

injuries of sensitive nerve-fibers as widely or as in their natural state.

#### TREATMENT.

1. Quiet, rest in the horizontal position and artificial moist heat have long been recognized as valuable means of restoring the lost tone to the vasomotor system.

2. Lower the head enough to make gravity aid in furnishing sufficient blood to nourish and excite to proper function the important reflex centers of respiration and the heart's action in the medulla, as well as the visceral ganglia in the lungs and heart themselves.

3. Experiments have conclusively shown that while shock first affects the vasomotor system, respiration is early impaired or stopped some time before the heart's action is seriously deranged or stopped, and, therefore, artificial respiration may be the means of continuing life by furnishing oxygenated blood for the vital centers in the medulla. The inhalation of oxygen is likewise indicated for the same purpose.

4. The interstitial and intravenous injection of the warm salt solution is perhaps our most efficient, certain, powerful and lasting remedy, particularly when there has been hemorrhage, and when the case is not specially urgent the same solution may be efficient when introduced into the stomach or rectum, and when convenient the peritoneal cavity may be used for the same purpose.

5. The therapeutic remedies are all those which will restore the tone of the vasomotor system and support respiration and the heart's action. Of the many drugs which have been recommended and used, strychnia probably claims, rightfully, the most friends, used in the way the operator deems best to reach the circulation and so the nerve-centers; next digitalis and strophanthus, nitroglycerin and ergot in appropriate dose, and lastly the various glandular extracts, as of the suprarenal, thymus, thyroid, mammary and parotid glands<sup>1</sup>. Of these the extract of suprarenal capsule in 5-gr. tablets<sup>2</sup>, internally, also locally and hypodermically, is the most in favor at present, as a vasomotor and heart stimulant.

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### THE RECONSTRUCTION OF THE PELVIC STRUCTURES INCIDENT TO LESIONS OF PERINEUM\*.

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When in London some time ago, the plastic repair of the pelvic structures was under discussion. One of the most distinguished surgeons said to me: "You will at least grant that we have settled upon the better methods for the restoration of the perineum," and yet, on further inquiry, I found that he advocated his own peculiar operation as the best, and disagreed with every other writer on the subject. I am quite sure that the methods in practice by distinguished operators differ essentially, both in principle and technic, and that which is of the most importance, the resultant, is often defective and unsatisfactory. I can not help thinking that this is due primarily to an imperfect knowledge of the structures and functions of the parts involved. Of the structures, the anatomy of the pelvic floor in woman has very generally been imperfectly described and studied.

I review my own publications on this subject with more than ordinary satisfaction, since they may be considered as progressive phases in the study of a problem

which has occupied more than an ordinary share of my attention for a number of years, and to what I now offer, although perhaps not conclusive or final, I invite your consideration and earnest criticism.

All good surgery must be based on a thorough knowledge of anatomy, and while this is essentially true in the consideration of every operative measure, as for example, the resection of a bone, or the ligation of a vessel, it is especially to be emphasized where the avowed object of the operator is the restoration of the injured parts to their original normal condition.

The surgical anatomy of the male perineum may be said to have been practically demonstrated, and the subject long since exhausted. It is a *sine qua non* to the graduation of every medical student, and properly so, because of the importance of such knowledge in the practice of every-day life; but if this is necessary to the proper consideration of diseases of the male, how much greater the need of a familiar and accurate understanding of the pelvic organs, their relationship, and supports, in the female!

Here, in addition to the lower segment of the alimentary canal and its outlet, the position and retention of the bladder with its efferent passage, are placed the complex organs of reproduction, which necessitate a third and the largest of the openings through the pelvic floor. Not alone should this give additional interest and importance to the careful study of the female pelvis and its contents, when in the exercise of the ordinary functions of life, but especially when we take into consideration the physiologic changes occurring during pregnancy and parturition—conditions so important and which occupy so large a share of the attention of the profession and often demand from its members the exercise of the highest skill and ability. If, happily, the recovery from parturition renders danger to life no longer imminent, nevertheless every practitioner listens to the almost daily complaint of suffering dependent on injury to the parts involved and the reflex disturbances resulting therefrom.

The comparison of the component structures of the male and female pelvis shows a closer analogy than is at first apparent. The levatores ani in the male are inseparably blended with the sphincter ani. The transversi perinei join in a central tendinous line with the levators and sphincter in front of the anus; and anteriorly, between this point and the accelerator urinæ and erector penis there exists an irregular space, floored by the deep perineal fasciæ, called the triangular ligament of the urethra. This corresponds to the vaginal opening in the female. The accelerator urinæ, or ejaculator muscle, separated in the median raphe, is not very unlike the sphincter vaginæ muscle. The erector penis and erector clitoridis are similar in position and function. The transversi perinei are placed more obliquely in the male than in the female, and are often less well developed.

