Int Urogynecol J (1998) 9:158–164

International Urogynecology Journal

Classical Article in Urogynecology

Urinary Incontinence in Women, Without Manifest Injury to the Bladder

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Editorial Comment: Dr Kelly published his landmark manuscript in 1914, shortly after White's publication on the paravaginal repair. Kelly's operative procedure was intended for the treatment of stress urinary incontinence by plicating the 'relaxed tissues at the vesical neck' with interrupted mattress sutures. His procedure in combination with an interior colporrhaphy was a simple and easy procedure to perform with a short-term success rate of up to 90%. His procedure was quickly adopted and became standard of care for the next 60 years.

Kelly's publication reviews the procedures available at the time and then outlines his own surgical approach. He describes in detail his case series of 20 patients who underwent his procedure. His follow-up in many cases was greater than two years. He reports both his short and long-term success rates, with the short-term at 90% and falling to 65% as a late result. His subjective findings are not too dissimilar to what has been found in our prospective, randomized trials comparing the anterior colporrhaphy with our current surgical approaches for the treatment of stress urinary incontinence. Given the simplicity of Kelly's technique and the rapid rise in popularity, White's approach to the repair of the paravaginal tissues has been largely ignored until recently. It is surprising that with the long history of Kelly's surgical approach to plication of the vesical neck and anterior vaginal wall, that few prospective studies have been done on its efficacy. Our recent literature has suggested, through randomized prospective trials comparing the anterior colporrhaphy with the Burch and needle procedures, that the anterior colporrhaphy using Kelly's approach is less than satisfactory for the cure of stress urinary incontinence. We have also been plagued with a high rate of recurrence of anterior vaginal wall defects. Thus, as with much of medicine, when we are met with unsatisfactory outcomes we often look to our history for answers to recurrent, persistent problems. In this respect, the paravaginal repair has come full circle. Using both White's approach of suturing the lateral sulci of the vagina to the white line, and Kelly's approach to the midline plication of the perivesical adventitial tissue, a more appropriate anatomical correction of the anterior vaginal wall prolapse may be accomplished.

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There is a type of urinary incontinence in women, without manifest injury to the bladder and having no relation to fistula, which most frequently comes on following childbirth, but is occasionally seen in nulliparæ. In our series of 20 cases, 85 per cent were among women who had borne children, while 15 per cent were nulliparæ. Two were post-operative: in one, a nullipara, incontinence followed an operation for tumor of the bladder; the other had incontinence following an operation for cystocele and relaxed vaginal outlet. In two cases there was an occasional dribbling of urine on standing or sudden exertion, which condition had been present from childhood. It is a disease of middle life: 55 per cent of the cases were in the fourth decade. As stated by Cumston [1], some women progressively develop an incontinence of urine when no history of a surgical or obstetrical nature can be elicited. It is mostly in elderly women that this unfortunate affliction arises, occasionally at about the time of the menopause.

The onset of this affection generally manifests itself, first, by an occasional escape of a few drops of urine following some unusual exertion. Later, gushes of urine follow coughing, sneezing, laughing, stooping, or walking; which may ultimately lead to an absolute loss of control, compelling the patient to wear some kind of protection constantly to prevent her clothes being wet

and soiled with malodorous secretions. Describing this condition, Farquharson [2], says that but few infirmaries are productive of so much inconvenience and mental depression or interfere so gravely with the present comfort and future prospects of its victims.

To summarize, one may call it, in general, an affection beginning in middle life, most common in multiparæ. It begins as a rule with slight leakage, which gradually grows worse, leading to complete incontinence with all its unfortunate and repellent sequelæ. It is not cured by any known means, and although numerous operations have been devised no one has been pre-eminently successful.

The methods of treatment for urinary incontinence have been legion, and we find some of the earlier procedures [3], very crude, such as ligation of the prepuce, the use of pressure bandages, and painting of the external meatus of the urethra with collodion. The most popular forms of hydrotherapy [4], which have been in use are: the cold-water foot-bath for five minutes, cold hypogastric douches for five or ten seconds, lumbar affusions, aromatic baths, and vaginal douches. Dieting, hygienic measures, counter-irritation by means of blisters, injection of the sacral nerves (Cathélin), lumbar puncture, subarachnoid mercurial injections, epidural injections of sterile water or salt solution, cauterization, tampons, pessaries [5], massage, and the use of electricity have played an important part in the treatment of incontinence. Therapy, by the use of ergot, pituitrin, belladonna, hyoscyamus, strychnia, tincture of iron, tincture of cantharides, santonin, chloral hydrate, potassium bromide, etc., has not received minor attention.

