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# Topology of the Fascial Structures in Rectal Surgery: Complete Cancer Resection and the Importance of Avoiding Autonomic Nerve Injury

Yusuke Kinugasa, MD, PhD,* and Kenichi Sugihara, MD, PhD†

**To decrease local recurrence and avoid autonomic nerve injury, mobilization of the rectum is performed by anatomical dissection along the fascial planes. Anterior to the rectum, Denonvilliers' fascia divides into several laminae at both sides and separates the mesorectum from the autonomic nerves. This fascia is better preserved when the tumor is not located on the anterior wall of the rectum. Posterior to the rectum, the prehypogastric nerve fascia covering the hypogastric nerves is evident between the fascia propria of the rectum and the parietal pelvic fascia. The prehypogastric nerve fascia connects to 1 of the lateral laminae of Denonvilliers' fascia. The dissection plane posterior to the rectum is between the fascia propria of the rectum and the prehypogastric nerve fascia. After dissection both anterior and posterior to the rectum, the medial part of the lateral ligament becomes clearly identifiable. The parietal pelvic fascia is located dorsal to the hypogastric nerves and ventral to the pelvic splanchnic nerves. Appropriate selection of dissection planes ensures the complete capture of the mesorectal package and simultaneously reduces the risk of nerve injury.**
**Semin Colon Rectal Surg 21:95-101** 

## Previous Understandings of Fasciae Around the Rectum

### Anterior to the Rectum

#### Origin of Denonvilliers' Fascia

In 1836, Denonvilliers[1] reported this fascia as a prostatoperitoneal membranous layer between the rectum and seminal vesicles. Two theories have been advanced regarding the development of Denonvilliers' fascia. In 1899, Cunéo and Veau[2] suggested that Denonvilliers' fascia developed from fusion of the embryonic peritoneum of the rectovesical cul-de-sac. Elliot Smith[3] supported the peritoneum fusion theory in studies of fetal dissections. In 1945, Tobin and Benjamin[4] concluded that the fascia was derived from the peritoneum based on a histologic study. In 1948, Uhlenhuth et al[5] also presented macroscopic anatomical evidence strongly supporting the peritoneal fusion theory. Recently, van Ophoven and Roth[6] concluded that Denonvilliers' fascia develops from fusion of 2 walls of the embryologic peritoneal cul-de-sac.

However, a different hypothesis exists regarding the development of Denonvilliers' fascia. In 1922 and 1923, Wesson,[7,8] who had provided the first histologic evidence supporting the peritoneal fusion theory, stated the septum was formed by the condensation of loose areolar tissue. In 1956, Silver[9] noted that the septum appears to form simply as a condensation of loose areolar tissue based on histologic examination of 52 embryos and fetuses.

#### Anatomy of Denonvilliers' Fascia

Milley and Nichols[10] disclosed that Denonvilliers' fascia histologically consisted of dense collagen, smooth muscle fibers, and coarse elastic fibers. In 1993, Richardson[11] demonstrated a dense double layer of elastin in the recto-genital septum under electron micrography. Although Denonvilliers' fascia has been suggested to consist of 2 fasciae, van Ophoven and Roth[6] and Bisset et al[12] concluded that the posterior layer of Denonvilliers' fascia actually corresponds to the fascia propria of the rectum. Kourambas et al[13] stated that this fascia had no definite layers and no definable lateral edge that widened and connected with the fascia running lateral to the rectum (pararectal fascia) posteriorly or with the fascia be-

*Colon and Rectal Surgery, Shizuoka Cancer Center Hospital, Shizuoka, Japan.
†Department of Surgical Oncology, Graduate School, Tokyo, Medical and Dental University, Tokyo, Japan.
Address reprint requests to: Yusuke Kinugasa, MD, PhD, Colon and Rectal Surgery, Shizuoka Cancer Center Hospital, 1007 Shimonagakubo, Nagaizumi-cho, Sunto-gun, Shizuoka 411-8777, Japan. E-mail: y.kinugasa@scchr.jp

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tween the levator ani and prostate (lateral pelvic fascia) anteriorly.

In the caudal border of Denonvilliers' fascia, Milley and Nichols[10] stated that this fascia attaches to the rectourethralis muscle, and Silver[9] described Denonvilliers' fascia as continuing to the external longitudinal muscle coat of the rectum. In 1993, Sato[14] demonstrated that the caudal end of Denonvilliers' fascia attached to the perineal body.

In 1980, Goligher[15] described Denonvilliers' fascia as more strongly adherent to the rectum than to the prostate, but Tobin[6] stated that this membrane was located between the loose connective tissue around the rectum and the more dense fibromuscular connective tissue around the prostate and seminal vesicles. Kiyoshima et al[16] also reported that Denonvilliers' fascia adhered tightly to the center of the posterior aspect of the prostatic capsule in 97% of cases. Huland and Noldus[17] described easy separation of Denonvilliers' fascia from the rectum during prostatectomy.

## Posterior to the Rectum

Reliable surgical dissection planes for dissection of posterior and lateral sides of the rectum have been proposed by many surgeons. These may arise from multilaminar fascial structures around the rectum. Surgeons and anatomists commonly recognize a fascia surrounding the mesorectum, but this is variously named the fascia propria of rectum,[12,18,19] the perirectal fascia,[20] the rectal fascia,[21] or the visceral layer of the pelvic fascia.[22-25]

Understandings also differ regarding the fascial constitution between the rectal fascia and sacrum. One interpretation is that no fascia is present between the rectal fascia and the hypogastric nerves (Fig. 1A),[18,22,26] while the other is that a fascia exists ventral to the hypogastric nerves (Fig. 1B).[12,19,20,25] Takahashi et al[23] described the hypogastric nerves as wrapped with the visceral endopelvic fascia (Fig. 1C). While agreeing, in part, Havenga et al[24] and Mutean[21] described the fascial constitution as differing between the upper and lower pelvis (Fig. 1D and E).

