Chordoma

T. FICHARDT, P. C. DE VILLIERS

SUMMARY

The history, origin, pathology, diagnosis, treatment and prognosis of chordoma involving the axial skeleton are reviewed, and the clinical histories of 3 cases of chordoma are given, noting some remarkable features, along with one case misdiagnosed as chordoma on the radiological appearance of the sacrum and treated as such, which later proved to be a case of multiple myelomatosis.

S. Afr. Med. J., **48**, 383 (1974).

Chordoma is a relatively slow-growing invasive neoplasm which relentlessly destroys and replaces the bone in which it develops, manifesting little disposition to distant spread, but occasionally pursuing a more progressive course producing widespread metastases. It arises from embryonic remnants of the notochord, which undergo neoplastic proliferation and develop most commonly in the axial skeleton at the base of the skull (in the dorsum sellae or clivus), or in the sacrococcygeal region; infrequently in the vertebrae; and rarely extranotochordally.

Therapy by means of surgery and radiotherapy remains disappointing. Theoretically, complete surgical extirpation should be curative but is seldom possible, while chordoma is said to be radioresistant. One is therefore confronted with a choice between two unsatisfactory alternatives. However, there is sufficient evidence that radiotherapy can cause growth restraint and tumour shrinkage, and authorities are agreed that if complete extirpation is impossible, the surgeon should remove as much of the tumour as is possible, at repeated attempts if necessary, and certainly followed by radiotherapy, because such combined therapy is bound to result in relief of pain and may even prolong life expectancy. However, the neoplasm is so seldom encountered that the experience of a single observer is likely to be limited to a few cases.

We have observed significant palliation following combined surgery and radiotherapy for chordoma, although eventually the patients succumb to the disease. Willis[1] states that in 1857 several examples of small gelatinous masses projecting into the cranial cavity from the clivus were described by Luschka,[2] Hasse,[3] Zenker,[4] and Virchow.[5] Virchow regarded these as cartilaginous and because of the vacuolated character of their cells, named them ecchondrosis physaliphora. In 1858 Müller[6] recorded a careful study of the notochord in the developing skull, and expressed the view that the so-called ecchondroses were really derived from notochordal remnants. Fischer and Steiner[7] were the first to call a tumour situated at the base of the skull a malignant chordoma, and Linck[8] recorded a similar tumour projecting into the pharynx. Chordomas in the sacrococcygeal region were first recorded by Feldmann[9] and Mazzia.[10] Soon, however, a number of chordomas were recorded in the literature, and it became evident that sacral chordomas were commoner than cranial chordomas. Chordomas of the vertebral column were then recognised by Chapell[11] and Güthert,[12] but these are extremely rare.

EMBRYOLOGY

The key to the understanding of the nature of chordomas lies in information related to the development of notochordal tissue in the embryo. In Beesley and Johnston's *Manual of Surgical Anatomy*,[13] it is stated that during the second week of intra-uterine life, a longitudinal furrow, termed the neural groove, appears on the dorsal aspect of the embryo. The walls and floor of this groove are formed by a thickening of the surface ectoderm. At a slightly later stage the margins of the groove unite and it becomes converted into the neural tube, which subsequently gives origin to the whole of the nervous system. At first the dorsal part of the neural tube is continuous with the surface ectoderm, but the two soon become separated by mesoderm which grows in from each side. On the ventral aspect of the neural tube lies the notochord or primitive skeletal axis, which is derived from the anterior end of the primitive streak. The mesoderm on each side of the notochord and the neural tube become divided into a series of segments or somites which are separated from one another by intersegmental septa. Portions of the somites grow medially and surround the notochord and the neural tube to form the membranous vertebral column. The membranous column is gradually replaced by cartilage and the notochord now passes along the whole length of the column within the cartilaginous vertebrae and the intervertebral tissue.

At the cranial end of the column, it traverses the body of the axis and passes in the suspensory ligament of the dens to the part of the cartilaginous base of the skull which becomes the basi-occiput and the basisphenoid. From the second month onwards the notochord begins to shrink. The portions of the notochord which become enclosed in the bone finally disappear with the onset of ossification. Between adjacent vertebral bodies, a part persists as the nucleus pulposis of the intervertebral discs. Remnants of notochordal tissue that should have disappeared may persist in certain situations, giving rise to the tumour known as a chordoma. Lichtenstein[14] points

Department of Radiotherapy, H. F. Verwoerd Hospital, and University of Pretoria

T. FICHARDT, M.D., D.SC., M.MED.(RAD.T.), D.M.R.E., F.F.R., *Past Professor and Consultant Radiotherapist*

P. C. DE VILLIERS, M.B. CH.B., M.MED.(RAD.T.), *Senior Lecturer and Consultant Radiotherapist*

Date received: 9 May 1973.

out that the development of the notochord is intimately associated with the development of both ectodermal and mesodermal tissues, which is significantly reflected in the cytology of chordomas. Thus, in any given instance, the tumour may be composed of epithelial-like structures, or, on the other hand, may closely resemble spindle-cell sarcoma, and both types of cell growth may be observed frequently in the same neoplasm. To be sure, the degree of differentiation, the rapidity of growth, and the extent of the neoplasia, are all factors influencing the cytology of any particular chordoma. Thus, at one extreme, one may observe well-differentiated chordomas containing regular cavities lined by cuboidal epithelium, closely resembling the primitive notochordal tube, and at the other, distinctly anaplastic chordomas whose recognition as such may occasion considerable difficulty.