Many operations have been devised in the surgical treatment of urinary incontinence in women, and they may be classified as follows:

A. Those which serve to create an artificial channel which can be placed under voluntary control.

B. Operations which restore the urethra with the normal power of retention.

In the first group three operations are described.

1. Procedure of Baker Brown [6]. A puncture is made under the arch of the pubis with a knife or trocar. An artificial channel entering the bladder is thus formed, into which a catheter is introduced. The patient wears an ingenious apparatus which serves to keep the catheter in good position and the urine under control.

2. Procedure of Rutenberg [7]. This surgeon closed the urethra and established a vesico-abdominal fistula. Control was obtained by means of a large pledget or ball-valve closing the mouth of the sinus.

3. Procedure of Rose [8]. A rectovaginal fistula is made, following which a plastic operation is performed on the vagina, completely closing it. The control of the urine is effected by means of the sphincter ani.

All other operations may be described as belonging to the second group, and prominent among them are the following procedures:

Simple compression of the urethra by anterior colporrhaphy.

Periurethral injections of paraffin. The use of an unabsorbable foreign body and the dangers arising from emboli have been the chief objections to this method. Also, the result in the hands of most operators has only been that of temporary improvement.

From the anterior vaginal wall, near the cervix, Schultze [9] excised an elliptical area 3 cm long by 1 cm broad at its widest point, and then narrowed the lumen of the urethra and the vesical neck.

Frank's [10] procedure is to place a small catheter in the urethra and then excise a wedge-shaped piece from the posterior urethral wall, including vaginal and urethral mucosa, and extending from the external urethral orifice to a point within 1 cm of the internal orifice. The incision is now continued in an elliptical form on the vaginal wall beyond the neck of the bladder. The whole wound surface is approximated by a transverse row of interrupted sutures. The anterior two-thirds of the relaxed canal of the urethra has thus been resected, and the elliptical portion of the denudation has formed a buttress behind the neck of the bladder.

Winckel [11] removed a wedge-shaped flap from the anterior vaginal wall, the narrowest portion of which corresponded to the mucosa of the urethra.

Engström [12] removed a triangular flap of vaginal mucous membrane the apex of which corresponded to the neck of the bladder. The excision on the vaginal septum is carried down to the urethral mucosa, yet does not include it.

Transverse folding of the urethra was done by Desnos [13]. He used a catheter in the bladder as a guide, and cut through the vaginal mucosa, exposing the upper two-thirds of the urethra; this portion was then dissected out, and a large catgut suture was placed 2 or 3 mm from the neck of the bladder and tied so tight that the catheter could just be moved. The vaginal incision was closed with silkworm gut.

Pawlick [14] initiated the attempt to control incontinence by bringing the walls of the urethra in close permanent apposition by bending and flattening the outer end of the urethra. The external orifice of the urethra is drawn well forward toward the clitoris and sharply to one side; then, after marking the point on that side to which it can be drawn without excessive tension, a long narrow denudation is made and sutures placed holding the urethra in position. After one week the other half of the urethra is treated in the same manner. This procedure was later modified by Duret [15].

Torsion of the urethra was first employed by Gersuny [16], who, after dissecting out the entire urethral canal twisted it on itself in an attempt to form a series of obliquely spiral folds dovetailing each other. He then sutured it in position. A fine bougie was inserted in the canal of the urethra to assure the operator that the lumen was not entirely obliterated.

After introducing a bougie into the urethra, Pousson [17] resects the external meatus and a portion of the urethra. After torsion of the canal through 180° it is transplanted to a point just below the clitoris.

Albarran's [18] procedure is quite similar to that of Pousson, the chief difference lying in the longitudinal

Table 1. Cases of urinary incontinence operated upon at the Johns Hopkins Hospital and Dr Kelly's Sanatorium

