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Original Article

Soft tissue reinforcement interposition flaps in hypospadias repair

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ABSTRACT

Purpose: To discuss the role and mechanism of action of soft tissue reinforcement interposition flaps (STRIFs) in hypospadias repairs (reinforced hypospadiac urethroplasties). **Materials and Methods:** Between 2000-2005, 120 consecutive hypospadiacs (distal 85, mid 20, proximal 15), who underwent primary reinforced urethroplasties employing different types of STRIFs, were retrospectively analyzed. The STRIFs were highly vascular soft tissue pedicled flaps (devoid of epithelium) interposed between neo-urethras and the covering skin to reinforce the neo-urethras against fistula formation. The STRIFs were harvested, without much donor site deformity, from: preputial skin, penile skin and scrotal skin by de-epithelialization. Those from Buck's fascia, corpus spongiosum and tunica vaginalis are STRIFs without epithelium anyway, therefore do not need de-epithelialization. Redo urethroplasties and micropenises were not included. Seven patients were excluded because they had incomplete follow-up. The remaining 113 (distal 84, mid 17, proximal 12) were followed up for nine to 40 months for number, size, location, spontaneous closure and persistence of urethro-cutaneous fistula (UCF), and other complications with regard to the severity of hypospadias, method of neourethral re-construction, types of STRIFs employed and skin cover used. A total of 158 STRIFs and 124 skin covers were used in 113 hypospadiac urethroplasties. **Results:** The first surgery was curative in 74 (65%) of 113 patients. In the remaining 39 (35%), various complications included 12 urethro-cutaneous fistulas (UCFs), 10 urethral strictures, six cases each of penile torsion and meatal stenosis and five cases each of superficial necrosis and poor cosmesis. Of these 39 patients, 25 (64%) recovered with conservative treatment and 14 (36%) required re-operation, i.e. UCFs and strictures in four cases each and penile torsion, meatal stenosis and dog-ears in two cases each. All the 12 UCFs were single, pinpointed and were located at the corona in five and at the shaft in seven. Eight (67%) of the 12 UCFs healed spontaneously during the follow-up period of 12 weeks. **Conclusions:** Harvesting STRIFs is technically easy, however, great care is required in their handling, accurate placement and suturing over and around the re-constructed neo-urethras for their secured reinforcement against fistula formation. Use of STRIFs in hypospadias repairs decreases fistula-associated morbidity but does not absolutely prevent fistula formation. The STRIFs reduce the size and prevent multiplicity of UCFs and locate the UCFs eccentrically well away from the neo-urethra to facilitate their spontaneous (conservative) as well as subsequent (surgical) closure. The mechanism of action of STRIFs is multi-factorial, like acting as a mechanical barrier; preventing suture line superimposition; inducing neo-angio-genesis; working as biological drain; providing mechanical support; and, filling the dead spaces.

KEY WORDS

Hypospadias, soft tissue reinforcement interposition flaps, urethra, urethro-cutaneous fistulas

Urethro-cutaneous fistulas (UCFs) usually result following loss of viability of tissues involved in hypospadias repair.[1] Necrosis of overlying skin and subcutaneous tissue leaves the neo-urethra and its seam exposed, thus resulting in either its total or partial disruption or fistula formation. Also, excessive backpressure due to distal obstruction can disrupt adequately reinforced repairs of good integrity.[2] The use of different types of reinforcement interposition flaps in hypospadias repair is not a new concept and their utilization by almost all the hypospadias surgeons is well documented in the literature, although named differently but mainly to serve a common cause, i.e. an attempt to reinforce the newly re-constructed neo-urethras against having fistula formations. These reinforcement flaps, irrespective of the tissues (preputial skin, penile skin, Buck's fascia, corpus spongiosum, scrotal skin and testes) used for their harvesting, their location (local or distant) and their pattern of vascularity (random or axial), have been collectively named by the authors as "STRIFs" (soft tissue reinforcement interposition flaps). In STRIF (soft tissue reinforcement interposition flap): *'ST'* stands for '*soft tissue*,' which mainly comprises vessels, lymphatics, fibrous tissue and no adipose tissue; *'R'* stands for 'reinforcement' of the reconstructed neo-urethra by covering it with additional soft tissue flap; *'I'* stands for '*interposition*' of the soft tissue by way of its sandwiching between the neo-urethra and the covering skin; and, *'F'* stands for '*flap*' because the re-enforcing soft tissue is highly vascular and pedicled.

