THE UPPER PELVIC FLOOR AND ITS IMPORTANCE IN TOTAL ABDOMINAL HYSTERECTOMY

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IN 1888 von Bardeleben of Jena reviewed the literature pertaining to Gynecology from the time of Leonardo da Vinci (*Der Älteste Median Schnitt*) up to and including his own period and characterized the writings "with few exceptions" up to the middle of eighteen hundred as "so gut wie nichts." He states that in the year 1854 there were published three papers by three different physicians, each in a different country which laid the foundation of Gynecology. Kohlrausch published in Leipzig *Zur Anatomie und Physiologie der Beckenorgane.* He said that the position of the uterus was dependent upon the fullness of bladder and rectum, and that the cervix was fastened to the bladder by a light reticular plane of connective tissue. The second paper was printed in the *Gazette Médicale* of Paris and was an exposition by Cruveilhier on the autopsy (*Cathéterisme Utérus suive de Mort*) of a young woman who had died following the repeated use, for several days, of an indwelling catheter introduced into the uterus to correct a sharp anteflexion. Cruveilhier said that disease produced malposition of the uterus, but that malpositions existed without symptoms and did not produce disease. In the discussions with Arvard at this time Cruveilhier gave his opinion, based upon autopsies, that there was no established normal position for the nonpregnant uterus. Arvard, who had palpated and moved the uterus in the living, and found that it would immediately return to position, claimed that an angle of 75 degrees with the horizon was the normal position for the uterus. The third paper was written by Matthews Duncan, and appeared in the *Edinburgh Medical and Surgical Journal* of that same year. It was entitled "On the Displacement of the Uterus." Duncan affirmed that "Death was not a good criterion as so much depended upon muscular tonicity and vascular turgescence which disappeared with life." Duncan also wrote "A uterus that is not mobile is in a pathologic state." This is the beginning of the study of anatomy, physiology, and pathology of the pelvic organs in women.

In the *History and Bibliography of Anatomic Illustrations* written by Ludwig Choulant, he writes, "The great universal genius Leonardo da Vinci illustrated the fetus in its natural position from direct personal observation and not until William Smellie in 1754 and William Hunter in 1774, both of London, published their monumental volumes do we actually find illustrations of the fetus in utero which were

really observed and faultlessly reproduced from an anatomic point of view." There are even fewer illustrations of the nonpregnant uterus, but da Vinci has one showing graphically the blood vessels of the uterus, and Versalius has one plate in his "Fabrica" of the fusion of the müllerian ducts, and the uterus complete with the cervix, vagina, and urethra. In 1754 William Smellie published the beautiful *Set of Anatomical Tables and Practice of Midwifery.* In this work is one illustration of real historic value in gynecology as it shows the uterus supported on the vagina as it was at that time commonly believed to be. It is of interest to note that the artist (Pieter Camper) has drawn the course of muscle fibers from vagina to broad ligament. These colpovaginal muscle fibers were not utilized in plastic work on the vagina until more than a hundred years later.

While so little was done for gynecology by the anatomists immediately following Smellie, the study of pelvic conditions in women was greatly stimulated by the publications of Kohlrausch, Cruveilhier and Duncan. The greater part of the research was done on frozen sections and naturally to a much less degree on the living. The reports were so at variance that Marion Sims wrote, "I would say therefore that some of the discrepancies of the authors may be reconciled when we remember that one speaks of the condition of things in the living subject and another in the dead. The knowledge of one is gained in the clinic, of the other in the dissection room." It was then that Henle wrote that deductions based upon frozen sections were of no value as both the consistency and the position of the uterus were altered after death, for in life the tone of the muscles and the filled blood vessels were of importance in establishing the position of the uterus. In 1863 Luschka described the organized muscle fascia rich in elastic tissue that makes up the broad ligaments together with the many blood vessels and lymphatics in the lower part of the ligaments. He traced out the formation of the muscle fibers from the folds of Douglas to their insertion in the lower end of the uterus and vagina which "helped to fix the position of the uterus," and called these ligaments the "retractor uteri." Virchow demonstrated later that many of the muscle fibers in the uterosacral ligaments extend along the sides of the uterus and join with muscle fibers from the anterior face of the uterus to make up the thin layer of muscle in the uteropubic fascial plane on which the bladder rests. The position and axis of the uterus continued to be the subject of discussion and debate.

It was in 1880 that Kocks when a Privatdozent in the University of Bonn wrote his monograph on the "Normal and Pathological Position and Shape of the Uterus, and Its Mechanics." In this paper, that is today a classic in gynecology, Kocks described the positions of the uterus: answering the arguments for and against the various displacements as found in frozen sections or as found on palpation of the living. His

opinion was that the uterus has no absolute but a relative position. His arguments against the positions as found at postmortem, are that in the living (1) there is a positive abdominal pressure, (2) the influence of inspiration and expiration must be considered, (3) in the ligamentous apparatus of the pelvic organs the connective tissue which binds them together has a certain degree of "turgescence" which is lost after death, and finally (4) the muscle elements in the ligaments act with sufficient force in the living to influence the position of the uterus. Kocks described the mechanics of the pelvis and says: "The Bases of the broad ligaments build the axis of the uterus and from their importance should be called the Cardinal ligaments." He said: "They build, according to my thinking, the material 'substrat' of the axis and account for the normal ante version of the uterus." He called the base of the broad

