VAGINAL SURGERY

SECOND EDITION

DAVID H. NICHOLS, M.D.
CLYDE L. RANDALL, M.D.

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David H. Nichols, M.D.,

Fellow American College of Obstetricians and Gynecologists; Fellow American College of Surgeons; Fellow International College of Surgeons
Professor and Chairman, Section of Obstetrics and Gynecology, Brown University-Division of Biology and Medicine
Lecturer: Obstetrics and Gynecology, Tufts University-School of Medicine, Boston
Obstetrician and Gynecologist-in-Chief, Women & Infants Hospital of Rhode Island
Surgeon-in-Chief, Department of Gynecology and Obstetrics, Rhode Island Hospital, Providence, Rhode Island

Clyde L. Randall, A.B., M.D.,

Fellow American College of Obstetricians and Gynecologists; Fellow American College of Surgeons; Fellow Royal College of Obstetricians and Gynecologists; Fellow American Gynecological and Obstetrical Society.
Emeritus Professor Gynecology and Obstetrics, State University of N.Y. at Buffalo
Former Chief Gynecology and Obstetrics, SUNY Affiliated Hospitals, Buffalo, NY
Johns Hopkins Program International Eduction, Gynecology and Obstetrics 1975–80

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Preface to Second Edition

Our investigations of the clinical anatomy of the female pelvis have disclosed some unexpected and significant differences in the interrelationships between the organs of the living woman and those of an embalmed cadaver. These differences might be likened to a comparison between grapes and raisins. The goals of a surgical reconstruction for the living should not be based on the relationships of organs as they have been observed in the cadaver. Attempts to do so have, on occasion, led to certain of the unphysiologic and unnatural reconstructions described in the past. From the studies of the anatomy of the living the authors have developed techniques and new objectives emphasizing reconstruction and restoration of normal physiologic interrelationships of the organs and supporting tissues within the pelvis. This has resulted in a greater degree of patient comfort and operative success than that achieved with some previous techniques. These earlier anatomic studies are now being used as the basis upon which physiologic relationships and function can be restored.

Much of the text as it appeared in the first edition has been rewritten. Several chapters have been expanded to include a more comprehensive consideration of the problems involved. The relatively new technique of retrorectal levatorplasty has been added to the consideration of posterior colporrhaphy. Detail has been added in regard to the diagnosis and operative treatment of the more commonly occurring types of genital fistulae. An entirely new chapter has been added to expand on the consideration previously given the choice of operation for urinary stress incontinence.

In another new chapter the technique, complications and sequelae of a dilatation and curettage are considered, with or without electroconization of the cervix. The purpose of this chapter is not so much to describe "how to" but rather to emphasize what not to do. Complications following either a simple dilatation and curettage or a conization are usually regarded as an operative, technical error, perhaps due to a predisposing factor that was not iatrogenic but almost always avoidable if precautions are observed and routinely practiced.

Since publication of the first edition, considerable additional experience has been gained with utilization of the sacrospinous ligament as the optimal tissue to which the apex of the vagina may be anchored to assure a more normal and desirable vaginal axis. This has proven to be a most effective operative treatment when procidentia or massive vaginal eversion has occurred and the individual, at any age, wants to preserve normal vaginal caliber and function. In an added chapter indications and advantages are discussed, and the technique of this procedure has been described and illustrated.

The anatomic developments to look for and the problems likely to be encountered which might well be anticipated by the gynecologist contemplating the

construction of a vagina are the subject of a new chapter. Several procedures are reviewed which have been recommended if the problem is a congenital absence of the vagina. Also described are the means by which a vagina too small to permit coitus may be made large enough to function satisfactorily, whether the difficulty is due to congenital smallness or to an ill-advised tightening of the vagina as a result of an episiotomy or poorly designed colporrhaphy.

In many gynecologic practices problems are now being experienced because of the increasing numbers of women over 65 years of age—and increasingly over 75—with whom the gynecologist must discuss the risks as well as the possible benefits of a major gynecologic repair. Indication for a pelvic laparotomy after 65 is usually a neoplasm evident to the patient and concerned relatives as well as her physician. Indication for a gynecologic repair is usually elective, yet it may provide virtually a new lease on life for an older woman whose activities have been restricted and whose outlook has been depressed for years. In a new chapter it is recognized that an altogether successful anatomic result can be discredited by a patient not happier, even though she is more comfortable, because she really has no desire to increase her activities. For that reason appraisal of the older woman's psychologic and emotional, as well as her nutritional and functional status should be taken into account before the gynecologist advises the patient and her family of the benefits that can be gained as well as the risks to be considered when electing a major gynecologic repair. Present-day prospects for the continuation of good health, however, do justify elective surgery even for the woman approaching 80 who, if more comfortable, may enjoy another decade or two of life and activity.

A dropped uterus is the result of a genital prolapse and not the cause of such obviously deranged relationships. Although an incidental hysterectomy is often performed, is usually desirable, and generally plays an important part in the reconstruction, a good result depends upon the adequacy of the repair itself. The widespread use of postmenopausal estrogen replacement therapy has given rise to an increasing incidence of iatrogenic endometrial hyperplasia and postmenopausal dysfunctional type uterine bleeding. The prevalence of this practice has provided another valid reason for coincident hysterectomy whenever an extensive reconstruction is indicated or even a simple vaginal repair is indicated after the woman's menopause.