The depth of the perineum is less than usually described. The axis of the anus, cutting that of the vagina at nearly right-angles, leaves, in the external angle, an irregular flattened portion of tissue rarely, when examined on the living subject, more than one-half an inch in thickness. In the nulliparous woman this is clearly defined as a firm portion of the pelvic floor, and is composed of skin, fat, elastic and connective tissue, transverse muscles, sustaining fascia, and the anterior portion of the sphincter ani.

The vaginal side is usually slightly concave, and the rectal side convex, owing to the interblending of the sphincter ani. If the finger be carried just within the

<sup>1</sup> Dr. J. B. Stober, Am. Jour. Obstetrics, September, 1898.

<sup>2</sup> Dr. W. H. Bates, Medical Record, Oct. 8, 1898.

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perineum proper and a little to one side, there can be felt the firm encircling band of the levator pubo-coccygeus, attached to each ramus of the pubis above and descending to join with the posterior fibers of the sphincter ani and coccyx. In the perineum posteriorly this is firmly interblended on either side with the transversus perinei muscles. These are under the control of volition in considerable degree, and acting conjointly, serve to draw the vagina forward on to the pubis.

The parturient and fecal canals are supported in the pelvic basin in close apposition, and the functional relationship is often such that the one may encroach on the other in such a way as to occupy nearly all the space accorded to both. This is especially true in parturition, when the rectal space is reduced to a thin folded tube; and often in elderly women who have borne children, the rectum becomes saccated, pushing forward the posterior vaginal wall, forming a considerable sized external tumor. The pelvic floor is so formed and blended about these openings that it not only properly supports the vagina and rectum, but materially aids in their physiologic function. In intimate relation to both are the bladder and uterus in their ever-varying functional activity, and each is surrounded by a delicate plexus of nerves and vessels.

The sacral prominence throws a large proportion of the abdominal weight on the symphysis pubis and the recti muscles, in the support of the body, and thus relieves the pelvic basin and takes off undue strain on the pelvic floor. The rectum is rarely entirely empty, is circular in shape, serves the digestive apparatus in a measure as a constantly receiving reservoir, and, when not distended, may be felt from the vagina, as a rule, curving posteriorly. It is suspended and supported, slung, so to speak, by the levator ani muscles, which holds the vagina in their encircling loop. On the contrary, the vagina, entirely unlike the earlier diagrams, is flattened antero-posteriorly on itself, and in health its walls are, when at rest, ever in close apposition. The vagina joins with the vulva at right-angles to its lateral opening at the entrance of its passage through the pelvic floor. The vulvar organs are all intimately blended with, and go to form a part of the perineum proper. On each side of the vaginal orifice are the erector clitoridis, the bulbo-cavernosus, and the transversus perinei muscles, and these with the levator ani make up, in large measure, the pelvic floor. The bulbo-vaginal and Bartholinian glands are covered by these muscles with their erectile plexus of vessels and abundant distribution of lymphatics and nerves.

The erector clitoridis and bulbo-cavernosus muscles with the transversus perinei join on each side to constitute the ovate, muscular vaginal orifice and, in their conjoined action, perform a very important physiologic function in sexual congress, often underestimated or ignored. Their impaired function frequently underlies certain reflex nervous conditions, distinctly pathologic, which are easily overlooked, but are the cause of much suffering and unhappiness.

The much discussed, so-called perineal body has, in my opinion, misled some of our prominent authors into false positions and caused great confusion and misunderstanding among physicians. I have been criticised, in emphasizing the muscular floor of the pelvis, that I underestimate the importance of the vari-ously distributed connective tissues and fascia. This is not by any means my intention. The superficial perineal fascia, in its deep layer in the male, as well as in the female, covers and encloses the transversus perinei

muscles, forming strong ligamentous transverse bands, uniting in the perineum, designated by Savage as ischio-perineal ligaments. The transversi are much more developed and cross the pelvic opening nearly at a right-angle to a line drawn from the symphysis to the coccyx. At their central point of union they interdigitate or blend with the fibers of the levator loop in the posterior vulvar region, and go to make up the central point of support in the floor of the pelvis. These muscles are interwoven and surrounded, reinforced as it were, by very considerable bundles of connective tissue. The method of the interweaving of these structures is worthy of special mention, since it is only possible to secure elasticity of this strongest component of the human body by the interweaving of its fibers diagonally. I do not know that this fact has been brought into special emphasis by any one, but its importance is at once apparent and has an illustrative example in the connective sheath of the intestine, where the crossing of the connective-tissue fibers diagonally permits of the shortening of the intestine, as in peristalsis, and its very considerable dilatation entirely within normal physiologic function. If, on the other hand, the connective-tissue fibers were arranged for strength only, as in the tendons, elasticity would be almost entirely wanting.