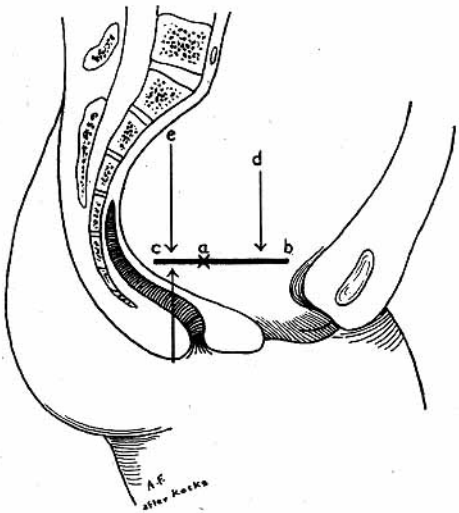

Fig. 1.—Cardinal transverse horizontal axis. (From Kocks.)

ligaments the "cardinal transverse horizontal axis" and said on this axis the uterus turns as on a lever with two arms (Fig. 1). The anterior longer arm (*a-b*) is the position of the uterus in young women or in nulliparas. The posterior shorter arm (*a-c*) is the position of the uterus after pregnancy has occurred. The uterus then has a longer axis upward due to its increase in size and sinks lower toward the vaginal outlet owing to the softening of the pelvic tissues, and it is not as sharply bent forward as in a nullipara. The intraabdominal pressure is greater on the axis *a-c*, but may be equal in both axes under certain conditions. In a summing up of the position and mechanics of the uterus, Kocks gives such an exact and concise description, I will quote in its entirety. He says: "The upper pelvic floor consists of the bases of the broad ligaments, the uterine end of the ligamentum sacri uteri, the ligamentum vesico uteri, the posterior wall of the bladder, and the anterior wall of the

rectum, all of which are bound together by connective tissue fibers and covered with peritoneum and inserted into the uterus at the height of the internal os. The finger thick bases of the broad ligaments form the true lever ('Drehpuntke') for the mechanics of the uterus.'' Two years after Kocks' monograph, Berry-Hart of Edinburgh published his atlas and about the same time Savage of London brought out his beautifully colored plates of the pelvic organs in women. Berry-Hart described the fibromuscular tissue of the uterosacral ligaments as alike in structure with the broad ligaments with which they are joined, differing only in the greater proportion of muscle in the uterosacral ligaments and in the great amount of elastic tissue throughout the broad ligaments, and the connective tissue at their base. The uterosacral ligaments have at their upper border a flat fold of muscle fascia that extends from the uterus to the rectum and if one wishes to be ana-

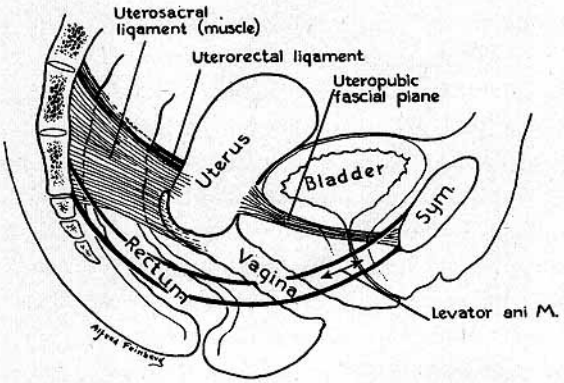

Fig. 2.—Uterosacral ligaments, uteropubic fascial plane, and the levator ani muscle.

tomically correct they should be called uterorectal ligaments. The true uterosacral ligaments lie just below these two folds and extend (on each side of the rectum) from about the third sacral vertebrae to be inserted into the posterior surface of the uterus at the height of the internal os and this insertion of the ligaments extends down the entire posterior cervix and then down to be inserted into the posterior wall of the vagina. It is due to the thickness of these muscles, and to their insertion into the posterior cervix and vagina that the uterosacral ligaments become the strongest factor in the upper pelvic floor that influences the position of the uterus. Luschka rightly termed them the ''retractor uteri.''

The elastic tissue in the broad ligaments allows of movement of the tissues themselves and of displacement of the uterus laterally or posterior or for growth of the uterus upward without disturbance or injury of the tissues themselves in the broad ligaments. The anterior portion of the upper pelvic floor is composed of light re-

ticular fascia, and the uteropubic fascial plane on which the bladder rests is made up of connective tissue with only a thin layer of muscle and almost no elastic tissue. It is for this reason that the powerful muscles in the uterosacral ligaments can influence the position and direction of the descending head in labor as proved by x-ray studies made by Caldwell and Moley. It is also the reason why the most common and often the only visible injury after labor is a resulting cystocele due to the pressure on the uteropubic fascial plane which splits longitudinally and its torn edges (so erroneously called the "pillars of the bladder") stretch apart from the continued intraabdominal pressure. The bladder forced by prolonged pressure from above slips through the gap in the torn fascial plane just as a loop of intestine does in a hernia. The connective tissue in the base of the broad ligaments was well described first by Savage who wrote: "The uterine system may be conceived as having been thrust into the pelvis between the rectum and bladder and there fixing itself by cellular attachments to every available part of the pelvic cavity." Savage was also the first to note that infection in the broad ligaments long remained local without involvement of the ureter, rectum, or bladder. He also showed that the uterine cellular system is continuous at its periphery with every part of the subperitoneal cellular tissue at the lower part of the abdomen. The beautiful illustrations in the atlas by Sappey of his work on the lymphatics of the body depict the glands lying in the broad ligaments and the course of the lymphatics from the uterus. The importance of removing these glands in the broad ligaments was stressed by Wertheim when performing hysterectomy for cancer of the cervix. In 1885 Freund published his work on the connective tissue of the pelvis and the result of an inflammation that involves it, and Testut later described the "phlegmons" or abscesses of the broad ligaments with the four routes of approach:

