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Sacrectomy

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OVERVIEW

Sacrectomy is used for the removal of pelvic tumors with sacral attachments or chordoma. It may be a satisfying dissection with clear margins or a difficult procedure with positive margins on nerve roots and considerable residual disability because of loss of nerve supply to anal and urethral sphincters. The tumors that involve the sacrum above the inferior border of the sacroiliac joints may require dissection or sacrifice of the S3, S2, or even S1 nerve roots. Tumors with an anterior component are approached through a combined abdominolateral approach in a lateral position or sequential abdominosacral positions. Tumors with a large posterior component are approached with the patient prone. Tumors may require en-bloc resection of the rectum or anal canal plus rectum. Following division of the origin of the gluteus maximus muscle from the sacral edge, the pudendal nerve must be spared, because it courses posterior to the ischial spine and then on the surface of the obturator internus in the ischiorectal fossa. The dural sac ends at the S2–3 junction. If the dura is entered, it must be meticulously repaired to prevent a CSF leak. The fused sacral laminae are transected proximally with fine rongeurs. Sacral nerve roots are displaced laterally and the dura superiorly. The fused sacral bodies anteriorly may be divided with an osteotome. Closure is over generous closed-suction drainage.

INTRODUCTION

Sacral tumors may present a difficult problem to the surgeon who desires to obtain a clear margin of excision. Frequently, tumors in this anatomic location are of low grade biologically and therefore unlikely to result in metastatic disease; yet they may be locally persistent. The problem of local control may be made worse by tumor spill resulting from biopsy or incomplete excision by an inexperienced surgeon. Often it may be wise to remove a sacral tumor mass intact without previous biopsy in order to prevent tumor spillage into the resection site, particularly if the resection is not considered likely to result in denervation of the sphincters (Figure 27.1).

INDICATIONS

Resections of the sacrum have been performed for several medical conditions. A limited resection of the distal sacrum (S4 and S5 vertebrae) along with the coccyx has been used in providing exposure, through a posterior approach, of the distal rectum for resection of a villous adenoma or a low anterior resection. In the latter situation, a combined abdominosacral approach may be used. With the patient in the right lateral position the abdomen is opened and resection of the appropriate portion of sigmoid and rectum performed. Simultaneously, through a transverse incision over the lower sacrum, the distal portion of this bone and the coccyx are removed, providing the necessary exposure for a very low anastomosis.[1] For extensive local recurrence involving the sacrum for colorectal carcinoma, a supine position has been advocated for an anterior transabdominal dissection initially, followed by placement of the patient in a prone position[2] or a lateral position with the left side down[3] for completion of dissection and removal of the sacrum. This plan, although it requires repositioning of the patient and does not permit the guidance in posterior dissection afforded by a simultaneously open abdominal incision, may be the preferable one if extensive, difficult dissection is anticipated anteriorly.

A primary tumor often involving the sacrum is chordoma.[4,5] Secondary involvement of the sacrum by direct spread is often due to a locally recurrent carcinoma of the rectum.[6,7]

Meticulous bowel preparation is advisable preoperatively along with perioperative antibiotics. The technique of resection is outlined in the figures below.
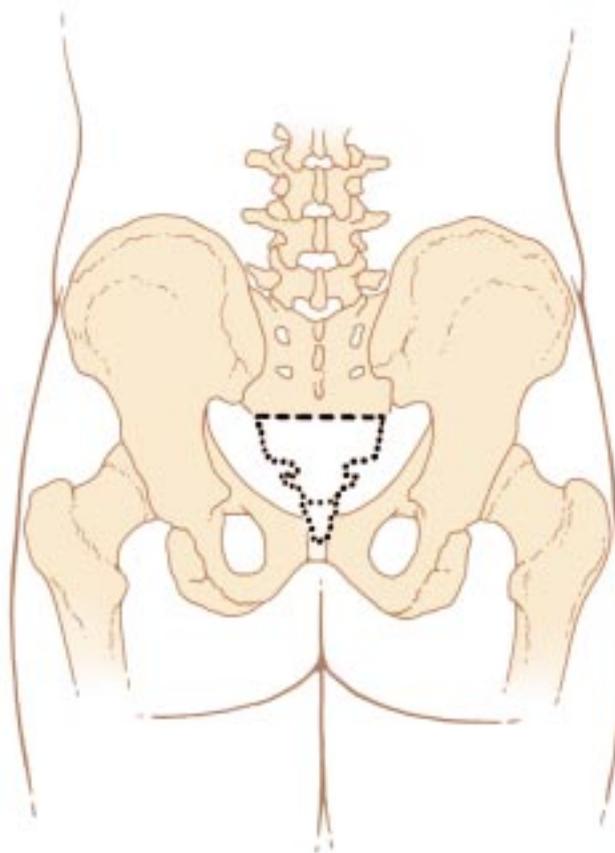

Figure 27.1   The sacrum and the attached tumor mass are removed at the level of the S2–S3 nerve root. The osteotomy is usually just below the sacroiliac joints.