The basic problems troubling the woman with genital prolapse have been essentially unchanged for many generations. Recognition, evaluation, and solutions to these problems have been the responsibility of operating surgeons for almost as long as time. This need has made it quite apparent that a critical analysis of the thinking of yesterday's and today's investigators of this subject is necessary in order to permit the growth of a useful heritage that will survive the tests of time and experience. It is one purpose of this book to consider the principles emphasized by the many contributors whose observations are applicable to today's patient and of significance to her surgeon. A few sources listed provide further references for the interested reader.

Appreciation is again due the editors and publishers of *Obstetrics and Gynecology*, *The American Journal of Obstetrics and Gynecology*, *The Anatomical Record*, and *Postgraduate Medicine* for permission to reprint portions of our studies which originally appeared in their publications.

Contents

CHAPTER 1

Pelvic Anatomy of the Living

GENERAL CONCEPTS

Vaginal surgery offers logical and effective methods for the restoration of distorted attachments and pathologic concentrations of pelvic connective tissues. Confusion and disagreements often arise, however, because concepts and definitions vary as to precisely what constitutes the normal state.

Effective vaginal surgery requires precise knowledge of the anatomy involved, an appreciation of the extent of individual variation, and an understanding of the effects of such physiologic processes as pregnancy, labor, delivery, menopause, and aging upon the tissues that are to be subjected to restorative surgery. Since the practitioner's knowledge of pelvic anatomy and his concept of normal anatomic relationships were first learned by study of the anatomy of the cadaver, many surgical reconstructions have been planned with the objective of recreating the anatomic relationships observed in the cadaver. Since these relationships are quite different from those of the living, many of the physiologic and symptomatic failures of gynecologic reconstructive surgery have been due to the intentional but erroneous development of cadaver-like relationships with unsatisfactory results that are both predictable and unfortunate.

Since the earliest days of medicine, dissections have been performed on, texts have been written about, and anatomy has been studied from elderly, often debilitated, and malnourished female cadavers. The anatomic interrelationships in such bodies are quite different from those found in the healthy, living, well-nourished, younger female. Furthermore, the standard anatomy textbook gives extensive description of only a small number of dissections and bases broad generalizations on this small number. There is no recognition of the large amount of variation that occurs quite normally and frequently between individuals and at different times of life.

The anatomic relationships of tissues and organs of an anesthetized patient are not quite the same as those of the patient who is wide awake; this is because of muscle paralysis from anesthesia, resting or baseline underdistention of the various organs, and the change in statics due to position. The horizontal position of the nonmoving surgical patient provides statics quite different from those of the vertical and active patient, whose pelvic organs are in varying stages of function and distention.

We shall, therefore, pursue in some detail the re-examination and redefinition of normal anatomy of the living. Moreover, every description of the procedures which follow will be similarly based on anatomic relationships observed in the living.

Vaginal reconstructive surgery is concerned with the return of abnormal organ relationships to a usual or normal state. There is no one site or degree of damage that must be repaired or restored; there are many, and they occur in various combinations at various times of life, from different etiologic factors, in varying degrees, and with varying degrees of symptomatology and disability.

For years there has been heated discussion as to whether the more important factor concerned with vaginal position within the pelvis is that of suspension from above (cardinal ligament complex), a view championed by Fothergill (12), or of support from below (levator anipelvic diaphragm), as emphasized by Paramore (24) and Halban (32). Mengert's (1) classic contribution in this area was to report an experiment whereby a tenaculum was applied to the cadaver cervix, a cord was attached to the tenaculum and run through a fixed pulley, and a 1-kg. weight was attached to the opposite end of the cord. One by one, starting at the top of the fundus, the lateral supports of the uterus and vagina were cut until prolapse of the uterus and vagina finally developed. It was only when the paravaginal tissues had been cut that prolapse occurred. "Marked descent of the uterus amounting to actual prolapse never occurred so long as any part of the upper two thirds of the paravaginal and/or lower two thirds of the parametrial tissues were intact." This experiment convincingly emphasized the importance of the suspensory apparatus.

Bonney (49) strongly defended the position that both points of view were correct, i.e., the vagina is suspended from above and supported from below, and one or both systems could be damaged, causing genital prolapse of a type which reflected the site or sites of primary damage. It is important for the gynecologic surgeon to recognize the primary site of damage so that appropriate steps can be taken in surgical reconstruction to minimize the chance of postoperative recurrence of the genital prolapse. Damage to the suspensory system can give rise to inversion of the upper vagina, often with elongation of the cervix and cul-de-sac hernia; damage to the lower supporting system is more likely to be associated with eversion of the lower vagina, including cystocele and rectocele.

Anatomy texts have described vaginal position in terms of the relationships evident in the cadaver (1–4) and usually refer to the vagina as an almost straight and hollow tube extending posterosuperiorly toward the sacral promontory (Fig. 1.1). This concept developed because this relationship is usually demonstrable on sagittal sectioning of the cadaver (Fig. 1.2). When such a concept becomes the objective of reconstructive surgery for the relief of genital prolapse, however, the result may be an unusual deviation of the vagina. In some instances the vaginal vault has been sewn to the sacral promontory or even to the anterior abdominal wall, the latter causing the vaginal axis to ascend in an almost vertical or anterior direction (5, 6).

Studies of the usual depth and axis of the nulliparous vagina in the living (Figs. 1.3 and 1.4) provide impressively different information (7–11), especially when considering the unanesthetized patient.