INCIDENCE, SITE, AGE, SEX, AND DURATION

Chordomas are recorded as rare neoplasms. Stewart and Morin[15] found 4 in 350, and Willis[1] 5 in over a 1 000 necropsies in which they were especially looked for. Harvey and Dawson[16] reviewed 240 cases and found a site distribution as follows: cranial 37%, vertebral 12%, and sacrococcygeal 51%. Lichtenstein[14] noted that the sacrococcygeal and basicranial sites account for fully 90% of all reported instances of chordoma. No age is exempt, with the average age differing according to the site of origin; for basicranial tumours it is 35 years, while for sacrococcygeal tumours it is 51 years. Higinbotham *et al.*[17] reviewed 46 cases of chordoma treated at the Memorial Hospital, New York, from 1930 to 1965, which included 30 cases of sacral origin, 10 of vertebral origin, 5 of basisphenoidal and 1 of extranotochordal origin, and found that the ages varied from 2½ to 71 years, with a ratio of males to females of 2 to 1. Mabrey,[18] analysing 150 recorded cases, found delays of 3 years and more from the onset of symptoms to the first treatment. The average duration of life, according to Littman,[19] from first manifestation to final demise, is 4 years. Pearlman and Friedman[20] found that 50% of their series of 15 patients survived longer than 5 years, with no evidence of regrowth of the tumour, and with the patients all asymptomatic.

PATHOLOGY

Willis[1] states that the typical chordoma is a slow-growing, well-defined, lobulated tumour, consisting of a soft gelatinous tissue, often within areas of haemorrhage, cystic degeneration or calcification, and sometimes within areas of more solid white tissue. It invades, distends and destroys the neighbouring bones, and extends into adjacent regions; the nasopharynx or orbits, or into the retroperitoneal tissues, or into the thighs and buttocks. Sacrococcygeal tumours may attain a very large size weighing up to 10 kg or more. The spheno-occipital growths do not attain such a large size; they project either into the pharynx or into the cranial cavity. Microscopically, representative sections of tissue are easy to recognise. The cells are usually aggregated in regular groups, separated by stromal connective tissues or by the mucoid matrix of the tumour itself. The characteristic cytoplasmic and intercellular vacuolation is prominent and vacuolated cells may assume signet-ring forms. In areas of greatest mucus formation, only scattered islets of cells may remain in a sea of mucinous matrix. Multinucleated cells are not uncommon. Mitotic figures are rare. Nuclear vacuolation has been described but is unusual.

METASTASES

Chordomas are said seldom to metastasise, yet metastases have been reported in the regional lymph nodes;[21,22] in the soft tissues of the scapula and buttock;[5] in the liver, lungs and skin;[23] and in many organs.[1] Higinbotham *et al.*[17] state that local recurrences and distal metastases are more common than is generally appreciated. In their series of 46 cases they found distant metastases present in 43%.

SYMPTOMS AND SIGNS

Involvement of the Clivus

The symptoms are variable and one or more of the following may be present: headache, diplopia, paresis of facial and tongue muscles on one side, defects of speech and difficulty in swallowing, a troublesome stiff neck and some loss of balance. The signs are usually the presence of a central pharyngeal mass projecting into the vault of the nasopharynx where it grows to produce nasal obstruction and deafness, paresis of the various muscles of the eyeball, face and tongue, impairment of speech and dysphagia. X-ray films may reveal a lobulated soft tissue mass projecting into the vault of the nasopharynx. There may be erosion of the body of the sphenoid, that is, destruction of the clivus. Inside the skull, there may be involvement of the clinoid processes with enlargement of the dorsum sellae. Tomograms may be necessary to demonstrate such changes. A myelogram may reveal lifting of the dura from the level of the dens to just behind the posterior clinoid processes, demonstrating intracranial and subdural extension of the chordoma.

Involvement of the Sacrococcygeal Region

The symptoms are invariably pain due to pressure from the pelvic mass, with a tendency for the pain to shoot down both legs. The pain may be excruciating at times. As the mass increases in size it may cause dysfunction of the rectum and the bladder with progressive constipation and frequency, sciatica, saddle anaesthesia and sphincter The signs may be a bulging mass projecting inwards and tending to fill the pelvis, or extending outwards to produce an external mass over the sacrum or in one or other buttock. X-ray films may, in the early stage of the disease, merely reveal a suspicious area of ground-glass appearance,

where the trabeculae of the sacrum look as if they have been rubbed out. Later there may be frank destruction of the trabeculae of the sacrum and coccyx, and this may be so extensive that it looks as if the sacrum and coccyx have been surgically removed. A soft tissue mass is generally discernible but there is no periosteal reaction present. Tomograms are of value to define the limits of the lesion.