Serial No. Gyn. No. Date.	Age. Race. Preg. Duration and type of incontinence. Operations.	Diagnosis	Operation	Immediate result (on discharge from hospital)	Late result
1 946 Apr. 8, 1900	35 yrs.; white; I-para; instrumental delivery, followed in 2 mos. by complete incontinence on standing; duration, 3 yrs.	Urinary incontinence; relaxed vaginal outlet.	Anterior colporrhaphy; suture of vesical sphincter.	Well, June 6, 1900.	Not located.
2 1092 Jan. 31, 1901	29 yrs.; white; nullipara. Occasional incontinence when standing, for 'years.'	Urinary incontinence.	Anterior colporrhaphy; suture of vesical sphincter.	Well, June 20, 1901.	Well, July 25, 1913;
3 1155 Apr. 25, 1901	21 yrs.; white; nullipara. 'Incontinence since a child.'	Urinary incontinence.	Anterior colporrhaphy; suture of vesical sphincter.	Improved; 'Incontinence twice before leaving hospital.'	Well, April 1902.
4 1690 Mar. 3, 1904	48 yrs.; white; III-para; labors prolonged and difficult. Incontinence on coughing, sneezing, and sudden exertion; duration, 4 yrs.; one unsuccessul operation for incontinence.	Urinary incontinence; descensus uteri; retroposition of uterus; relaxed vagina outlet.	Amputation of cervix; anterior and posterior colporrhaphy; suture of vesical sphincter.	Well, April 3, 1904.	Well, Oct. 8, 1913.
5 1744 June 1, 1904	48 yrs.; white; nullipara. Partial incontinence following operation for tumor of the bladder; duration, 7 yrs.	Urinary incontinence (postoperative); prolapsus of vaginal walls.	Narrowing of urethra; suture of vesical sphincter.	Well, July 6, 1904.	Not located.
6 1887 Mar. 30, 1905	42 yrs.; white; II-para (15 & 11); 1st delivery instrumental. Incontinence when standing and on coughing and sneezing; duration, 13 yrs.	Urinary incontinence; relaxed vaginal outlet.	Anterior and posterior colporrhaphy; suture of vesical sphincter.	Well, April 26, 1905.	Improved, July 24, 1913; 'almost complete control for 6 yrs.; occasional incontinence on sudden exertion, for past 2 yrs.'
7 3646 Mar. 2, 1911	42 yrs.; white. Occasional incontinence when standing, 'of several years' duration.'	Relaxed vesical sphincter; relaxed vaginal outlet.	Anterior and posterior colporrhaphy; suture of vesical sphincter.	Well, March 30, 1911.	Improved, July 23, 1913; 'occasional incontinence now on exertion.'
8 3691 Apr. 12, 1911	60 yrs.; white; I-para (30); menopause at 48 yrs. Incontinence on coughing and sudden exertion; duration, 2 yrs.	Urinary incontinence; prolapsus uteri.	Vaginal fixation of uterus (Wertheim); suture of vesical sphincter; posterior colporrhaphy.	Well, May 8, 1911.	Improved, Aug. 3, 1913; 'no return of trouble for a yr.; 'occasional incontinence on sudden exertion.'
9 3720 May 3, 1911	39 yrs.; white; III-para (17, 15, & 11). Incontinence on coughing or sneezing.	Urinary incontinence.	Repair of vesical sphincter.	Well, May 30, 1911.	Improved, Aug. 1, 1913; complete control for 13 mos.; occasional incontinence after sudden effort.
10 2731 May 15, 1911	32 yrs.; white; I-para (4). Occasional incontinence on exertion since birth of child; worse since plastic operation on urethra 16 mos. ago.	Urinary incontinence, with relaxed vesical sphincter; relaxed vaginal outlet.	Suture of vesical sphincter; repair of relaxed vaginal outlet.	Well, May 29, 1911.	Not located.
11 3914 Feb. 16, 1912	48 yrs.; white; II-para (20 & 18). Incontinence on coughing, sneezing, and when walking.	Relaxed vesical sphincter; relaxed vaginal outlet.	Oval resection of anterior vaginal wall; suture of vesical sphincter; repair of relaxed vaginal outlet.	Well, Mar. 9, 1912.	Improved, July 25, 1913; 'complete control for 6 mos.; occasional incontinence on sudden exertion, but very materially improved.'
12 3989 Mar. 12, 1912	40 yrs.; white; II-para (12 & 6); both stillborn and instrumental deliveries. Incontinence for 14 yrs.; no control for 6 yrs.; two unsuccessful plastic operations; before marriage, slight incontinence on sudden exertion.	Incontinence of urine, due to relaxation of vesical sphincter. Prognosis: poor; sphincter badly lacerated.	Repair of vesical sphincter.	Improved for several weeks.	Unimproved Sept. 3, 1913; one operation since (unsuccessful).
13 4003 Mar. 30, 1912	41 yrs.; white; IV-para (17 & 9). Occasional incontinence on stooping, coughing, and when walking; duration, 2 yrs.	Relaxed vesical sphincter; relaxed vaginal outlet.	Suture of vesical sphincter; repair of relaxed vaginal outlet.	Well.	Well, July 24, 1913.
14 4056 Apr., 1912	42 yrs.; white; II-para (16 & 14), first stillborn; instrumental delivery; perineal repair 1 yr. following. Incontinence on coughing or straining; duration, 16 yrs.	Urinary incontinence, due to relaxed vesical sphincter.	Anterior colporrhaphy; suture of vesical sphincter.	Unimproved.	Unimproved, July 27, 1913.
15 4330 Mar. 12, 1913	42 yrs.; white; II-para (17 & 9). 'Constant flow of urine since birth of last child.' Birth at term; normal labor.	Relaxation of vesical sphincter; relaxed vaginal outlet.	Anterior and posterior colporrhaphy; suture of vesical sphincter.	Well.	Well, July 26, 1913.

