



A Novel Modification of HAYASHI-KOYANAGI Repair For Proximal Hypospadias: Preliminary report

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ABSTRACT

Objective: To report preliminary results of urethroplasty for proximal hypospadias by a novel modification of HAYASHI-KOYANAGI technique.

Methods A total of 5 boys(5-11yrs), with penoscrotal hypospadias underwent urethroplasty over a period of one year (1st Oct'18 -30th Sept'19). The technique used, was essentially Hayashi- Koyanagi, with a modification. The modification consists of, excising an outer strip of skin, 5mm in breadth, all around the perimeatal flap, without any dissection of the Dartos fascia; this facilitates the midline reconstruction of neo-urethral plate and then the tube formation over a stent. This policy of non-dissection causes minimal disturbance of already precarious blood supply of this long loop-shaped continuous flap. This neo-urethral tube is then covered by Tunica Vaginalis flap. All patients had suprapubic drainage for 2 weeks and urethral stents for 1week.

Results: No boys developed any fistula; one boy developed a sub-coronal diverticulum after 1.9 yrs due to noncompliance with meatal dilatation; follow up ranges from 6m -2 yr maximum.

Conclusion: This novel technique will be an addition to the existing literatures of one-go urethroplasty methods, needing further evaluations by peers on a large scale with post-pubertal follow-ups.

Keywords: Proximal Hypospadias, One Stage Repair, Modification over Hayashi-Koyanagi

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Introduction

The management of proximal hypospadias is a formidable challenge to the pediatric urologist, more so when the parents want a permanent full proof solution in one go. The multitude of techniques described in the literature, only reflects that no single technique is full proof. So, we as pediatric urologists always thrive for a better solution. Herein, we are describing our attempt to further decreasing the complication

rate of Hayashi-Koyanagi Repair by a novel modification in the dissection technique with simultaneous use of TV flap.

Materials and Methods

From January 2018 to June 2019, a total of 5 boys with an age range from 5 to 11years, with Penoscrotal Hypospadias with severe chordee and poor urethral plate was operated by the first author. No patient had any scrotal transposition. No preoperative hormone therapy was given to