TREATMENT

The treatment of choice for chordoma is complete surgical extirpation, but since this is seldom feasible, it is important that the surgeon remove as much of the tumour as is possible, followed by postoperative radical radiotherapy by means of supervoltage (1 - 10 MeV, i.e. million-electron-volts) teleroentgen or telecobalt therapy. Although chordoma is reported to be a radioresistant tumour, pre-operative or postoperative radiotherapy, or radiotherapy for the advanced inoperable or recurrent chordoma, should not be withheld on this account, because chordomas are also known to vary in radioresponsiveness, and there is no doubt that in most cases radiotherapy produces not only growth restraint and tumour shrinkage, with resultant relief of pain and discomfort from pressure due to the tumour mass, but also increases life expectancy. No worthwhile cancer chemotherapeutic agent is at present available. MacCarthy *et al.*[24] reported their experience in treating sacrococcygeal chordomas by radical surgery only, and in a preliminary report of their results, they claim encouragement because 7 out of 18 patients are without recurrence 1 - 12 years after treatment.

Higinbotham *et al.*[17] state that the radiotherapist should not be discouraged easily in treating chordoma because the response of the tumour to radiotherapy is often very slow. Time and again there is but minor relief of pain towards the end of treatment and little or no change in tumour dimensions, but in the following month or two the pain disappears completely as tumour regression becomes evident. They found that a tumour dose of 4 000 rads in 20 exposures over 4 weeks with pendulum supervoltage teleroentgen therapy, was generally tolerated very well, while 7 000 rads in 25 exposures over 5 weeks produced acute radiation reactions resulting in troublesome cystitis and proctitis. In an analysis of their 46 patients there were 30 of sacrococcygeal origin of which radiotherapy only was given to 9, surgery only to 8 and combined surgery and radiotherapy to 13. The specific therapy schedules for the remaining 16 patients are not clearly recorded. Their results are summarised in Table I.

Pearlman and Friedman[20] report that the clinical course of their 15 cases of chordoma who underwent radical radiotherapy following biopsy, or incomplete surgical removal, or complete surgical extirpation, was as follows: 7 survived longer than 5 years; 7, including 2 with basisphenoid tumours, did not benefit significantly, the longest survival being 3,5 years. One patient alive with disease is at risk for only 1,5 years.

In an analysis of 113 cases cited in the literature to determine optimum dosage for irradiation of chordoma, Pearlman and Friedman[20] found that tumour doses of less than 4 000 rads in 5 weeks offer little likelihood of tumour restraint, while tumour doses of 8 000 rads in 7 weeks are more likely to be successful. Field sizes are not mentioned. They point out, however, that there are failures in every dose range, and that the risk of radiation injury is very real in the higher dose ranges mentioned. Repeated courses of irradiation increase the risk. When the first adequate course of irradiation fails, it is unlikely that repeated courses will succeed. Table II summarises their results.

TABLE II. ANALYSIS OF THE RESULTS OF 113 CASES OF CHORDOMA CITED IN THE LITERATURE[20]

Tumour dose (rads)	Failure		Significant palliation		Success	
	No.	%	No.	%	No.	%
Up to 4 000	47	85	5	9	3	6
4 001 - 6 000	18	60	6	20	6	20
6 001 - 8 000	8	43	5	31	4	26
Over 8 000	2		1		8	80
Total	75	66	17	15	21	18

A number of authors recommend hemicorporectomy for the appropriate case, that is, where patient and family and medical staff are fully cognizant of all it entails, not only with regard to the magnitude of the procedure itself, but also to the vigorous commitment of all to total physical, mental and economic rehabilitation.[25-28]

TABLE I. CHORDOMA SURVIVAL RATES FOLLOWING TREATMENT AT MEMORIAL HOSPITAL, NEW YORK, 1930 - 1965[17]

Location of chordoma	No. living with disease up to death or last follow-up						Living free of disease			Total
Duration (years)	2,5	5,0	7,5	10	12,5	15	5,0	10	15	
Sacrococcy	5	9	4	5	2	2	—	1	2	30
Sphenoidal	2	2	—	—	—	—	1	—	—	5
Vertebral	5	2	2	—	—	1	—	—	—	10
Scapula	1	—	—	—	—	—	—	—	—	1
Total	13	13	6	5	2	3	1	1	2	46

PROGNOSIS

Willis[1] observes that the ultimate outlook for cases of chordoma is uniformly poor, but many tumours are of slow growth and some patients survive for many years. Stewart and Morin[15] found that the average duration of cranial cases from onset of symptoms was 2,8 years, and of sacral cases 6,4 years. Even when complete removal of the growth appears to have been achieved, the prognosis must be guarded. In Stewart's case recurrence ensued after 5 years of apparent freedom from disease following excision. The total duration of this case from first appearance of the tumour to death was 19 years. Higinbotham *et al.*[17] point out that in these chronic types of cancer, where 5-year survivals are common, even without treatment, it is difficult to express the benefits of treatment in quantitative terms. Little data of the results of radiotherapy have been found in the literature. In a prolonged follow-up of these patients the better quality of survival in treated patients is quite striking when compared to the pain, depression, inability to work, and visceral dysfunction with secondary infection, which are the lot of those untreated or not responding to treatment.

CASE REPORTS

It is impossible to give full descriptions of the case histories of our 4 patients as they are rather extensive; suffice it to state only the cardinal points.

Case 1

A White male journalist, 36 years of age, was referred on 16 August 1963 for radiotherapy, with the diagnosis of a recurrent chordoma of the clivus, and with the following case history.