Figure 27.2 Combined abdominolateral sacral position. A combined abdominolateral sacral position is preferred when it is known, or highly suspected, that the rectum is involved, or when previous surgery in this area is expected to have caused dense adhesions between the rectum and the anterior surface of the sacrum. In most of these cases the patient is placed in a lateral position with the left side up, because this makes the mobilization of the rectosigmoid easier. The anterior wall of the abdomen, the left flank, and the sacral area are prepped and draped-in as one continuous field, leaving the iliac crest exposed. The drapes are fixed to the desired position after their placement with skin clips. Posteriorly the entire sacrum is exposed, including the tip of the coccyx, while anteriorly the midline is exposed from above the umbilicus to the pubic symphysis.

If, on the basis of the rectal and/or endoscopic examination, it is known that the rectum is involved, it is usually wise to start with the abdominal portion of the operation. As an abdominal incision one may use an oblique incision extending from the left costal margin to the pubic symphysis, a left paramedian, or a midline can easily be done with some rotation of the table. Not only is the opening and closure more rapid, but also it does not interfere with the construction of the end sigmoid colostomy, which is often needed.

Following disease into the peritoneal cavity, abdominal exploration is carried out to rule out the presence of metastatic disease.

The "white" lines are then incised along the descending and sigmoid colon in order to allow their mobilization. The left ureter is identified and traced down to its insertion to the bladder. The incision in the peritoneum is continued in the retrovesicle or retrouterine area and then to the right of the rectosigmoid. Careful blunt and sharp dissection is now carried out in the presacral space, separating only that portion of rectosigmoid from the upper sacrum that can now be dissected off with minimal effort. Obviously, one should be careful to avoid entering into the tumor as the bowel is separated off the anterior sacral surface. On the other hand it is important, when possible, to free the anterior surface of the first two sacral vertebrae, since their complete resection involves considerable difficulty. The lateral aspects of the rectum are dissected free further down, and the anterior surface is exposed by separating it from the bladder or uterus and upper vagina, to the extent possible through the abdominal approach.

As soon as the decision is made that the rectosigmoid should be resected en-bloc with the sacrum, the bowel mesentery must be divided at the appropriate level. As is true generally of any bowel resection, the peritoneum should be incised first in a radial fashion on either side of the mesentery at the desired level. The adipose tissue is also incised, and the mesenteric arterial and venous branches are exposed. It then becomes obvious how these branches should be divided so that pulsatile blood flow will be present at the end colostomy. The bowel itself is then divided at the midsigmoid portion or distal descending colon as indicated. The distal end is dropped into the pelvis while the proximal end is brought out as an end colostomy.

It is best not to close the abdominal incision at this point lest further dissection be required transabdominally as the sacral resection proceeds. Careful technique should be used to avoid contamination of the incision. The incision over the sacrum is now performed. Flaps, consisting of skin and subcutaneous fat, are developed to the sacral margin, the fibers of the gluteus maximus are divided along the sacral edge, and then the sacrotuberous and sacrospinous ligaments are divided. Following division of the anococcygeal raphe, gentle, blunt finger dissection is performed for a short distance on the anterior surface of the bowel until the level of the transabdominal dissection is reached. Occasionally, in completing the dissection and providing guidance for its safe performance, the simultaneous presence of an operator on the abdominal side is very helpful.

When no part of the rectum can be saved, and an abdominal perineal resection en-bloc with the resection of the sacrum has to be performed, the midline incision over the sacrum is extended inferiorly around and at an appropriate distance from the anal verge. The plane anteriorly between the lower rectum and the prostate or vagina is developed and continued on the sides of the rectum until the level of transabdominal dissection is reached. In this sitution no attempt is made to expose the lower anterior surface of the sacrum.