The organs of the female pelvis are readily distensible within certain maximal limits. Bladder, vagina, or rectum distend quite independently in the course of their normal functions. Each is able rather quickly to resume its usual or resting shape, dimension, and relationship after such individual and functional distention has been relieved. Functioning in concert, they reinforce one another; the histologic components which permit such a range of activity include combinations of varying amounts of smooth muscle, striated muscle, elastic tissue, and collagen.

Smooth Muscle Fibers

Smooth muscle fibers are in a constant state of activity, helping to maintain tone, but permitting cellular elongation whenever necessary with no significant increase in tone. Smooth muscle cells will lengthen readily until a limit of elasticity is reached. Once this elastic limit is attained, the cells will behave like an inactive fascial tissue. The response to mechanical or chemical stimuli is mediated involuntarily through the autonomic nervous system and spinal reflex arcs. Although smooth muscle will maintain tone, it is of limited value for support because

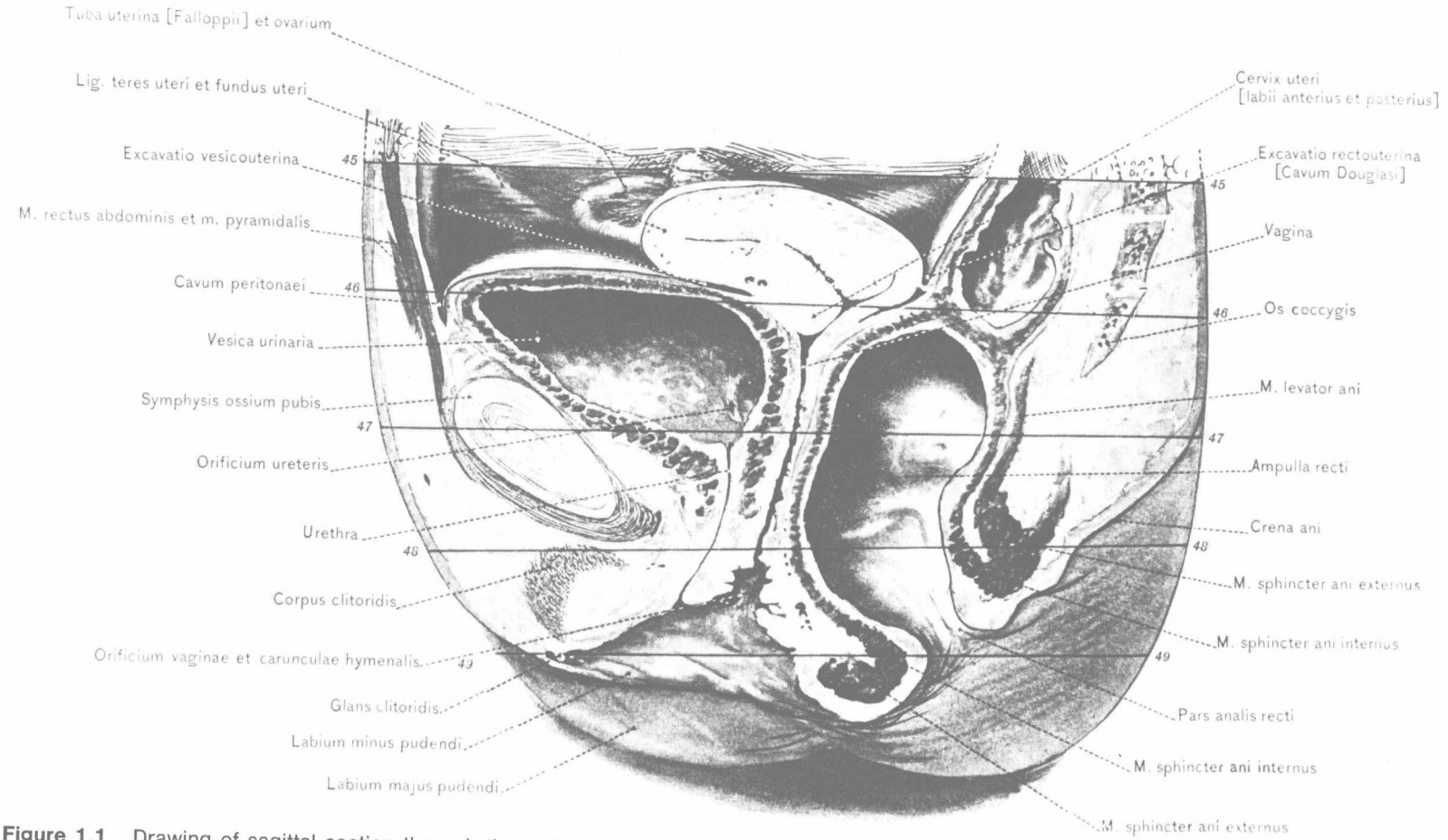

Figure 1.1 Drawing of sagittal section through the embalmed cadaver showing the axis of the vagina to be in an almost vertical position. It is displaced anteriorly by the dilated rectum, a relationship not often found in the living. (From Carter et al.: *Cross-Sectional Anatomy: Computed Tomography and Ultrasound Correlation*, 1977; reproduced with permission of Appleton-Century-Crofts.)