In August 1958 he developed a 'blocked' nose, nasal discharge and deafness. Examination revealed a posterior nasopharyngeal tumour 3,0 cm in diameter and 2,0 cm in depth, clearly visible on raising the uvula. It was central in position and smooth in outline. There were no palpable glands present in the neck. X-ray films showed no bone erosion at the base of the skull, pituitary fossa or occipital region. A biopsy and histological investigation confirmed the clinical diagnosis of chordoma of the clivus.

On 23 October 1958 the patient was referred for telecobalt therapy at the Meyerstein Institute of Radiotherapy, Middlesex Hospital. He was treated through 2 opposing fields of 50 cm^2 placed on each side of the neck, to a tumour dose of 7 200 rads in 40 exposures over 54 days, from 27 October to 19 December 1958 (excluding Saturdays and Sundays). Towards the end of treatment the patient developed a sore throat, and over Christmas he could only swallow jellies. He was in the habit of examining his own throat regularly, and although his throat remained sore for some time, looking red with streaks of yellow, the tumour disappeared completely. He returned to South Africa in January 1959.

In January 1962, after a 3-year period of good health after the telecobalt therapy, he was shocked to notice a recurrence of the tumour in his throat. There had been no after-effects of the telecobalt therapy, except that the beard on his cheeks at the angles of the jaw did not grow again. He was once again referred to London.

In April 1962 the tumour was operated on and removed from the posterior nasopharynx, from where it had extended into the basi-occiput. The surgeon felt that he had removed the whole tumour, and in view of the previous radical telecobalt therapy, did not refer the patient for a further course. The patient returned to South Africa and remained well for almost a year when in March 1963 the tumour recurred in the nasopharynx. The X-ray films revealed involvement of the whole of the basi-occiput, with penetration through to the brain side of the bone. At this stage we were consulted about telecobalt therapy. In view of the previous telecobalt therapy, we suggested surgical removal of as much of the nasopharyngeal tumour as possible, followed by telecobalt therapy if complete removal was found to be impossible. A large swelling was present below the soft palate extending upwards on the posterior wall of the nasopharynx out of view. There was fasciculation and wasting of the right side of the tongue with deflection to the right on protrusion due to XIIth nerve involvement. A myelogram revealed a lifting of the dura posteriorly from the level of the the dens to just behind the posterior clinoid. The displacement was considerable.

On 20 March 1963 the surgeon operated and approached the tumour through the posterior fossa transdurally on either side. A thorough removal of the tumour was obtained. Sections of the tumour tissue removed showed histologically the presence of chordoma. The patient made an uneventful recovery and was discharged on 1 April

Fig. 1. Chordoma before treatment with telecobalt therapy.

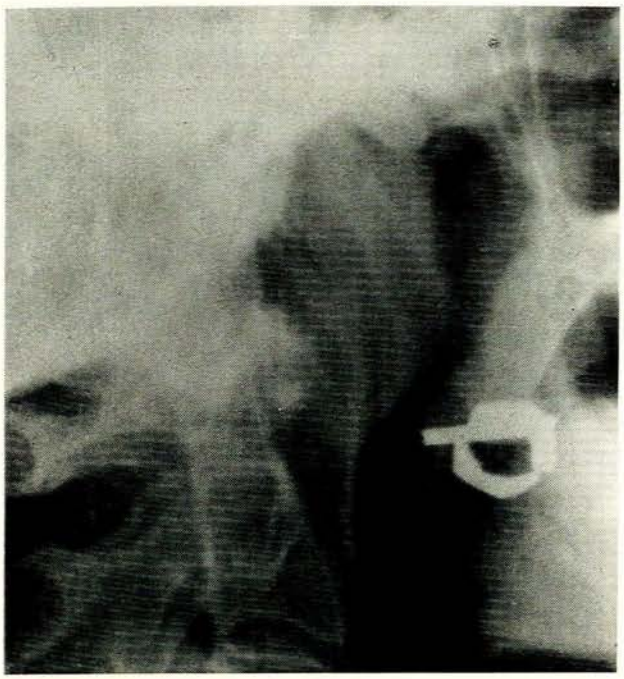

Fig. 2. Chordoma after treatment with telecobalt therapy.

1963. But on 19 April 1963, he was readmitted with headache, nausea and vomiting and a diagnosis of meningitis was made. Cerebrospinal fluid was normal, however, and no bacterial growth could be cultivated. A low-grade staphylococcal infection was assumed and the patient put on Erythrocin every 6 hours. By 4 May 1963 the episode had cleared completely and the patient was discharged. On 17 June 1963 the patient had a similar bout which cleared on antibiotic therapy.

On 26 August 1963 the patient was referred to us with slurred speech, slight deafness and a recurrent soft tissue tumour of rubbery consistency but smooth in outline, about 3,0 cm in diameter, situated centrally in the posterior nasopharynx and bulging forwards onto the soft palate. There were no palpable cervical lymph nodes present. X-ray films revealed a bulging soft tissue mass with erosion of the basi-occiput. There were no lung metastases (Fig. 1). Pendulum telecobalt therapy was planned to pass through an angle of 60° on both sides of the neck. The treatment was administered, through windows of 6 × 6 cm^2 cut on either side of a plaster cast, to a tumour dose of 6 000 rads in 20 exposures over 26 days, at a source-tumour-distance of 60 cm.