In 1974, Crapp and Cuthbertson[27] reported the rectos acral fascia as a constantly situated sheet of fascia running from the periosteum overlying the body of the fourth sacral vertebra to the rectal fascia, 3-5 cm above the anorectal junction. Based on detailed dissections of 45 cadavers, Sato and Sato[28] reported that the rectos acral fascia originated between

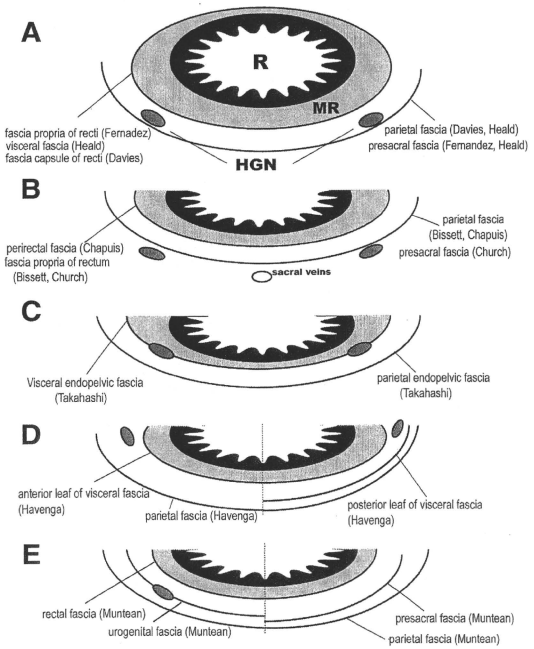


**Figure 1** Previous interpretations of retrorectal fascial structures. (A-E) represent schematic views of previous interpretations of retrorectal fascial structures. (D and E) The right half of the panel represents the superior level, and the left half is the inferior level. R, rectum; MR, mesorectum; HGN, hypogastric nerves.

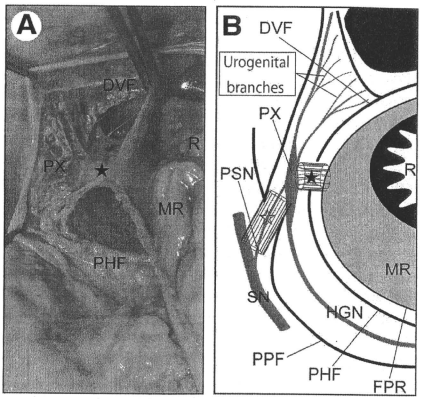


**Figure 2** Lateral ligament of the rectum. (A) is an operative photograph of the left lateral ligament. (B) is a schematic view of the left lateral ligament. The lateral part of the ligament (open star) is beside the pelvic splanchnic nerves, and the medial part (black star) is near the rectal branches of the pelvic plexus. DVF, Denonvilliers' fascia; HGN, hypogastric nerves; MR, mesorectum; PHF, prehypogastric nerve fascia; PPF, parietal pelvic fascia; PSN, pelvic splanchnic nerves; PX, pelvic plexus; R, rectum; SN, sacral nerve.

the third and fourth sacral vertebrae in most cases, but in some cases from any part between the second sacral vertebra and the first coccygeal vertebra. However, Church et al,[19] Havenga et al,[24] and Diop et al[25] described the rectos acral fascia as an adhesion of 2 fasciae existing posterior to the rectum.

### Lateral to the Rectum

In 1949, Goligher[29] described the lateral ligament as an important structure during rectal surgery, and Michels et al[30] confirmed this structure from anatomical dissections in 1963. Sato and Sato[28] described the lateral ligament as a structure between the pelvic side wall and rectum and consisting of 2 segments: a lateral segment of the ligament composed of the pelvic splanchnic nerves and a medial segment constituting the rectal branches of the pelvic plexus and lymphatic vessels.[28] The visceral branches of the pelvic plexus were first reported by Kimmel and McCwea[31] in 1959 (Fig. 2).

Various reports have described relationships of the middle rectal artery to the lateral ligaments. Boxall et al[32] reported that the middle rectal artery does not run in the lateral ligament, while sometimes the accessory middle rectal arteries run in this ligament. Nano et al[33] recently reported that the ligament contains fat tissue, vessels, and nerve filaments, and that the middle rectal artery courses anteriorly and inferiorly in respect to the lateral ligament. In 1997, Rutegard et al[34] reported the lateral ligament as histologically consisting of clear nerves, fat, and fibrous tissue in all 13 specimens they examined, with small blood vessels included in only 2 specimens. Heald et al[35] described none of the lateral ligaments in his paper regarding the surgical procedure for total mesorectal excision, although Moriya et al[36] and Enker[37] stressed the lateral ligament as an important structure during rectal surgery with nerve preservation, the medial segment to be divided during rectal mobilization, while the lateral segment is to be preserved.

## Fascial Structures Around the Rectum

### Fascia Propria of the Rectum

The fascia propria of the rectum is a thin visceral fascia covering the rectum and mesorectum. The mesorectum is a distinct compartment that contains the superior rectal arteries and veins, mesorectal fat, lymphatic vessels, and nodes. This fascia is also called the peri-rectal fascia, rectal fascia, and visceral fascia (Figs. 3 and 4).

### Denonvilliers' Fascia

Denonvilliers' fascia is clearly identifiable between the fascia propria of the rectum and the seminal vesicles or prostate. The recto-vaginal septum in women corresponds to Denonvilliers' fascia. The consistency of Denonvilliers' fascia varies between individuals, from a fragile translucent layer to a tough leathery membrane.[10] The recto-vaginal septum is less prominent in women than Denonvilliers' fascia is in men. The fascia is thicker in younger individuals and thins out

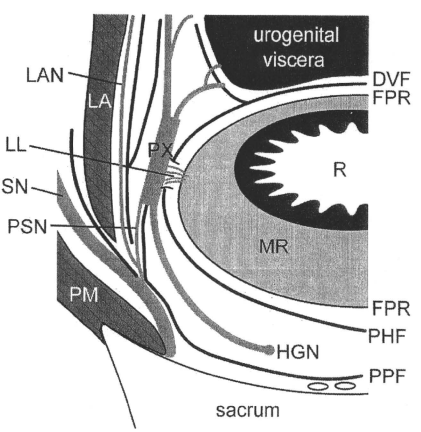


**Figure 3** Schematic representation of fasciae around the rectum (horizontal). DVF, Denonvilliers' fascia; FPR, fascia propria of rectum; HGN, hypogastric nerves; LA, levator ani muscle; LAN, levator ani nerve; LL, lateral ligament; MR, mesorectum; PHF, prehypogastric nerve fascia; PM, piriformis muscle; PPF, parietal pelvic fascia; PSN, pelvic splanchnic nerves; PX, pelvic plexus; R, rectum; SN, sacral nerve.

