

The Hypospadias, Chordee, Orthoplasty and The Prepuccial Hood

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Abbreviations:

DTAP-Dorsal Tunica Albuginea Plication; DDTAP-Double Dorsal Tunica Albuginea Plication; TA-Tunica Albuginea.; IPFTSG-Inner Prepuccial Full Thickness Skin Graft; OPFTSG-Outer Prepuccial Full Thickness Skin Graft; DG-Dermal Graft; VTAP-Ventral Tunica Albuginea Plication; IH-Inguinal Hernia; ARM-Anorectal malformation; UDT-Undescended Testis; DNVB-Dorsal Neuro-Vascular Bundle; UCFs-Urethro-Cutaneous Fistulas; VVFs-Vesico-Vaginal Fistulas. TVG-Tunica Vaginalis Graft. TVF-Tunica Vaginalis Flap.

Keywords:

Hypospadias; Chordee; Artificial erection; Orthoplasty; Chordee excision; Dorsal tunica albuginea plication; Double dorsal tunica albuginea plication; Ventral tunica albuginea plication; Inner prepuccial full thickness skin graft; Outer prepuccial full thickness skin graft; Dermal graft; Tunica vaginalis graft; Tunica vaginalis flap; Neo-urethroplasty; Urethro-cutaneous fistulas; Water-proofing flaps; Inguinal hernia; Undescended testis; Ano-rectal malformation; Balanitis xerotica obliterans.

1. Abstract

1.1. Purpose: Making the surgeons aware of the significance of penile chordee, need of optimal straightening of penile shaft (orthoplasty) and appropriate use of well-developed prepuccial hood for re-construction of an ideal neo-urethral plate and a near normal neo-urethra by its tubularization and finally re-enforcement of the neo-urethra by prepuccial dartos fascial flap to minimize post-operative morbidities.

1.2. Aims and Objectives: Exact assessment of characteristics of chordee by artificial erection of penis, achieving acceptable orthoplasty before commencing upon final neo-urethroplasty and making maximum use of prepuccial hood skin in (i) formation of neo-urethral plate and to have an ideal near normal non-hairy and resistance free neo-urethra and or (ii) designing and harvesting various types of skin and or water proofing flaps because of its axial vascularity.

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1.3. Material and Methods: Material related to the penile chordee, orthoplasty and appropriate utilization of prepuccial hood was collected from the photographic record of hypospadias patients who attended “Hypospadias and VVFs Clinic” between 2004-2016. Based upon the characteristics of penile shaft and its chordee, various surgical techniques used for acceptable correction of the chordee (orthoplasty) were circum-coronal degloving of penile shaft up to its root, excision of chordee, Dorsal Tunica Albuginea Plication (DTAP), Double Dorsal Tunica Albuginea Plication (DDTAP), Ventral Tunica Albuginea Plication (VTAP), Inner Prepuccial Full Thickness Skin Graft (IPFTSG), outer Prepuccial Full Thickness Skin Graft (OPFTSG), Dermal Graft (DG), Tunica Vaginalis Graft (TVG) and Tunica Vaginalis Flap (TVF). Accidental breach in Tunica Albuginea (TA) was identified and repaired in water tight fashion. Special care was taken to prevent injury to Dorsal Neuro-Vascular Bundle (DNVB). Hypospadiacs with Bala-

nitis Xerotica Obliterans (BXO) were excluded from study.

1.4. Observations: Neo-urethroplasty in an uncorrected chordee is deemed to be associated with subsequent anatomical, functional and aesthetic problems, thereby warranting re-do orthoplasty and neo-urethroplasty including total dismantling of the previous surgical repair. The presence of fully developed prepuccial hood proved to be a boon to the surgeon in repairing both the fresh as well as re-do cases of neo-urethroplasty and also in harvesting water-proofing flaps to decrease post-operative morbidities. Presence of Undescended Testis (UDT), Inguinal Hernia (IH) and Ano-Rectal Malformation (ARM) are to be corrected on priority.

1.5. Conclusion: (i) Pre-operative assessment of characteristics of penile chordee by normal saline induced artificial erection, (ii) optimal straightening of the penile curvature using appropriate surgical technique, (iii) re-construction of an ideal neo-urethral plate by using non-hairy genito (prepuccial hood)/ oro (buccal mucosa)/ uro (bladder urothelium) or the intestinal (colonic mucosa) epithelial lining, (iv) re-construction of neo-urethra having acceptable anatomical, functional and aesthetic results and (v) re-enforcement of neo-urethra by designing appropriate water-proofing flap are the principal aims of the operating surgeon, so that hypospadias repaired patients remain asymptomatic and free from any of the morbidities associated with hypospadias repair in longer-terms of follow-ups.

2. Introduction

Achievement of perfection in neo-urethroplasty and an anatomical, functional and aesthetic penile shaft in proximal hypospadias with severe chordee is the real test for the competency and expertise of the operating surgeon, who could happen to be a Plastic Surgeon, Paediatric Surgeon, Paediatric Urologist, Urologist, Hypospadiologist, Genito-urinary Surgeon or the General Surgeon. Since the chordee has variable characteristics and the prepuccial hood could have various developmental anomalies, therefore, different surgical techniques need to be adopted for straightening of penile shaft and re-construction of neo-urethral plate to achieve the ultimate goal of creation of an ideal neo-urethra subsequent to tubularization of the matured neo-urethral plate. The prepuccial hood is of great importance in proximal hypospadias having varying amount of deficiency of dispensable and usable tissue, whereas, the absence of prepuccial hood has no much of significance in distal hypospadias where chordee is invariably absent and neo-urethroplasty is completed without the help of prepuccial hood due to the presence of well-developed glans and a deep glandular groove lined by normal native urethral plate, therefore, circumcision in distal hypospadias does not affect its repair, however, its presence will facilitate re-construction of prepuce (prepuccioplasty) to provide aesthetic appearance to penis, thereby boosts the moral and manhood among the repaired hypospadias. Absence of native urethral plate and glans groove (flat glans), presence of distal penile chordee and keratinized skin in place of urethral plate

(hairy-skin lined region of native plate), attenuated distal part of native urethra are the circumstances where presence of prepuccial hood can play vital roles even in distal hypospadias to have near normal penile shaft and neo-urethra.

3. Material and Methods

The study material constituted the photographic record of hypospadias patients (hypospadias) who attended the “Hypospadias and VVFs Clinic” run under the Department of Burns and Plastic Surgery of Postgraduate Institute of Medical Sciences (PGIMS), University of Health Sciences Rohtak (UHSR), Haryana, India during the period 2004 – 2016, wherein the hypospadias having chordee and prepuccial hood of different characteristics were thoroughly examined and questioned (Figure 1a, Figure 1b, Figure 1c), orthoplasties were carried out and their respective prepuccial hoods were utilized as per the requirements like full thickness skin graft (Figure 2), Byar’s flaps from prepuccial hood or other advancement, rotation and transposition skin flaps from banked part of un-used prepuccial hood during previous surgery (Figure 3a, Figure 3b) dartos fascial flap (Figure 4) and prepuccial re-construction, i.e., prepuccioplasty (Figure 5a, Figure 5b). All cases were followed-up till final neo-urethroplasties were carried out to the satisfaction of both the operating surgeon and the hypospadias patients. Various techniques adopted to correct chordee were (i) simple circum-coronal incision and de-glowing of penile shaft up to its root in sub-dartos avascular plane for correction of skin and dartos chordee (Figure 6a, Figure 6b, Figure 6c), (ii) circum-coronal degloving and release of Buck’s fascia for correction of chordee due to asymmetrical Buck’s fascia, (iii) circum-coronal incision, de-glowing of penile shaft up to its root in sub-dartos avascular plane and then excision of dense fibrous chordee tissue (a representative of corpus spongiosum of the un-developed urethra) causing ventral penile curvature (Figure 7a, Figure 7b), (iv) circum-coronal incision, de-glowing of penile shaft up to its root in sub-dartos avascular plane, then excision of dense fibrous tissue (a representative of corpus spongiosum of the un-developed urethra causing chordee) and finally transverse scoring of the outer layer of Tunica Albuginea (TA) having fine residual fibers of chordee tissue (Figure 8), (v) circum-coronal incision, de-glowing of penile shaft up to its root in sub-dartos avascular plane, then excision of dense fibrous tissue causing chordee, transverse scoring of the outer layer of tunica albuginea having fine fibers of chordee and finally Dorsal Tunica Albuginea Plication (DTAP), which could be bilateral on either side of the Dorsal Neuro-Vascular Bundle (DNVB), i.e., paramedian DTAP (Figure 9a, Figure 9b) or in the midline after dissecting and displacing the DNVB, i.e., median DTAP (Figure 10), (vi) Double Dorsal Tunica Albuginea Plication (DDTAP) which could be para-median or median, (vii) transverse incision of ventral half of tunica albuginea from 3° clock to 9° clock and dermal grafting of the raw area to make both dorsal and ventral walls of tunica albuginea equal and symmetrical, (viii)