MATERIALS AND METHODS

One hundred and twenty consecutive hypospadiacs (distal 85, mid 20, proximal 15) who underwent primary urethroplasties between 2000-2005 employing STRIFs constituted the study. Those with second stage and re-do urethroplasties were not included. Seven patients (distal one, mid three, proximal three) had incomplete follow-up and were excluded. The remaining 113 consecutive hypospadias patients (distal 84, mid 17, proximal 12) aged two to 18 years (mean seven years) were retrospectively analyzed regarding size, number, location, spontaneous closure or persistence of UCFs, and for other complications with regard to degree of hypospadias, method of neo-urethral re-construction, types of STRIFs employed and the skin cover provided. All were followed up for at least nine months (range nine to 40 months).

During preoperative counselling and while taking written consent, all adult hypospadias and the parents of minor hypospadias were explained about the possibility of different postoperative complications like (i) partial or full thickness necrosis of skin, (ii) partial or total disruption of the repair, (iii) UCFs, (iv) meatal stenosis, (v) early or late urethral strictures, (vi) residual chordee, (vii) penile torsion and (viii) poor cosmesis (ix) hypospadias cripple. Postoperative potency, fertility/pregnancy of spouse, penile growth, job entry and not requiring any subsequent surgical procedure (around adulthood or marriage) were not guaranteed.

General or spinal anaesthesia was administered to those below and above 15 years of age, respectively. The choice of a) techniques of neo-urethral re-construction, b) selection of STRIFs and c) providing skin covers were influenced by: (i) surgeon's preference and expertise; (ii) severity of hypospadias; (iii) chordee; (iv) the quality of glans, glans groove, urethral plate and prepuce; and, (v) the associated preputial, penile or scrotal skin pathologies.

Per-operative magnification was not used. The tissues that were apparently nonviable or of doubtful viability were excised. Special care was taken to use non-crushing fine instruments for meticulous harvesting and gentle holding of the flaps to minimize tissue trauma. All neo-urethral tubes were re-constructed with 5-0 or 6-0 chromic catgut or vicryl® on round body or reverse cutting needles using subcuticular-interrupted sutures. The glans (glandular groove, area of glans wings and site of glans stay suture), coronal attachment of the preputial hood, urethral plate and peri-meatal areas were infiltrated with small amounts of 0.5% xylocaine-adrenaline solution using 26-gauge hypodermic needle and the procedure was started after 5-7 min for the purpose of producing vasoconstriction and haemostasis. Additionally, the dissected tissues were kept compressed by adrenaline (1:200,000 solution) soaked gauzes to control diffuse oozing. Electro-coagulation (monopolar/bipolar) was used only for isolated and well-defined blood vessels lying well away from the neo-urethral tube, STRIFs and the covering skin. During excision of chordee, the bleeding following accidental puncture of corpus cavernosa in four proximal hypospadiacs required suturing with 6-0 Vicryl. When tunica vaginalis (TV) flap or scrotal dartos flap were employed, the scrotal sac was routinely

drained by using a glove drain and this was removed 48-72 h later. Bladder was drained using infant feeding tube No. 8 and 10 for boys less than and more than 10 years of age respectively and removed on the 10th to 14th postoperative day.