Figure 1.2 Photograph of sagittal section of cadaver pelvis and almost vertical vaginal axis is shown, maintained by postmortem changes and chemical tissue fixation. (From Nichols, D. H., Milley, P. S., and Randall, C. L.: Significance of restoration of normal vaginal depth and axis. Obstet. Gynecol. *36*:251–256, 1970; reproduced with permission of The American College of Obstetricians and Gynecologists.)

cellular length will increase with increased stress up to a point of maximum distention. The syncytium of smooth muscle also evidences rhythmic contractions. The number of smooth muscle cells present within given tissues appears likely to be constant throughout the mature lifetime of the individual and does not significantly decline with age.

Clinical Applications. Review of the literature describing reconstructive surgery for the repair of genital prolapse suggests that smooth muscle bands within the subperitoneal tissues have been consciously, although perhaps not deliberately, utilized in the most successful repair operations. That these tissues are mainly composed of smooth muscle was suggested by Fothergill (12) in 1907, who first suggested operating within the avascular lines of cleavage between the vagina and bladder, followed by fascial overlapping of the vesicovaginal and rectovaginal septa. An amputation of the usually elongated cervix in the repair of prolapse was later added. Apparently under the impression that he was working with layers of fascia, Fothergill was, in fact, overlapping layers that were predominantly smooth muscle fibers. He was effectively shortening and reinforcing musculofibrous groups capable of considerable support. We must now realize that the essential accomplishment in a successful repair operation is the restoration of the normal functioning and supportive abilities of the *smooth muscle* content of this "fascial layer" and is not the result of a duplication and strengthening of a nonelastic connective tissue.

Striated Muscle

Striated muscle also responds rapidly to stress and maintains tone and equilibrium. Striated muscle lacks inherent rhythmic contractions. The cells tend to maintain a constant length by contracting in response to strain. This favors maintenance of equilibrium as well as tone of supporting tissue. Smooth muscle

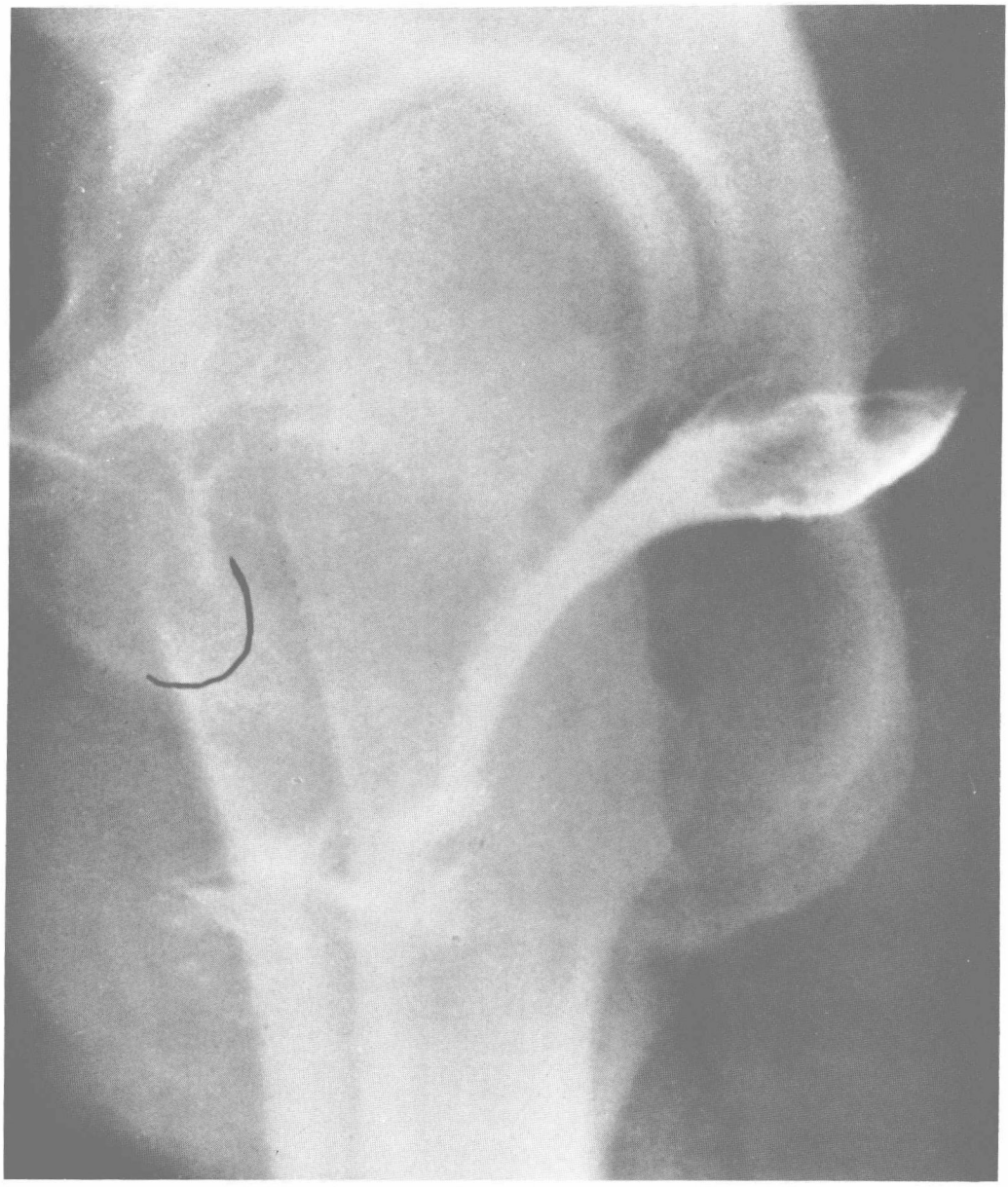

Figure 1.3 A normal vaginal depth and axis. Colpogram of a healthy 25-year-old nulligravida standing at rest. The vaginal walls have been painted with barium. The perineal curve of the lower vagina is shown along with the more horizontal axis of the upper vagina (St. Francis Hospital, x-ray 69–3159, courtesy of Dr. Paul J. de-Marsovsky, radiologist). (From Nichols, D. H., Milley, P. S., and Randall, C. L.: Obstet. Gynecol. *36*:251–256, 1970; reproduced with permission of The American College of Obstetricians and Gynecologists.)