penile root plication to bring penile shaft in midline (Figure 11), (ix) plication of distal conical ends of TA for correction of glans chordee (Figure 12a, Figure 12b, Figure 12c, Figure 12d), (x) tunica albuginea plication on both lateral sides at different sites for correction of S-shaped chordee (Figure 13), (xi) bilateral ventral tunica albuginea plication (VTAP) to correct dorsal chordee resulting due to previous over doing of DTAP or avulsion injuries (Figure 14a, Figure 14b), (xii) simple skin re-orientation or Z-plasty to correct skin chordee and prepuccial chordee (Figure 15) and (xiii) transverse incision of ventral half of TA and patching the gap with tunica Vaginalis Graft (TVG) or Tunica Vaginalis Flap (TVF) (Figure 16). The prepuccial hood was appropriately utilized for (i) re-construction of prepuce (prepuccioplasty), (ii) designing two Byar's flaps from whole of the prepuccial hood skin, skin flaps from part of prepuccial hood or from banked prepuccial skin (advancement, rotation or transposition flaps), (iii) harvesting of inner or outer prepuccial full thickness skin graft (IPFTSG, OPFTSG) for re-construction of non-hairy neo-urethral plate (Figure 17), (iv) neo-urethral tube from free skin graft of prepuccial hood (Figure 18), (v) inner prepuccial transverse island tube or patch urethroplasty (Figure 19a, Figure 19b), (vi) interposition urethroplasty for congenital short urethra (Figure 20), (vii) inlay patch urethroplasty for widening of narrow part of urethral plate (Figure 21), (viii) onlay patch urethroplasty to correct urethral stricture, (ix) harvesting of dartos fascial flap for water-proofing of neo-urethra and closed urethro-cutaneous fistulas (Figure 22) and (x) banking of extra redundant prepuccial hood for future use. Presence of mild or moderate residual chordee in a well-developed penile shaft having adequate penile length is corrected by DTAP through a dorsal midline penile incision without interfering the previously re-constructed near normal neo-urethra.



Figure 1a: Index finger of a hypospadiac depicting status of moderate chordee, however artificial erection must be done to know the details of the characteristics of the chordee

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Figure 1b: Finger depicting severe ventral penile chordee. Correction would require circum-coronal degloving, chordee excision, transverse scoring of ventral TA, DTAP or DDTAP.



Figure 1c: Distal glans chordee depicted by tip of middle finger



Figure 2: Hydro-dissection of inner prepuccial lining to facilitate harvesting of IPFTSG. Smooth, shiny and non-keratinized skin graft is obvious.

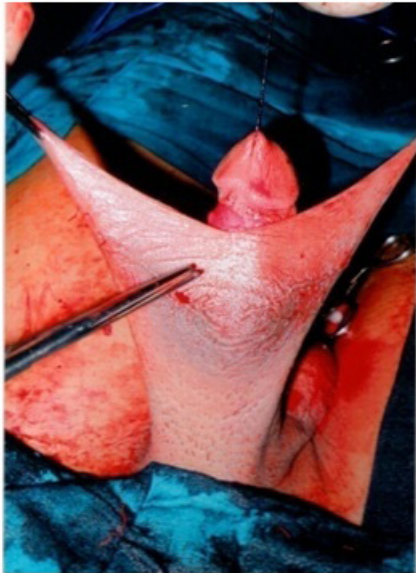


Figure 3a: Byarsization of the prepuceal hood to design two flaps to ventralize them to re-construct neo-urethral plate.



Figure 5a: Prepuceal hood being used to re-construct prepuce (prepuceoplasty).



Figure 3b: Banked un-used part of prepuceal hood displayed, which can be used as skin flap or for harvesting of dartos fascial flap for closing and water-proofing of urethra-cutaneous fistula (UCF).



Figure 5b: Prepuceoplasty completed.

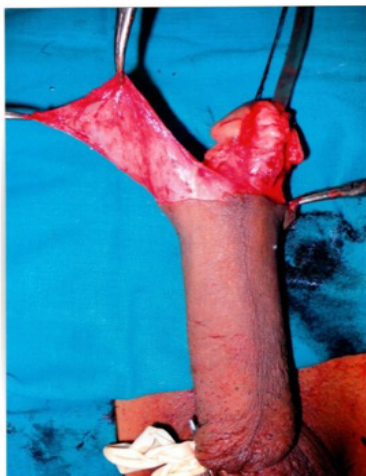


Figure 4: Large prepuceal dartos fascial flap for water-proofing of neo-urethra against fistulization.
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Figure 6a: Circum-coronal degloving of penile shaft through avascular sub-dartos plane. The chordee tissue is seen.



Figure 6b: Circum-coronal degloving showing severe chordee

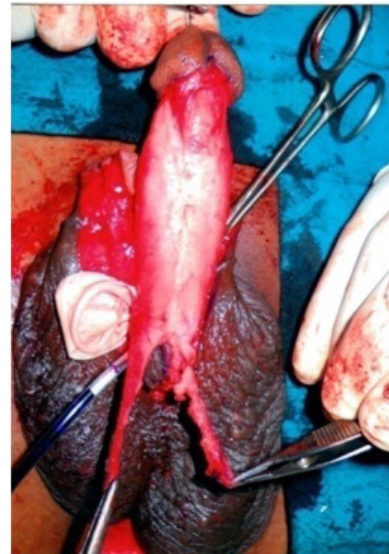


Figure 7b: The chordee tissue is being excised and glistening TA is exposed.



Figure 6c: Moderate chordee demonstrated by penile root compression after circum-coronal degloving of the penis through sub-dartos fascial plane.



Figure 8: The remaining ventral chordee is being corrected by transverse scoring of the outer wall of the TA without causing any breach in its integrity.

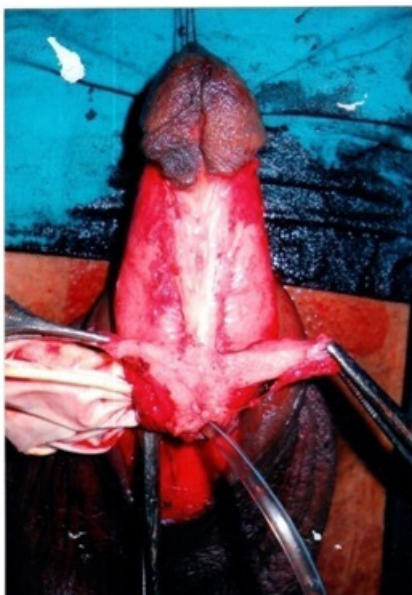


Figure 7a: Dense fibrous tissue responsible for causing ventral penile chordee is defined.
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Figure 9a: Marking of sites for para-median DTAP to correct chordee.

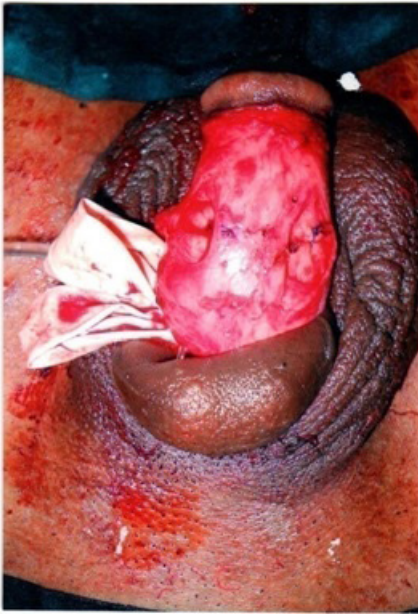


Figure 9b: Transversely done DTAP. Vicryl sutures are clearly seen on either side of the midline.