The actual telecobalt therapy was administered as planned from 26 August to 19 September 1963 (excluding Saturdays and Sundays), when he developed the maximum clinical reaction that the normal tissues of the throat will tolerate, namely a confluent membranous reaction, and treatment had to be stopped when he had received a tumour dose of 4 683 rads delivered in 16 exposures over 21 days. Ten days later the tumour was much smaller, his speech less slurred and deafness less pronounced. The telecobalt reaction had cleared, and it was decided to give a further tumour dose of 1 100 rads in 4 days to bring the tumour dose up to 5 783 rads. The patient tolerated the further treatment very well (Fig. 2).

The patient was followed up at regular intervals and on 4 February 1964 the nasopharyngeal mass was barely visible, his speech had improved, and he was back to doing a full day's work. But he was beginning to have trouble with double vision. Each eye on its own had excellent vision, but co-ordination was faulty. We did not see him again, but heard that he had had a rather checkered health career, although he carried on with his work almost up to the time when he died of his chordoma in January 1968, almost 10 years after the diagnosis was made. Combined surgery and telecobalt therapy kept the disease under control for many years.

Case 2

A 65-year-old married woman was referred to us for postoperative radiotherapy on 10 December 1970, with the diagnosis of a chordoma of the sacrum with the following history.

On 26 July 1966 an orthopaedic surgeon operated on her for the removal of a chordoma of the sacrum. The diagnosis was histologically verified. During the operation she suffered cardiac arrest, which necessitated an immediate thoracotomy and cardiac massage. The patient recovered most satisfactorily, but owing to the cardiac arrest, removal of the chordoma was incomplete. A cause for concern was that she developed a supraventricular tachycardia and was rather hypotensive. The possibility of a coronary thrombosis or pericardial tamponade was entertained. The electrocardiogram taken was not diagnostic of coronary thrombosis and clinically there were no signs of pericardial tamponade.

Up to November 1967, when there was a recurrence of pain and discomfort in the sacral region, the patient was very well. The clinical history from November onwards is very sketchy, all that could be elicited from the patient was that she was operated upon on 2 occasions, in November 1967 and again in January 1968, and received radiotherapy on 4 occasions, in January 1968 (15 exposures); December 1968 (10 exposures); January 1969 (5 exposures); and in August 1969 (5 exposures).

On 10 December 1970, the patient developed pain in the left buttock and experienced difficulty with defaecation. On 13 January 1971 examination revealed several soft tender tumours of large size in the left gluteus maximus muscle, which were raising the skin. Rectal examination showed a lobulated tumour, bulging into the pelvis from the left side, fixed to the pelvic wall and almost completely closing off the rectum. X-ray films of the pelvis revealed the absence of the sacrum, but the presence of a soft tissue mass on the left side, pressing on the rectum, which is revealed as a thin streak of air to the pubic bone. The full bladder is pushed slightly to the right side. The distal part of rectum and anus are air-filled behind the symphysis pubis. X-ray films of the chest indicated the presence of a large round opacity about 6,0 cm in diameter, at the base of the left lung, resting on the paralysed left leaf of the diaphragm. The opacity had apparently been present and remained static since

the cardiac arrest and was regarded as an encysted and inspissated effusion (Figs 3, 4 and 5).

In view of the favourable appearance of the skin, a radical course of telecobalt therapy on the Theratron 60 unit was planned through two opposing fields 22 × 22 cm^2, one anterior and one posterior directed over the left buttock, and a tumour dose of 2 000 rads in 15 exposures over 21 days at a depth of 11,5 cm was administered from 13 January to 2 February 1971. Towards the end of treatment there was some shrinkage of the tumour masses with some relief of pain. Two months after the patient was seen, although there was considerable improvement, she still did not feel quite comfortable, and while the defaecation was better, she still had the sensation of fullness in the pelvis. The tumour masses once again enlarged, causing considerable discomfort and pain. X-ray films of the chest revealed the presence of numerous small circular metastases clearly visible in the right lung field. A second course of telecobalt therapy was administered to the pelvis—1 000 rads in 5 exposures through a single posterior field 17 × 17 cm^2. This afforded some relief and the same treatment was repeated once more.

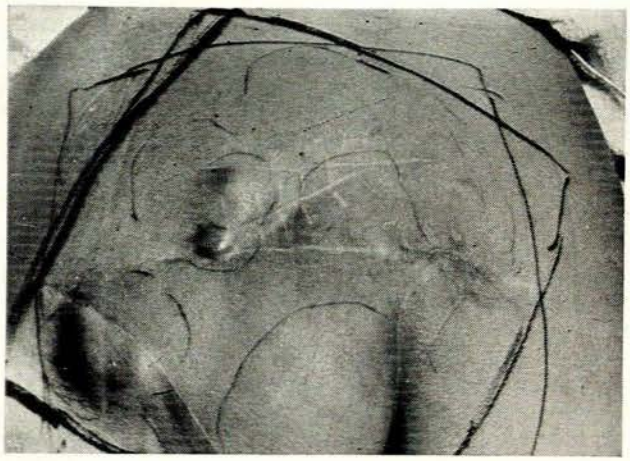

Fig. 3. Nodular masses present above and to the left of the left buttock.