A

B
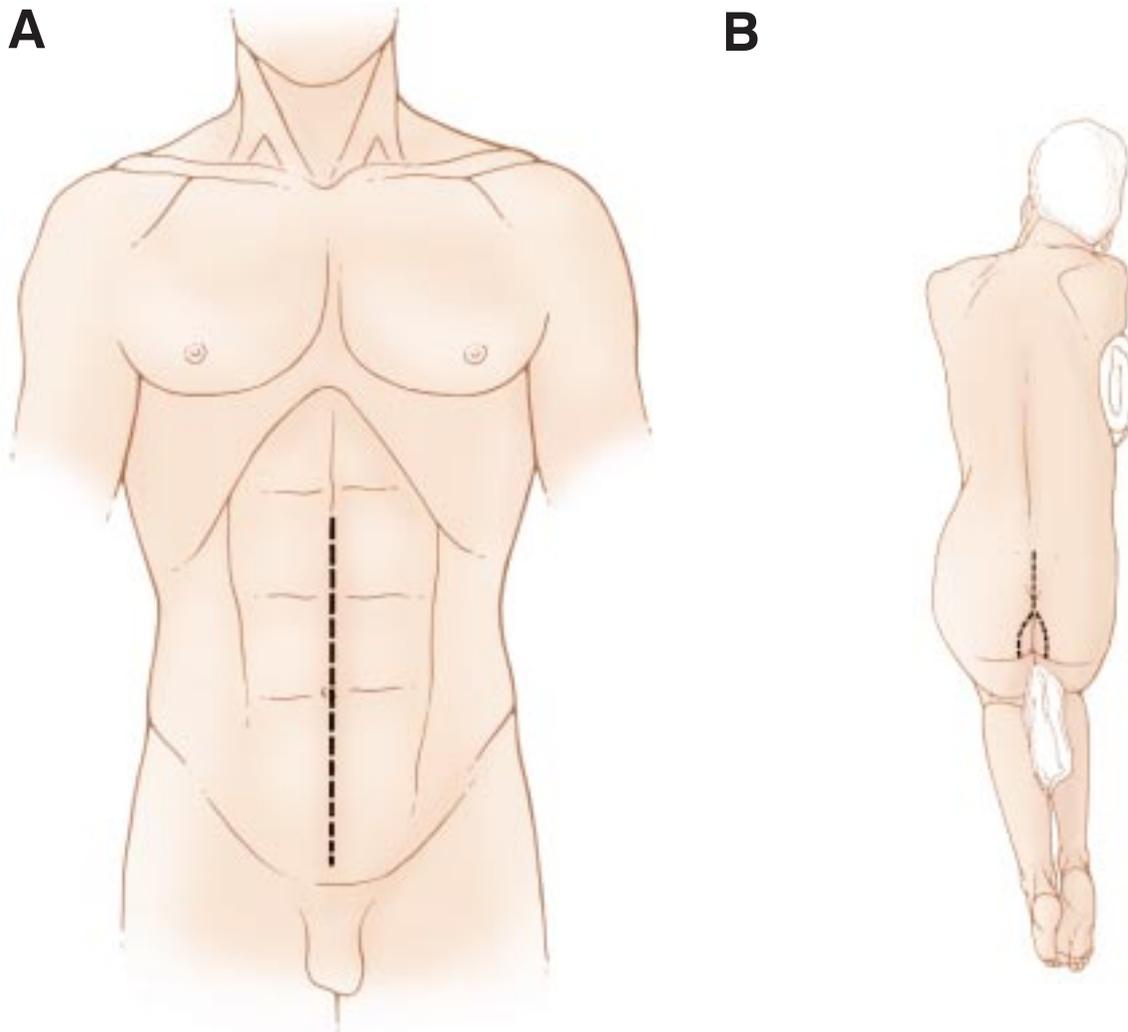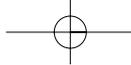
Figure 27.3   Sequential abdominolateral sacral position. Infrequently, wide abdominal dissection may be needed to completely mobilize the intra-abdominal portion of the specimen. If there is extensive visceral tumor involvement or pelvic adhesions, a full midline abdominal incision in a supine position is required. (**A**) After all attachments to the sacral tumor specimen have been divided, the specimen is usually packed into the pelvis and the abdomen is closed. The patient is turned to a full lateral position. (**B**) Usually the left side is up, but this may be revised depending on the soft tissue component of the tumor lateral to the sacrum. Visualization is best on the superior margin of the sacrum as the patient is placed in a lateral position.
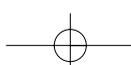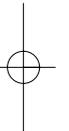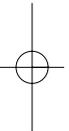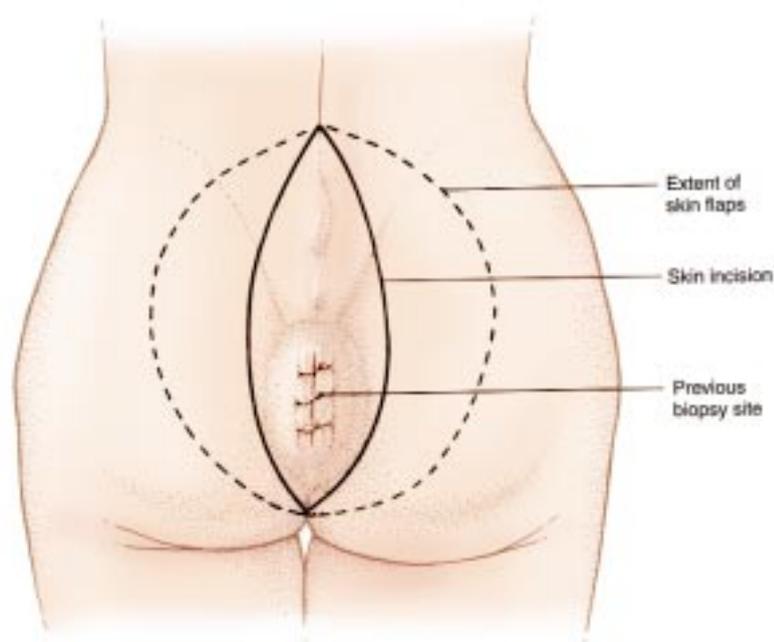
Figure 27.4   Prone position. The prone position is utilized when the tumor mass remains posterior to the rectum and excision of the latter is not required to achieve a tumor-free margin of excision. In the case of a primary tumor of the sacrum, such as a chordoma, when, on rectal and endoscopic examination as well as radiologic evaluation by CT scan, it appears that the rectum is not involved and no prior surgery has been performed that would obliterate the plane between the rectum and the sacrum, it is best to start with the posterior approach. In a substantial portion of patients this will suffice to complete the resection. If the tumor extends into the buttock(s) to a large extent, or is recurrent with multiple deposits, wide exposure of the posterior surface may be needed, and then it is also best to place the patient in a prone position.