Figure 10: Residual chordee detected after neo-urethroplasty can be corrected by DTAP through a dorsal midline penile skin incision without dismantling the re-constructed neo-urethra.



Figure 11: The site of exposure of TA is pointed out to plicate it at the base of the penis to correct root chordee by centralizing the penis.



Figure 12a: Complex chordee, a combination of right-lateral root chordee and ventral glans chordee.

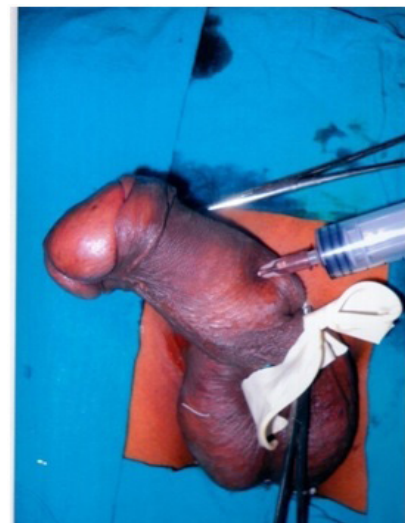


Figure 12b: Glans chordee defined by artificially induced erection by injecting normal saline under tourniquet



Figure 12c: Further saline injection makes rigid erection and venous prominence



Figure 12d: Distal penile chordee made prominent after saline injection.



Figure 13: S-shaped penile chordee following penile fracture after a forceful intercourse.
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Figure 14a: Mid-shaft dorsal penile chordee (post-traumatic in road side accident).



Figure 14b: Dorsal penile chordee following avulsion injury of peno-scrotum with split skin grafting. Penile splinting could prevent such secondary contraction and chordee.



Figure 15: Asymmetrically developed prepuce. The urinary stream is directed on right side because of the direction of prepuce opening (prepuce chordee).



Figure 16: Left testis delivered for harvesting tunica vaginalis graft/ flap for use in chordee correction or neo-urethral plate re-construction (tunica vaginalis supported split skin graft).



Figure 19a: Inner prepuce transverse island flap is incised to be raised for single stage tube-urethroplasty. Similar procedure is done for patch urethroplasty.



Figure 17: Post-chordee excision and designing of glans wings raw areas are grafted with IPFTSG to re-construct non-keratinized and non-hairy neo-urethral plate with adequate dimensions.

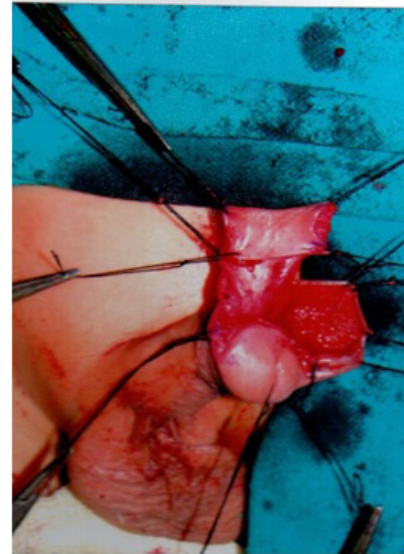


Figure 19b: Inner prepuce transverse island flap is raised on its dartos fascia pedicle.



Figure 18: The shining, smooth and non-keratinized IPFTSG could be used either as free graft to re-construct neo-urethral plate (staged procedure) or tubularized to re-construct neo-urethra (single staged).

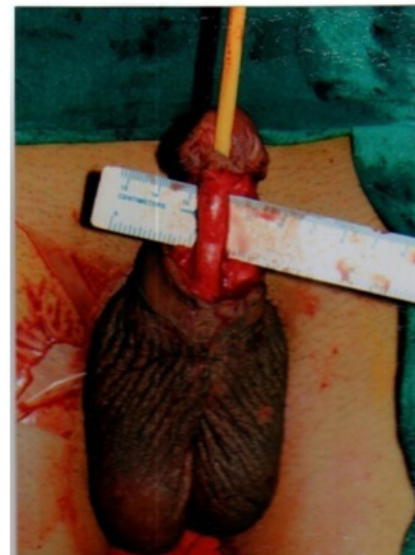


Figure 20: Congenital short urethra to be managed by transection and interposition urethroplasty.



Figure 21: Prepuce skin graft patched to widen narrow part of urethral plate



Figure 22: Dartos fascial flap designed by de-epithelialization of prepuce hood for water-proofing of re-constructed neo-urethra.

4. Observations

Apart from other adverse findings in hypospadiacs [(like micro-penias (Figure 23), agenesis of native urethral plate (Figure 24), hypoplastic prepuce (Figure 25a, Figure 25b, Figure 25c), scrotal or perineal hypospadias, peno-scrotal fusion, attenuated native urethral wall (Figure 26), previous incomplete DTAP (Figure 27), extra-genital hairy skin used for re-construction of neo-urethral plate, residual chordee (Figure 28) with multiple UCFs, re-construction of short neo-urethra necessitating its transection and interposition urethroplasty and circumcised penis with severe chordee)], the presence of severe chordee is the major factor that makes

repair of hypospadias more complicated, i.e., either the treating surgeon drops the ideas of operating such difficult case or the repair is planned to be multi-staged with an interval of 3 – 6 months in-between successive stages or re-do of whole repair due to the presence of left over significant residual chordee or other significant anatomical, functional or cosmetic problems. In other words, hypospadias neo-urethroplasty either would have been extremely easy or no surgery would have been required, had the hypospadias not been associated with severe chordee, i.e., the hypospadias surgery would have been like any other routine surgery in the absence of significant chordee, because mild chordee has no adverse effects on the functions of penile shaft and can be left uncorrected. Chordee in hypospadias is routinely presumed to be a ventral chordee, but when a large number of fresh and failed hypospadiacs are examined in Special Clinic, then the chordee is found to have different characteristics like:

1. Root chordee (Figure 29).
2. Shaft chordee (Figure 30a, Figure 30b, Figure 30c).
3. Glans chordee.
4. Lateral chordee (Figure 31a, Figure 31b).
5. S-shaped chordee.
6. Inverted L-shaped chordee (Figure 32).
7. Mild chordee (Figure 33).
8. Moderate chordee (Figure 34).
9. Severe chordee (Figure 35a, Figure 35b).
10. Complex chordee (Figure 36a, Figure 36b, Figure 36c).
11. Residual chordee.
12. Inevitable chordee.
13. Primary chordee.
14. Secondary chordee.
15. True chordee.
16. False/ virtual chordee.
17. Iatrogenic chordee (Figure 37a, Figure 37b).
18. Recurrent chordee.
19. Skin chordee.
20. Dartos chordee.
21. Buck's fascial chordee.
22. Tunica albuginea chordee.
23. Corporeal disproportion.
24. Chordee without hypospadias.
25. Congenital short urethra.
26. Prepuce chordee.



Figure 23: Micropenis and left undescended testis. Care full straightening of the penile shaft will be required at appropriate time when the penile shaft attains near normal dimensions, else the penile growth would be adversely affected.



Figure 25b: Well defined glandular groove, fit enough to tubularize it to re-construct glandular neo-urethra without the help of the prepuccial hood. Multiple blind pits are seen.



Figure 24: Small glans. No native urethral plate. This will require alternate epithelial lining to re-construct neo-urethral plate. Through a perimeatal incision, the meatus and distal 1 cm of native urethra is mobilized to remove ventralizing effects of chordee tissue.

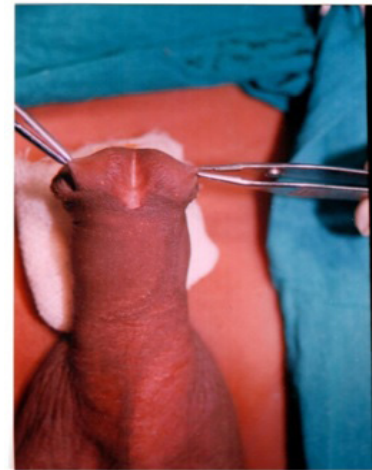


Figure 25c: Deep glans groove fit for neo-urethral re-construction. Prepuccial hood is rudimentary and is immaterial as it is not needed for neo-urethral re-construction.