helps to maintain tone but, since it more readily permits elongation, does not effectively tend to restore or maintain equilibrium. Striated and smooth muscle have complementary activities which permit and contribute to functional changes within the limitations of the pelvic supporting tissues.

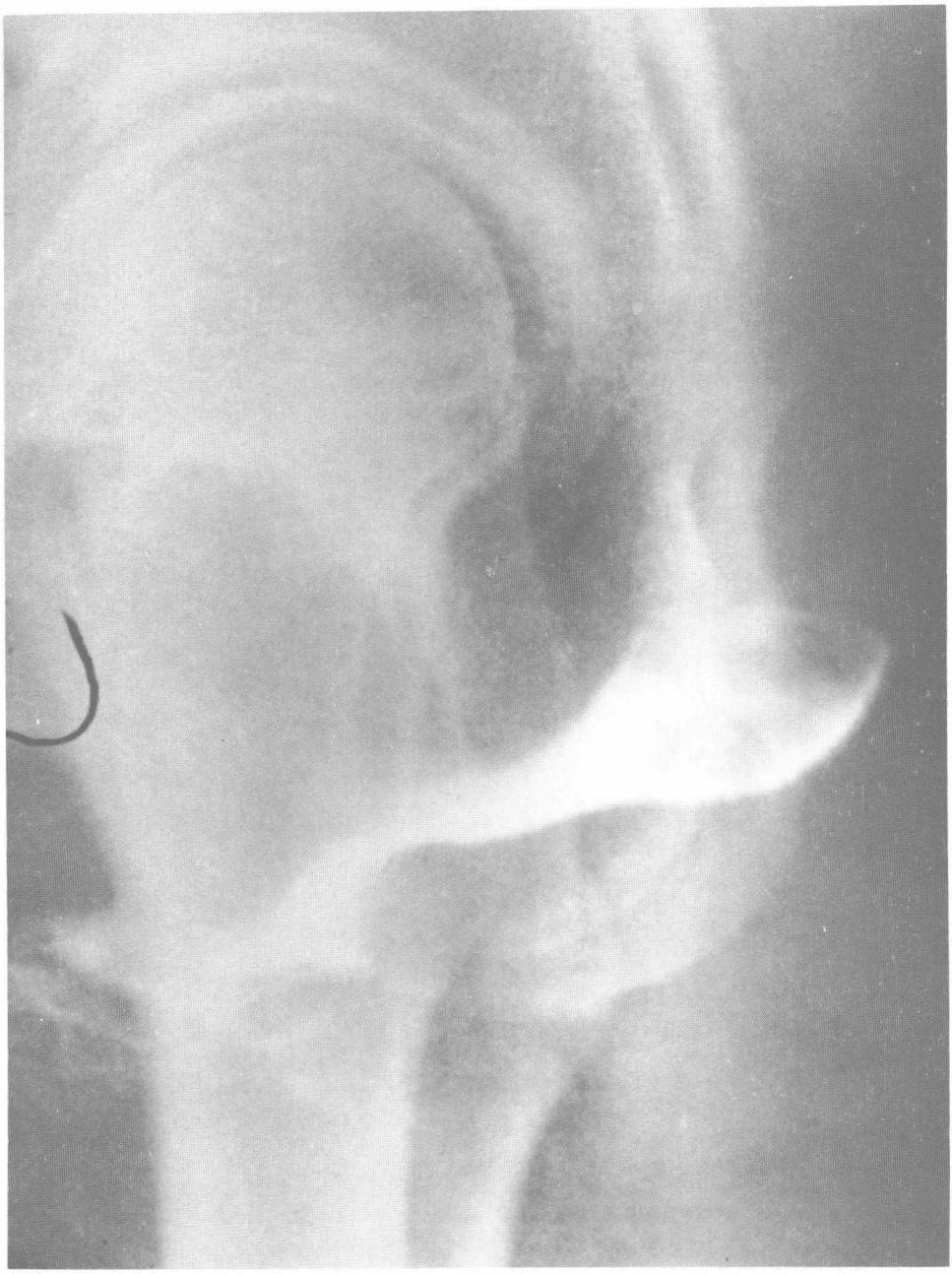

Figure 1.4 The same patient is straining, as by a Valsalva maneuver, which accentuates the horizontal axis of the upper vagina (St. Francis Hospital, x-ray 69–3159, courtesy of Dr. Paul J. deMarsovsky, radiologist). (From Nichols, D. H., Milley, P. S., and Randall, C. L.: Significance of restoration of normal vaginal depth and axis. Obstet. Gynecol. *36*:251–256, 1970; reproduced with permission of The American College of Obstetricians and Gynecologists.)