A longitudinal incision is performed through the midline. The two ends may curve leftward off the midline or toward the buttock with maximal involvement by tumor. In the presence of a previous biopsy an elliptical incision is made. Curving the two ends of the incision provides greater length and exposure and makes initial development of the flaps easier, especially if tumor extends into the buttock, since the skin in the midline is tethered to the underlying fascia with dense fibrous tissue
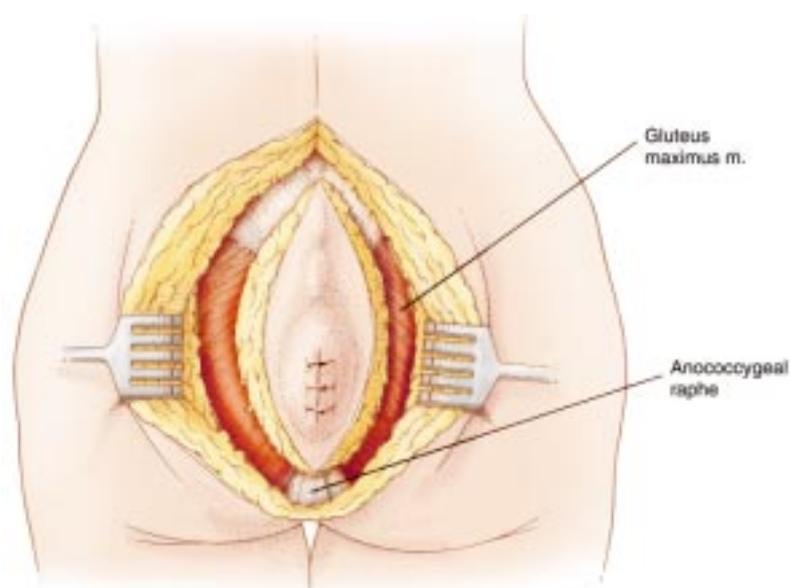