1. Vaginal route. By incision direct without opening the peritoneum.
2. Perineal route of Hegar and Sänger that crosses the ischiorectal fossa and levator ani.
3. Parasacral route of Zuckerkandl and Wolfer and is made at the border of the sacrum upon the sides of the rectum.
4. Abdominal "Sous peritoneale" of Pozzi.

The sympathetic ganglia lying on the posterior leaves of the broad ligaments had been shown as early as 1867 by Frankenhauser and proved by their location why operations on the posterior pelvis produce so much more shock than in operations on the anterior part of the pelvis. It is undoubtedly one reason for less shock in a vaginal hysterectomy than in an abdominal hysterectomy as there is not nearly so great an invasion and injury by clamps to the broad ligaments in the former that there is in the latter. In 1894 Mackenrodt of Berlin wrote concerning "the normal and pathologic position of the uterus" and described the tissues

of the broad ligament which he called the "ligamentum transversale Colli." This ligament ("band") has been the subject of much discussion and several papers have been written denying its existence, the reason being, I believe, is a misconception of Mackenrodt's use of the word "band." The illustration published in the same issue of the *Archives of Gynecologie* certainly leaves no doubt that Mackenrodt intended the entire broad ligament as the "ligamentum transversale Colli." Mackenrodt's exposition of the tissues in the broad ligament adds nothing to the work of the previous writers but is of value in as much as he maintains that the broad ligaments are the supporting structures of the uterus. The objection is often made that the tissues described by both Kocks and Mackenrodt are not true ligaments, and this may explain why their studies have not received more recognition.

In 1899 Waldeyer of Berlin in his great work "Das Becken" showed by illustrations the embryologic and anatomic formation of the structures composing the broad ligaments. (a) The three ligaments that lie on each side of the uterus in the folds of the broad ligaments begin early in embryologic life as two strands of tissue that cross (one on each side) the müllerian ducts. Later in fetal life having derived muscle from the outer coat of the uterus, the anterior portion of each strand of tissue becomes a round ligament, similar to the "Gubernaculum" of John Hunter, and composed of muscle and elastic tissue in its upper half and of connective tissue in the lower half where it is attached to the pubic bone and labia majora. Berry-Hart in his interesting work has traced the physiologic descent of both the ovaries and testes in the human fetus and says the descent of the ovary is analogous to that of the testes, but its further descent in the pelvis is checked by the broad ligament and the uterus. In the adult female the ovaries lie on the posterior aspect of the broad ligament, on the lateral pelvic wall in front of the sacroiliac joints, immediately below the ileopectineal line and with the ureter curving behind. The pelvic ectopia testis is analogous to the normal ovarii position. The inguinal and lateral ectopia ovarii are normal stages for the testes. The upper part of the strands of embryonic tissue Waldeyer showed take their muscle from the uterus and are continued as the ovarian ligament and then as the infundibulo pelvic ligament. If the ovaries are to be left in situ when performing a hysterectomy, the ovarian ligaments (by virtue of this muscle) should be fastened to the vaginal or cervical wound before closing it.

Luschke (in 1863) first called attention to the proximity of the ureter to the ovary just as the ureter is about to enter the broad ligament, where it lies superficially under the posterior leaf of the broad ligament to which it is attached. The ureter continues directly under the hilum of the ovary to which it is often adherent, and as it emerges from the broad ligament lies close to the vaginal plexus of veins. (b) The origin of the base of the

broad ligament is shown by Waldeyer to be from the uterus at the height of the internal os. The muscle is derived from the outer muscular coat of the uterus as shown (in 1600) by Pietro Sue. Its fibers extend from the uterus transversely and obliquely to the pelvic wall and laterally are continuous with the adjacent tissue. There is no line of demarcation between this muscle and the uterus and no attachment of the broad ligament to the uterus as it is sometimes stated in the textbooks. The connective tissue sheaths of veins, lymphatics, blood vessels, and ureters run more or less obliquely from back forward and from above downward through the broad ligament, strengthening them but not fixing the tissues rigidly, for the great amount of elastic tissue present in the folds of the ligaments permits considerable movement of these sheaths, and allows for the growth of the uterus upward in pregnancy or for lateral or posterior displacements of the uterus or for its enlargement by tumors.