*Neo-urethral reconstruction [*Table *1]:* Neo-urethral reconstruction by Snodgrass tubularized incised plate urethroplasty (STIPU) with creation of a wide elliptical meatus was done in 92 hypospadiacs (distal 78, mid-penile 12 and proximal two) and was the overall preferred method.[3,4] Mathieu repair was done in 11 hypospadiacs (distal six, mid-penile five) who had thin atretic urethral plate and shallow glans groove.[2] Free skin tube urethroplasty (FSTU) was performed in 10 proximal hypospadiacs who had moderate chordee (10-15 degree), round glans without any glandular groove and the urethral plate was ill-defined, inadequate in length and breadth, atretic, inelastic and non-pliable.[5] The moderate chordee was corrected by dorsal tunica albugenia plication, i.e. TAP.[6,7]

Harvesting of STRIFs [Table 1]: STRIFs could be harvested from: preputial skin, i.e. triangular soft tissue flap[1] [Figure 1] and Belman flap[8] [Figure 2]; penile skin, i.e. Smith D flap[9] [Figure 3]; penile shaft, i.e. Buck's fascial flap [Figure 4]; corpus spongiosum of proximal native urethra, i.e. peri-meatal turnover flap [Figure 5] and corpus spongiosum flap from the fanning spongiosum;[10] scrotal skin, i.e. scrotal dartos flap[11,12] [Figure 6] and the testes, i.e. tunica vaginalis flap[13-16] [Figure 7]. Harvesting of STRIFs from preputial skin, penile skin and the scrotal

Figure 1: Triangular soft tissue flap harvested from the distal part of one half of Byar's flap

Figure 2: Belman flap harvested from full one half of the Byar's flap

Figure 3: Smith D flap harvested from the penile skin

Figure 4: Buck's fascial flap harvested from the penile shaft (juxtra neo-urethral)

Table 1: The various methods for neo-urethral reconstruction, different types of STRIFs, and various methods of skin cover

Different types of hypospadias	*Different techniques of neo-urethral re-construction*			*Different types of STRIFs*							*Different skin covers from preputial skin, penile skin and scrotal skin*				
				Preputial and penile skin STRIFs			*Penile shaft and urethral STRIFs*		*Scrotal and Testicular STRIFs*						
	STIPU	*Mathieu*	*FSTU*	*TSTF*	*Belman*	*Smith D*	*Buck's fascia*	*Spongios*	*Scrotal dartos*	*TV flap*	*Byar's*	*Nesbit*	*Scrotal*	*PPWC*	*Scrotal v-y plasty*
Distal (84)	78	6	0	52	17	3	0	15	0	5	63	3	0	18	0
Mid-penile (17)	12	5	0	15	0	6	2	0	0	2	8	1	0	8	0
Proximal (12)	2	0	10	8	0	12	2	0	7	12	12	0	6	0	5
Total (113)	92	11	10	75	17	21	4	15	7	19	83	4	6	26	5

Total number of hypospadiacs operated 113
Total number of STRIFs used 158
Total number of skin covers used 124
Mid and Proximal hypospadiacs invariably required more than one type of STRIF and skin cover

Figure 5: Peri-meatal corpus spongiosum turnover flap harvested from proximal native urethra

Figure 6: Scrotal dartos flap harvested from scrotal skin (tunnelled)

Figure 7: Tunica vaginalis flap (TV Flap) harvested from testis (tunnelled)

skin required careful and meticulous de-epithelialization, whereas Buck's fascia, corpus spongiosum and tunica vaginalis are STRIFs themselves, therefore, not