Figure 27.5   Construction of skin flaps. The incision is carried down to the deep fascia and then flaps are raised to the palpable edges of the sacrum or beyond the soft tissue extent of the tumor. The incision stops distally just below the coccyx when it is known that the distal 4–5 cm of the rectum is uninvolved.
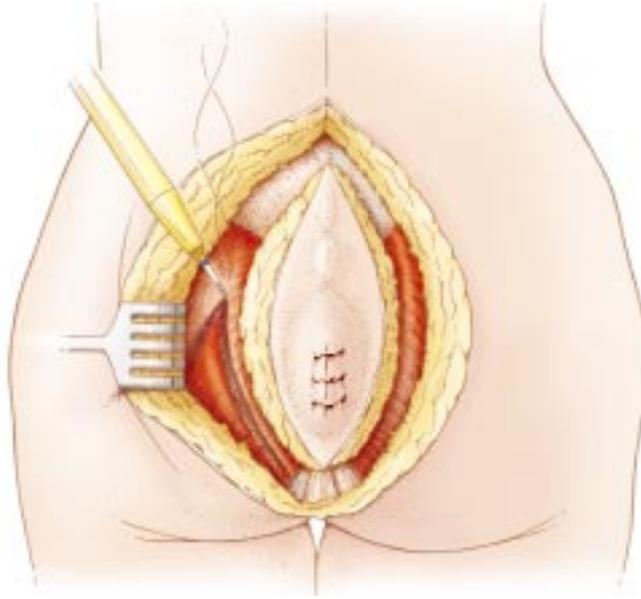
Figure 27.6   Division of gluteus maximus muscles with sparing of sciatic and pudendal nerves. The fibers of the gluteus maximus muscles are divided near their origin from the posterior sacral surface. In the case of a tumor extending beyond the limits of the bone, obviously the dissection is guided by the palpable extent of the tumor.

For large tumors it becomes necessary for a safe resection to expose the sciatic nerves bilaterally, immediately distal to the greater sciatic notch. For such tumors it is also advisable to expose the pudendal nerve, at least one on each side, in the ischiorectal fossa. The anatomic landmark for its identification is the ischial tuberosity. This is easily palpable and is exposed following division of the fibers of gluteus maximus coursing over this bony prominence. The sacrotuberous ligament is divided just medial to the tuberosity, exposing the ischiorectal fossa. The pudendal nerve is found on the lateral wall of this fossa on the surface of the obturator internus muscle. This nerve can be traced proximally as it courses posterior to the sacrospinous ligament, and should be retracted laterally as the latter is divided.
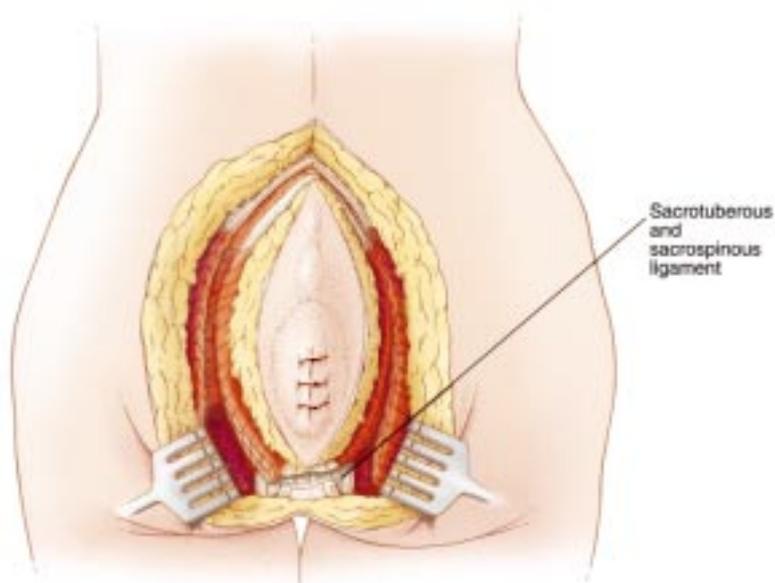

Figure 27.7   Division of the anococcygeal raphe, sacrotuberous, and sacrospinous ligaments. Division of the anococcygeal raphe allows one to enter the presacral space. The dissection along either sacrococcygeal edge is carried out as guided by palpation of the tumor from within the rectum.