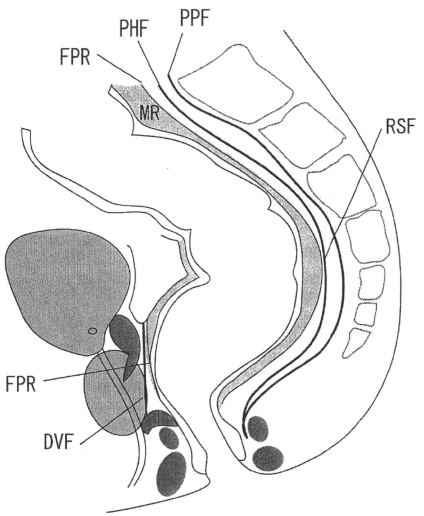


**Figure 4** Schematic representation of fasciae around the rectum (sagittal). DVF, Denonvilliers' fascia; FPR, fascia propria of rectum; MR, mesorectum; PHF, prehypogastric nerve fascia; PPF, parietal pelvic fascia; RSF, rectosacral fascia.

with age and may be more obvious in patients with preoperative radiotherapy to the pelvis or with transmural inflammation of the rectum (ie, Crohn's disease).[19]

Laterally, Denonvilliers' fascia divides into several thin laminae, and 1 of the lateral continuations extends dorsolaterally and separates the mesorectum from the pelvic plexus and urogenital neurovascular bundle.[38] The caudal part of the Denonvilliers' fascia joins the prostate or recto-urethral muscle, and for that reason, is more easily separated from the rectum than from the prostate.

### Prehypogastric Nerve Fascia

The prehypogastric nerve fascia is variously known as the urogenital fascia,[21] hypogastric nerve sheath,[39] or uretero-hypogastric fascia.[40] This fascia is located immediately behind the fascia propria of the rectum, covering the right and left hypogastric nerves[41] and the pelvic plexus, and connecting with the lateral continuations of Denonvilliers' fascia at the level of the pelvic plexus (Fig. 2). The left ureter runs dorsal to the prehypogastric fascia, while the right ureter runs ventral to the fascia.[42]

### Parietal Pelvic Fascia

The parietal layer of the pelvic fascia is located dorsal to the hypogastric nerves and ventral to the sacral veins and iliac vessels and divides into several laminae extending ventrolaterally: (1) the fasciae lining or enclosing the pelvic plexus; (2) the fasciae providing a posterior attachment for the levator ani muscle and lining the medial or superior surface of the muscle sheet; and (3) the fasciae enclosing the pudendal nerve and associated inferior gluteal and internal pudendal vessels.[41] The most medial fascia covers the pelvic splanchnic nerves and fuses with the prehypogastric nerve fascia at the pelvic plexus.

### Rectosacral Fascia

The rectosacral fascia is not a true fascial structure[41] but represents part of any thickened pelvic fascia[19] or adhesion or of connections between the layers of fasciae existing posterior to the rectum: the fascia propria of the rectum; the prehypogastric nerve fascia; or the parietal pelvic fascia.[25] Clinically, however, a band is apparent between the posterior wall of the rectum and the sacrum at 3-5 cm above the anorectal junction, or higher, as described by Havenga et al.[24] One reasons for this finding is that fascia-like structures easily develop or become thickened during dissection or surgery, as noted by Range and Woodburne.[43] This fascia should not be confused with Waldeyer's fascia, which only refers to the most distal portion of the presacral fascia joining the anorectal junction.[19,27]

## Autonomic Nerves

Sympathetic supply to the rectum and upper anal canal originates in the first and second lumbar spinal segments. The fibers are distributed through the inferior mesenteric plexuses via the lumbar splanchnic nerves and through the pelvic plexus via the sacral splanchnic nerves. Parasympathetic nerves are supplied to the rectum through the pelvic plexus via the pelvic splanchnic nerves.[44]

The pelvic urogenital autonomic nerve system is present immediately outside the rectum. Nerve-sparing surgery aims to preserve several major nerve structures in the pelvis, including peripheral nerve bundles, such as the hypogastric nerves, pelvic splanchnic nerves, and cavernous nerves (Fig. 5).

### Superior Hypogastric Plexus

The superior hypogastric plexus is a network of sympathetic pre- and postganglionic fibers emerging from the second to fourth lumbar splanchnic nerves and located 3-7 cm caudal to the origin of the inferior mesenteric artery and just caudal to the bifurcation of the aorta.[45] The plexus extends down about 4 cm with fine nerve-fibers to the rectum and divides into right and left hypogastric nerves.

### Hypogastric Nerves

The hypogastric nerves represent extensions of the sympathetic nerves dividing from the superior hypogastric plexus, and extending down along the pelvic wall under the prehypogastric nerve fascia to connect the pelvic plexuses, while sending small rectal branches around the superior rectal artery penetrating through 2 fasciae: the prehypogastric nerve fascia; and the fascia propria of the rectum. The hypogastric nerves play a role in ejaculatory function, causing closure of

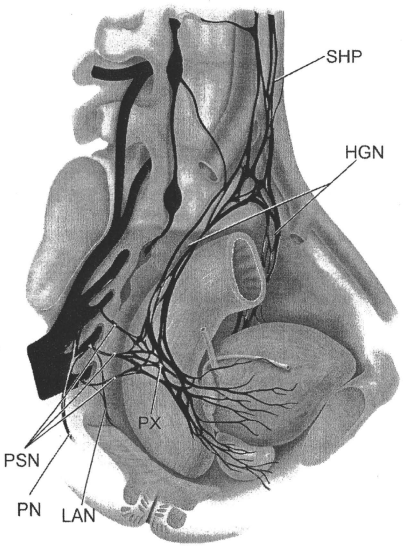


**Figure 5** Topographic anatomy of the pelvic autonomic nerves. HGN, hypogastric nerves; LAN, levator ani nerve; PN, pudendal nerve; PSN, pelvic splanchnic nerves; PX, pelvic plexus; SHP, superior hypogastric plexus.

the internal ostium of the urethra and constriction of the internal sphincter muscles. According to the severity of damage to the hypogastric nerves, various disturbances of ejaculatory function may develop, including retrograde ejaculation.

### Pelvic Splanchnic Nerves

The pelvic splanchnic nerves, which are parasympathetic nerves, form as branches of the second, third, and fourth (mainly the third and fourth) sacral nerves emerging from the anterior sacral foraminae on either side. The pelvic splanchnic nerves, which often form a common trunk with the levator ani nerves at their origin, run to the target pelvic organs via the pelvic plexus and to the sigmoid and descending colon as far as the splenic flexure and distal transverse colon along to the inferior mesenteric artery and left colic artery. These nerves activate the smooth muscle of the rectum, anus, and bladder wall and inhibit the vesical sphincter.