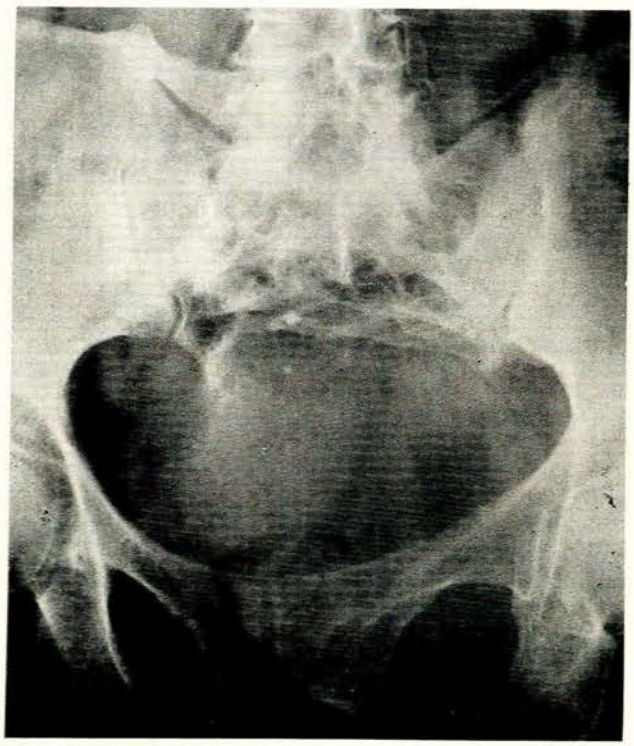

Fig. 4. Pelvis with sacrum and coccyx surgically extirpated, and soft tissue mass in pelvis. At the beginning of radiotherapy, 13 January 1971.

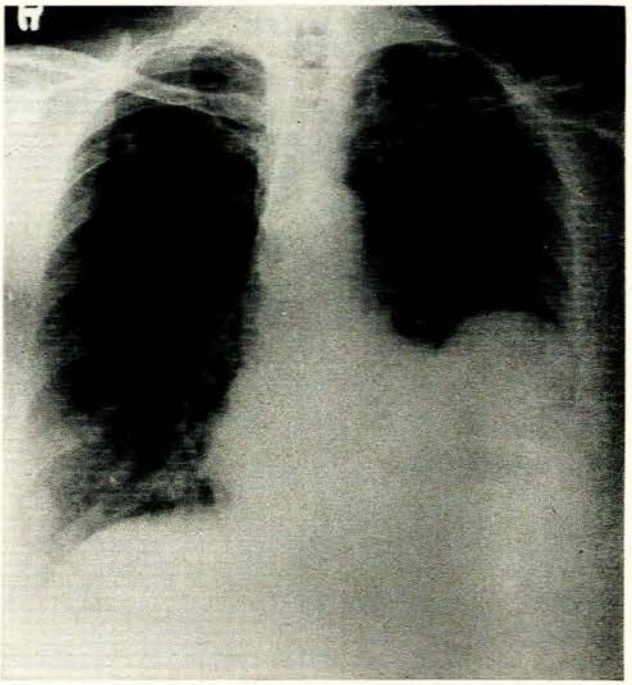

Fig. 5. X-ray film of the chest reveals the large encysted and inspissated mass in the left lung field resting on the raised left leaf of the diaphragm. Metastases are now clearly visible in the right lung field, 4 May 1971.

The patient went to Germany and we did not see her again but heard that she had died on 21 December 1972, after a long period of indifferent health. The course of this patient's chordoma extended over a period of 6,5 years.

Case 3

A Provincial inspector aged 41 years was referred for postoperative radiotherapy for a sacral chordoma (histologically verified but incompletely removed surgically on 13 October 1964).

On 4 November 1964 the patient complained of pain in his 'tail bone'. On examination no obvious lump could be felt externally or per rectum. X-ray films revealed the

right half of the sacrum removed surgically (Fig. 6). Telecobalt therapy on the Gammatron unit was planned

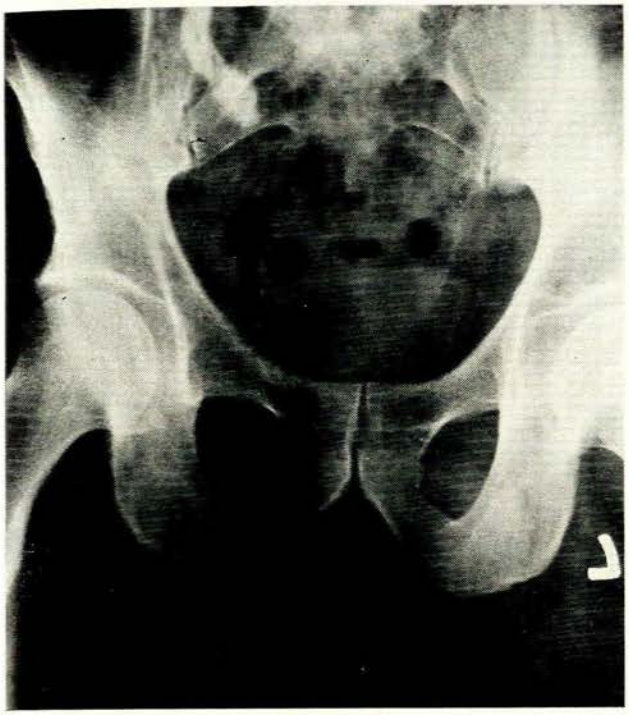

Fig. 6. X-ray film of pelvis showing the right half of the sacrum removed by surgery.