Figure 25a: Deep glans groove and rudimentary prepuccial hood.
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Figure 26: Severe mid-shaft chordee and attenuated distal part of native urethra.



Figure 27: Severe residual ventral penile chordee due to un-corrected chordee during previous repair.



Figure 28: Mild residual chordee in flaccid state.



Figure 29: Left-lateral penile root chordee.



Figure 30a: Mid-shaft right-lateral chordee with neo-urethral plate re-constructed. Plication of TA on left lateral side will correct this lateral deviation.



Figure 30b: Left-lateral root chordee with no native urethral plate. The area of urethral plate is lined by keratinized skin which is unfit for neo-urethral re-construction.

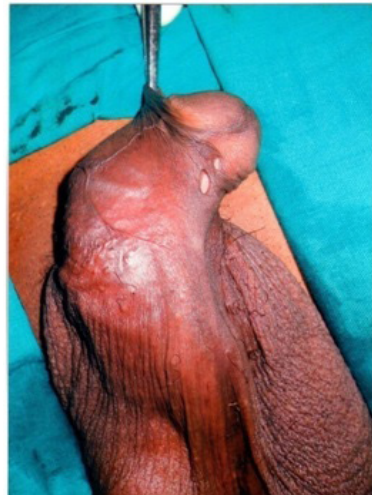


Figure 30c: Mid-shaft left-lateral chordee. Urethral meatus is seen in the sub-coronal region.

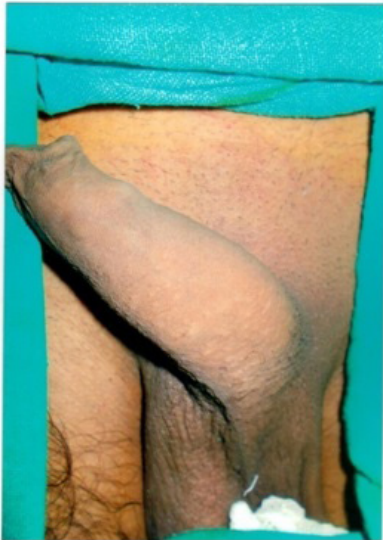


Figure 31a: Right-lateral penile root chordee.



Figure 31b: Left-lateral penile root chordee.



Figure 32: Inverted L-shaped severe distal penile chordee. Such chordee need careful correction to prevent injury both to TA and the DNVB.



Figure 33: Post-operative mild chordee is seen due to tissue oedema and fibrosis. Such mild chordee could be corrected by application of penile splint for 3 months.



Figure 34: Moderate chordee seen on normal saline induced artificial penile erection after putting glove-cuff tourniquet at root of penile shaft.



Figure 35a: Mid-shaft severe chordee of 90° demonstrated on artificial erection. The prepucial hood is well developed.



Figure 35b: Severe ventral penile chordee depicted by index finger.



Figure 36c: Complex chordee, a combination of right lateral chordee and anti-clockwise rotation.



Figure 36a: Post-infective and post-ischaemic necrosis of skin flaps to produce secondary complex chordee.



Figure 37a: Post-operative wound infection. Secondary chordee following fibrosis as a result of healing by secondary intention.



Figure 36b: Complex chordee, a combination of ventral and lateral chordee.



Figure 37b: Post-infective secondary chordee due to fibrosis and contracture

Correction of significant chordee is of utmost priority before proceeding to final neo-urethroplasty. The main concerns of chordee are listed below:

1. It is an anatomical and structural anomaly of the penile shaft.
2. This is associated with functional morbidity like urination in sitting position similar to a girl and difficult or painful intercourse or masturbation.
3. There is aesthetic concern because of its un-natural look in
 1. flaccid and or in state of erection.
4. The anatomical, structural, functional and cosmetic anomalies produce psychological, mental, social and sexual disturbances.
5. Marital disharmony like denial to marry, lack of friendship, sexual incompatibility, separation, breakdown and divorce.
6. The social and friend circles are curtailed.
7. Loss of outdoor activities like the picnic with school mates, group activities, water games and school sports.
8. Risks of infertility due to incomplete and painful intercourse or the presence of azoospermia/ oligospermia/ hormonal imbalance.
9. Denial to schooling and routine school medical examinations.
10. Fear of occurrence of such congenital anomalies in siblings.
11. Parents are worried about potency, fertility and manhood of the affected child.
12. Presence of associated inguinal hernia (IH), undescended testis (UDT), cryptorchism, ano-rectal malformation (ARM) and other cardio-respiratory anomalies.
13. Adversely affected social, psychological and mental development.
14. The treating surgeon has to (i) inquire about presence of chordee during examination and questioning, (ii) perform normal saline induced artificial penile erection to assess the characteristics of chordee and (iii) repeat artificial erection before proceeding to final neo-urethroplasty at second stage of repair.

5. Characteristics of Chordee

5.1. Root Chordee

The penile shaft is straight but is either deviated to left or right side of the median plane. The root opposite to the side of deviation is exposed through a vertical incision, the tunica albuginea (TA) is defined and made free of all of its overlying soft tissues, thereafter, the TA is plicated in a direction at right angle to the long axis of the penile shaft. The TA plication can be single or double layered depending upon the severity of deviation. The wound is closed in layers after full haemostasis.

5.2. Shaft Chordee

This is the commonest variety of penile chordee seen in hypospa-

dias where penile shaft is curved ventrally. Stepwise correction is done till the optimal straightening of penile shaft is achieved.

5.3. Glans Chordee

The major part of penile shaft is straight but its distal most part in the region of glans is curved ventrally. This requires dissection of glans tissue from the tip region of TA of corporeal bodies and thereafter the TA plication is done to straighten out the tip. The glans tissue is re-draped over the straightened-out tip to achieve uniformly straight penile shaft. There are risks of injury to dorsal neurovascular elements which are very fine and branched in the region of corona. Hypoesthesia and ischaemia of the glans will result in displeasure during intercourse.

5.4. Lateral Chordee

The penile shaft in its middle is deviated to left or right side to attain C-shape or reverse C-shape. This is because of asymmetrical length of TA on either side of penile shaft, i.e., longer TA on convex and shorter TA on concave side. The longer side (convex side on erection) is singly or doubly plicated to straighten the penile shaft.

5.5. S- Shaped Chordee

The penile shaft is curved laterally at two different sites to attain S- shape on erection because of the asymmetrical length of TA at two different sites on either side of the penile shaft. Depending upon the penile length (micropeniacs or fully developed) either TA plication is done to shorten the longer TA or the shorter side is lengthened by incising it transversally and patching the gap with a dermal graft. Both these procedures would correct chordee to make the penile shaft straight.

5.6. Inverted L-Shaped Chordee

Here the distal part of penile shaft is in the shape of inverted-L. This would require DTAP in the distal part of penile shaft under extreme of precautions to prevent damage to DNVB.

5.7. Mild Penile Chordee

The degree of penile curvature is up to 5-15°, and this much ventral curvature will not produce any significant anatomical, functional and aesthetic problems, therefore, this can be corrected easily with simple measures like degloving in sub-dartos plane. However, left over mild chordee will not have significant functional problem.

5.8. Moderate Penile Chordee

The chordee is from 15- 30° and will cause functional as well as aesthetic problems, therefore, its complete correction is required using appropriate surgical steps.

5.9. Severe Chordee

The chordee is more than 30° and will cause extreme of anatomical, functional and aesthetic problems, therefore, depending upon the characteristics of the penile shaft (under developed or fully developed), qualities of neo-urethral plate (matured/ immature,

short, un-even surfaced), the prepucial hood (under developed or fully developed or circumcised), native urethral walls (thick or attenuated), previous surgical interventions (DTAP or dermal grafting), nature of graft used for neo-urethral plate/ neo-urethra (genital skin or extra-genital skin), characteristics of neo-urethra (short or narrow/ longer and wide, strictured, diverticulized, fistulized) or whether the chordee is primary, secondary, residual or recurrent, it is mandatory to correct the chordee using appropriate surgical steps before proceeding towards final neo-urethroplasty.