The pubo-coccygei, acting in unison with the other muscles of the pelvic floor, draw forward and thus aid not only in closing the rectum, but hold both it and the vagina in the anterior curve so important to be retained for the preservation of normal function. A horizontal section, made through the floor just above the sphincter vaginae and posterior to the junction of the transversus perinei, shows the deeper fibers of the pubo-coccygeus, united in a loop behind the lower border of the rectum, holding it from the fixed point at the pubes as in a sling. This loop is connected with the transversus perinei, bulbo-cavernosus, erector clitoridis, sphincter vaginae and sphincter ani muscles by strong layers of connective tissue, the importance of which for union and support cannot be readily overestimated.

On the posterior wall of the vagina, in its lower third, longitudinal muscular fibers are found external to the circular layer, and these intimately blend with the pubo-coccygeus, giving a firm support to the vaginal outlet quite as the outer longitudinal fibers of the rectum unite with the deep layers of the sphincter ani. The physiologic action of the muscles thus grouped serves to draw the rectum forward toward the pubic arch and approximate it in close relation to the urethra, and this explains, in large degree, why the circular fibers of the vagina, left free to act in other directions, are intrafolded laterally, making in cross-section an imperfect letter H, first pointed out by Freund. This intrafolding of the vagina at right-angles to the axis of the vulvar outlet is very important in its relationship of support to the uterus and its appendages.

The vaginal axis is normally about parallel to the conjugate of the brim. The anal axis is nearly at right-angles with the vagina and on a line with that of the uterus. The urethra, vagina, and rectum are disposed in curves corresponding to the sacral line. Architecturally considered, these are the lines and disposition of supports adapted to give the least outlay of power to retain the organs in position. This is the more to be emphasized, since the physiologic function demands mobility of the organs in conjunction, and also each independent of the other. Viewed from this standpoint, a still further analysis of the vagina as a column of elastic support to the cervix uteri is of interest and importance.

We have already observed that the circular loop of the muscular fibers of the pubo-coccygeus, posterior to the anus, carries the rectum forward on to the vagina and changes the vertical vulvar outlet into an antero-posterior closure of the vaginal canal, and that this is again thrown into two lateral folds. The longitudinal muscle fibers external to the vaginal muscle and which extend, both in front and behind the vagina, along the distal third, are the chief causes in producing this intrafolding, constituting in large degree the so-called columnæ rugarum. The letter-H shape, thus given to the vaginal column in section is well known in the arts as the form adapted to the resistance of vertical weight. This elastic column, retained in its shape and position by its basic bulbar and perineal support, is blended in its upper border with the cervical tissues. The union thus made with the uterus is nearly at right angles to the vagina and serves to hold the lower segment of the uterus backward, retaining that organ, like a ship at anchor, swung on its lateral supports, with freedom of mobility at its moorings. This vaginal support to the uterus is so effective in the normal condition that the cervix uteri is rarely displaced without there first ensues a change in the vagina. Although there are exceptions, of which the scope of this article will not permit the discussion, the general consensus of medical opinion is that the changes which occur in the vagina usually commence with those lesions of the outlet and contiguous tissues dependent on parturition.

A weakness in the base of support, the change of muscular action which causes a drawing upward and backward of the posterior vaginal wall, with an eversion of the vulvar outlet, produce a change in the axis of the vagina, bringing it and the uterus toward a common plane, and then the cervix, instead of being held at right-angles to, becomes a wedge in line with the vaginal outlet, separating its walls.

This change in the position of the uterus causes the weight of the abdominal contents, deflected toward the pubis, no longer to fall on the organ posteriorly, but vertically, and little by little, following the sacral curve in its descent, prolapsus with varying degrees of retroversion ensues.

Another anatomic fact, not usually taken into consideration, is the structure of the vaginal tissues and the relation of the vagina to the pelvic floor. The vaginal muscle is attached to the perineal structures normally only by a very loose interlacing of connective-tissue fibers, and at its vulvar junction is posteriorly folded in on itself not unlike the sleeve of a coat, except that it is fitted to an elastic opening. A little fold of this tissue posteriorly constitutes the more or less pronounced hymen.