Table 1. *continued*

Serial No. Gyn. No. Date.	Age. Race. Preg. Duration and type of incontinence. Operations.	Diagnosis	Operation	Immediate result (on discharge from hospital)	Late result
16 4715 May 14, 1913	64 yrs.; white; IV-para. Developed incontinence 2 yrs. ago, following operation for cystocele and relaxed vaginal outlet.	Relaxed vesical sphincter.	Anterior colporrhaphy; suture of vesical sphincter.	Well.	Well, July 30, 1913.
17 17129 Nov. 23, 1910	45 yrs.; white; III-para. Incontinence of 13 yrs. duration; complete for 3 yrs., following vaginal suspension of uterus.	Urinary incontinence; relaxed vaginal outlet.	Suture of vesical sphincter.	Improved; 'no control except when lying down;' Dec. 11, 1910.	Unimproved, July 27, 1913, 'better control for several mos.; another operation since (unsuccessful)'
18 18469 June 16, 1912	51 yrs.; white; V-para; all deliveries instrumental. Incontinence on coughing, sneezing or sudden exertion.	Urinary incontinence; relaxed vaginal outlet; subinvolution of uterus.	Anterior and posterior colporrhaphy; suture of vesical sphincter.	Well.	Improved, July 22, 1913; 'occasional incontinence only on exertion.'
19 18873 Nov. 19, 1912	47 yrs.; white; X-para. Complete incontinence for 4 yrs.	Urinary incontinence; relaxed vaginal outlet.	Anterior and posterior colporrhaphy; narrowing of urethra; suture of vesical sphincter.	Improved; 'almost complete power to retain urine.'	Unimproved, July 22, 1913; 'better control for 2 mos.'
20 19308 May 11, 1913	25 yrs.; white; II-para; forcepts delivery 13 mos. ago. Incontinence of urine for 13 mos.; complete for 3 mos.	Urinary incontinence; descensus uteri; relaxed vaginal outlet; hypertrophied cervix.	Anterior and posterior colporrhaphy; suture of vesical sphincter; vaginal suspension of uterus; amputation of cervix.	Well, June 1, 1913.	Well, Sept. 5, 1913;

invagination as a means of narrowing the lumen of the urethra rather than torsion. The canal of the urethra is dissected out and transplanted below the clitoris.

Dudley [19] published an operation in 1905, the principle of which is the same as that involved in the operations of Pousson and Albarran, i.e., advancement of the meatus urinarius to the clitoris. His procedure, however, obviates the danger of sloughing of the urethra, as he advances the external orifice without dissecting the urethra free. The operation is described in two steps, as follows:

(*a*) A horseshoe-shaped surface is rather deeply denuded between the meatus urinarius and the clitoris, and to either side of the urethra throughout the entire length of it.