After division of the fibers of the gluteus maximus, the thick fibrous bands that constitute the sacrotuberous and sacrospinous ligaments can be palpated. These are divided in order to gain free access to the ischiorectal fossa. On the anterior surface of the sacrum, blunt finger dissection is used to separate sacrum from the posterior rectum.
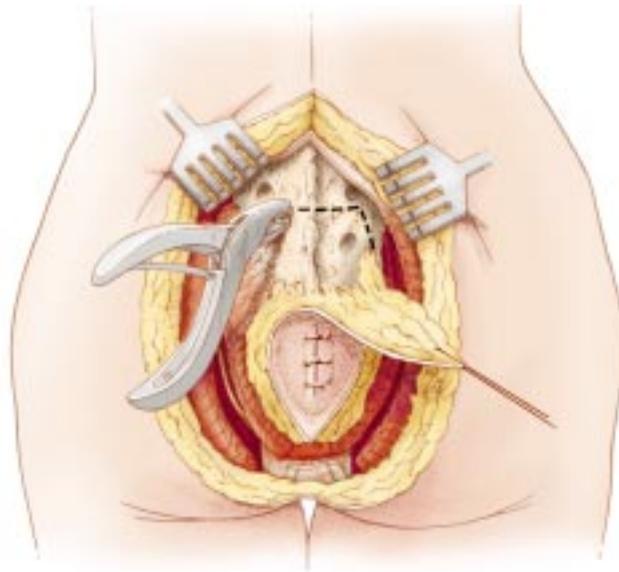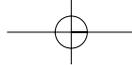
Figure 27.8 Transection of the sacrum. So far the description has covered the dissection around the lower sacrum with preservation of the rectum. What remains is the dissection through the proximal portion of the bone to complete the resection. It is easier to identify and count the sacral foramina on the anterior surface when the latter is not obscured by tumor. On the basis of the preoperative radiologic studies one should know the level at which the sacrum should be transected. The level of division of the sacrum is of critical importance. Division of this bone just below the lower border of S3 vertebra is safe in preserving sphincteric function. Bilateral sacrifice of S2–S4 nerve roots leads to urinary and fecal incontinence, and impotence for males.[8–10] Patients about to undergo high sacral resections should be apprised of this risk, because the need for a clear margin of resection is obvious. The tumor, if not operated, is bound to interfere with these functions and pain and further dissemination of the tumor will occur. Unilateral preservation of S2 root maintains perfect anorectal continence, whereas some authors maintain that when both S2 roots are preserved, sphincter problems are mild and reversible.[11] Apparently early rehabilitative treatment for 1 year after surgery may restore normal bladder function.[12]
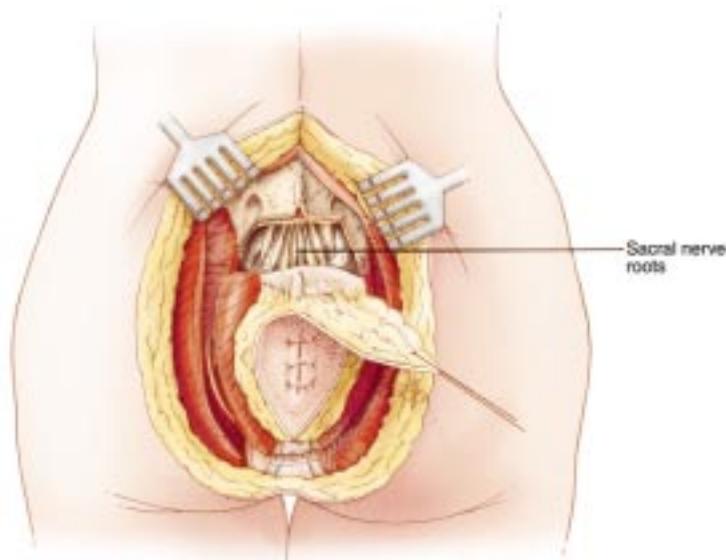

Figure 27.9 Transection of proximal sacrum. If one is able to divide the bone in a straight line, e.g. with a Gigli saw, then one is well below the lower border of S2 vertebrae and generally below the S3 vertebra. The sacroiliac articulation does not allow dissection on the lateral surface of the sacrum, above S-3, unless one uses bone instruments. In order to divide the sacrum through S2 or S1 vertebrae, one has to reach at this level along either lateral side by using bone-cutting instruments and then divide the bone across the midline.

In the past it was taught that division of the sacrum proximally should be carried out with an osteotome. However, this technique does not allow any discrimination of what one is dividing. Often it is a matter of 1–2 mm distance between this plane of division and proximal roots of the pudendal nerve. Furthermore, the distance between this plane reaches the level of S2 vertebra and may be entered when the bone is divided with an osteotome. The result can be a disturbing leakage of CSF fluid in the wound, despite suturing of the dura, and potential infection resulting in meningitis.