Figure1. Illustrations of the operative procedure

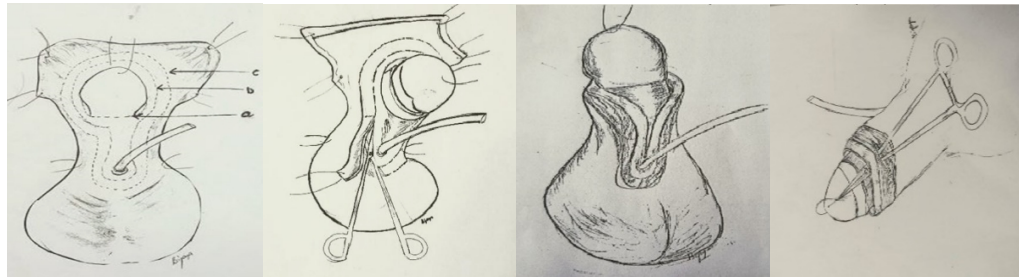


Figure 1A. Incision marking

Figure 1B. Excision of 5 mm skin outer rim of paramental flap

Figure 1C. Paramental flap after skin excision

Figure 1D. Ventralisation of the flap

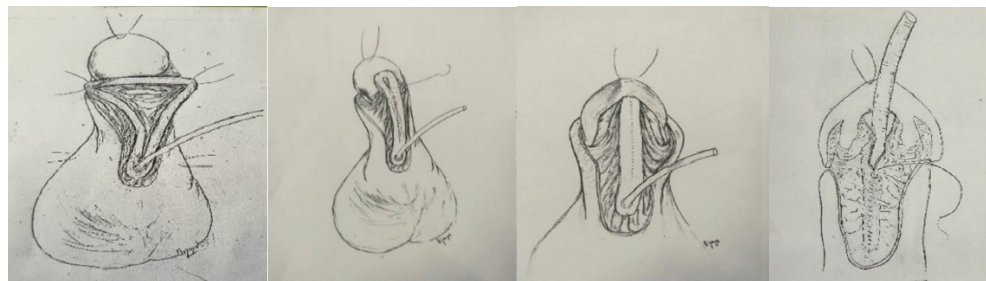


Figure 1E. Flap after ventralisation

Figure 1F. suturing of the medial edge of the flap

Figure 1G. Neo urethral plate

Figure 1H. Tubularisation over stents

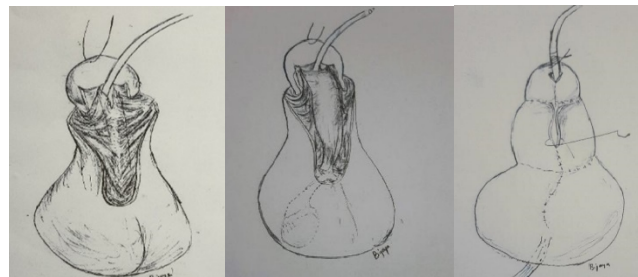


Figure 1I. neourethroplasty

Figure 1J. neourethroplasty with tv flap

Figure 1K. final construction

(A) Marking of incisions:(a)paracoronary incision marking(b) paramental flap incision marking.(c) additional incision marking, the area between b and c to be removed. (B) after resection of urethral plate and chordee correction, A parallel strip of skin of width 5mm is excised outer rim of proposed Hayashi modified Koyanagi paramental flaps excision) of skin strip all around the paramental flaps. (C)modified koyanagi flap after excision of skin (D) paramental flaps transport ventrally. (E) position of flaps after ventralisation which is continued dartos fascia. (F) medial edges of paramental flaps sutured to make a wide urethral plate. (G) neourethral plate in situ with dartos fascia. (H) neourethroplasty tubularisation over appropriate stents and few distal stitches are interrupted in nature. (I)neourethroplasty and suture line covered with dartos fascia after the procedure. (J) neourethroplasty covered with tunica vaginalis flaps(K) final reconstruction.

any children. The procedure was performed under GA and epidural analgesia. A vertical stay suture of 3/0 polypropylene was taken through glans and multiple stay sutures were taken through the preputial skin margin to open it widely for facilitating markings of further incisions (Figure 1A).

A circum-coronal incision keeping a collar of 3mm of preputial skin attached to the glans penis, was given; the two ends of this circum-coronal incision was extended on to the ventral aspect of penile shaft keeping a rim of 1mm penile skin attached

Figure 2. Some intraoperative and postoperative photos



(A) Penoscotal hypospadias with severe chordee. (B) marking of incision (a) Para coronal marking (white arrow) 3 mm below glans. (b)peri meatal based flap incision marking (green arrow). (c). marking the outer aspect of the proposed flap (blue arrow). (C) the skin between green and blue arrow excised. (D) a sub coronal incision and transection of the urethral plate. A parallel strip of skin (green and blue arrows) outer aspect of the proposed flap is excised. (E) dorsal aspect of the penis. (F) Hayashi Koyanagi modified flaps parametalar flap transport ventrally, no dissection was done space between two arrows. (G) the medial edge of flap sutured for proposed urethral plate and area between arrows showing continued dartos fascia(H) neourethroplasty completed over a stent. (I) neourethroplasty with tunica vaginalis flap. (J) after immediate postoperative. (K) after 3 weeks of postoperative. patients passing urine in a good stream. (L) same patient at follow up after 8 month.

to the dysplastic urethral plate, which met in the midline proximally, just on to the dorsal lip of the urethral meatus. Through this incision, the penile shaft was degloved and dysplastic urethra and chordee tissue excised till the erection test shows a straight penile shaft; these 5 patients did not show any corporal disproportion.

The next step was to design the Hayashi-Koyanagi flap; the most important modification which the 1st author made was to excise an outer rim of 5mm skin strip all around the skin flap (Hayashi-Koyanagi) designated for new urethral plate reconstruction; this helps easy neourethral tube formation, without any tension and any dissection in the penile dartos underneath the flap skin (Figure 1B, 1C).