through 3 fields 11 × 9 cm²; one posterior and two anterior, directed at the sacrum, to give a tumour dose of 5 400 rads at a depth of 12 cm with a focal-tumour-distance of 65 cm in 20 exposures over 46 days. There was an interval of 2 weeks due to gastro-enteritis and severe diarrhoea aggravated by the radiotherapy. He developed a left-sided exophthalmos with dilated pupil, and anaesthesia of the skin of the forehead on that side, due to a metastasis at the base of the skull in the region of the pituitary gland.

The pain and discomfort in the sacral region cleared up almost completely but the patient was suffering from severe headaches and his general condition had deteriorated rapidly. We decided to irradiate the brain. A course of telecobalt therapy on the Gammatron unit was planned through 2 opposing lateral fields 7 × 5 cm² directed at the pituitary fossa, to give a tumour dose of 5 800 rads in 20 exposures over 26 days. After the first exposure of 165 rads tumour dose the patient became very ill and he died on the 24 December 1964. From the date of diagnosis to death was 2½ months.

At necropsy the brain showed no obvious abnormality, but in the sella turcica there was infiltration of the left half of the pituitary gland by a metastatic chordoma. The right adrenal was replaced by a metastatic chordoma and weighed 150 g. In the left adrenal there was a metastastic lesion in the medulla, although peripheral cortical tissue was still present. The reticulo-endothelial system showed no obvious abnormality. Obvious tumour tissue was present in the sacrum and a sinus extended from this tumour to the retrovesical pouch. Histological examination of this tumour showed the features of chordoma with large vacuolated mucin-secreting cells.

The case is remarkable for the rapid course of the disease, and the metastases to the pituitary gland and both suprarenal glands from a sacral chordoma.

Case 4

A White diamond-drill operator, 41 years of age, was referred for radiotherapy with a diagnosis of chordoma of the sacrum, and with the following case history.

In December 1969 the patient was manipulated for chronic low backache with considerable relief of pain. In April 1970 he slipped while lifting a stretcher, injured his back, and suffered severe pain which gradually subsided on rest. In May 1970 his back became so painful that he had to seek medical advice, and an X-ray film of the back showed displaced discs between L5-S1 and L4-L5.

On 20 June 1970 a surgeon performed a laminectomy and removed a large protruding disc between L4-L5 and a smaller one between L5-S1, with considerable relief of pain. About 3 months later, after a haemorrhoidectomy, the patient suffered from episodes of low backache and an X-ray film showed a large erosion of the sacrum, and a possible smaller one at the junction of the inferior ramus of the os pubis on the right side and the ischium, suggestive of a chordoma of the sacrum, but myelomatosis and osteolytic metastases were considered.

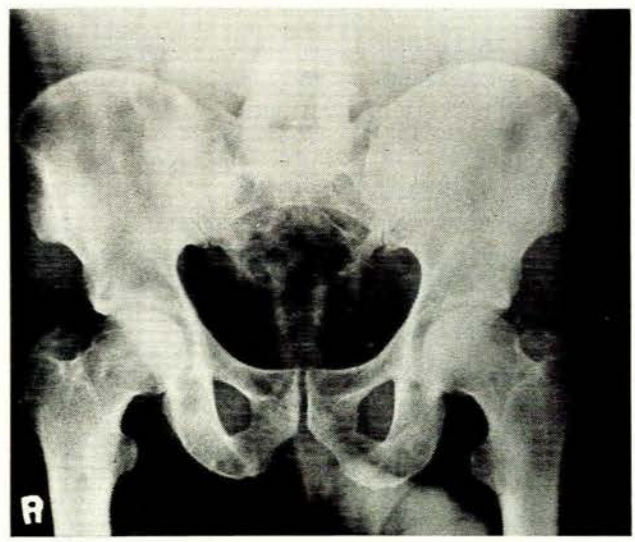

Fig. 7. Chordoma of the sacrum, before treatment, 30 September 1970. Note the extensive erosion of the sacrum including the sacro-iliac joints on either side, which is rather typical of a chordoma of the sacrum. But there is also a smaller erosion of the superior ramus of the os pubis at the junction with the inferior ramus on the right side, which raised the possibility of an X-ray diagnosis of myelomatosis.

On 30 September 1970 the patient complained of severe low backache, and great difficulty in sitting for any length of time. The X-ray film confirmed the diagnosis of chordoma of the sacrum (Fig. 7). We considered having a biopsy of the sacrum done, but decided against it. We proceeded to plan a course of telecobalt therapy on the Theratron 60 unit. A 3-field cross-fire technique was employed, with 1 posterior and 2 anterior fields, each 15,5 × 15,5 cm², directed at the sacrum at a source-tumour-distance of 60 cm to deliver a tumour dose, at a depth of 8,0 cm, of 3 000 rads in 15 exposures over 19 days. The patient was placed on his stomach, with the posterior field falling perpendicular onto the sacrum from above, and the 2 anterior fields angled at 130° on either side from below. The treatment was administered through all 3 fields every day for 5 days a week.