Rectum
(posterior wall)
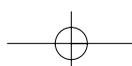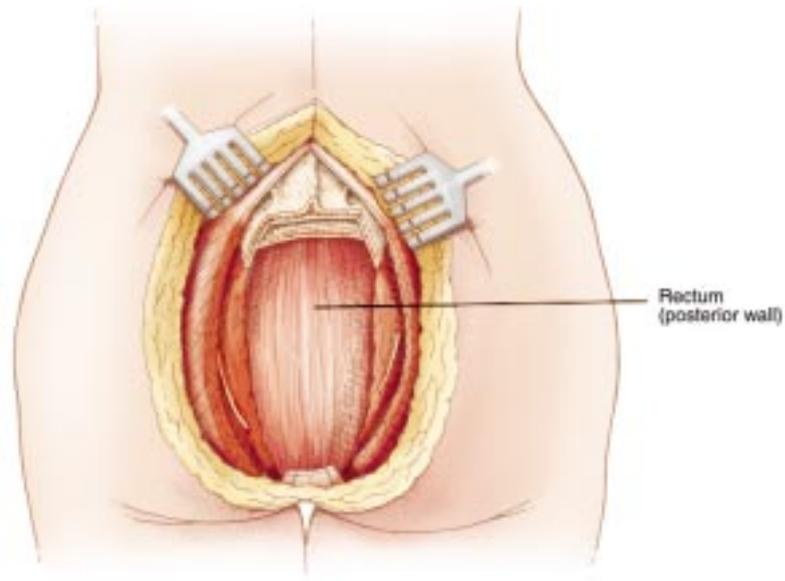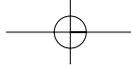
Figure 27.10 Dissecting sacral nerve roots at resection site. A discriminating technique in dividing this bone proximally is the use of fine rongeurs with which the posterior sacral plate is divided at the desired level, and the sacral canal is entered. Nerve roots can then be displaced laterally and the dura superiorly. If one has dissected the pudendal nerve outside the sacrum, one can actually trace its continuity to the S2 root, although the lower roots S3 and S4 may have to be sacrificed. The lower sacral roots may be seen as slender branches issuing from the tumor surface and entering the pudendal nerve. It might thus be possible, if the tumor permits, to salvage the S2 and possibly the S3 roots, unilaterally at least, and their continuation into the pudendal nerve. After the nerve roots have been isolated and preserved, one may then use an osteotome to divide the fused sacral bodies, anteriorly, at this level.
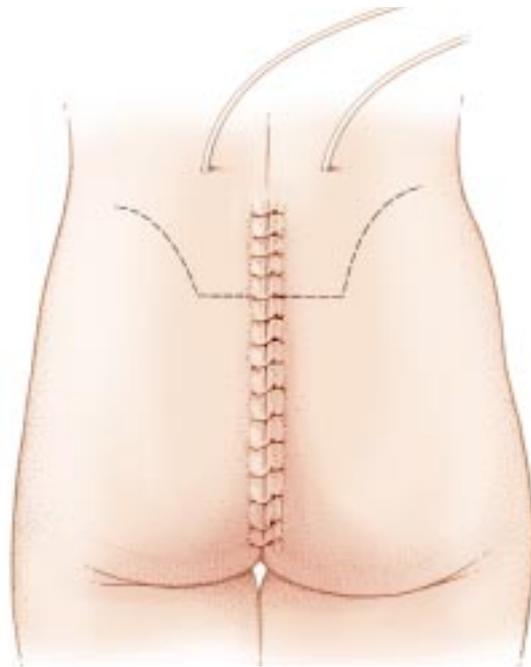

Figure 27.11 Closure. Following removal of the specimen, examination by the pathologist is requested. A frozen section may not be possible if the lesion is confined in the bone, but smears could be obtained from the proximal margins. For interosseous lesions clearly visible on preoperative films, some authors recommend a plain radiograph of the specimen before the incision is closed, in order to assess the margin of resection. The wound is then irrigated and a closed-system drainage with suction is used. The incision is closed in a routine fashion. These wounds have a high rate of wound infection, apparently due to the proximity to the anus.
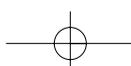
DISCUSSION

Resections of the sacrum are not commonly performed, except in referral centers dealing with these problems. However, given a thorough knowledge of the anatomy of this area and a full knowledge of the principles of dissection, the operation can be performed safely and deliberately. Resections below the body of S3 vertebra do not endanger continence of the anal and bladder functions. Divisions of the bone immediately below or through S2 vertebra or occasionally through S1 are possible and can be done more safely in terms of avoiding nerve root injury or entrance into the subarachnoid space by cutting first through the posterior sacral plate (the fused sacral laminae) with rongeurs. The sacral canal is thus entered, permitting in some patients the identification, dissection, and preservation of nerve roots that are not involved by the tumor (Figure 27.12).