The cavernous nerves (nervi erigentes) supplying vasodilator fibers to the erectile tissue of the penis and clitoris, and arise mainly from the fourth pelvic splanchnic nerve, run in the neurovascular bundles posterolateral to the prostate[46] and penetrate the rectourethralis muscle posterior to the anorectal junction in about half of cases.[47]

### Pelvic Plexus

The pelvic plexus, also known as the inferior hypogastric plexus, appears as a meshlike triangle located under the prehypogastric nerve fascia on the pelvic side walls anterolateral to the rectum and posterolateral to the seminal vesicles, prostate, and urinary bladder in men, and lateral to the uterine cervix, vaginal fornix, and bladder and often extending into the broad ligaments of the uterus in women. This plexus is mainly formed by the hypogastric nerves and pelvic splanchnic nerves and sends nerve branches arising at the anteroinferior corner of the plexus to the genitourinary organs, running with the blood vessels (neurovascular bundles).

### Levator Ani Nerves

The levator ani nerves represent 1 of the components of the pudendal plexus. The origins of the nerves often form a common trunk with the pelvic splanchnic nerves and extend down along the levator ani under the thick parietal pelvic fascia (levator ani fascia), sending branches to the muscles. Injury to the levator ani nerves means that the dissection has deviated from the recommended plane, within the distal pelvis, and may present as urinary or fecal incontinence.[48]

### Pudendal Nerves

The pudendal nerves, which are mainly sensory nerves for the perineum, arise from the sacral plexus (second to fourth sacral nerves), leave the pelvic cavity through the greater sciatic foramen, enter the gluteal region, cross the sacrospinous ligament close to the ischial spine, and run through the pudendal canal (Alcock's canal) toward the ischio-anal fossa. These nerves then divide into the inferior rectal, perineal, and dorsal nerves of the penis or clitoris.

## Surgical Dissection Planes

Total mesorectal excision (TME)[35] or tumor-specific mesorectal excision[48] are the standardized procedures for rectal cancer surgery. The purpose of TME is removal of the rectum and mesorectum enveloped by the visceral layer of the pelvic fascia as a package, including lymphatic channels draining from the area harboring the cancer, and, together with sphincter-preservation, to preserve the autonomic nerves distributing to the urogenital organs. However, even in recent reports using TME, complicated urinary and sexual dysfunctions are common.[49-54]

Various discussions about the surgical plane of TME have been presented.[38,55] Many surgeons have recommended surgical planes outside the intact Denonvilliers' fascia. However, Lindsey et al[56] and Kinugasa et al[38] claimed that removing Denonvilliers' fascia with the mesorectum is not always necessary. The most dangerous points of nerve injury during surgical dissection are the anterolateral sites of the rectum, where laminated leaves of the lateral parts of Denonvilliers' fascia and nerve branches from the pelvic plexus cross[38] (Fig. 2). Denonvilliers' fascia can be preserved when the tumor is not located on the anterior wall of the rectum.

Two surgical dissection planes are possible posterior and lateral to the rectum: between the fascia propria of the rectum and the prehypogastric nerve fascia; and between the prehypogastric nerve fascia and the parietal pelvic fascia. The first dissection plane is better to avoid nerve damage. A dissection plane behind the parietal pelvic fascia risks injury not only to the pelvic plexus, but also to the levator ani nerves.[49,57] The risk of nerve injury varies with surgical dissection plane selected.[58,59] The surgical dissection plane selected should thus be considered along with the location and depth of the tumor.

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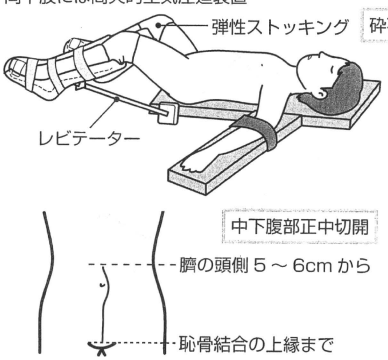
# 6 直腸低位前方切除術

東京医科歯科大学大学院腫瘍外科学分野　山内慎一（やまうち・しんいち）
同 助教　石黒めぐみ（いしぐろ・めぐみ）
同 教授　杉原健一（すぎはら・けんいち）

## 直腸低位前方切除術って、どうするの？①

### 1 体位、開腹

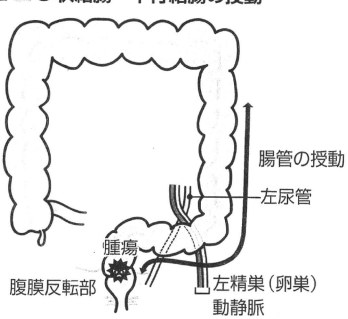
両下肢には間欠的空気圧迫装置




**ポイント**

- 手術は砕石位で行います。血流障害や神経障害が生じないように注意して、下肢を固定します。
- 深部静脈血栓・塞栓症の予防のため、弾性ストッキングを着用してもらったり、間欠的空気圧迫装置を装着します。
- 臍の頭側 5 ～ 6cm から恥骨結合の上縁まで皮膚切開をおき、開腹します（中下腹部正中切開）。

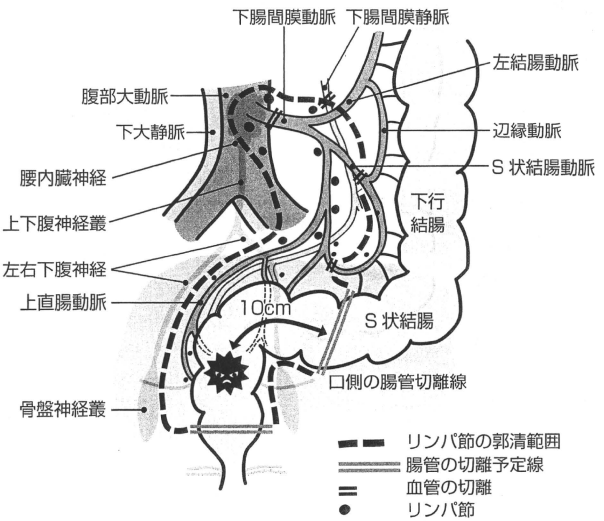
### 2 S 状結腸～下行結腸の授動




**ポイント**

- S 状結腸から下行結腸にかけて後腹膜から剥離・授動します。
- 適切なカウンタートラクション（牽引）をかけると、層と層の間がみえてきますので、S 状結腸間膜と後腹膜の間を出血なく剥離できます。正しい層で剥離すれば、尿管や精巣（卵巣）動静脈は背側に温存されます。これらを損傷しないように注意します。
- 腸管は十分に授動しておき、再建の際に、吻合部に緊張がかからないようにします。