(*b*) The meatus is drawn up to a point near the clitoris and is secured there by means of two sutures. The lateral portion of the denuded surfaces is now closed. Thus the

Table 2. Analysis of successful operations for urinary incontinence. Result – Well

Serial No. Gyn. No.	Age	Preg.	Instrumental deliveries	Type of incontinence; duration	Time elapsing since operation
1 946	35	1	1	Complete when standing; duration, 3 yrs.	Discharged well, 13 yrs. 4 mos. ago.
2 1092	29	0	0	Partial	12 yrs. 6 mos.
3 1155	21	0	0	Partial; 'since a child.'	1 yr.
4 1690	48	3	0	Partial (4 yrs.); one unsuccessful operation for incontinence.	9 yrs. 7 mos.
5 1744	48	0	0	Partial (post-operative); duration, 7 yrs.	Discharged well, 9 yrs. ago.
6 3731	32	1	0	Partial (4 yrs.); one unsuccessful operation for incontinence.	Discharged well, 2 yrs. ago.
7 4003	41	4	0	Partial; duration, 2 yrs.	1 yr. 4 mos.
8 4330	42	2	0	Complete; duration, 9 yrs.	4 mos.
9 4715	64	4	0	Partial (following cystocele operation); duration, 2 yrs.	4 mos.
10 19308	25	2	1 second del.	Complete; duration, 3 mos.; incontinence 13 mos.).	5 mos.

Table 3. Analysis of successful operations for urinary incontinence. Result – Improved

Serial No. Gyn. No.	Age	Preg.	Instrumental deliveries	Type of incontinence; duration	Time elapsing since operation
1 1887	42	2	1 first del.	Partial; duration, 13 yrs.	8 yrs. 4 mos.
2 3646	42	?	?	Partial; 'several yrs.'	2 yrs. 5 mos.
3 3691	60	1	0	Partial; duration, 2 yrs.	2 yrs. 4 mos.
4 3720	39	3	0	Partial.	2 yrs. 3 mos.
5 3914	48	2	0	Partial.	1 yrs. 5 mos.
6 18469	51	5	5	Partial.	1 yr. 1 mo.

Table 4. Further analysis of the results in cases of urinary incontinence

Result	Immediate result			Late result		
	Number of cases	Per cent		Number of cases	Per cent	
Well	15	75	90	7	35	65
Improved	3	15		6	30	
Unimproved	2	10		4	20	
Not located	2	10		3*	15	

sagging, displaced urethra is replaced and retained in its functional relations.

He states that in many cases it will be necessary to combine with the operation some appropriate treatment for an associated cystocele, and in nearly all cases to perform perineorrhaphy to relieve relaxation of the posterior vaginal outlet. Five cases were reported, and in all the relief was immediate. Five months' time, however, was the longest period any one case had been observed.

For the past thirteen years, Kelly has adopted an operative procedure which we believe has been more successful than any yet proposed. This affection is due to the loss of elasticity or normal tone of the urethral and vesical sphincter, so well shown by the cystoscopic picture, which in many cases presents a gapping internal sphincter orifice which closes sluggishly as the cystoscope is withdrawn. The point of vantage toward which the operative treatment should be directed is the internal orifice of the urethra and the sphincter of the bladder. The operation [20] which has been described by Kelly may be performed under local or general anæsthesia, and is as follows:

A Pezzer catheter with a stem not over 5 mm in diameter is introduced into the bladder. With the patient in the lithotomy position and slightly elevated, the posterior wall of the vagina is retracted, and the area at the neck of the bladder is brought down by means of forceps or four tension sutures.

The next step consists in slitting the vaginal wall down to the urethra and the bladder in the median line for about 3.5 or 5 cm. The neck of the bladder should fall at about the center of the incision. The position of the bladder sphincter is easily determined at all times by moving the catheter to and fro, and feeling its head, which presses closely against the urethra. The utmost care should be taken not to cut the urethra or the bladder at any step of the operation. After making this median

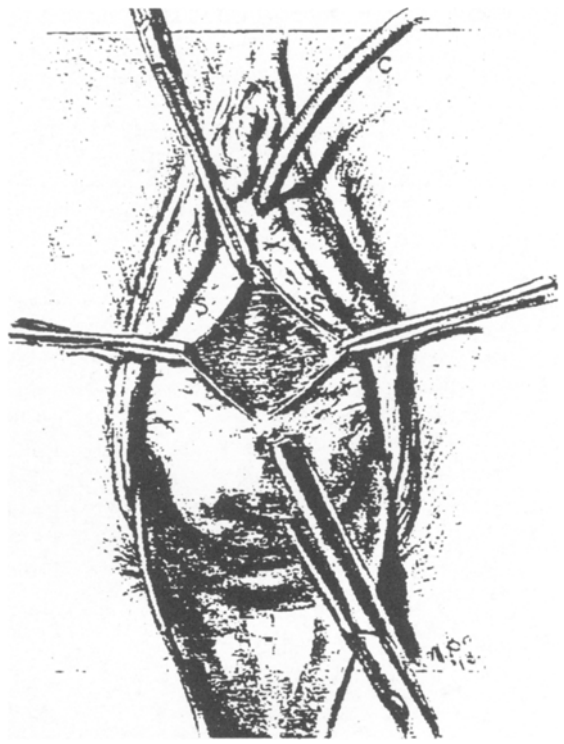

Fig. 1. SS – Position of bladder sphincter, which is determined by means of a Pezzer catheter.