An excellent description of the external appearance of the broad ligament is given by Testut who says: "The broad ligament consists of two folds of peritoneum as they leave the sides of the uterus in close apposition one to the other for a part of the distance to the lateral walls of the pelvis. They form a sheet of tissue irregularly quadrilateral whose upper border is free, thin and mobile, whose other borders are thick and attached to the lateral wall of the pelvis and to the upper pelvic floor and of a part of the uterus. This sheet of tissue8 forms on each side of the uterus as two wings to the uterus and consists only of the broad ligaments. (A) The anterior face of the broad ligament looks forward and downward. (B) The posterior face, which is larger, looks backward and upward and envelopes part of the ovary and its ligament, the mesosalpinx and the hooded cap of the ovary. (C) The superior border encloses the fallopian tube, ovary, and its ligaments. (D) The inferior border, the thickest of the four borders, rests on the upper pelvic floor. It is in close contact with the lateral culdesac of the vagina. It contains the ureter and the horizontal part of the uterine artery. (E) The internal border, thick and short, rests at the side of the uterus, it contains the ascending part of the uterine artery and the venous plexus. (F) The external border relatively thin rests at the lateral wall of the excavation. In the upper part between the pavillon of the tube and the external extremity of the ovary, it is free and "flottant." Below the ovary it adheres closely to the pelvic wall near the obturator internum and its aponeurosis, and at the extremity of the ovary it continues as the ligamentum infundibulo pelvic or ilio-ovarium or lumbar ovarian. It lodges the ovarian artery and vessels and contains smooth muscle (Luscke's 'retractor of the fallopian tube'). It crosses the iliac vessels, then the border of the psoas muscle to the lumbar region. (3) Anatomique construction: The broad ligament is composed essentially of two leaves of serous tissue with a sheet of smooth muscle and united one with the other by a bed of cellular vascular tissue. A sagittal

section shows it consists of: (A) Mesosalpinx; Two leaves of peritoneum, between is a bed of cellular elastic tissue and some blood vessels. (B) Base of the broad ligament; lymphatics, cellular tissue, and blood vessels.''

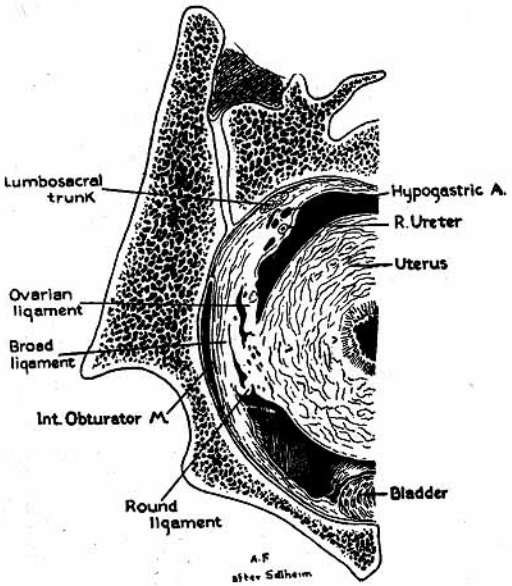

Fig. 3.—Cross-section at about the first sacral vertebra showing the broad ligament and its relation to the obturator internus muscle, etc. (After Sellheim.)

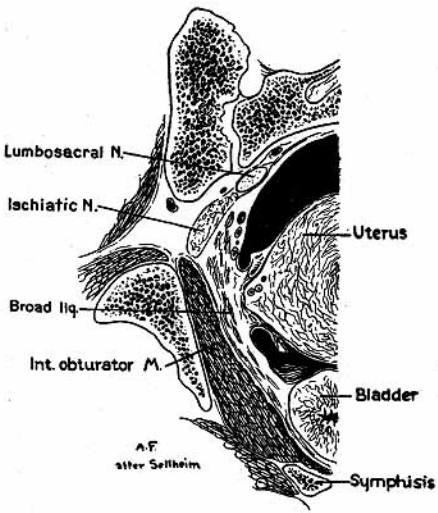

Fig. 4.—Cross-section 2 cm. below that in the preceding illustration showing the broad ligament and its relation to the obturator internus muscle and the sheaths of the nerve trunks. (After Sellheim.)

The relation of the structures to one another in the broad ligaments and to the adjacent structures have been shown by the admirable dissection (Fig. 3) made by Sellheim. Comparative anatomy of the female

pelvic organs has seldom been described and never more beautifully illustrated than in these dissections (Fig. 4). If we bear in mind that as Blair-Bell has said, the important fact that there are no aponeurotic fasciae except in relation to muscle surfaces (Fig. 5) and that when fascia comes

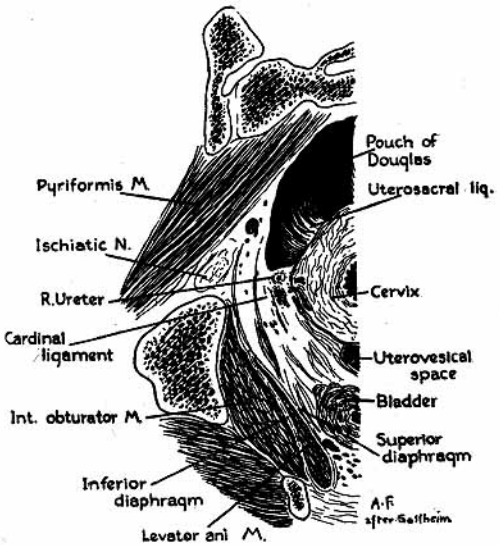

Fig. 5.—Cross-section 2 cm. below that in the preceding illustration, showing the cardinal ligament and its relation to the pyriform, internal obturator, and levator ani muscles, the sheaths of nerves, ureter and blood vessels. (After Sellheim.)