necessitating any de-epithelialization. Preputial and penile skin dartos fascial flaps were preferred in distal and mid-penile hypospadiacs. Tunica vaginalis flap (TV flap) and the scrotal dartos fascial flaps were ideal for proximal penile hypospadiacs. Urethral spongiosum and Buck's fascia were utilized when conservation of peno-preputial skin was required for coverage. Depending on the availability of tissues, every attempt was made to use more than one STRIF and skin flap in proximal hypospadiacs to provide added reinforcement against fistula formation and tension-free skin closure. A total of 158 STRIFs and 124 skin covers were required in 113 different hypospadiacs [Table 1]. Harvesting of TV flap is not feasible in cases of bilateral cripto-orchidism, but it can be harvested from the right side in cases of left-sided undescended testis or varicocele. Depending on the pattern of vascularity, the triangular soft tissue flap, Smith D flap, Buck's fascial flap, corpus spongiosum flap and scrotal dartos flap are random pattern STRIFs, whereas the Belman flap (superficial external pudendal artery) and the tunica vaginalis flap (cremasteric artery) are axial pattern STRIFs. These STRIFs could be local or distant. While harvesting the STRIFs, it was ensured that they permit generous mobility and versatility to facilitate their tension-free placement and suturing on and around the reconstructed neo-urethras for their maximum reinforcement.

Skin cover [Table 1]: Byar's fascio-cutaneous flaps[17] were the commonest flaps used for providing skin cover in 83 hypospadiacs. When preputial-based STRIF such as Belman flap was used, the prepuce was divided asymmetrically, depending upon the pattern of division of the peno-preputial vasculature (as judged against the OT light), into larger (more vascular) and smaller (less vascular) Byar's flaps of 3:2 ratios, respectively. The larger and more vascular flap was used for harvesting the STRIF for coverage of neo-urethra. The smaller and less vascular half of Byar's flap was used to cover the lateral and ventral penile shaft. Initially, in 26 (distal penile 18, mid-penile eight) hypospadiacs, after degloving the penile shaft, the preputial skin was distally de-epithelialized (STRIF) and then it was rotated and ventralized to be used as a continuous suture-free wrap cover, i.e. peno-preputial wrap cover (PPWC) for neo-urethra, that resulted in penile torsion in six patients, therefore, it was abandoned for future usage. Where the prepuce was inadequate to provide total skin coverage in proximal hypospadiacs the scrotal transposition flaps (six cases) or scrotal v-y plasty flaps (five cases) were utilized to obtain additional skin for coverage. Nesbit flaps[18] in four patients (distal three, mid-penile one) were demonstrated for teaching purposes and it was not a preferred method for providing skin cover due to its poor cosmesis.

Postoperatively, patients were administered antibiotics, analgesics, antipyretics, anti-inflammatory drugs, antispasmodics, sedatives and anxielytics as and when indicated or demanded. In children less than 10 years of age, penile erection was not a significant problem. In all patients, topical antiseptics (Povidone-iodine cream or Neosporin ointment) and compression dressings[19] were employed; and, the repairs were inspected and dressings changed on the fifth and 10th postoperative days. The follow-up was scheduled weekly for the first month, monthly for the first year and three-monthly for the next year and thereafter, annually or once in two years. At discharge, adult hypospadiacs were instructed not to indulge in masturbation, intercourse or marriage within six months of successful surgery or correction of complications.

RESULTS

An uneventful recovery with good cosmetic outcome was achieved in 74 (65%) of 113 patients. In the remaining 39 patients (35%), complications included 12 urethrocutaneous fistulas (UCFs), 10 urethral strictures, six cases each of penile torsion and meatal stenosis and five cases each of superficial skin necrosis and poor cosmesis. Of these 39 patients, 25 (64%) were managed by non-surgical measures; and in the remaining 14 (36%), re-operation was warranted in four cases each of persistent UCFs and strictures and in two cases each of penile torsion, meatal stenosis and unsightly dog-ears [Table 2]. The urethro-cutaneous fistula (UCF) was the most common complication despite the use of STRIFs. All UCFs were single, small-sized (micro UCFs, i.e. less than 3mm size) and were located either at the corona (n = 5, distal three, mid one, proximal one) or on the lateral penile shaft (n = 7, distal four, mid one, proximal two). In eight patients (distal four, mid two, proximal two) with coronal and lateral fistulas, spontaneous healing of fistula occurred by the 12th and eighth postoperative weeks, respectively. Therefore, the ultimate incidence of persistent UCFs (micro UCFs and singular UCFs) had fallen from 10.6% (12/113) to only 3.5% (4/113). After waiting for a minimum period of six months, the remaining four persistent UCFs (distal three, proximal one) were