### 3 リンパ節郭清

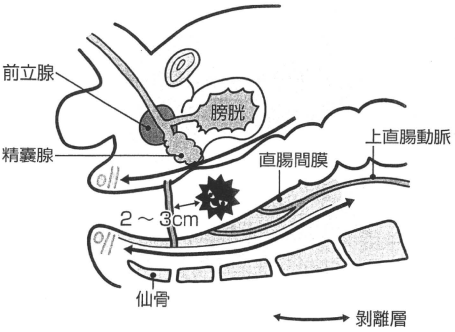



**ポイント**

- 腹部大動脈から分岐する下腸間膜動脈の根部の周りのリンパ節を郭清します。
- 下腸間膜動脈を根部で結紮・切離します。その付近で、下腸間膜静脈も結紮・切離します（下腸間膜動脈は根部で切離せず、周囲の郭清だけを行って、左結腸動脈を温存する場合もある）。
- 腹部大動脈の表面に絡み付いている自律神経は、背側に残して温存します。
- 下腸間膜動静脈を結紮・切離した部分から、腫瘍の約 10cm 口側の腸管（ここが口側の腸管切離線になる）に向かって、腸間膜を切離します。腸間膜には、辺縁動脈などの血管が含まれていますので、適宜、これを結紮・切離します。

# 直腸低位前方切除術って、どうするの？②

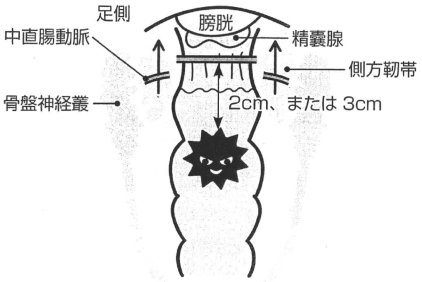
## 4 直腸の剥離・授動




**ポイント**

- S状結腸を腹側へ吊り上げながら、直腸の左右の後腹膜を、腹膜反転部の付近まで切開しておきます。
- 直腸の後壁の授動は、左右の下腹神経を温存しながら、直腸間膜の外縁の層で直腸後腔を仙骨下縁あたりまで十分に剥離します。
- 前壁では腹膜反転部を切開し、男性では精嚢腺と直腸との間、女性では膣と直腸との間で、肛門側に向けて十分に剥離します。

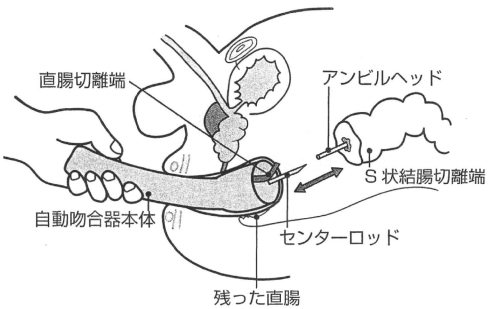
## 5 直腸の切離

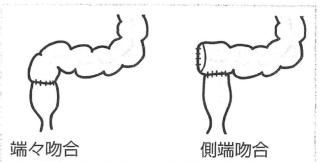



**ポイント**

- 腹膜反転部より肛門側の直腸の左右の側壁は、側方靭帯で固定されています。これを切離して直腸を授動します。
- 上部直腸(Ra)がんでは、腫瘍下縁から3cm、下部直腸(Rb)がんでは、2cm肛門側で直腸を切離します。自動縫合器を用いるのが一般的です。
- 図3の口側の腸管切離線でS状結腸を切離し、標本を摘出します。
- 下部直腸の進行がんでは、標本を摘出した後、側方郭清を行う場合があります。側方郭清とは、内・外腸骨動静脈周囲などの骨盤壁に沿った領域にあるリンパ節を郭清することです。

## 6　再建法(吻合)

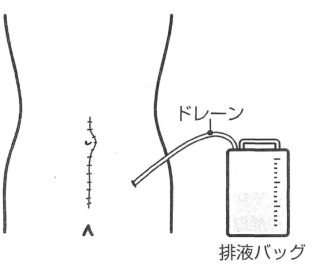



**ポイント**

- 環状自動吻合器(サーキュラーステープラー)を用いるのが一般的です。
- 口側腸管の切離端からアンビルヘッドを挿入し、装着します。
- 肛門から自動吻合器の本体を挿入し、閉鎖された直腸切離端からセンターロッドを出し、アンビルヘッドに接続して吻合します。
- 吻合には、端々吻合や側端吻合などがあります。
- 自動吻合器を使わず、手縫い吻合を行う場合もあります。

## 7　ドレーン留置と閉腹




**ポイント**

- 吻合部の背面に先端がくるように、左下腹部から閉鎖式ドレーンを留置します。
- 出血のないことを確認し、置き忘れがないか、器械・ガーゼのカウントをしてから閉腹します。

## 手術操作

### 1　術式

「前方」とは、**腹腔側からのアプローチ**を意味し、「低位」とは、**腸管の切離・吻合が腹膜反転部より低い(肛門側)位置で行われること**を意味しています。

### 2　再建法(吻合)

再建は、図6で示したような器械による吻合が一般的です。器械吻合でも手縫い吻合でも、縫合不全を起こす可能性があります。

## ケアのポイント

### 1　縫合不全

直腸低位前方切除術の縫合不全の発生率は、5～10%前後です。吻合の位置が肛門に近いほうが縫合不全を合併しやすくなるので、縫合不全のリスクが高い事例では、予防的に一時的回腸人工肛門(ストーマ)を造設して、吻合部を便が通らないようにする場合もあります。この人工肛門は、通常3～6カ月後に閉鎖します。縫合不全を見逃さないように、ドレーン排液の性状や熱型には特に注意することが、術後のケアのポイントです。

### 2　排便管理・性機能障害や排尿障害に対するケア

直腸低位前方切除術では、肛門は温存されますが、直腸の大部分が切除され、便をためておくスペースがなくなるため、1回の排便量は少なくなり、排便回数が増え、**頻便**になります。

また、吻合部が肛門に近い患者さんでは、肛門括約筋の機能が低下する場合もあり、**便失禁**となることもあります。特に、術直後はトイレに間に合わない場合もよくありますので、ポータブル便器を用意しておくなどのケアが必要です。

直腸の周りには、膀胱、前立腺、子宮などの臓器があり、排尿機能や性機能を司(つかさど)る自律神経がたくさん走行しています。また、腫瘍下縁が腹膜反転部より肛門側にある進行がんの場合、側方リンパ節に転移する頻度が高いため、**側方郭清**が適応になります。側方郭清では、骨盤神経叢(自律神経)の周囲を郭清しますので、目に見える自律神経をできるだけ温存しても、高率に**性機能障害**や**排尿障害**をきたします。リンパ節郭清の程度によって、排尿障害の発生の頻度や程度も変わりますので、術式に応じて、膀胱留置カテーテルの抜去時期を決める必要があります。