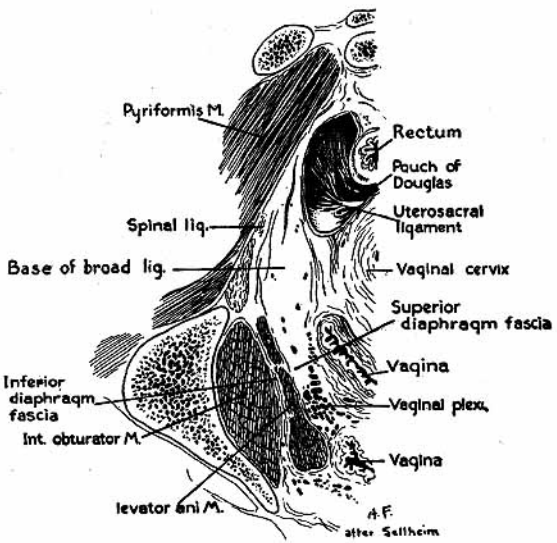

Fig. 6.—Cross-section 2 cm. below that in the preceding illustration showing the base of the broad ligament and its relation to the pyriform and levator ani muscles, the spinal ligament and the ureterosacral ligament. (After Sellheim.)

into relation with blood vessels, lymphatics or nerves, it forms fibrous bands and sheaths. This increases the supporting power of the structures in the broad ligaments. Add to this the fact that the levator ani (Fig. 6)

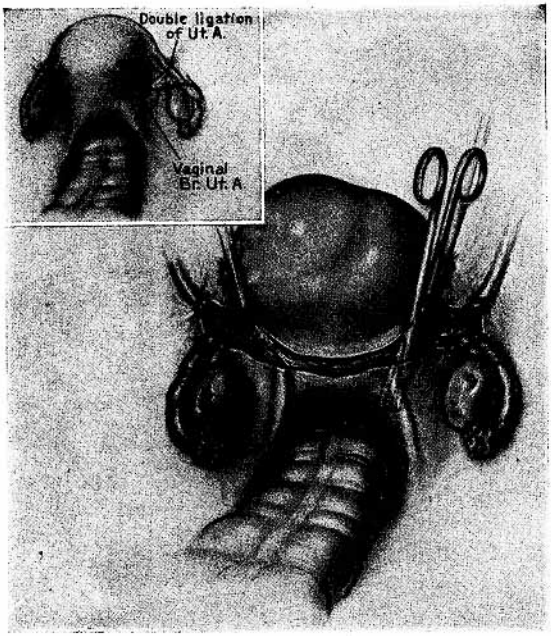

Fig. 7.—Uterine artery ligated at entrance into lateral wall of uterus and again beyond origin of vaginal branch from uterine artery. Scissors cutting down sides of uterus—*no clamps.*

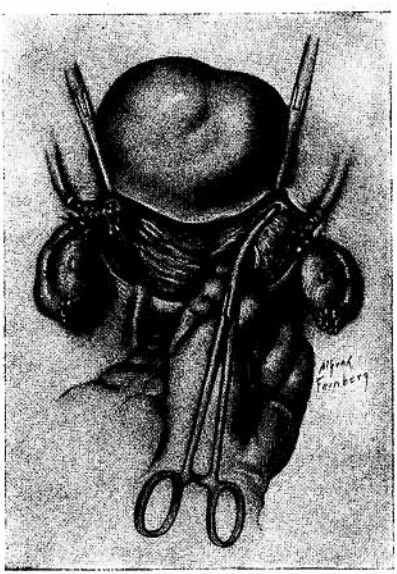

Fig. 8.

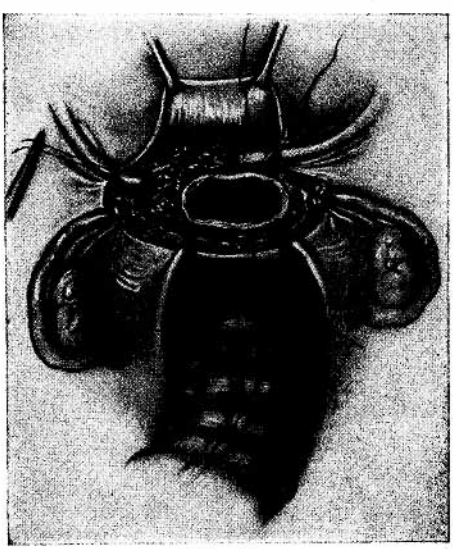

Fig. 9.

Fig. 8.—Finger introduced through the opening made into vagina to apply an artery clamp close to side of uterus before cutting out uterus.

Fig. 9.—Sewing the round ligaments to the sutured vaginal wound.

arises from the back of the pubic bone and the fascia on the internal surface of the compressor urethrae with which its fascial coverings are blended, that its superior fascial covering is attached to the aponeurosis of that of the muscles above, and posteriorly its aponeurosis is adherent to the ischial spine and continues to the side and anterior surface of the coccyx where the fasciae from either side unite in the midline. Thus the whole upper floor forms a united structure for the support of the uterus.