Table 2: Complications

Severity of hypospadias	*UCFs*	*Stricture*	*Torsion*	*Stenosis*	*Dog-ears*
Distal (84)	7	0	6	4	3
Mid-penile (17)	2	0	0	2	1
Proximal (12)	3	10	0	0	1
Total (113)	12	10	6	6	5
Healed conservatively(25)	8	6	4	4	3
Required re-operation (14)*	4	4**	2	2	2
Awaiting third surgery	0	2***	0	0	0

Total No. of Cases 113; Successful outcome after first surgery 74 (65%); Various complications observed 39 (35%); Of these 14* patients, re-operation was curative only in 10; The 4** residual strictures were first laid open and two were successfully repaired six months later; 2*** still awaiting third surgery; Overall 111 out of 113 hypospadiacs were treated successfully; Five had superficial skin necrosis (mid = 2, proximal = 3), not mentioned in the table

successfully: (i) circum-incised, dissected and partially excised; (ii) closed air- and watertight using multi-layered closure of the perifistular soft tissue (previously banked STRIF); and, further (iii) reinforced by local penile/scrotal skin flaps. Using circum-coronal incision, the torsed penile shaft was carefully degloved without injuring the urethra and was then re-sutured, followed by dressing after proper alignment of the penile shaft. Dorso-ventral meatotomy and subsequent calibrations treated the residual meatal stenosis. All the 10 patients who underwent free skin tube urethroplasty (six from inner preputial skin, i.e. genital skin and two each from the medial aspect of the arm and the inguinal crease, i.e. extra-genital skin) developed urethral strictures that were managed by weekly dilatation. Persistence of the stricture in four patients (one inner preputial skin neo-urethral tube, i.e. genital skin; and, two medial arm skin neo-urethral tube and onw inguinal skin neo-urethral tube, i.e. extra-genital skins), despite weekly dilatation, necessitated re-operation by laying open the strictured segments of the neo-urethras. After six months of waiting, two were closed (circum-incised, tubularized and reinforced with other side TV flap and local penile/scrotal skin flaps) and both were asymptomatic at two years of follow-up. The remaining two are yet to be repaired. For correcting dog-ears, the overlying skin of the dog-ears was de-epithelialized and the underlying soft tissue, so exposed, was partially trimmed and plicated and thereafter the skin was finally closed. There was no pouching or ballooning or diverticulization in the region of the native urethra from where the corpus spongiosum peri-meatal turnover flaps were harvested. Frequent urinary bladder spasms and peri-catheter urinary leakage with wetting of the dressings were common in hypospadiacs below 10 years of age. Peri-catheter urethral discharge and frequent postoperative penile erections were seen in adults of more than 10 years of age. After the second operation, 98% (111/113) of the patients were treated successfully [Table 2] with an acceptable functional (single thick projectile urinary stream without straining, no chordee and no impotency) and cosmetic (without dog-ears, suture tracts, sinuses, fibrosis, tight/short penile skin, asymmetrical skin distribution and penile torsion) outcome.