I have deemed it necessary to emphasize thus much the anatomy and physiologic function of the pelvic structures in woman, in order to make clear the anatomic type which the surgeon must aim to secure in the reconstruction of these tissues, more or less damaged in parturition. Even in an article of the present brevity, we must take into consideration the pathologic conditions which demand restoration. An elastic opening, which is too small normally to permit the passage of a body, must yield by lesion. Many of the minor tears, however, of the perineum, are undoubtedly produced by the still prevalent custom of "supporting the perineum," which generally means a pressure from below upward, preventing the downward descent of the fetal head, in order to permit the escape of the occiput beneath the pubic bone. Naturally the tissues will yield where the

tension is greatest, and this may be central or lateral, and may extend through the sphincter muscle into the bowel.

Generally the first important structure to yield is some point near the central union of the transversi muscles, and then the vaginal and vulvar structures rarely escape injury. The resultant is an injury and widening of the levator loop, and the drawing to either side by the sundered transversi toward their respective origins. If the sphincter ani has not been injured, by a slow process, a rectocele almost necessarily follows. If the sphincter is torn through, as might easily be inferred, the pouching of the bowel can not occur and, as a consequence, the uterus is less likely to be displaced.

Intelligently conducted operative measures are undertaken to restore the structures as far as possible to their normal standard. With this problem before the operator, it would not seem difficult to make the procedure definite and comparatively simple. In a paper read before this Section some years ago, on this subject, I threw on the screen about fifty photographic illustrations, in order to enable my audience to follow intelligently with me the different methods devised for the surgical repair of these lesions, and yet I am sure I did not include all, while many have been added to the list during the intervening years.

The first great point of difference lies in the selection of the operative field; shall it be *on*, *through*, or *behind* the vagina? This opportunity does not permit a differential discussion of the question, but since the vaginal structures do not enter into the formation of the pelvic floor, it would seem wise to eliminate them as far as possible from the problem. To dissect them entirely away with a portion of the injured vulvar structures, as is the more common custom, is unwise, since they should be preserved for important physiologic purposes. To preserve them intact seems rational, since they are thus less injured and serve the subsequent important purpose of protecting the wound from infection. In order best to do this, the dissection is carried through the cicatricial tissue laterally to the point on either side which marks its former attachment, and upward through the loose connective-tissue, post-vaginal attachment quite to the crest of the rectocele.

This vaginal flap is lifted forward by an assistant, and on examination the fibers of the levator loop are easily demonstrated. A careful inspection of the vagina before operation will enable one to detect a depression on either side, which marks the site of the separated, contracted transversi.

It is generally wise to extend the incision posteriorly on each side to the level of the anterior border of the anal opening, and laterally on either side by reflecting a small portion of tissue. The limit of this dissection is determined by the depth of the sulcus or depression, which is usually found posterior to the vulvar or-gans. This makes a wide, open wound which permits of the careful readjustment and reunion of the injured parts.

In this way only can the surgeon intelligently restore these structures to their former normal relationship. If this has been aseptically performed, and the aseptic condition maintained, primary union will supervene with complete restoration of function.

Thus briefly have I outlined what I consider to be the essentials of the operation. Technic may and should vary with different operators, since a man does his work best in the way most familiar to himself. This permits

a somewhat wide digression as to variety of method. As ordinarily attempted, the dissection is not easy and is greatly facilitated in the following manner:

An assistant on either side separates the vulvar opening, while the operator introduces two fingers of his left hand quite into the rectum. Anterior to the anus, a slight opening is made through the structures thus held tense, into which a knife with a small rounded end, obliqued to an angle of about 40 degrees on a firm handle, is introduced. Force applied in the line of the handle brings the cutting edge to an angle with the structures to be divided, and they are thus separated with ease and accuracy. After the cicatricial structures are divided, the right and left angled Emmett curved scissors are introduced to complete the external incision. Then the division of a few bands with the scissors will permit of the anterior lifting of the vaginal sheath and the operator for the first time is surprised at the ease with which the further separation to the crest of the rectocele is effected, often by the thumb and finger alone. By the aid of the fingers retained in the rectum, the bowel is protected from injury and, once inserted, the surgeon retains them there until the operation is completed. To me the *sine qua non* of the operation is the buried suture, and only by its use can a readjustment of the parts be accurately effected. Many surgeons prefer a curved needle and continuous suture. By means of this a lacing stitch can be applied from side to side for coaptation.