直腸がんの手術では、**排便障害**、**排尿障害**、**性機能障害**などの、生活に密接にかかわる後遺症が起こる可能性があります。**がんの根治性**と**機能の温存**の両方を兼ね備えた手術を行う

ために、適切な**肛門側直腸の切離距離**と、**リンパ節郭清範囲**を設定することが重要です。

### 3　コロンプレパレーション(腸管処置)

腫瘍による腸管狭窄がある場合には、術前に**腸管処置**(下剤の内服)を行った際に、腹痛を起こしたり、穿孔したりする場合があるため、注意が必要です。患者情報を聴取する際には、排便状態や腸閉塞症状の有無などにも気を付けましょう。腸管処置のための下剤を内服させた後は、**腹痛**や**腹部膨満**などの腹部症状の有無に注意しましょう。

### 4　早期離床

腹部手術全般にいえることですが、**術後肺炎**や**血栓・塞栓症**、**腸管蠕動運動の遅延**などの予防のためにも、**早期離床**を目指しましょう。そのためにも、術直後の患者さんの状態をよく把握することが大切です。

**ここが大切**

**直腸低位前方切除術におけるケアのポイント**

1. 術前の腸管処置を行う前に、腫瘍による狭窄症状の有無を必ずチェック！
2. 早期離床を促しましょう。
3. 主な術後合併症は、縫合不全、創感染、イレウスです。
4. ドレーン排液の性状・量に注意を！　出血はみられないか？　便汁や膿で汚くなっていないか？
5. 熱型をよくみましょう。術後３～４日が経過しても発熱が続くときは、縫合不全の可能性も……。
6. 排ガス・排便の有無、腹部膨満の有無、腸蠕動音の状態なども大事なポイントです。
7. 膀胱留置カテーテルの抜去時期は、側方郭清の有無などの術式の違いによって、異なります。

## 直腸低位前方切除術の最近の動向

腫瘍が肛門の近くにあるため、従来は肛門を温存できず人工肛門になった事例に対し、最近では、**内肛門括約筋切除術**(ISR)という新しい術式で、肛門温存を行う場合もあります。

直腸がんに対する腹腔鏡下手術は、その有効性・安全性が十分に確立されていないのが現状です。習熟した術者・施設により、臨床試験で有効性と安全性の確認を行っている段階です。

開腹手術

# 低位前方切除術

東京医科歯科大学大学院腫瘍外科学[1]
同 応用腫瘍学[2]

樋口哲郎[1] 小林宏寿[1] 榎本雅之[1]
飯田 聡[1] 石川敏昭[2] 石黒めぐみ[1]
加藤俊介[1] 植竹宏之[2] 杉原健一[1]

■S状結腸，直腸の剝離授動：骨盤内という視野のとりにくい術野のため，十分な外科解剖知識・経験が必要となる．正しい剝離層で剝離授動していくことが，安全な手術，術後機能障害の回避，また術後局所再発を減らすための正しい腫瘍学的切除範囲を行うことにつながる．

■吻合：切離，吻合に使用するリニア・ステイプラーおよびサーキュラー・ステイプラーにはデバイスごとに特性があるので，それぞれの特徴を理解して正しく使用することが，縫合不全を予防するうえで大変重要である．

## はじめに

直腸癌は，結腸癌と比較すると，治癒切除例の5年生存率で結腸癌83.7%，直腸癌77.1%と予後が悪く[1]，再発率も高い．直腸癌の治療の困難性は，解剖学的な問題と術後の機能障害である．

解剖学的問題点として，直腸は，

①腹腔と違い，骨に囲まれた狭い骨盤内に存在する．

②下腸間膜動脈に沿った上方向のリンパ流と内外腸骨動脈に沿った側方向のリンパ流の2系統が存在する．

③泌尿生殖器および，それを支配している自律神経系と近接している．

という点である．これらの点より，狭い部位での手術操作が必要なうえ，2系統のリンパ節郭清や自律神経温存という技術と解剖学的知識・経験が必要となる．また，術後に排便機能障害，排尿障害，性機能障害などが起こりやすく，術後のQOL低下が問題となる．

そのため，直腸癌の診療においては，術前に適切な診断を行い，根治性と術後QOLに配慮した治療方針を立てることが重要となる．

## 低位前方切除術

前方切除術は，直腸癌に対する肛門機能温存手術の基本となる術式である．経肛門的切除術などの直腸局所手術が会陰側から行うのに対して，前方切除術とは，前方（腹側）からのアプローチ法という意味である．

直腸癌において，直腸肛門側切離線が腹膜反転部より口側に位置する場合を高位前方切除術，腹膜反転部より肛門側に位置する場合を低位前方切除術と呼ぶ．

1982年Healdら[2]によって，直腸癌術後の局所再発を抑える目的で，全直腸間膜切除（total

0386-9857/10/¥500/論文/JCOPY

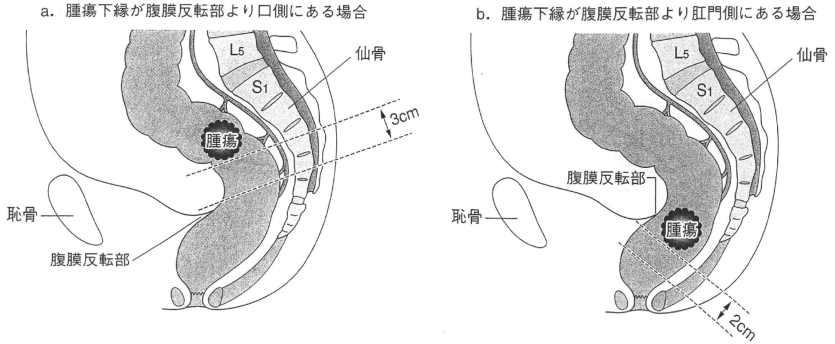



**図1　直腸S状部・直腸癌に対するTSME**

（文献4より引用）

mesorectal excision：TME）という概念が提唱された．これは，直腸と直腸間膜を直腸固有筋膜に包まれた状態で切除することであり，肛門管直上までの直腸間膜を全切除するという概念である．しかし，上部直腸癌に対してTMEに従って直腸間膜すべてを切除すると，残存直腸の血流不全となり，縫合不全のリスクが高くなる．そのため，わが国においては直腸癌の肛門側直腸間膜の切除範囲に関する臨床研究が行われ，腫瘍下縁からの直腸間膜内肛門側進展はある一定距離であることが明らかになり[3]，この結果に基づいて「大腸癌治療ガイドライン2009年版」[1]では，直腸S状部（RS）癌および上部直腸（Ra）癌では3 cm以上，下部直腸（Rb）癌では2 cm以上の直腸間膜内進展は稀であるとし，ここまでの切除を推奨している．この一定距離の直腸間膜切除方法は，tumor-specific mesorectal excision（TSME）と呼ばれている（**図1**）．