Before this tube is completed, for glansplasty, the glans was splitted in the midline and glans wings fashioned with a tourniquet on the penile shaft; the distal dorsal lip of the neourethral plate was fixed to the tip of the splitted glans with shaft maximally stretched, to compensate for possible length after erection, in the post-operative period; the lower limit of the future external urethral meatus was marked on the glans wings so that a vertical meatus could be produced; the last few distal stitches are taken for tube formation were interrupted in nature and the most distal stitch incorporates the two outer glans wings and two inner skin lined urethral plate margins in one knot. This meatoplasty was completed without any stretching in a relaxed state.

Now a Tunica Vaginalis flap was fashioned and applied on to the neourethral tube as a barrier layer and fixed by sutures; glansplasty was then completed in two layers of stitches, with outermost layer as subcuticular stitches as far proximally as it could be done without any undue tension. An erection test was again performed to exclude iatrogenic chordee; if found further dissection of vascular pedicle of TV flap was done to correct this.

After this resurfacing of the penis was done; at the penoscrotal junction, tension was usually encountered, which was managed with a limited dorsal slit confined to proximal shaft. Sutures used are: 5/0 Polyglycolic acid, for Urethral plate formation/ external meatal stitches/TV flap fixation/penile skin, and scrotal repair; 6/0 Polydioxanone, for urethral tube formation/ glansplasty and the anchoring stitch marking the midline dorsal and ventral lip of neo-meatus.

All patient had suprapubic cystostomy for 2 weeks and urethral stent of proper size (8/10 F) for 1wk. the patients were discharged usually after 1 week with suprapubic cystostomy, removing stent and dressing. Oral medications which were started from the evening on the operation day were continued to prevent bladder spasm and erection till suprapubic tube was removed. All received 3 days of I /v antibiotics in the early postoperative period, and oral antibiotic prophylaxis till suprapubic tube was removed.

All parents were taught meatal dilation with an anterior urethral dilator (which will glide easily by gravity) daily, from 3 weeks to 9wks; then on alternate days for 6wks more and weekly for up to 6m from the day of operation, when the scar tissue was thought to stabilize; the size of the dilators was changed to appropriate size when it deemed fit. The policy was not to thrust it but to glide it under the force of gravity. All parents were told to increase the fluid intake during the daylight hours to at least 3L for life long (or at least for 2years, the period by which scar tissue was believed to mature) and schools were also notified about this. Four of these series of five boys had not to be dilated after 6 months.

Results

No child developed any immediate or delayed complication of UC fistula or wound disruption. One child developed a late complication in the form of coronal diverticulum 1.9 months with meatal stenosis; this boy of 11yrs did not comply with meatal dilation at all. His neo-meatus would admit only 6F Nelaton catheter when he presented. His parents did not turn up for further surgery. We could not perform Uroflowmetry in these children but clinically the rest had good stream without any strain and voided within a reasonable time when watched.

Discussions

The original Koyanagi repair, had a high rate of complications of 45% to 50%¹²³ as it paid little attention to the vascularity of this oblong loop of random flap and had relied on dissection and mobilization of penile dartos and bisection of the loop distally at the midline (12'Clock position) to move it ventrally to place within glans flap (Wing Flap-Flipping Urethroplasty). Hayashi⁴ and Snow and Cartwright⁵ modified the technique by dissecting the vascular pedicle of the preputial portion of flap and transposing it ventrally by making a buttonhole in the vascular pedicle in the

midline. While Hayashi reported a complication rate of 37%, Snow and Cartwright only described the method without the results (Yoke repair). Snow and Cartwright, however, extensively dissected under the distal and proximal flaps to produce dartos pedicle.

The merits of Koyanagi repair are:

- 1) that most of the proximal hypospadiac deformities can be corrected at one stage with this procedure including penoscrotal transpositions and bifid scrotum.
- 2) there will never be a shortage of length of skin for neourethra as the flap lengths are always greater than the urethral defect length.
- 3) there is only one circumferential anastomosis at the reconstructed external urethral meatus and hence the chance of stricture formation is not there or minimal.
- 4) There is no twist or torsion of penile shaft as in other one-stage procedures; so, it has a better cosmetic outcome.