5.10. Complex Chordee

The penile shaft has curvatures in different directions and has a mixture of problems of TA and corporeal bodies, multiple-times operated with scarring and neo-urethra having short length or there is fistulization and diverticulization or stricturization, i.e., the picture like that of a hypospadias cripple.

5.11. Residual Chordee

The presence of chordee is iatrogenic due to incomplete correction of chordee during the previous orthoplasty. This would require use of routine technique to correct penile curvature to achieve its optimal straightening. Dorsal chordee as a result of overdone DTAP will need VTAP to straighten-out the penile shaft.

5.12. Inevitable Chordee

Here the surgeon has tried all surgical means to correct the chordee like the degloving and DTAP or the dermal grafting, but further correction of the chordee is not possible without causing permanent damage to the structure and function of penile shaft, therefore, further surgical interventions are stopped. The left over chordee is inevitable, i.e., cannot be further corrected safely and is better to stop at this point. There could be too much penile shortening or damage to DNVB or injury to TA and the corporeal bodies, rendering the penile shaft anaesthetic, ischaemic or flaccid. The risks of impotency are also present following too much of surgical interventions.

5.13. Primary Chordee

Here the chordee is present since birth, i.e., de-novo chordee. Proximal hypospadiacs are invariably accompanied with varying degrees of chordee.

5.14. Secondary Chordee

The hypospadiac had no chordee when presented to the treating surgeon, but developed chordee subsequently due to reasons like (i) post burns, (ii) post penile fractures, (iii) peno-scrotal avulsion injuries, (iv) Peyronie's disease, (v) human or animal bites, (vi) repeated papaverine injections induced deep corporeal scarring, (vii) short ventral penile cover, (viii) short neo-urethral plate due to inadequate graft, used to re-construct neo-urethral plate, (ix) short neo-urethra and (x) ischaemia, infections and loss of tissues with healing by secondary intention. Appropriate surgical procedure is adopted to straighten the penile shaft.

5.15. True Chordee

This is a chordee which manifests on penile erection. However, at times the penile shaft could also be seen curved in its flaccid state, but most of the time the penile shaft is straight in its flaccid state and only seen as curved on natural or artificial erection.

5.16. False/ Virtual Chordee

Here the penile shaft is seen curved in its flaccid state but is found straight on natural or saline induced artificial erection.

5.17. Iatrogenic Chordee

The chordee has developed due to technical errors like:

- a. Organized haematoma on ventrum due to inadequate hae-mostasis.
- b. Post-operative wound sepsis and healing by secondary intention to produce scarring, contraction and chordee.
- c. Major loss of IPFTSG/ OPFTSG.
- d. Urinoma getting infected to induce fibrosis.
- e. Short ventral cover, short neo-urethra or the inadequate neo-urethral plate.
- f. Disruption of sutures of DTAP.
- g. Ischaemia, hypoxia, necrosis or tissue loss due to excessive dissection.
- h. Wrong estimation of tissue requirement.
- i. Injury or accidental rupture of TA.
- j. Failure to advise post-operative splinting in secondarily healed wounds.
- k. Excessive DTAP resulting in dorsal chordee.
- l. Incomplete DTAP resulting in left over ventral chordee (residual chordee).

5.18. Recurrent Chordee

The causes for such repeated occurrence of penile chordee could be (i) incomplete excision of chordee every time by untrained operating surgeon, (ii) short neo-urethra, (iii) short neo-urethral plate, (iv) pre-mature interventions in immature tissues every time, (v) lack of dispensable healthy tissue, (vi) straight line closure of tissues and skin, (vii) repeated infections and peri-urethral fibrosis and (viii) breakdown of DTAP sutures due to technical fault or sustained and un-controlled post-operative penile erection.

5.18.1. Various Tissue Layers of Penis Affected to Produce Chordee

Chordee tissue constitutes the atretic corpus spongiosum of the un-developed native urethra distal to the hypospadiac external urethral meatus. Invariably, the severity of the chordee depends upon the proximity of hypospadias, i.e., more proximal hypospadias will have more severe chordee, but at times, the chordee may be minimal despite proximal hypospadias.

5.19. Skin Chordee

The penile skin is short ventrally, however the deeper tissues are normal in all aspects, i.e., the quality and quantity.

5.20. Dartos Chordee

In this condition, the dartos fascia is affected and its contraction and shortening produces ventral chordee.

5.21. Buck's Fascia Chordee

The deep fascia of penis (Buck's fascia) is affected adversely to produce ventral curvature.

5.22. Tunica Albuginea Chordee

The ventral side of the TA is short and disproportionate to the dorsal part of the TA, thus produces ventral curvature on erection. The TA could be affected on dorsum, left or right side or on ventrum, and accordingly the penile curvature.

5.23. Corporeal Disproportion

The corpus cavernosa in its ventral part is defective and remains short, thus producing ventral curvature on erection.

5.24. Chordee Without Hypospadias

Here ventral penile curvature is in the presence of normally located external urethral meatus at the tip of the glans. There is no hypospadias. The dissection of urethra free from tunica albuginea and excision of the chordee and other fibrous tissues will cause straightening of penile shaft. The dissected urethra is of adequate length and the ventral curvature could be due to TA or corporeal shortening. After freeing the urethra from TA, saline induced artificial erection will demonstrate loose native urethra and tight corporeal bodies.

5.25. Congenital Short Urethra

After freeing the native urethra from the TA, saline induced artificial penile erection will demonstrate tight and short native urethra causing bowing of the corporeal bodies. This will require transection of native urethra and re-construction by interposition urethroplasty (urethral tube formed either by using IPFTSG or OPFTSG or designing an inner prepuce transverse island tube urethroplasty). This condition is congenital in origin, but it could be acquired following re-construction of a short neo-urethra/ short neo-urethral plate/ short graft used for re-surfacing large raw area.

5.26. Prepuce Chordee

Here the penis looks curved just because of the asymmetrical prepuce growth. This is corrected by Z-plasty to elongate the shorter side of prepuce. The prepuce is intact all around and there is distal hypospadias (hypospadias with intact prepuce).

The prepuce hood proved to be useful mainly in (i) re-construction of an ideal neo-urethral plate and neo-urethra, (ii) prepuce re-construction (prepuceplasty), (iii) providing water proofing flaps to re-enforce neo-urethra and the fistulas by its dartos fascial flap and (iv) meeting out tissue deficiency for widening of narrow

neo-urethral plate and neo-urethra.

6. Discussion

The hypospadias and its accompanying chordee has been given due importance since ages and the same can be realized when the penile shaft was routinely amputated distal to the hypospadiac external urethral meatus to enable the person to pass urine from the tip of the penis in standing position, else the hypospadiacs had to remain sitter like a girl. This type of mutilating surgery produced severe psychological and mental trauma including sexual disharmony. It had been prevented after knowing the aetiology of chordee, exact detection of characteristics of the chordee and various surgical techniques used to straighten the curved penile shaft, so that the penis was (i) not required to be amputated, thus maintained its length, (ii) got artificially erected to assess all characteristics of the chordee (the site, severity and direction) and (iii) straightened by planning appropriate surgical technique (orthoplasty). Various factors have revolutionized the ultimate outcome of hypospadias surgery like (i) the correction of ventral curvature by Nesbit's dorsal tunica albuginea plication [1], (ii) break-through in assessment of the characteristics of chordee by Gittes and Mc Laughlin technique [2] of normal saline induced artificial penile erection, (iii) detailed knowledge of the vascularity of various skin and water-proofing flaps, that have decreased the incidence of urethro-cutaneous fistulization through their mechanical and biological properties [3], (iv) increasing interest and confidence of young surgeons towards hypospadiology because of the availability of better single and multi-staged surgical techniques and axial flaps for re-enforcement and re-strengthening of the repaired hypospadias and closed UCFs, (v) understanding the importance of preservation of native urethral plate and the attenuated native urethra, (vi) realizing the significance of using mucosal graft in the presence of Balanitis Xerotica Obliterans (BXO) [4] (Figure 38), (vii) limiting the extent of de-skeletonization in micro-peniacs due to future risks of retarded penile growth, (viii) staged procedures that are associated with decreased incidence of post-operative complications as compared to single staged repair in proximal hypospadias [5], (ix) the best non-hairy substitutes found for re-construction of neo-urethral plate after orthoplasty are IPFTSG, OPFTSG, buccal mucosal graft [6], bladder urothelial graft [7], colonic mucosa [8] and (x) safe and avascular plane of dissection between the glans tissue and the tips of the TA of distal conical ends of corporeal bodies so as to correct glans chordee with glanduloplasty (creation of conical tip of glans with external neo-urethral meatus located at its tip of the glans to be a pointer rather than sitter), (xi) awareness of high risks of complication associated with dermal grafting, penile dismantling and DDTAP, (xii) ignorance of mild degree of penile chordee because of absence of any functional morbidities and its correction by DTAP would un-necessarily result in penile shortening, (xiii) understanding the importance of using penile splint to facilitate early maturation and smoothening of neo-urethral plate

(Figure 39) without contracture formation, (xiv) safe infiltration of 1:200,000 adrenaline normal saline solutions in to glans using insulin syringe for promoting vasoconstriction to help dissection of glans wings in relatively avascular surgical field (Figure 40) and (xv) understanding the risks of priapism and post-operative penile erection and its control by different medications like the alprazolam, diethyl-stilbestrol and terbutaline (bricanyl).