Elastic Tissue Fibers

Elastic tissue is made up of fibers constructed in irregular networks which are especially well developed in tissues usually subject to stress. These fibers respond to stress with stretching, but they resist such stretching by a natural tendency to return to their original state, much in the manner of a rubber band. The quantity of elastic tissue decreases with age, but the extent to which this is hormone related and reversible is not known. The histogenesis of these fibers is unknown, although they are apparently produced by fibroblastic cells or histocytes. They do not seem to have an innervation, and the decrease in their number with aging probably partially accounts for the differences in composition and recurrence rate of cystoceles and other manifestations of genital prolapse in women long past menopause as contrasted to those still in the reproductive years.

Collagen fibers are also arranged in an interlacing mesh work; but, unlike elastic tissue fibers, they do not stretch. With age they swell, fuse, and become hyalinized. Because they are flexible, they permit movement without stretching, much like a piece of string or rope.

Bone and cartilage are inflexible, firm and strong, and resist sudden strain and stress but respond to prolonged stress and strain by gradual changes in architecture. This response appears to be both age and hormone related.

ANATOMY

Relationships of Ureter to Vaginal Hysterectomy Ligatures

Hofmeister and Wolfgram (13) studied the reasons why the ureter is less often injured during vaginal procedures than during abdominal procedures even though it is more difficult to palpate or see. They performed vaginal hysterectomy in an x-ray department with multiple consecutive x-ray visualizations, radiopaque ureteral catheters, and wire sutures on the uterine pedicles.

It was possible to demonstrate that anterior retraction through the anterior peritoneal opening lifted the ureter as much as an additional 1 cm. away from the zone of danger.

"The distances demonstrated during the vaginal hysterectomy procedures varied from over 2.1 cm. at the level of the parametrial areas during the hysterectomy to 1 cm. when the tube and ovary were removed by clamping the infundibulopelvic ligament. During the repair of the bladder, the needle was measured as 0.9 cm. distant from the ureter" (13).

These studies suggest that the traction applied to the cervix during vaginal hysterectomy in combination with adequate retraction involving the anterior vesicouterine peritoneal fold provides protection against ureteral trauma not equaled during abdominal hysterectomy. They further demonstrated in these studies that the closest distances between the operator's clamps and the ureter were at the level of the infundibulopelvic ligament during salpingo-oophorectomy and during subsequent cystocele repair when the operator's needle was 0.9 cm. distant from the ureter.

Anatomic Systems Responsible for Pelvic Support

It is evident that there are at least six different anatomic systems responsible for varying degrees of support of the birth canal. These can be injured or damaged separately or in various combinations, but they must be individually recognized and identified if restorative surgery is to achieve its stated goal. The following significant anatomic support systems are evident and will be considered separately in greater detail: (a) the bony pelvis, to which the pelvic soft tissues ultimately

attach; (b) the broad ligaments, including the smooth muscle components and round ligaments; (c) the cardinal and uterosacral ligament complex; (d) the urogenital diaphragm, including the pubourethral ligaments; (e) the pelvic diaphragm, and particularly the pubococcygeus component and the levator plate; (f) the perineum, including the perineal body.

Although each of the above is a separate anatomic unit, they are often interrelated, and additional components may exert synergistic, supportive, or even sphincter-like action, e.g., the intact bulbocavernosi contracting in concert with the pubococcygei exert an almost sphincter-like effect on the vaginal outlet (Fig. 1.15). It is uncommon for any of these anatomic units to be individually defective, other than by congenital anomaly. With this exception, damage to these individual units may be either primary or secondary, generally in combination. Successful reconstructive surgery depends upon recognizing the combination of different types of damage. Equally important is the recognition of active etiologic agents to which corrective attention can be drawn.

The Bony Pelvis

The bones of the pelvis are the ultimate fixed attachment of the pelvic soft tissues, and can be defective and thus deficient in support as a result of either congenital anomaly (e.g., extrophy of bladder) or trauma (fracture, avulsion, or surgery). Significant deficiency should be taken into consideration when a plan of repair is being formulated.

The Broad Ligaments

The broad ligaments provide routes for entrance and egress of blood vessels and lymphatics supplying the organs they ensheath. They supply minimal support of the genital system except when they are pathologically strengthened, for example, when severe fibrosis and scarring develop as a result of endometriosis, previous infection, cancer, previous surgery, or radiation therapy.

Severe fibrosis may prevent the descent of the uterus. Prolapse of the lower birth canal and cervix may then develop, often with pronounced and sometimes extreme elongation of the cervix. Some relative independence of these various levels of support may explain, in the reverse situation, why independent surgical suspension or fixation of the uterus may not arrest the development and progression of cystocele, rectocele, and descent of the cervix. The round ligaments provide only accessory support to maintain anteversion of the uterus, permitting the stability of a uterine axis under normal circumstances with a narrow angle relative to the upper vagina.

The Cardinal and Uterosacral Ligament Complex

These ligaments include a fine mesh work of muscle fibers and are part of the suspensory apparatus that serves to hold the cervix and upper vagina over the levator plate.

The blood vessels and lymphatics from the hypogastric plexus enter and leave the uterus and vagina along their lateral margins, as the vessels connect with their origin from the main internal iliac (hypogastric) vessels. These vessels are surrounded by strong perivascular fibroareolar sheaths closely attached to their adventitia. The histology of these so-called ligaments has been studied by many observers, perhaps most accurately by Range and Woodburne (14). They found that these ligaments consist principally of blood vessels (largely veins), nerves, lymphatic channels, and areolar connective tissue; the connective tissue is more dense lateral to the cervix and vagina. Collagen bundles parallel the veins, and the connective tissue contains many smooth muscle fibers associated with the adventitia of the blood vessels. They found that the loosely arranged connective tissue

mesh strands become stretched or elongated longitudinally in the direction of a force applied to them (Fig. 1.5).