The demerits of Koyanagi repair are:

- 1) that, with the long ventral suture line, the risk of UC fistula formation is very high.
- 2) the penile skin cover suture line superimposes the neo-urethral suture line.
- 3) the long loop of flap has a precarious blood supply and does not follow the principle of any random flap.
- 4) for tension-free urethral tube formation, the lateral margins of the flaps need dissection underneath, which further jeopardizes the blood supply.

So various modifications of the Koyanagi had been described in the literature e.g., the interposition of TV flap⁶, scrotal septal flap on vascular pedicle⁷ or altogether modifying the operation by shifting dorsal skin ventrally like 2 stage operation but forming the urethra simultaneously and completing the operation in one stage⁸.

The normal vascular supply of the penile skin is dependent on the radial vessel branches (from four axial vessels) forming a network of micro-

vessels in the penile dartos with free anastomosis. The main vessels for penile skin, two in number, come bilaterally from external pudendal at the base, and then branch axially into ventrolateral and dorsolateral branches⁹; in the flaccid state, they are somewhat serpiginous to accommodate the actual length when erect. This abundance of the microvascular network along with dartos is absent on the whole ventral area in hypospadias penis and ends abruptly at the margin of the dystopic meatus and the, so-called, urethral plate.

Moreover, the penile dartos is abnormal histologically in hypospadias with lower elastin and total collagen fibers; the collagen fibers are thick; there is increase in reticulin to total collagen ratio¹⁰. This abnormal histology of the penile dartos hinders the free mobility of the penile skin over the Buck's fascia.

The operative technique described here, tried to solve these issues by:

- 1) the skin(1mm) tethered to the abnormal urethral plate is excised along with, so that the vascularity and medial mobility is not hampered when neourethral plate is being reconstructed.
- 2) excision of a strip of 5mm skin, all around the skin flap for urethroplasty, makes tubularization tension free without dissection underneath the flap (which is solely dependent on underlying blood supply in the penile shaft portion).
- 3) it also allows automatic covering of neourethral tube with the free dartos fascia devoid of skin which moves from lateral to a medial position easily and effectively forms the first barrier layer.
- 4) an appropriate dorsal slit makes ventral resurfacing by penile skin tension-free, over a second barrier layer of TV flap.

The results of urethroplasty in our cases could be assigned satisfactorily as, there are no urethra-cutaneous fistulae, but it is a very small series indeed. In one case, meatal stenosis with diverticulum formation, essentially points to the inherent deficit of a uniform caliber of skin made urethral tube all through and the long-term inadequacy of any skin tube¹¹. It also points to the glaring fact, that the policy and regimen of urethral dilatation, is difficult to be followed by parents, in a conscious state with anxious uncooperative children. We must have to do away

with this. In this procedure, probably in the future, this problem can be solved by making a wider skin tube at the glans portion to allow for future contraction. Dilation is to be done, as and when necessary, under GA. Increased fluid intake may probably help in this regard by hydro dilation, till the scar tissue is mature, usually by 2 years or may sometimes be lifelong.

Also, during Glanulo-meatoplasty, we must remember that in normal morphometry the vertical length of the external meatus is always greater than the distance from the tip of frenulum to the lower lip of the meatus¹² and normal glans is never conical in the truest of its' sense as in the ventral midline it is clefted by the frenulum and a septum, the Septum Glandis, in MRI pictures¹³. The meatus is also not on the tip of a cone but usually slightly ventral when the penis is flaccid. It should also be remembered that the normal frenular arteries are ventral branches of the bilateral circumflex arteries (terminal branches of the deep dorsal artery of the penis), which divides to supply glans wings and frenulum, in contrast to rest of the prepuce⁹; in hypospadias, even in MIP variants, frenulum with its arterial supply is absent. Glans wings should be fashioned superficial to this arterial plane. All these facts should be considered during Glanulo-meatoplasty and too tight a glans closure should be avoided at all cost to prevent stenosis in this part. We plan to modify our procedure further in this regard in future cases.

This early report aims to highlight our modification of a versatile one-stage procedure for proximal hypospadias. We admit that true merits of this modification are to be tested in the long run by operating on more cases and it should be replicable by our peers.

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