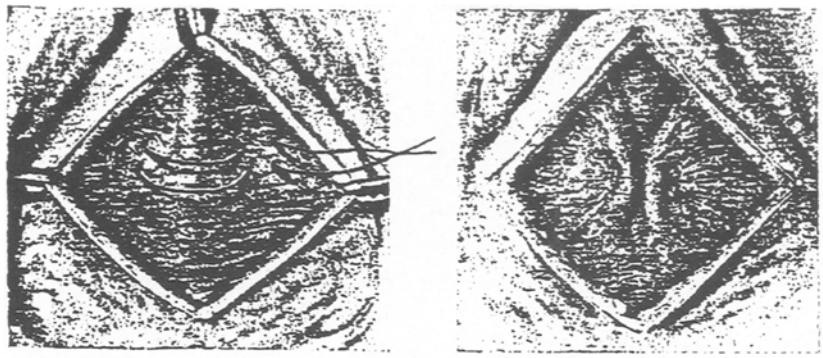

Fig. 2. Method of insertion of the mattress sutures at the vesical neck. First suture tied.

incision, the vagina is further detached on both sides, with tissue forceps and scalpel or a blunt dissector, and dissected away for a distance of 2 to 2.5 cm around the neck of the bladder. This may also be done with blunt pointed scissors, which push their way into the tissues, separating the bladder from the vaginal walls. The dissection should be deepest at the neck of the bladder. With the detachment of vagina from bladder completed, the finger should be able to grasp at least one-half or two-thirds of the neck of the bladder including the contiguous urethra. Sometimes the bladder wall is so thin in the median line, due to the rupture of its muscle fibers, that its mucosa shines through.

The torn or relaxed tissues at the vesical neck should then be sutured together using two or three mattress sutures of fine silk or linen, passed from side to side: the first suture, taking in about 1.5 cm of tissue, is tied at once and may be used as a tractor; the succeeding one is applied on the outside of this, further contracting and bringing together the tissues at the neck. This is the essential part of the operation, and when done, the mushroom catheter should be removed. The head of the catheter escapes with a little jump as it clears the tightened, reconstructed sphincter area. The more or less redundant vaginal walls, which have been detached in order to expose the sphincter area, are now resected so that the remaining tissue can be snugly brought together from side to side, thus supporting the vesical area operated upon and avoiding dead space between bladder and vagina. This suturing is best done with a continuous fine catgut suture in one or two layers. In some cases it may be advisable to repair the relaxed posterior vaginal outlet.

The post-operative treatment is simple. The patient should not be catheterized unless it is imperative, although sometimes it must be done for several days, or even for a week. A Gatch bed with a half-way-up posture should be used immediately after operation.

Twenty cases have been operated upon for urinary incontinence and of this number, sixteen were successful. With the exception of one case (Gyn. No. 1887) in the list of patients designated as improved, all have practically complete control; yet an occasional incontinence on sudden exertion forces us to place them in the 'improved' column. Communications have been received from all excepting three whose operations were performed two, nine, and thirteen years ago, respectively. They were discharged well.

There were four cases in which the operation was not successful. All were multiparæ. Three had previous operations: one, two unsuccessful plastic operations for incontinence; another, a perineal repair; the third, a vaginal suspension of the uterus, following which there was complete incontinence. Prior to operation, incontinence was complete in three cases for periods varying from three to six years. The prognosis was exceedingly unfavorable in all, because of the presence of dense scar-tissue in the vaginal vault and at the site of the vesical sphincter.

Conclusions

1. There is a type of urinary incontinence in women, with no manifest injury to the bladder, which is due to an impairment of the function of the sphincter muscle at the internal orifice of the urethra. It is most common among multiparæ in the fourth decade.
2. The operation as performed by Kelly is the most satisfactory thus far suggested for this type of incontinence. Entire control is given in a large percentage of cases by means of a mechanical restoration of the sphincter area at the vesical neck. Operation may be under local or general anæsthesia.

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