Von Peham and Amreich (15) realized that this rich network of blood vessels lateral to each side of the upper vagina and cervix is strengthened by the connective tissue and muscle sheaths surrounding the valveless blood vessels and named this the horizontal connective tissue ground bundle. At the cervix of an anteverted uterus this lateral paravaginal condensation of tissues makes a rather abrupt turn anteriorly, following, as it turns, the axis of the lateral side of the cervix (Fig. 1.6);

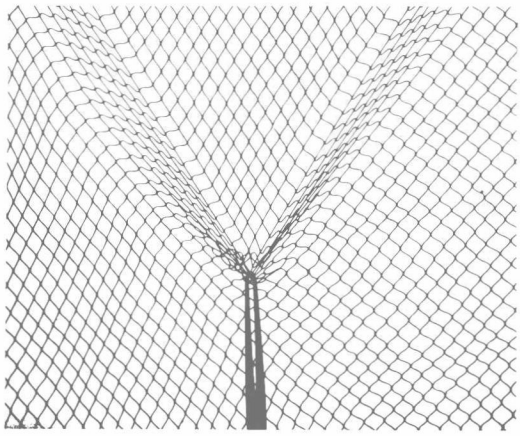

Figure 1.5 The effect of traction on the connective tissue fibers of the cardinal and uterosacral ligaments. A forceps has been applied to the center of a piece of plastic net, and traction has been applied, demonstrating the distortion of the pelvic tissues resulting from traction on the cervix. Condensation and obliteration of intra-areolar spaces account for "ligaments" apparent at operation, reinforced by blood vessels, lymphatics, and nerves and their sheaths, which both enter and exit along the lateral margin of the upper vagina cervix. (From Nichols, D. H., and Milley, P. S.: Clinical anatomy of the vulva, vagina, lower pelvis and perineum. In *Gynecology and Obstetrics*, J. Sciarra, editor, 1977; reproduced with permission of Harper & Row.)

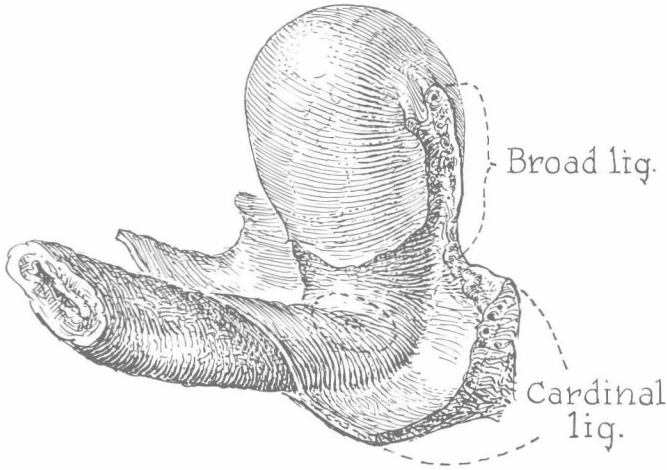

Figure 1.6 The cardinal ligament is shown as it attaches to the lateral portions of both cervix and upper third of the vagina. Notice that it follows the angulation of the intersecting axis of these two organs. (From Nichols, D. H., and Milley, P. S.: Clinical anatomy of the vulva, vagina, lower pelvis, and perineum. In *Gynecology and Obstetrics*, J. Sciarra, editor, 1977; reproduced with permission of Harper & Row.)

thus, the cardinal ligament is in reality the same as the horizontal connective tissue ground bundle and serves to supply and to hold both cervix and upper vagina in place over the levator plate.

Campbell (16) studied the anatomy and histology of the uterosacral ligaments. He found that they were attached to the posterolateral aspect of the cervix at the level of the internal os and to the lateral vaginal fornices. Although nearest the cervix, these ligaments are definite bands of tissue covered by peritoneum; they become thinned out as they course posteriorly, forming the superior boundary of the cul-de-sac of Douglas. The posterior third of each uterosacral ligament is fan shaped and consists of more delicate strands of tissue which attach to presacral fascia opposite the lower portion of the sacroiliac articulation. There is much individual variation in the thickness and strength of these ligaments, and they do increase in prominence when tension or traction is applied to them. Histologically, the anterior or cervical third of these ligaments contains, in order of prominence: smooth muscle, fibroelastic connective tissue, blood vessels, sympathetic and parasympathetic nerves, and lymphatics. The intermediate third is made up of a connective tissue network with prominent sympathetic nerve ganglia and a few scattered strands of smooth muscle and some lymphatics. The posterior or sacral third is composed almost entirely of loose strands of connective tissue with a few blood vessels, nerves, and lymphatics. For these histologic reasons, it seems unlikely that under physiologic conditions the ligaments which primarily convey the pelvic parasympathetic nerve fibers from the sacral plexis to the lateral aspects of the uterus have any significant supportive function. They may assist in maintaining the position of the uterus and upper vagina over the levator plate. As a general principle, nerves in the body are usually arranged in positions protecting them from trauma, so it is unlikely that the primary purpose of these ligaments is to provide for the suspension of the uterus. The connective tissue elements of these ligaments are to a large measure enmeshed with those of the lower portion of the cardinal or transverse cervical ligaments and are, from a practical point of view, not only inseparable but constitute a surgically useful complex. The proliferation of connective tissue in this complex observed during surgery in patients with genital prolapse is probably a secondary pathologic hypertrophy. This hypertrophy is most likely a secondary line of defense in the body's attempt to compensate for the loss of homeostasis caused by increased intraperitoneal pressure or as a result of deficient support from a weakened levator plate.