The tissues in the broad ligament vary greatly even in young women depending upon the age, general constitution and muscular develop-

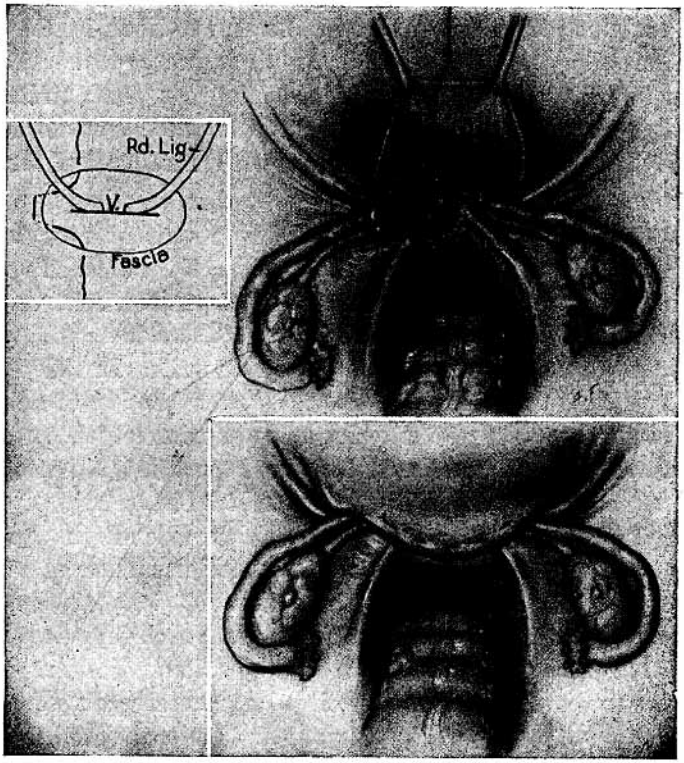

Fig. 10.—Sewing uterosacrals to round ligaments and uteropubic fascial plane.

ment. They are greatly increased in vascularity and elasticity during pregnancy. In the normally developed young women and in nulliparas the broad ligaments are soft, firm and only moderately yielding to pressure, unless examined when the individual is under an anesthetic. In multipara the tissues are thicker and less resistant. In the aged the muscles are much thinner and the uterus is more readily displaced downward, due not always to torn muscle, but also to the loss of the very large amount of elastic tissue that is normally present in the younger women. If fibroids have developed in the uterus, the tissue of the broad ligaments may have the same firmness as the uterine tissue and be as hard to cut as gristle when taking out the uterus in an abdominal

hysterectomy. The effect of inflammation or suppuration in the parametrium may be to leave a chronically thickened tissue across the base of the upper pelvic floor. The development of connective tissue and its supporting effect may be seen after radium treatment for cancer of the cervix when the vault of the vagina has become narrow in width and much thickened with no prolapse of the now shrunken cervix, although perhaps below the irradiated tissues may be seen a gaping vulvar orifice with a large cystocele and rectocele bulging into the vagina. The development and character of the tissues in the broad ligaments vary greatly then in the living, depending not only upon age and constitution but also upon the effect of injuries incident to labor, loss of muscular tone and elasticity, and to inflammation or tumor growth, all of which should be taken into consideration before operating. As Von Bardeleben said many years ago: "Anatomy is not the knowledge of a cadaver, nor of dead tissues, but it is a part of the knowledge we have of the living."

It was not until nearly the end of 1800 that surgeons began to use the paracervical and paravaginal tissues in repair of prolapse of the uterus. In 1887 and 1888 Ernst Cohn of Berlin published the results obtained by Schroder and Olshausen who performed anterior or posterior colporrhaphy for this condition and in a few cases the combined operation on both the anterior and posterior vaginal walls. In 1888 Archibald Donald of Manchester, England did his first operation of amputating the cervix and then doing an anterior and posterior colporrhaphy on the same patient. Donald published his first report in 1902 and in 1903 Alexandroff of Smolensk of Russia described his technic of bringing the base of the broad ligaments from either side of the cervix and suturing them to one another and to the anterior surface of the cervix. It is of further interest that in the year 1907, 1908, 1909, surgeons of different countries should so nearly duplicate their knowledge and use of these tissues in prolapse. In 1907 Halban and Tandler published their work on the anatomy and etiology of genital prolapse in women in which they state that the levator ani and the associated muscles are the essential factors in keeping the uterus in place. In 1908 Fothergill of Manchester, who has continued to practice the technic first used by Donald and which now is called that of the Manchester School, wrote on the "Support of the Pelvic Viscera." In a later paper Fothergill said: "Clinical experience gradually taught me that the uterus, vagina, and bladder are mainly kept in their place by the lateral combination of unstriped muscle and connective tissue known as the parametrium and the paracolpos." One year later William Mecklenburg Polk presented before the American Gynecological Society "The Suprapubic Operation on the Upper Pelvic Floor for Prolapse of the Uterus." Since then two other members of this society namely, Robert L. Dickinson, and Robert T. Frank have contributed greatly to our knowledge of the supporting tissues of the upper pelvic floor.