DISCUSSION

Fistula formation depends on a fine balance between (i) healthy or ischemic neo-urethral tube, (ii) thick and vascular versus thin and attenuated STRIF, (iii) uniform, patent and adequate neo-urethra versus its irregularity, stenosis, stricture and diverticulization, (iv) healthy or partial/full-thickness necrosis of the covering skin, (v) long and oblique versus short and superimposed fistulous tract, (vi) genital versus extra-genital full-thickness skin graft urethroplasty, (vii) experienced versus infrequently operating surgeon, (viii) gentle versus rough dissection handling and electro-cauterization of delicate tissues, (ix) with or without proper pre, per and postoperative precautions and (x) many other unknown and unidentifiable factors. On account of this multi-factorial aetiology of UCFs, despite the use of STRIFs, they remained the most common complication of hypospadiac urethroplasties. In the present series, no obvious single factor responsible for the formation of the four persistent UCFs could be identified. More so, unlike the multiple macro UCFs encountered in the past following non-reinforced hypospadiac urethroplasties (where no additional soft tissue was used to strengthen the neo-urethra), all the UCFs in this series of reinforced hypospadiac urethroplasties were singular micro-sized and healed spontaneously in eight (67%) of the 12 cases. This can be attributed to STRIFs, which are discussed in detail below.

Role of STRIFs in the prevention and outcome of UCFs in hypospadias repair

In the absence of adverse factors responsible for UCF

formation, the STRIFs reduce the fistula-associated morbidity by forming a mechanical barrier to the leakage of urine, preventing overlapping of suture lines, filling the dead spaces, adding strength to the neo-urethra and preventing its excessive dilatation by the urinary stream, increasing the vascularity of a comparatively hypovascular area by neo-angio-genesis, and providing an alternative route for lymphatic drainage by acting as a biological drain. In the event of UCF formation, STRIFs reduced the size and persistence of UCFs by providing additional vascularity that enhanced healing, decreasing edema by way of absorption of tissue fluid *via* lymphatics (biological drain), and providing soft tissues capable of wound contraction during healing. *In cases of tissue necrosis resulting in urethrocutaneous fistula formation, it is presumed that the STRIFs act as scavenger by way of their high vascularity resulting in increased local cellular defence mechanism.* Furthermore, when abundant and well vascularised STRIFs were used, the UCFs were located laterally on the penile shaft, favouring spontaneous healing. These observations denote that although the STRIFs act as mechanical barriers against leakage of urine they do not completely prevent fistula formation.

Mandatory criteria to be followed during harvesting of STRIFs

The STRIFs should not have tension, torsion, kinking or accidental buttonholing; and, must have definite vascularity (as judged by adequately bleeding flap margins), optimum thickness and adequate dimensions to cover the reconstructed neo-urethras, especially the coronal and anastomotic sites.

Factors governing the choice of STRIFs

The STRIF should be chosen in such a way that it would provide maximum protection to the re-constructed neo-urethra with minimum additional dissection, de-vascularization, de-epithelialization, deformity and disfigurement. It should also, preferably, add to the cosmesis of the repair. However, this ideal situation may not always be technically feasible and a variety of factors such as the severity of hypospadias, previous circumcision, technique of urethroplasty, primary or redo urethroplasty, single or multi-staged repair, integrity of repair and probability of UCF formation, previous scarring and fibrosis, type of STRIF used previously, and, penile and preputial size may determine the choice or limits of availability of STRIF. Other situations that limit the choice of STRIFs are (i) peno-preputial skin of doubtful viability, then random flaps are not used, instead, axial flaps are used for better protection; (ii) testicular and scrotal anomalies restricting the use of tunica vaginalis flaps and scrotal flaps, respectively; (iii) patients with chordee, proximal hypospadias and lengthy phallus requiring longer STRIFs; and, (iv) thin, attenuated, fibrosed and buttonholed flaps with poor vascularity and reliability.

Advantages, disadvantages and complications of STRIFs

Advantages: STRIFs reduce the size, multiplicity and ultimate incidence and persistence of fistulas, provide vascularity to precarious skin covers, facilitate spontaneous closure (due to longer and oblique tracts), and improve subsequent surgical closure of persistent UCFs due to the presence of previously banked perifistular soft tissue, facilitating easy and safe dissection and multilayered closure. *The secondary/incidental benefit of TVA flap harvesting is prevention of future hydrocele.*

Disadvantages: STRIFs entail de-epithelialization of skin otherwise reserved for skin cover and also require additional time and expertise for meticulous dissection.