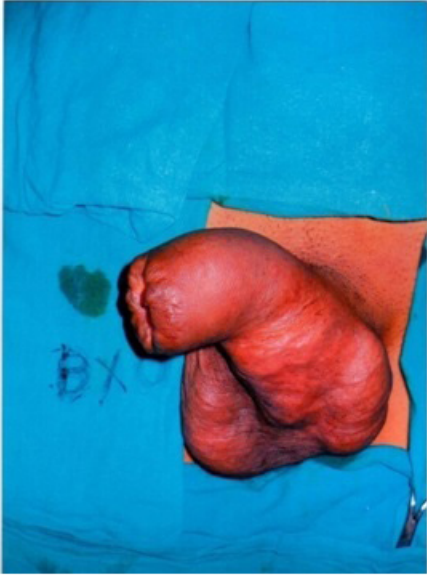


Figure 38: Balanitis xerotica obliterans (BXO). Destruction of distal part of glans and glandular urethra. Such case was excluded from study.



Figure 39: Velcro loop and fastener penile splint for early maturation of graft to have soft, supple and smooth neo-urethral plate.



Figure 40: Insulin syringe with 30G needle used for infiltrating 1:200,000 solutions of adrenaline and normal saline solutions in to surgical field and glans to have blood-less operative field and for designing glans wings. Intra-corporeal and intra-vascular injection are avoided.

7. Dis-Advantages of Orthoplasty

There are number of advantages of correction of severe chordee, but it is not free from such morbidities like:

1. Shortening of length of penile shaft due to DTAP or DDTAP. This is considered as a serious side effect for the manhood, especially in those hypospadiacs who have small and poorly developed penile shafts.
2. There is risk of damage to the DNVB during its dissection or while putting sutures for DTAP.
3. There could be a breach in the integrity of TA to produce leakage of blood on erection, thus affecting rigid erection adversely.
4. Over correction of ventral chordee by DTAP could produce dorsal chordee.
5. There could be deep adhesions between the skin graft and the TA to result in decreased mobility of penile skin over the shaft and a painful intercourse and masturbation.
6. Under correction will result in residual ventral chordee.
7. Excessive de-skeletonization could result in hampered penile growth
8. There are chances of irregularities, un-evenness, dog ears, palpable suture knots, granulomas and felling of foreign body sensations due to knots of sutures following DTAP.
9. Chronic pain in the flaccid state of the penis due to accidental engulfing of nerve fibres in sutures of DTAP. Sensory loss to the glans and penile skin could be due to extensive dissection resulting in to damage of fine nerve fibres.

10. Retention cysts due to buried dermal graft.
11. Localized ballooning of shaft on erection at the site of loosely placed dermal or TV graft.
12. Lateral deviation of penis due to lateral extension of suture line while correcting ventral chordee by dorsal transverse plication of TA.

Apart from skin graft and flaps, various tissues have also been used for correction of the penile chordee, which include (i) dermal graft [9], (ii) buccal mucosal graft, (iii) bladder mucosal graft, (iv) colonic mucosal graft, (v) tunica vaginalis graft [10] and (vi) tunica vaginalis flap [11]. Multi-staged procedures have less of post-operative complications as compared to single-staged procedures for repair of hypospadias. The use of water-proofing flaps decreases overall post-operative morbidities in repaired hypospadias.

8. Precautions During Chordee Correction (Orthoplasty):

Precise detection and assessment of characteristics of chordee through history, examination, questioning and normal saline induced artificial penile erection.

1. The first surgical step in correction of chordee is to perform circum-coronal degloving of penile shaft till its root in the avascular plane, i.e., the sub-dartos plane.
2. The complete extent of chordee tissue must be exposed to enable its complete excision, i.e., chordee tissue extends from proximal, around and underneath the hypospadiac meatus, diverging distally in a fan shaped manner and finally getting inserted under the proximal margins of glans wings.
3. For complete excision of the chordee tissue, one has to dissect the hypospadiac meatus all around and proximally up to one centimetre, excising the fibrous bands from the underlying tunica albuginea and then designing the glans wings to ensure complete division and excision of the total chordee tissue. This will remove ventral banding effects of chordee tissue from proximal shaft, mid shaft and distal shaft. The hypospadiac external meatus will recede proximally on complete straightening of the penile shaft.
4. The maximum depth of incisions could be the outer layer of tunica albuginea, because deeper incision would cause rents in the integrity of TA to produce decreased tumescence. Such breach in TA must be avoided and be repaired in a water tight manner, if so happens.
5. The surface of TA must be smooth and free from loose hanging non-viable tissues to facilitate full graft take to produce smooth neo-urethral plate.
6. Extensive cautery must not be used, rather spray electro-cautery or warm saline soaked sponges be used to have good haemostasis without having any dead and foreign matters on the recipient bed.

7. The graft be adequately sutured and stabilized (margins, quilting, tie-over dressing) for its un-eventful take (Figure 41).
8. The DTAP must be done using inverted interrupted sutures of 3-0 vicryl on round-bodied needle so that the knots are not palpable. Both the techniques of strip burying and simple inverting sutures are equally effective in correcting ventral chordee.
9. While incising the TA, utmost care is taken not to cut the fibres of the underlying corpus cavernosum, else it will cause penile indentation and angulation.
10. To prevent anastomotic stricture during second stage (neo-urethroplasty), through a peri-meatal incision, the hypospadiac meatus along with native urethra must be dissected proximally and the distal end is trimmed obliquely to excise its traumatized and ischemic part and a dorsal meatotomy is done (Figure 42) to create a V-shaped defect in the dorsal aspect of freshened end of native urethra in which a triangular tongue of the proximal end of skin graft is sutured. To prevent meatal stenosis of the neo-meatus, a triangular flap is designed from the central portion of glans tissue while designing glans wings and this triangular glans tissue is sutured in to the V-shaped gap of the incised distal end of the skin graft. These measures prevent circular anastomosis and circular neo-meatus, which have tendency to form strictures (anastomotic stricture and meatal stenosis).
11. The glans wings on either side are raised from the underlying conical tips of the TA in an avascular plane, and the exposed raw surface of the glans wings on either side is re-surfaced by the skin graft. The skin graft is secured in place by using interrupted 6-0 vicryl sutures on round bodied needle at the margins of graft and glans wings and the bed by quilting sutures. After non-adherent dressing over the graft and insertion of an appropriately sized draining tube, a tie-over type of dressing is applied to stabilize the graft for its better take.
12. The mobilized and freshened proximal native urethra must be fixed by single or three interrupted 6-0 vicryl sutures on round-bodied needle to the underlying TA to prevent kinking of the re-constructed neo-urethra at the anastomotic site, which can cause difficulty in free flow of urinary stream.
13. It is always mandatory to do normal saline induced artificial penile erection before proceeding to final neo-urethroplasty. Alternatively, intra-corporeal injection of papaverine can be used to assess the status of presence or absence of residual chordee

9. Chordee Correction and Resultant Raw Area

The correction of chordee leaves a raw area on the ventrum of penile shaft which can be re-surfaced by using different epithelial elements to re-construct neo-urethral plate, and these are:

1. IPFTSG.
2. OPFTSG.
3. Buccal mucosal graft (Figure 43).
4. Bladder urothelial graft.
5. TV-supported SSG.
6. Full thickness skin graft from upper eye lid.
7. Non-hairy penile shaft skin.
8. Median smooth and non-hairy scrotal skin in cases of bifid scrotum.
9. Partially circumcised distal prepuce opening (prepuce rim) of the re-constructed prepuce can be de-folded and used where skin deficiency exists.
10. Colonic mucosal graft.

