this tumour and non-specific radiological signs, an accurate diagnosis requires histopathological and immunohistochemical characterisation.
- ▶ The primary approach should be surgical with an aim to achieve complete tumour resection with negative margins or maximal safe resection.
- ▶ Complete resection may not be possible at vertebral site, so adjuvant radiotherapy should be considered within 4 weeks. The role of adjuvant chemotherapy is doubtful.
- ▶ Owing to aggressive nature of leiomyosarcoma and the potential for seeding at time of surgery, radiotherapy planning should incorporate the whole postoperative tumour bed.

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REFERENCES

- Major FJ, Blessing JA, Silverberg SG, *et al.* Prognostic factors in early-stage uterine sarcoma. A gynecologic oncology group study. *Cancer* 1993;71:1702–9.
- Nordal RR, Kristensen GB, Kaern J, *et al.* The prognostic significance of stage, tumor size, cellular atypia and DNA ploidy in uterine leiomyosarcoma. *Acta Oncol* 1995;34:797–802.
- Potsi M, Stavrinou P, Patsinakidis N, *et al.* Primary osseous leiomyosarcoma of the spine: a rare entity-case report and review of the literature. *J Neurol Surg A Cent Eur Neurosurg* 2012;73:238–42.
- Tahara K, Yamashita K, Hiwatashi A, *et al.* MR imaging findings of a leiomyosarcoma of the thoracic spine: a case report. *Clin Neuroradiol* 2016;26:229–33.
- Spiro RH, Koss LG. Myosarcoma of the uterus. A clinicopathological study. *Cancer* 1965;18:571–88.
- Enzinger FM, Weiss SW. Leiomyosarcoma. In: Enzinger FM, Weiss SW, eds. *Soft tissue tumors*. 3rd edn. St Louis: Mosby, 1995:713–25.
- Hashimoto H, Daimaru Y, Tsuneyoshi M, *et al.* Leiomyosarcoma of the external soft tissues. A clinicopathologic, immunohistochemical, and electron microscopic study. *Cancer* 1986;57:2077–88.
- Hashimoto H, Daimaru Y, Takeshita S, *et al.* Prognostic significance of histologic parameters of soft tissue sarcomas. *Cancer* 1992;70:2816–22.
- Mirra JM. Primary leiomyosarcoma. In: Mirra JM, ed. *Bone tumors: clinical, radiologic and pathologic correlations*. Philadelphia: Lea and Febiger, 1989:874–86.
- Antonescu CR, Erlandson RA, Huvos AG. Primary leiomyosarcoma: a clinicopathologic, immunohistochemical, and ultrastructural study of 33 Patients and a literature review. *Am J Surg Pathol* 1997;21:1282–94.
- Fornasier VL, Paley D. Leiomyosarcoma in bone: primary or secondary? A case report and review of the literature. *Skeletal Radiol* 1983;10:147–53.
- Kroe DJ, Hudgins WR, Simmons JC, *et al.* Primary intrasellar leiomyoma. Case report. *J Neurosurg* 1968;29:189–91.
- Shapiro S. Myelopathy secondary to leiomyosarcoma of the spine. Case report. *Spine* 1992;17:249–51.
- Varela-Duran J, Oliva H, Rosai J. Vascular leiomyosarcoma. The malignant counterpart of vascular leiomyoma. *Cancer* 1979;44:1684–91.
- von Hochstetter AR, Eberle H, Rüttner JR. Primary leiomyosarcoma of extragnathic bones. Case report and review of literature. *Cancer* 1984;53:2194–200.
- Young MP, Freemont AJ. Primary leiomyosarcoma of bone. *Histopathology* 1991;19:257–62.
- Ritter AM, Amaker BH, Graham RS, *et al.* Central nervous system leiomyosarcoma in patients with acquired immunodeficiency syndrome. Report of two cases. *J Neurosurg* 2000;92:688–92.
- Guse TR, Weis LD. Leiomyosarcoma of the femur in a patient with a history of retinoblastoma. A case report. *J Bone Joint Surg Am* 1994;76:904–6.
- Lo TH, Van Rooij WJ, Teepen JL, *et al.* Primary leiomyosarcoma of the spine. *Neuroradiology* 1995;37:465–7.
- Ochiai H, Yamakawa Y, Fukushima T, *et al.* Primary leiomyosarcoma of the cervical spine causing spontaneous compression fracture: report of an autopsy case. *Neuropathology* 2000;20:60–4.
- Nishida J, Kato S, Shiraishi H, *et al.* Leiomyosarcoma of the lumbar spine: case report. *Spine* 2002;27:E42–6.
- Krepler P, Windhager R, Bretschneider W, *et al.* Total vertebrectomy for primary malignant tumours of the spine. *J Bone Joint Surg Br* 2002;84:712–15.
- Sasaguri T, Tanimoto A, Kimura S, *et al.* Primary leiomyosarcoma of the vertebra: case report and review of the literature. *Pathol Int* 2004;54:73–6.
- Abell MR, Littler ER. Benign metastasizing uterine leiomyoma. Multiple lymph nodal metastases. *Cancer* 1975;36:2206–13.
- Esteban JM, Allen WM, Schaerf RH. Benign metastasizing leiomyoma of the uterus: histologic and immunohistochemical characterization of primary and metastatic lesions. *Arch Pathol Lab Med* 1999;123:960–2.
- Kadry M, Sievers C, Engelmann C. Pulmonary leiomyomatosis in women after hysterectomy for uterine myoma. Benign metastasizing leiomyoma? *Acta Chir Hung* 1998;38:57–61.
- Kirkpatrick JP, van der Kogel AJ, Schultheiss TE. Radiation dose–volume effects in the spinal cord. *Int J Radiat Oncol Biol Phys* 2010;76:S42–9.
- Hensley ML. Uterine/female genital sarcomas. *Curr Treat Options Oncol* 2000;1:161–8.

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