On 18 January 1971 it was noted that the backache had improved and that he was now able to sit with comfort. However, he now complained of pain in the ribs on both sides at about the level of the 6th rib. X-ray films revealed no obvious pathological changes in the ribs. Since the chordoma of the sacrum was showing evidence of healing, the appearance still suggested activity and a further course of telecobalt therapy was decided upon. On this occasion a tumour dose of 2 000 rads, through 1 anterior field 13 × 13 cm² not previously irradiated, was planned and administered in 10 exposures over 12 days.

On 22 March 1971 the patient reported severe pains in the ribs on both sides of the chest. An X-ray film of the chest revealed pathological fractures of the 2nd and 6th ribs on the right side, and the 8th rib on the left side. In view of these findings the diagnosis of multiple myelomatosis became a serious possibility, but all the blood and urine tests were negative. Another course of telecobalt therapy was planned to relieve the pain in the ribs, and, since the sacral lesion was incompletely healed, a third course of telecobalt therapy was given to the sacrum. One posterior field 14 × 8 cm² at the level of T5 and a posterior field 14 × 10 cm² over the sacrum to a dose of 2 000 rads in 10 exposures over 12 days, were delivered.

On 1 April 1971 a bone marrow biopsy was performed. Microscopical examination of a section from the 6th rib showed the presence of tumour tissue, the histological appearances of which were consistent with those of multiple myelomatosis.

On 5 April 1971, the patient was referred for cytostatic therapy which included high daily oral doses of L-phenylalanine mustard (L-PAM) and 6-methylprednisoline. The patient showed a good response to treatment and the L-PAM was reduced to low oral maintenance doses with intermittent 6-methylprednisoline booster courses. In September 1972 X-rays showed progression of his lesions and he was then put on cyclophosphamide (Endoxan), intravenously. He did not show any improvement on this regimen, and developed a pathological fracture of the femur. The fracture was stabilised by means of a Kunschner pin, and he then received a course of intravenous vincristine and bleomycin and high doses of prednisone. His response to this form of treatment was most encouraging, and when last seen on 12 December 1972 he was remarkably fit.

This case is remarkable for the misleading, rather typical X-ray film appearance of a chordoma of the sacrum.

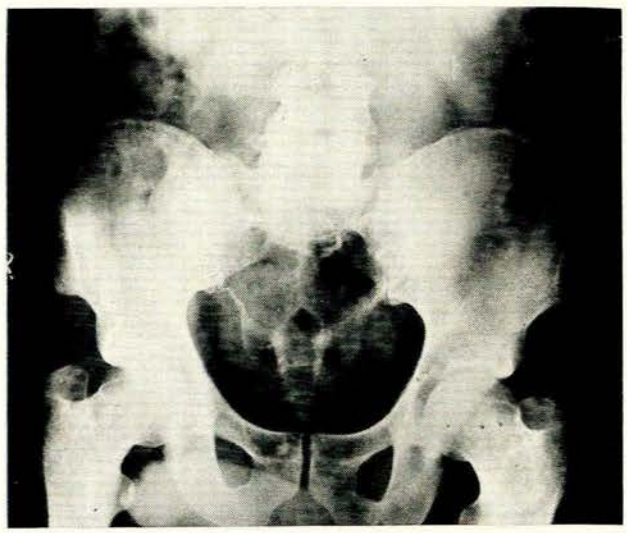

Fig. 8. Chordoma of the sacrum, after treatment, 14 September 1971. Note the erosion of the sacrum has almost completely been replaced by new bone formation and trabeculation.

CONCLUSION

Although chordoma is seldom cured, it is usually slow-growing, enabling the patient to survive for many years with the disease, but generally, in the absence of adequate surgery and/or radical radiotherapy, suffering great discomfort and agonising pain, which at times may be excruciating. The treatment of choice is, therefore, complete surgical extirpation, or failing this, removal of as much of the tumour as possible, followed by postoperative radical radiotherapy, with supervoltage units in both cases, and in all inoperable and recurrent cases, with a repeat course if necessary, especially where there has been a response in the past, in an all-out effort to relieve the patient of any discomfort and pain and to prolong a life worth living.

Professor Fichardt was in receipt of a grant from the National Cancer Association of South Africa.

REFERENCES

1. Willis, R. A. (1960): *Pathology of Tumours*, 3rd ed., p. 922. London: Butterworths.
2. Luschka, H. (1857): Virchows Arch. path. Anat., **11**, 8.
3. Hasse, C. (1857): *Ibid.*, **11**, 395.
4. Zenker, F. A. (1857): *Ibid.*, **12**, 108.
5. Virchow, R. (1857), cited by Stewart, M. J. (1922): J. Path. Bact., **25**, 41.
6. Müller, H. (1858): Z. ration. Med., **2**, 202.
7. Fischer, B. and Steiner, R. (1907): Beitr. path. Anat., **40**, 109.
8. Linck, A. (1909): *Ibid.*, **46**, 573.
9. Feldmann, I. (1910): *Ibid.*, **48**, 630.
10. Mazzia, O. (1910): cited by Stewart, M. J. (1922): J. Path. Bact., **25**, 40.