つまり上部直腸進行癌に対しては，適切な肛門側断端距離を保ったTSME＋上方向リンパ節郭清であり，下部直腸進行癌の場合は，TME＋上方向・側方向リンパ節郭清（側方郭清の適応に基づいて）となる．

われわれの低位前方切除術の適応は，腫瘍下縁と肛門管上縁の距離が，進行癌で2 cm，早期癌で1 cm以上のものとし，肛門挙筋群に腫瘍の浸潤を認めない症例である．

## 手術の実際

### 1 体位

直腸癌の手術では，特に良好な視野を保つことが重要である．術中に下肢の位置を適切に調整することが可能なレビテーターを用いて砕石位とする．通常は大腿をできる限り水平な位置にしている．骨盤内操作の場合は，頭高位にしたほうが骨盤内の視野が良くなる．当然，会陰側からの吻合操作の際は，下肢を挙上した体位とし，吻合を直視下の確実なものとする．

深部静脈血栓症予防のため，弾性ストッキングと間欠的空気圧迫装置を下腿に装着する．

体位をとった後，直腸指診を行い，腫瘍の大きさ，局在，固定性，肛門縁，歯状線からの距離を確認する．また，女性の場合は膣洗浄を行う．

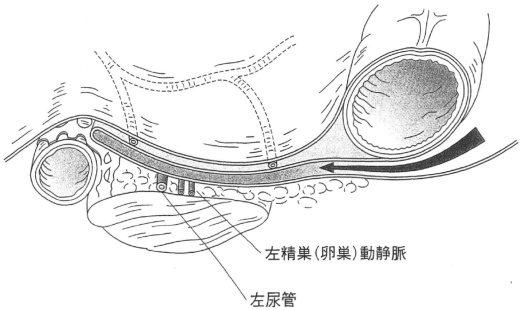



**図2　S状結腸間膜剝離**

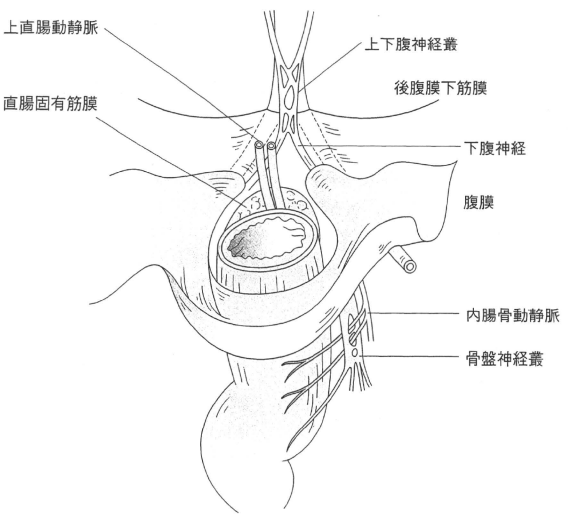



**図3　直腸周囲の自律神経系**

**2 皮膚切開**

術者は患者の左側に立つ．下腹部正中切開で臍を左方に回り延長し，開腹する．骨盤内の視野を保つために，膀胱漿膜および腹壁腹膜を恥骨皮膚部に針糸で3針縫合する．

**3 S状結腸間膜剝離（図2）**

助手がS状結腸を右側に牽引し，S状結腸間膜と後腹膜との癒合部を十分に露出する．この癒合部（Monksのwhite line）を電気メスにて切開すると，後腹膜に連続する薄い膜（下腹神

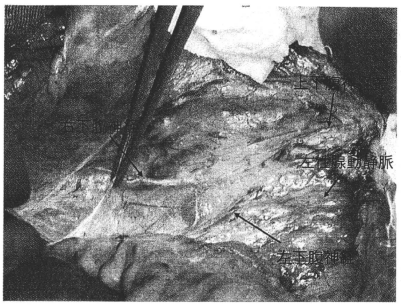


図4　上下腹神経叢，下腹神経

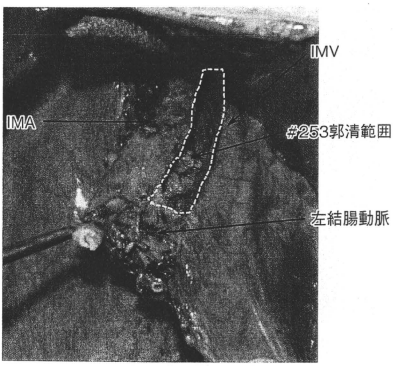



図5　IMA 周囲のリンパ節郭清範囲

IMA：下腸間膜動脈，IMV：下腸間膜静脈

経前筋膜）とその腹側に疎な結合組織の層がある．この層をきれいに出すようにして，頭側は左腎の下極まで内側は大動脈前面まで剝離する．外側から後腹膜下筋膜に覆われた左精巣（卵巣）動静脈，左尿管を認め，これを背側に落としていく．左尿管は下腸間膜動脈（IMA）根部付近の高さでやや内側寄りに走行するため，この部分の S 状結腸間膜と後腹膜下筋膜を十分に剝離しておくことが，次に続くリンパ節郭清の操作には重要になる．

**4 上下腹神経叢，下腹神経の同定と温存（図 3，4）**

大動脈分岐部付近（S 状結腸間膜の基部）で上直腸動静脈の背側で頭側から尾側に白く細い線維（上下腹神経叢）を同定し，これを温存しながら剝離を進めていく．大動脈前面と上直腸動静脈との間には，鈍的には剝離できない線維が存在する．これは上下腹神経叢から上直腸動静脈への神経枝で，電気メスを用いて切離して，上下腹神経叢を背部に落とし温存する．

**5 下腸間膜動脈周囲の処理（図 5）**

S 状結腸間膜右側の漿膜を切開して，IMA 根部に向かって郭清を進める．IMA 根部周囲を U ターンするように，漿膜，脂肪織とリンパ節を郭清剝離する．IMA 根部左側後方の操作では，左腰内臓神経がすぐ近くを走行しているため損傷に注意し，温存する．進行癌に対する中枢方向のリンパ節郭清の標準術式は，IMA 根部での結紮切離を伴う D3 郭清であるが，最近では，#253 に転移が疑われない場合は，IMA 根部を露出し，IMA に沿って#253 を郭清し，左結腸動脈分岐の末梢で IMA を結紮切離する左結腸動脈温存の D3 郭清を行っている．これは，吻合部の血流をさらに良好に維持するためと，異時性大腸癌の手術切除時の腸管温存のためである．しかし，左結腸動脈を温存することにより再建腸管において緊張がかかる場合は，IMA 根部での処理を行う．下腸間膜静脈（IMV）は左結腸動脈交叉部で結紮切離する．