The importance then of the upper pelvic floor in total abdominal hysterectomy is to avoid so far as possible injuring the structures that lie in its depths and utilizing the supporting tissues in closing. (1) Hemorrhage from the vaginal venous plexus may be avoided by ligating the uterine artery, not only where it enters the uterus, but also before the vaginal and cervical branches is given off from the uterine artery. (2) Injury to the sympathetic ganglia lying on the posterior leaf of the broad ligament may be avoided by cutting down the broad ligaments close to the sides of the uterus without applying any clamp to the broad ligaments (Fig. 7). (3) By cutting the uterosacral muscles and entering the vagina (Fig. 8) posteriorly the uterus will be loosened and a finger introduced into the vagina (which may be done safely if the vagina has been properly scrubbed, douched, and iodinized) which may act as a guide for the application of clamps to the vagina and insures cutting out the uterus; but neither cutting too much of the broad ligament and injuring ureters or bladder, nor cutting into the uterus and leaving part of the cervix in situ. In this the technic resembles that of the usual vaginal hysterectomy. (4) Careful closure of the vaginal wound which should be made in an anteroposterior direction and not from side to side as it may distort or injure the ureters (a) by suturing the muscle walls of the vagina, (b) attaching to them, round ligaments, uterosacral ligaments, ovarian ligaments if left and the uteropubic fascial plane, (c) covering the wound completely and exactly with the vesical peritoneum.

CONCLUSIONS

1. The upper pelvic floor is made up of unstriped muscle, elastic and connective tissue derived from or attached to the lower part of the uterus and vagina. It includes the fibrous bands or sheaths of the nerves, blood vessels, lymphatics and ureters lying in the broad ligaments, the levator ani and its fascial coverings which are attached to that of the compressor urethrae anteriorly, to the ischial spine and coccyx posteriorly and which blend with the aponeurosis of the muscles which lie above it in the broad ligament.

2. It is important in total abdominal hysterectomy to employ a technic by which one may remove the entire uterus without invading the broad ligament.

3. The tissues of the parametrium and paracolpos should be used to ensure a firm closure of the vaginal wound and maintain the support of the upper pelvic floor.

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DISCUSSION

DR. J. P. PRATT, DETROIT, MICH. (By Invitation).—All investigations to determine the means of support of the uterus by the upper pelvic floor seem to emphasize the importance of the broad ligaments. Attention has of course wisely been focused on the difference between the state of the living subject and the cadaver. In either case, however, the broad ligament is given first place. The ingenious experiments of Mengert upon the cadaver (Mengert, W. F.: Mechanics of Uterine Support and Position, AM. J. OBST. & GYNEC. 31: 775, 1936) furnish confirmation of the value of the broad ligaments and indicate also an equal importance for the paravaginal tissue.

In the living subject, ample opportunity to confirm the findings in the cadaver is provided by observation at the time a vaginal or abdominal hysterectomy is performed. During the operation the support of the uterus is maintained until the parametrial and paravaginal tissues are divided. Only then is it possible to move the uterus an appreciable distance from its normal position. An occasional exception occurs when the uterosacral ligaments are unusually well developed or fixed. Collective observations of normal individual variations as well as pathologic conditions emphasize the similarity and close association of the parametrial, paravaginal and uterosacral structures in the living subject.

Satisfactory restoration of the upper pelvic floor may be accomplished by any method that brings the normal supports together without tension. In abdominal hysterectomy, closure of the vagina by a purse string suture rather than in an anterior-posterior direction has the following advantages: (1) By this method the tension is equalized. (2) If scarring disturbs the elasticity in a portion of the circumference of the vagina the more elastic tissues yield, and compensate for the abnormally fixed tissues. (3) The main supports of the pelvic floor come from the sides of the pelvis, and a purse string tends to approximate the lateral structures and obliterate the weak area in the center.

The independence of the upper from the lower pelvic floor is demonstrated when an abdominal hysterectomy is performed in the presence of uterine prolapse, cystocele, and rectocele, and when for various reasons the two latter lesions remain unrepaired. A few such cases have been observed several years after the original operation. Some of these have showed the vaginal vault well supported in spite of the persisting cystocele and rectocele.

DR. C. B. INGRAHAM, DENVER, COLO.—In Mengert's experiments, division of the round, ovarian, infundibulo-pelvic ligaments, and the upper part of the broad ligaments hardly affected the position of the uterus in the pelvis. The uterosacral ligaments furnished a small amount of support, which he explains by the fact that they are closely connected anatomically to the parametrial tissues. The so-called pubocervical ligaments played a negligible rôle. When all parametrial and paravaginal tissues were severed, but the round ligaments were left intact, the cervix prolapsed through the introitus without even tensing the round ligaments.

The pelvic diaphragm and the pelvic floor remained intact in all experiments, and in no instance interfered with uterine descent. It is doubtful whether the pelvic floor affords any support to the uterus. Division of the parametrial and paravaginal tissues comprising the lower two-thirds of the broad ligament, and the upper two-thirds of the paravaginal structures, allowed the uterus to descend over 10 cm. 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. When all the structures above the vagina were severed, so that the sole support of the uterus was its attachment to the vagina, and in one instance when only 1 cm. of the circumference of the vaginal wall remained attached to the uterus, noticeable descent did not occur.

These experiments show that the paravaginal support is fully as important as the parametrial, if not more so, and that these structures furnish practically all of the uterine support. The parametrial and paravaginal are identical structures, one merely a continuation of the other, and whether a ligament or fascia, or loose areolar tissue, is not so important as the fact that they are the main support of the uterus.