The Urogenital Diaphragm and the Pubourethral Ligaments

Milley and Nichols (17) studied the connective tissue supports of the urethra and confirmed the observations of Zacharin, that the urethra is suspended from the pubic bone (Figs. 1.7 and 1.8) for most of its length by arched, bilaterally symmetrical anterior, posterior, and intermediate pubourethral ligaments. These studies further showed, as was suggested by Curtis et al. (18), that the anterior and posterior ligaments were formed by reflections of the inferior and superior fascial layers of the urogenital diaphragm (Figs. 1.9 and 1.10). The intermediate ligament represents a fusion of these fascial layers.

Histologic section showed the pubourethral ligaments to consist of dense collagen, both smooth and striated muscle, and elastic fibers. The striated muscle might represent a pubourethral continuation of some fibers of the pubococcygeus (Fig. 1.11).

The remainder of the urogenital diaphragm is sandwich-like, composed of superior and inferior fascial layers separated from one another by a layer of striated muscle, the deep transverse perineal. There is minimal striated muscle extending in this area to the wall of the urethra. In general, sphincters of the body under voluntary control are formed by concentric layers of striated muscle. This

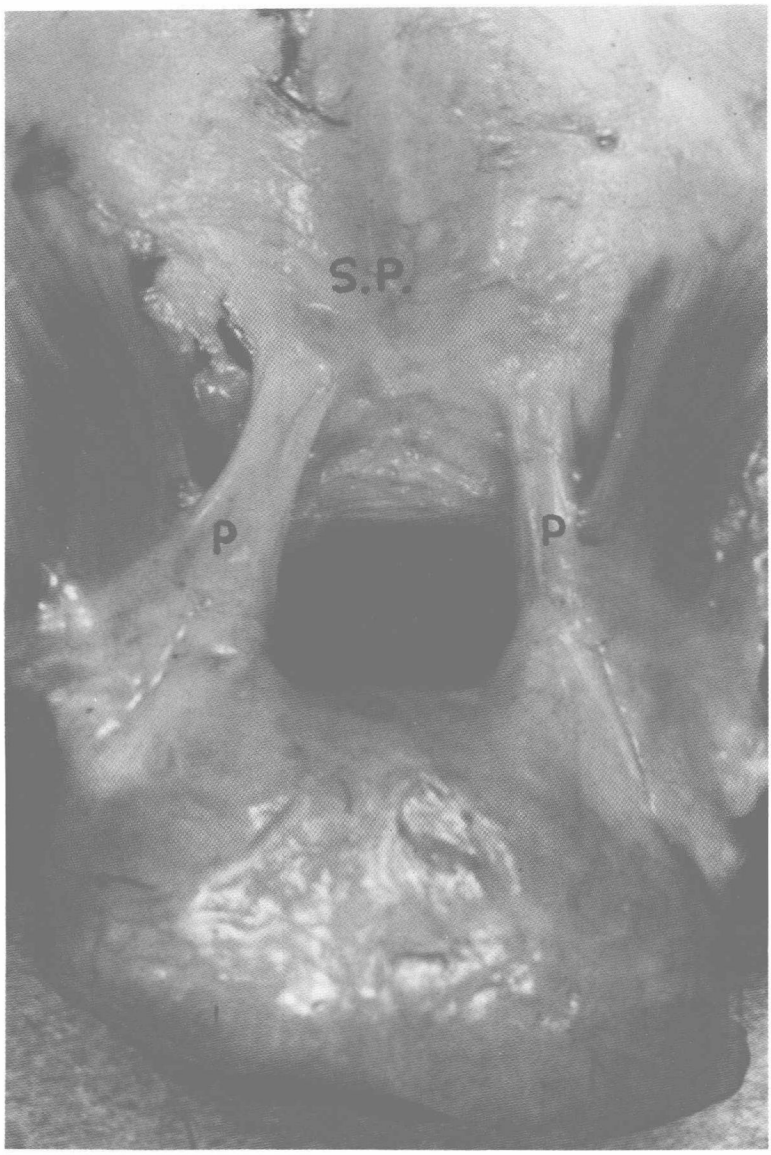

Figure 1.7 A fresh cadaver dissection is illustrated looking into the pelvis from above. The pubic symphysis (*S.P.*) is seen at the upper portion of the photograph. The bladder has been displaced posteriorly showing the posterior pubourethral ligament (*P*). The darker colored levator ani (*L.A.*) arising from the arcus tendineus is seen lateral but distinct from the pubourethral ligaments. (From Zacharin, R. F., and Gleadell, L. S.: Abdominoperineal urethral suspension. Am. J. Obstet. Gynecol. *86*:981–994, 1963; reproduced with permission of the author.)

is not true for the urethra, although some external sphincter action is provided in the midportion of the urethra by pressure from the nearby pubococcygeus muscle and in the distal urethra by pressure from the bulbocavernosi.

The urogenital diaphragm runs between the inner surfaces of the ischiopubic