However, I still greatly prefer the needle fixed in a handle with large curve and eye near the point. The introduction of the first stitch is the most important. It must include the retracted end of the transversus in its association with the displaced levator loop. This being effected on one side, the suture is made to penetrate the junction of the vagina and rectum at the crest of the rectocele, and is carried across to include the transversus on the opposite side. The loop of the suture held by an assistant, the operator easily approximates the parts with it, and three or four continuous double stitches, taken in this way—Marcy's stitch—reunite the most important structures. A fine continuous suture, introduced by a full-curved Hagedorn needle, renders it easy to make complete deep coaptation of the surfaces laterally, while every stitch is buried in healthy structures. Even here we find the collodion seal is of value and makes an impervious dressing for one or more days. As soon as it is loosened, it should be removed. A light dusting with iodoform is the only subsequent dressing needed. In this way it is easy "to build out" the structures so that the depression posterior to the vulva disappears. The folding of the vagina anterior to the wound frequently results in a thin membraform wall closely resembling a slightly ruptured hymen. Months later it would indeed be difficult oftentimes for an expert to determine that the woman were not a nullipara.

When the rupture is complete, that is involving the bowel, the essentials of the above operation still pertain. The dissection anteriorly differs only in that there is a central rent through the separated vaginal sheath; posteriorly, in that the rent includes the sphincter ani and extends in a greater or less degree up the rectum. The dissection here must be continued farther down on the sides of the anal opening in order to reach the retracted ends of the sphincter muscle. The vaginal rent is united by a buried continuous tendon suture, introduced from side to side on its dissected surface, the end of which is for a time left long and given over

to the care of an assistant. In the same way the edges of the injured bowel are restored, and thus we reduce the conditions to those pertaining to an incomplete rupture of the perineum. The remaining steps in the operation are the same as already described, with the exception that care must be taken to reunite the sphincter ani muscle.

Vagino-rectal fistula is fortunately much less often seen now than formerly, and yet when it does occur, even in the hands of our best operators, it proves one of the most troublesome conditions for cure. For many years I have treated it by the lateral separation of the structures as above described, closing the vaginal and rectal openings separately. Oftentimes, when comparatively little tissue is left, it is easier to divide the sphincter and intervening parts centrally to the fistula.

Following the description of this operation, one might at first infer that it was difficult and tedious. As a matter of fact it is simple and rapid, often completed within fifteen minutes. The convalescence is easy and rapid with very little suffering. I prefer that the urine should be drawn with a catheter during the first three or four days, and that hardened fecal masses shall not be permitted to accumulate in the lower bowel. In securing primary union, much depends on the subsequent care of such a patient by the nurse.

The operation is also a test of the surgeon's ability to make and maintain an aseptic wound in this, one of the most difficult parts of the body. Failure to secure good results under the proper care is the exception and is rare. I have operated several hundred times by this method. Recently I inquired of the head nurse in my hospital, "how many failures to secure a good perineum have occurred since you have been with me?" With seeming surprise at the question, she replied, "Not one," and she has had supervision of my work uninterruptedly for the last thirteen years.

In a paper<sup>1</sup> published ten years ago, on the repair of the perineum, I closed with the following as the essentials of my method:

"1. The dissection of the posterior third of the vagina, *not in its mucous membrane*, from its vulvar attachment, carried as deemed necessary into the recto-vaginal space, and the *retention* of this flap.

"2. In lifting forward the vagina from its vulvar attachment, the retracted transverse perineal muscles with their connections are reached and reunited by deep buried sutures, making in this way a true restoration of the pelvic floor.

"3. In rectocele with prolapse, the closure of the deep layers of the post-vaginal fascia by a continuous buried animal suture, taken either in single or double line of stitches.

"4. The coaptation of all superficial surfaces by a buried animal suture, applied as a continuous stitch, taken from side to side, covering the wound, when dry, with iodoform collodion.

"5. In rupture involving the sphincter, the lateral dissection, the joining of the rectal and vaginal edges with buried sutures, and then finishing the operation as in incomplete rupture."

I consider the closure of wounds aseptically by the buried animal suture, preferably tendon, my best contribution to surgery, and its application to the plastic repair of the pelvic structures is second in importance to few other operations.

<sup>1</sup> "The Perineum, Its Anatomy, Physiology and Methods of Restoration After Surgery." Reprinted from Trans. Am. Assn. Obst. and Gyn., September, 1898.