**6 下腹神経前筋膜の切開（図 6）**

直腸左右の腹膜切開を腹膜反転部まで最初に行う．S 状結腸間膜剝離の際，温存した上下腹神経叢とその尾側で連続する左右下腹神経幹を確認する．直腸を尾側に展開して左右下腹神経

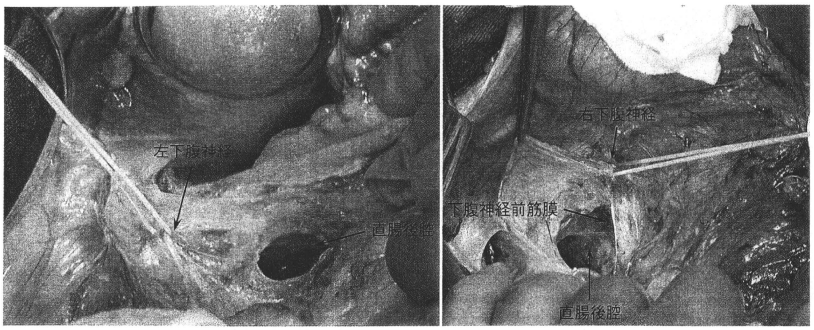



**図6　直腸後腔の展開**

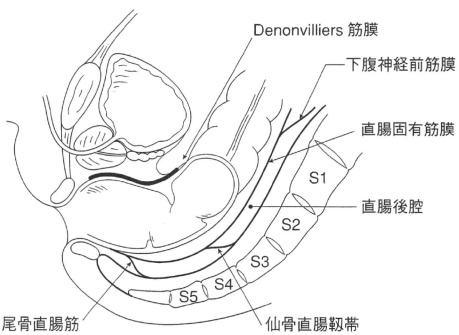



**図7　直腸を支える筋膜**


**図8　仙骨直腸靱帯の切離**

幹の正中で，下腹神経からの直腸への神経枝を電気メスで切離しながら，直腸固有筋膜から両側下腹神経を剝離する．岬角の尾側と直腸後壁の間に薄い白色の膜状組織（下腹神経前筋膜）の癒合を認める．これを鋭的に電気メスで切離して，直腸後腔へ入っていく．

### ⑦ 直腸後方の剝離，直腸後腔の展開

直腸後腔は疎な結合組織からなり，直腸を腹側に挙上牽引しながら，長クーパー剪刀や直腸直角鉤を用いて正中で深部へ向かい，それを徐々に左右に拡げ展開していく．ここで剝離層を十分に確認し，仙骨側に寄らないように注意する．仙骨前面の静脈を損傷すると出血し，視野を失う危険があり，また止血に難渋することが多い．

### ⑧ 直腸後方のさらなる剝離，仙骨直腸靱帯の切離（図7，8）

仙骨 S3 のレベル付近で仙骨直腸靱帯にぶつかる．この靱帯内には外側および正中仙骨血管を含んでいる場合があり，電気メスを用いてこの仙骨直腸靱帯を切離する．この操作により，挙筋上腔に入り，正中で長クーパー剪刀を用い

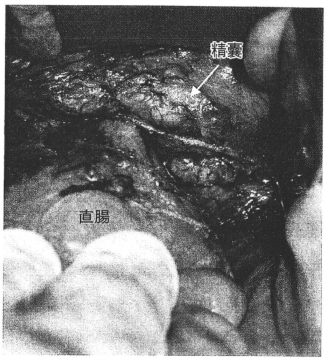



図9　直腸前壁の剝離（男性）

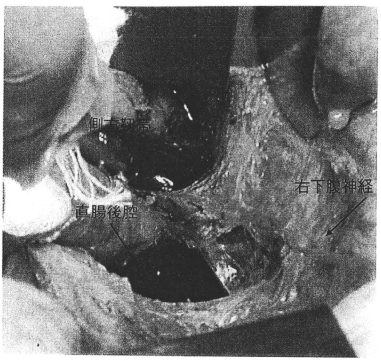



図10　側方靭帯

て直腸後壁を十分授動し，この剝離層を連続させるようにしてU字型に左右側方に剝離・展開していく．

### 9 直腸前方の剝離，膀胱直腸窩の切開と直腸前壁の授動（図9）

直腸を頭側背側に牽引し，セントマークス鉤で膀胱を腹側に牽引し，腹膜翻転部に緊張をかけ，膀胱直腸窩（子宮直腸窩）を直視下に露出し，腹膜反転部のやや頭側の腹膜を切開し，左右の腹膜切開線と連続させる．正中部で直腸固有筋膜との間の層を慎重に剝離していくと，男性では精嚢，女性では腟後壁が確認できる．この正中部でDenonvillier筋膜を確認し，この筋膜を破らないよう精嚢腺を露出するように剝離していく．女性の場合，Denonvillier筋膜が明確でないこともあり，腟後壁に切り込まないように注意して剝離する．正中部での剝離は容易なことが多いが，直腸の前側壁と精嚢腺との間は癒着が強いことがあり，出血もしやすいので，電気メスを用いて切離していく．やがて精嚢腺を越え，前立腺の移行部付近ではDenonvillier筋膜が前立腺に収束していくため，剝離がやや困難となる．

### 10 直腸側方の剝離，側方靭帯の切離（図10）

腹膜反転部より尾側の直腸壁外側をクーパー剪刀で探ると，疎な結合織の腔に入る（直腸側腔）．この腔を鈍的に剝離し十分に展開すると，先に展開してある直腸後腔との間に結合組織を認める．S3が骨盤神経叢へ連続するやや内側の部位に，直腸へ流入する血管と骨盤神経叢からの直腸枝から構成される結合組織で側方靭帯である．

直腸を骨盤壁から離すように強く牽引し，下腹神経に緊張をかけると，下腹神経と骨盤神経叢の合流部が明らかになる．側方靭帯を，骨盤神経叢内側で，電気メスと鈍的剝離にて切離する．中直腸動脈があれば電気メスで凝固するか，または，血管のみを結紮する．

直腸前側壁は精嚢を確認し，骨盤壁側にあまり近づかないように，やや直腸側で剝離する．骨盤壁側で剝離すると，骨盤神経叢から出る膀胱枝を損傷し，術後の排尿・性機能障害につながる．

側方靭帯を切離すると，直腸側方から後面に