The extra-genital skin graft is never advisable because of its hairy and keratinized in nature, not-accustomed to constant wetting and exposure of urine, early onset of chronic dermatitis to cause destruction of elastic and collagen fibers, induction of peri-urethral fibrosis and its contraction to produce ventral penile curvature (iatrogenic chordee), dilatation, diverticulization, fistulization and metaplasia of the neo-urethra. Concretions and stone formation in the diverticulum would finally produce carcinoma of urethra and penis.

10. Before Placement of Graft To Re-Surface The Resultant Raw Area on Ventrums of Penile Shaft, Some Pre- Cautions Are Required To Be Taken Like

1. De-fattening of graft adequately, but without causing it's too much of thinning, trauma and button-holing (Figure 44).
2. Suturing of graft under normal tension to avoid bunching and wrinkling to result in smooth neo-urethral plate (Figure 45). Graft sutured under excessive tension would result in short neo-urethral plate and ultimately short neo-urethra, thus iatrogenic ventral penile chordee.
3. Quilting of the graft for intimate contact of graft with recipient bed (Figure 46).
4. Multiple fenestrations in graft for exit of the blood and serum (Figure 47).
5. Evacuation of the blood clots (Figure 48).
6. Re-fixation of dislodged graft.
7. Use of banked graft when found lost on first dressing.
8. Use of absorbable sutures in children.
9. Snugly fitted tie-over dressing.
10. Splintage using Velcro loop and fastener penile splint.
11. Sedatives and other medications to prevent post-operative penile erection. Utilities of Prepuce Hood



Figure 41: Tie-over dressing for immobilization of skin graft to facilitate its take to have smooth neo-urethral plate and to prevent collection of blood and serum underneath the graft.



Figure 42: The triangular tongue of the proximal end of the IPFTSG is inserted in to the V-shaped area of the dorsal meatotomy (arrow) to prevent anastomotic narrowing (anastomotic stricture) due to circular anastomosis.



Figure 43: Marking is done to define boundaries of the buccal mucosal graft to re-construct neo-urethral plate.



Figure 44: Atraumatic de-fattening of IPFTSG. Care is taken to prevent button-holing. The whole dermis of the full thickness prepucial skin graft along with thin film of sub-cutaneous tissue is use for re-surfacing raw area to re-construct neo-urethral plate.

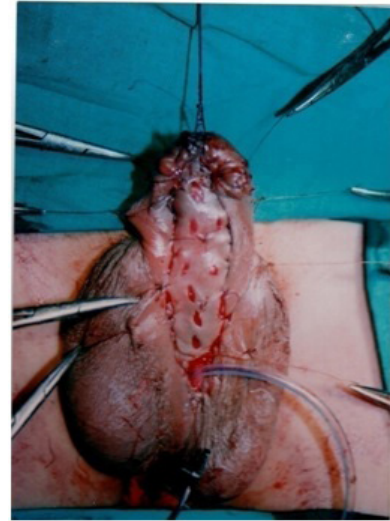


Figure 47: Multiple fenestrations are done for permitting the collection of blood and serum to come out. to facilitate graft take.



Figure 45: The IPFTSG sutured under normal tension to prevent wrinkles.

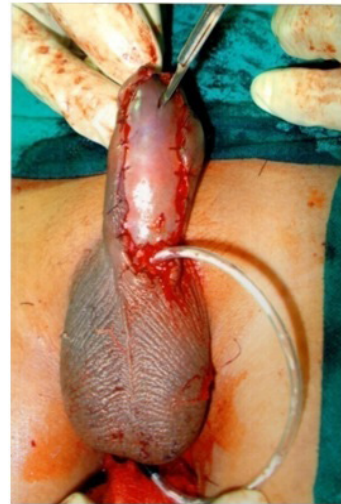


Figure 48: Neo-urethral plate re-construction by using IPFTSG from prepucial hood. Dorsal meatotomy is done to prevent anastomotic stricture. Fenestrations are being planned for exit of the collection from underneath the graft.



Figure 46: Quilting of IPFTSF for better take by causing intimate contact of graft with recipient bed.
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Figure 49: The prepucial hood is ventralized by tunnelling the glans through a transverse incision (Nesbit's procedure) to provide skin cover to the distally re-constructed neo-urethra.

11. Utilities of Prepuccial Hood

1. Inner and outer prepuccial full thickness skin graft for re-construction of neo-urethral plate during multi- staged repair.
2. Inner and outer prepuccial transverse island tube and patch urethroplasty during single-staged repair.
3. Dartos fascial water-proofing flaps for re-strengthening the neo-urethra and closed urethro-cutaneous fistulas
4. Skin flaps (advancement, rotation or transposition).
5. Byar's flaps.
6. Neo-urethral tube re-construction from free skin graft of prepuce during single-staged repair.
7. Nesbit's ventralization of prepuccial hood through its buttonholing to re-enforce neo-urethra (Figure 49).
8. Prepuccial re-construction (prepuccioplasty).
9. IPFTSG for re-surfacing small raw areas resulting after release of contracture.
10. IPFTSG for inlay or onlay patch graft for widening of urethral strictures.
11. Loose penile skin cover for its easy gliding over the penile shaft during intercourse and masturbation.
12. Painless penile erection.
13. Absolute non-hairy neo-urethra.
14. No other donor site deformity created.
15. Hidden scars of previous surgery by re-constructed prepuce.

Therefore, absence of prepuccial hood could pose problems at different steps and stages of repair of hypospadias, especially in the presence of proximal variety with severe chordee and tissue deficiencies.

12. Special Characteristics of the Prepuccial Hood

These are:

1. The prepuccial hood has dual epithelial lining, i.e., independent inner and outer skin lining.
2. The dartos fascia (soft tissue) is sandwiched between inner and outer epithelial lining of prepuccial hood.
3. Both inner and outer skin lining of prepuccial hood are absolutely non-hairy, hence most suitable for re-construction of ideal neo-urethral plate and neo-urethra.
4. The prepuccial hood is accustomed to exposure of urine, therefore the re-constructed neo-urethra remains free from any adverse effects of urine till infinity.
5. Harvesting of inner or outer prepuccial full thickness skin graft does not interfere with the vascularity of each other as well as of the intervening dartos fascia.
6. The prepuccial hood has protective functions for glans against recurrent friction of undergarments and environmental exposure, thus preventing it from becoming insensate or hypoaesthetic.

thetic.

7. The dartos fascia has axial pattern vasculature through superficial external pudendal vessels, that are branches of femoral vessels, hence can be raised proximally till the root of penis without any adverse effects on vascularity.
8. The inner as well as outer prepuccial skin can be harvested as island flaps for re-construction of single-staged circumferential neo-urethroplasty (tube urethroplasty) or ventral one-half of the circumference of neo-urethra (patch urethroplasty).
9. The prepuccial hood is incised in its midline to design two Byar's flaps which are ventralized to re-construct neo-urethral plate after excision of the ventral penile chordee where multi-staged repair is contemplated [12].
10. The prepuccial hood is folded on itself, therefore it can be de-folded to have larger skin flaps to re-surface larger raw area on the ventrum of penile shaft following excision of severe ventral chordee with peno-scrotal fusion.
11. The one-half of the prepuccial hood can be designed in the form of a skin flap and the other-half can be de-epithelialized to harvest water-proofing flap as described by Belman [13].
12. The dartos fascia of the prepuccial hood can be incised in its midline and both flaps can be double breasted to re-enforce neo-urethra or the closed fistula.
13. The piece of full thickness skin graft from the inner or outer prepuccial skin can be used as an inlay or onlay patch graft for widening the narrow urethra.
14. The excess and redundant part of unused prepuccial hood can be banked in the region of corona or other site where complication is expected post-operatively, so that this genital skin can be used as a skin or dartos flap when subsequently required during longer-term of follow-ups.
15. The prepuccial hood can be partially circumcised in the region of prepuccial opening, and this can be de-folded to have enough skin graft to re-surface raw area and the remaining part of prepuccial hood will protect the glans (partial/ distal circumcision).
16. The intact prepuccial hood causes retention of smegma all around the glans, thus causing balanoposthitis or metaplasia and penile cancer in long run.
17. The inner prepuccial island flap, because of its axial vasculature, remains viable despite its dartos pedicle being dissected till the root of the penile shaft, thus attaining free mobility in all directions around the penile shaft.
18. The dartos fascia of the prepuccial hood, having rich network of lymphatics, acts as a biological drain to reduce post-operative edema following hypospadias repair.
19. The dartos fascia causes neo-angiogenesis and thus neo-vascularization of ischaemic tissues to promote healing with less

of infection, minimal scarring, fibrosis and contraction.