Mackenrodt felt that the parametrial and paravaginal tissues were the primary support of the uterus referring to the "pelvic fascia sending out firm bands to the cervix uteri and the vagina, holding and fixing them."

The idea of injury to the sympathetic plexus is an important observation as regards shock. Dr. Farrar's means of preserving these tissues with a minimum of injury, and her reconstruction of the upper pelvic floor after total abdominal hysterectomy, brings us a valuable contribution.

DR. JOSHUA WILLIAM DAVIES, NEW YORK, N. Y.—To understand pelvic anatomy, it is desirable to go back to an early ancestor before the fusion of the iliac bones with the sacrum in back and with each other in front formed a rigid pelvic outlet. Then the pelvic outlet may be compared with the anterior abdominal wall and this comparison will lead to logical conclusions about the sphincters of the urethra, vagina and the rectum. This ancestor was an aquatic animal surrounded by three muscular planes which were ensheathed with a layer of restraining tissue called fascia. Superficial and deep to the musculofascial structure was a layer of fibroareolar tissue containing varying quantities of fat, fibrous tissue and involuntary muscle strands. On the deep side of the musculofascial structure the fibroareolar layer is called the preperitoneal layer.

It is in this preperitoneal layer that the thoracic, abdominal and pelvic organs develop. The peritoneum is pushed before the future abdominal organs into the peritoneal cavity so that the intestine, liver and uterus appear to lie in the abdominal cavity. The bladder, vagina and uterus also develop in this preperitoneal layer. To communicate externally the bladder, vagina and rectum must perforate the three musculofascial planes surrounding the body, hence each opening is surrounded by three voluntary sphincters. Each of us readily accepts such a sphincter control around the anus, but without comparing the outlet with the abdominal wall, it is rather difficult to do so.

The vagina is the result of the fusion of the two Muellerian ducts which lie in the preperitoneal layer. Each duct has its own blood supply and as the ducts approximate each other and fuse, the vagina, cervix and uterus lie in the center of a sling which is composed laterally of blood vessels lying in the preperitoneal layer. Instead of being called the broad ligament of the uterus and the lateral ligament of the vagina, the term "mesenteroid" would be more descriptive. Practically, this fact is of value in plastic cases which are greatly relaxed as well as in complete hysterectomies because a side to side closure of the vault of the vagina will increase the tonicity of the vaginal supports.

DR. GEORGE GRAY WARD, NEW YORK, N. Y.—Dr. Farrar's presentation emphasizes the principle that when we remove the entire uterus we should not sacrifice the structures that supported the organ and the vaginal vault, but should employ a technic that maintains their integrity.

These structures, which were called the "upper pelvic floor" by Polk in contradistinction to the pelvic diaphragm below, are not only the main support of the uterus, but hold as well the upper vagina as the paracolpos fuses with it. This slide I show is a diagrammatic representation of this "upper pelvic floor." We see this plane of connective tissue and fascia completely surrounding the cervix with a firm collar and extending out in a fan shape to the walls of the pelvis. Anteriorly it forms the pubocervical fascial plane which supports the base of the bladder. Laterally it forms the base of the broad ligaments, the cardinal ligaments, which are dense and strong, and posteriorly it divides to form the uterosacral ligaments.

Victor Bonney has designated it as the "pelvic shelf" and stresses that it is a continuous sheath. Robert Frank has aptly termed it the "holding apparatus" of the uterus, and speaks of the pelvic diaphragm below at the pelvic outlet as the "supporting apparatus" which acts as a shock absorber in case of stress. Dr. Chipman has likened the uterus to a person sitting in a swing, the upper pelvic floor—and steadied above with the feet resting below on a foot rest—the pelvic diaphragm, which is an accessory support.

In doing a panhysterectomy we should bear in mind the importance of conserving this structure in order to maintain an adequate support of the upper vagina and the vaginal vault, and we should employ a technic which hugs the uterus sufficiently close so as not to destroy these important tissues which contain blood vessels, lymphatics and nerves.

DR. GEORGE W. KOSMAK, NEW YORK, N. Y.—A word of commendation should be extended to Dr. Davies for the exceedingly illuminating description he has given of the arrangements of these muscles and fascia. We have not gone back far enough into embryology and comparative anatomy properly to evaluate these various structures in the female pelvis.

DR. LILIAN K. P. FARRAR (Closing).—There are only one or two things that I would like to speak of. First, Waldeyer demonstrated that the uterosacral ligaments are continuous (along the sides of the uterus) with the uteropubic fascial plane and for this reason it is better to close the vaginal wound in an anteroposterior direction. This direction is better also for the very important reason that closure from side to side will distort the ureters. Second, it was Kocks in 1860 who first used the term "Upper Pelvic Floor."

Third, Dr. Worrall of Australia and Dr. Lahey of Boston when performing an hysterectomy cut down the sides of the uterus, leaving a part of the uterus and cervix in situ. They say that by doing so they do not disturb the attachments of the broad ligaments to the uterus. But there are no "attachments." The muscle is continuous from the uterus to form the broad ligaments. The entire uterus and all the cervix should be removed, otherwise the operation is a subtotal and not a total hysterectomy.