Complications of STRIFs include necrosis (when too thin lustreless STRIFs with non-bleeding margins are harvested either following improper de-epithelialization or from attenuated/fibrosed peno-preputial skin); oedema (when STRIFs are compressed by tight skin sutures); drumstick deformity (when more bulky flaps are banked in the region of the corona); penile torsion (when the STRIFs are rotated too much or due to the torque effect of the peno-preputial wrap cover); ventral penile chordee (when too much distal advancement of an otherwise short STRIF is done); additional scrotal scarring; accidental damage to pempiniform plexus and vas deference (while harvesting TV flap); obstructed external meatus (by too much distal placement of bulky STRIFs under the glans wings); shortage of the covering skin (when too much of the skin is de-epithelialized to harvest excessive amount of a STRIF); scrotal haematoma (when bleeder is left or drain is not put in the scrotal sac); and, transient upward displacement of testis (forward and upward pull of TV flap) when TV flap is used for interposition.[4] In two patients with >90 degree anticlockwise torsion, marked deviation of urinary stream necessitated subsequent de-gloving of penis for release of torsed shaft and realignment of the skin and soft tissues.

Functional and cosmetic outcome

The urethral stricture occurred exclusively when extra-genital free skin tube urethroplasties (FSTU) were

performed in proximal hypospadiacs. Strictures following use of full-thickness skin graft (FTSG) urethroplasties are due to the inherited contraction of the unsupported graft during its initial period. The contracted FTSG subsequently may yield to dilators or urinary stream during the process of maturation. The persistent strictures, after six months of conservative treatment, in four proximal hypospadiacs requiring surgical correction, could be attributed to scarring from recurrent urinary dermatitis and fibrous contraction, mainly of the extra-genital FTSG neo-urethras, which are not accustomed to urine. Meatal stenosis (required minor dorso-ventral meatotomy) resulted when the incision for Snodgrass urethrotomy was erroneously carried too distally onto the glans.[4] Acute angulations of the preputial skin resulted in dog-ears and were observed in all patients where Nesbit flaps were used for skin cover and were successfully corrected using de-epithelialization and soft tissue plication. None had residual chordee and all were potent.

CONCLUSIONS

The use of STRIFs alone will neither prevent UCF formation nor will decrease fistula-associated morbidity when other major causative factors responsible for formation of UCFs are present. The ultimate decreased incidence (3.6%) of persistent UCFs in late follow-up periods, formation of singular and micro-sized UCFs, laterally placed UCFs with oblique tracts favouring their spontaneous closures and facilitation of subsequent surgical closure of persistent UCFs by simple surgical techniques (easy dissection and multilayered closure of UCFs due to the presence of abundant perifistular soft tissues) are the unique advantages. The UCFs in non-reinforced urethroplasties are mostly multiple, macro-sized, superimposed directly on the neo-urethra, deficient in perifistular soft tissues, associated with thin-walled neo-urethras, and therefore impose difficulties in spontaneous closures as well as require complex surgical procedures for their subsequent surgical closures. Hence, to prevent formation of multiple and macro UCFs, as were seen in the past in non-reinforced urethroplasties, the routine use of STRIFs for reinforcement of the neo-urethral tubes (reinforced urethroplasties) should be considered as an integral part and procedure in all types of hypospadiac urethroplasties. More so, use of more than one STRIF and the skin flap would provide additional reinforcement to the neo-urethra and would also ensure tension-free skin closure. Recently, these STRIFs have also been used by the authors for the successful reinforcement of: (i) second stage urethroplasties, (ii) redo urethroplasties, (iii) closure of macro UCFs, (iv) repaired urethral injuries, (iv) urethral diverticulectomy and (vi) urethral stricturoplasties.

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