20. The prepuceplasty hides the post-surgical scarring of the glans, thus prevent long-term felling of (i) inferiority among school-mates and (ii) adversely affected manhood in family and society.

13. Drawbacks of Prepuce Hood

1. Circumcision is said to be contraindicated in hypospadias, however this does not affect repair in distal hypospadias with deep glans groove and native urethral plate, where neo-urethra can be re-constructed without the help of prepuce hood. In proximal hypospadias with severe ventral chordee, there could be a problem in deciding an appropriate donor site for harvesting skin graft for re-construction of an ideal neo-urethral plate in the absence of prepuce hood. Alternate surgical procedure would be required where bladder, buccal or colonic mucosa and the tunica vaginalis supported split skin graft are planned to be used for re-construction of neo-urethral plate.
2. The prepuce hood could be just rudimentary and thus not worth using, because it can neither be de-folded nor the dartos fascial flap can be harvested.
3. The inner prepuce skin could be densely adherent to the glans, thus its separation would produce raw area over the glans. This will require wait till the raw area is healed spontaneously by epithelialization. The retained smegma will need removal and washing of glans and prepuce with normal saline.
4. Asymmetrical development of the prepuce hood could result in ventral curvature and downwardly directed prepuce opening (prepuce chordee), which would require Z-plasty to correct it.
5. The prepuce skin cannot be de-epithelialized due to its extreme thinness.

Presence of significant chordee in hypospadiac penile shaft not only frightens the infrequently operating surgeon but is a matter of great concerns even among trained and expertized hypospadiologists. Final neo-urethroplasty should not be attempted before doubly ensuring straightening of the penile shaft using Gitties and Mc Laughlin technique of normal saline induced artificial erection. Had there been (i) enough dispensable non-hairy and non-keratinized skin in the absence of significant chordee, (ii) robust peno-prepuce skin to withstand routine infections, wear and tears and the normal tissue traction, (iii) no relations with potency, fertility, intercourse, manhood and happy married sexual life, (iv) no pre, per and post-operative challenges, especially the formation of Urethro-Cutaneous Fistulas (UCFs), diverticulum and stricture formation, difficulty in urination and adversely affecting the upper urinary tract, (v) absence of involvement of deeper penile tissues like the TA and the corporeal bodies, (vi) no necessity of non-hairy neo-urethra and (vii) presence of similarities in each case of hypospadias, then the hypospadias surgery would not have

(i) gained so much of surgical importance, (ii) resulted in innovations of too many surgical techniques of repair, (iii) encouraged the hypospadiologists for making too many modifications of the original basic principles of hypospadias repair to prevent complications, (iv) forced the operating surgeons to choose special donor sites for harvesting skin or mucosal grafts for re-construction of near normal neo-urethral plate and neo-urethra, (v) necessitated establishment of Special Clinics for Hypospadias and Inter-Sex Disorders, (vi) given birth to National and International Societies for conducting conferences and CMEs exclusive on hypospadias, (vii) required writing textbooks on hypospadias, (viii) formed major part of work in Paediatric Urology, (ix) resulted in issuance of special issue on hypospadias by many different journals, (x) been so much technically demanding, (xi) generated special interests in many young surgeons and (xii) required long term follow-ups, rather it would have been like any other day care surgery needing only a short-term hospital stay and follow-up. At times, there could be concealed hypospadias, i.e., distal hypospadias with intact circumferential normally developed prepuce, where neo-urethra can be re-constructed without using prepuce.

14. Conclusion

To conclude, (i) clinical examination of penile shaft in flaccid state to make a rough judgement about existence of penile chordee (Figure 50), (ii) asking the patient to simulate penile curvature in its erectile state through finger or pencil (Figure 51a, Figure 51b), (iii) accurate assessment of chordee by saline induced artificial erection under tourniquet (Figure 52), (iv) optimal straightening of penile shaft (Figure 53) by executing suitable surgical technique, (v) re-surfacing of the resultant raw area on the ventrum of penile shaft using best possible genital skin to re-construct neo-urethral plate of adequate dimensions needing no subsequent widening,

(vi) re-construction of neo-urethra from absolutely non-hairy (noteven single hair Figure 54) and non-keratinized epithelial lining of neo-urethral plate by its tubularization and (vii) finally re-enforcement of the neo-urethra or the closed fistula against their breakdown and recurrences, all together or in combinations will achieve the ultimate goals of re-construction of a sustainable and an ideal neo-urethra in longer-term of follow-ups of repaired hypospadias. Un-usual types of chordee must be corrected carefully and re-checked before doing neo-urethroplasty (Figure 55a, Figure 55b). During school medical examination, the prepuce must be retracted to detect concealed hypospadias, and it can be repaired without producing any externally visible obvious scarring, thus raising no questions and concerns pertaining to adverse impacts on psychology, manhood, marital relations, inferiority, shyness and disharmony among society, family and school-mates. Use of extra-genital skin in re-construction of neo-urethral plate and neo-urethra must be avoided [14].



Figure 50: Mid-shaft severe ventral penile chordee in flaccid state. The severity is increased after NS induced erection.



Figure 52: Application of glove-cuff tourniquet at the root of penile shaft before doing normal-saline induced artificial penile erection to assess characteristics of chordee.

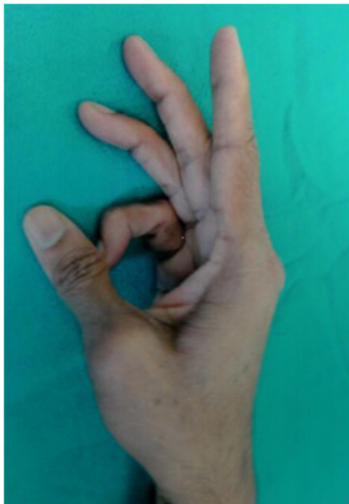


Figure 51a: Diagrammatic representation of chordee. 1-straight penile shaft, 2- mild chordee, 3-moderate chordee, 4-severe chordee, 5-root of penis, blue arrow shows normal penile direction and yellow line and red arrow shows left-lateral root chordee.



Figure 53: Straight penile shaft after excision of the chordee tissue, as demonstrated by normal saline induced artificial penile erection.

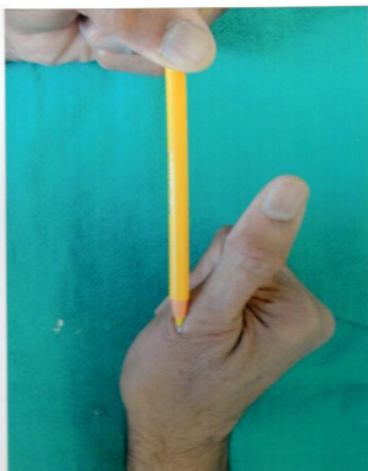


Figure 51b: Pencil directing normal central penile position and thumb showing right-sided penile root chordee.
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Figure 54: Scarring and occasional hair in the ne-urethral plate (hair being electro-depilation).



Figure 55a: Complex chordee, a combination of C-shaped chordee and mild anti-clockwise penile rotation.



Figure 55b: Complex chordee with ventral and right-lateral elements of penile curvature due to fibrosis as a result of healing by secondary intention.

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