In two of our patients with high transection of the sacrum the dural sac was entered. In the first, as the bone was divided with an osteotome, a large amount of CSF appeared in the wound, the dural sac was sutured after removal of the specimen, and the wound healed without complications, although the patient had sphincter incontinence. She was required to self-catheterize her bladder three or four times daily and, due to collection of feces in the ampulla, she required frequent disimpaction. In the second patient, with chondrosarcoma reaching the level of S1, the tumor was curetted at that level and treated with intraoperative radiation, but no evident CSF leak occurred intra-operatively. However, postoperatively he developed large collections of CSF in the wound, thus requiring repeat aspirations, and developed meningitis, which required several weeks of antibiotic therapy before it resolved.

Tumors extending into S1 vertebra present a special problem. These have been managed by transecting the bone through the middle of S1. After opening the posterior sacral plate, one carefully dissects laterally whatever nerve roots can be preserved. Residual tumor into the proximal half of S1 can be curetted out, and the area of potential microscopic residuum treated later with radiation. A dose of intraoperative radiation may also be given, when available, with the pelvic viscera appropriately shielded. The preliminary evidence from other centers also suggests that this may be helpful.[13]

Complete resection of the sacrum is seldom, if ever, practiced. There is a concern first for the removal of support for the spinal column that the sacrum provides. Experience, with hemicorpectomies, entailing division below the body of L5, however, suggests that removal of the entire sacrum would not be likely to result in "collapse" of the spine, or some other catastrophic occurrence. However, the sciatic nerve comprises L4 through S3 nerve roots. The lumbosacral trunk (L4, L5) courses over the sacral ala, and S1, S2, and S3 roots issue through the upper three anterior sacral foramina. It is therefore clear that a radical resection of the entire sacrum would result, in addition to sphincteric incontinence, in considerable denervation of both lower extremities in the distribution of the sciatic nerves.
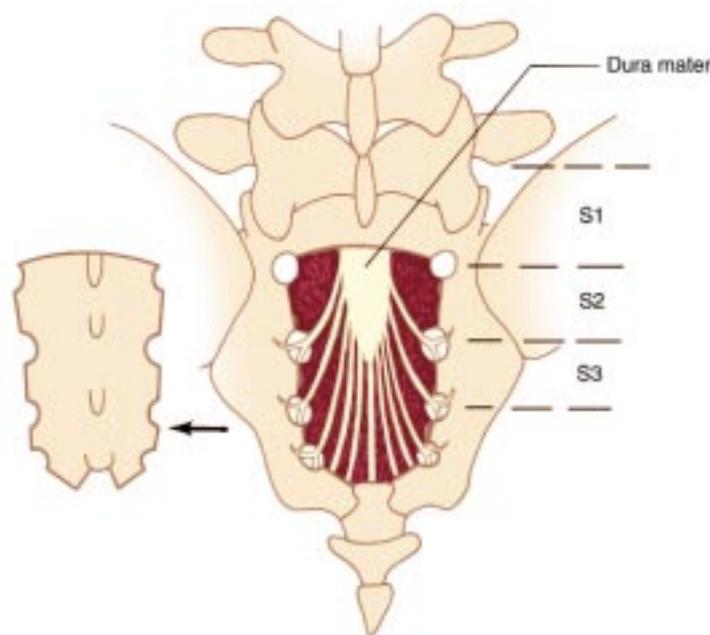

Figure 27.12   Sacral nerve root distribution.

As in other anatomic areas, the cure rate following sacral resection depends on the adequacy of resection, the use of adjuvant modalities, and the biologic nature of the tumor. Local spill of tumor cells with biopsy, or partial resection by an inexperienced surgeon, may severely compromise the opportunity for a complete recovery.[14,15] This is very clear from experience with chordoma excision. For localized tumors, resections of the sacrum, when involved, can be performed safely if certain oncologic principles are followed. Often there is preservation of sphincteric control, and the result is cure or significant palliation.

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