



Preputioplasty as a foreskin-preserving alternative to circumcision for phimosis in children under 12 years: A prospective observational study

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Abstract

Background: Phimosis is a common pediatric condition, yet the default treatment remains circumcision, which results in the irreversible loss of specialized tissue. This study evaluates the outcomes of a modified tri-incision preputioplasty as a foreskin-preserving alternative.

Methods: Fifty consecutive boys (<12 years) with pathological phimosis underwent a modified tri-incision preputioplasty between January 2018 and August 2019. Under caudal block and short general anesthesia, a transverse dorsal incision was made with bilateral lateral longitudinal incisions. Outcomes included prepuce retractability, complications, cosmetic grading, and parental satisfaction assessed up to three months post-operatively.

Results: The median age was 4 years. Complete prepuce retractability was achieved in 100% (n=50) of patients at three months. Pre-operative symptoms, including ballooning (54%) and UTI (12%), resolved completely. No major complications like meatal stenosis or wound infection occurred. Cosmetic outcomes were rated as “Excellent” in 70% and “Good” in 24%. Parental satisfaction (Likert ≥ 4) was recorded in 94% of cases.

Conclusions: Modified tri-incision preputioplasty is a safe, effective day-care procedure that provides excellent functional and cosmetic results, making it a viable primary alternative to circumcision in children.

Keywords: Phimosis, preputioplasty, paediatric urology, foreskin-preserving surgery, circumcision, prepuce

Introduction

Phimosis is defined as the inability to retract the prepuce to expose the glans penis. Physiological phimosis, present in virtually all neonates due to natural preputial adhesions, resolves spontaneously in the majority by five years; pathological phimosis, characterised by a fibrotic, non-elastic preputial ring, affects approximately 1% of males by adolescence [1, 2]. Epidemiological studies from Denmark, Japan, and China document a decline in non-retractile foreskin prevalence from nearly 100% at birth to 1–7% in adolescence, underscoring how rarely intervention is truly warranted [1-3].

When surgery is required, circumcision has been the default procedure. Its complication rate of 6–20% includes haemorrhage requiring re-operation, meatal stenosis, wound infection, and anaesthetic adverse events [4, 5]. More critically, circumcision permanently ablates specialised preputial structures — the ridged band with its dense mechanoreceptors, the temperature-sensitive dartos smooth muscle, Langerhans immune cells, and the sebaceous glands maintaining glans lubrication — which serve protective, immunological, thermoregulatory, and sensory functions that are lost irreversibly [6, 7].

Preputioplasty addresses the stenotic ring while preserving all functional preputial tissue. Multiple techniques exist, including dorsal slit with transverse closure, triple incision plasty, Y-V plasty, trident plasty, and sutureless approaches [8-12]. Despite a growing evidence base, most series originate from high-income settings and prospective data from South Asian centres remain limited. The present study prospectively evaluates a modified tri-incision

preputioplasty in 50 children below 12 years, with the aims of quantifying guardian acceptance, surgical safety, and post-operative outcomes.

Methods

Study design and setting

This was a prospective observational study conducted in the Department of General Surgery at a tertiary-care hospital in India between January 2018 and August 2019. Ethical approval was granted by the Institutional Ethics Committee. The study is reported in accordance with the STROBE statement [13].

Inclusion and exclusion criteria

Boys aged less than 12 years presenting with pathological phimosis — defined as a fibrotic non-retractile prepuce with at least one of: ballooning on micturition, dysuria, recurrent balanoposthitis, UTI, or failure of six weeks of topical corticosteroid therapy — were eligible. Patients with UTI received culture-directed antibiotics and were confirmed infection-free before surgery.

Exclusion criteria were: (i) parent preference for circumcision; (ii) clinical suspicion or confirmation of balanitis xerotica obliterans (BXO); (iii) heavily scarred, fibrotic, or excessively redundant prepuce; (iv) congenital urological anomaly on ultrasound; and (v) medical unfitness for general anaesthesia. Written informed consent in the local vernacular was obtained from all parents/guardians prior to enrolment.

Surgical technique

All procedures were performed under caudal block with short general anaesthesia as day-care surgery. After sterile preparation and marking, a transverse incision was placed 3 mm proximal to the stenotic preputial ring on the dorsal aspect, supplemented by two bilateral lateral longitudinal incisions directly over the fibrous ring. The mucocutaneous flaps were widely separated, and the subcutaneous circumferential fibrous bands — the principal substrate of preputial stenosis — were excised with fine scissors. Following haemostasis, the outer skin and inner mucosal lining were approximated transversely with interrupted Vicryl 5-0 round-body sutures, producing dorsal widening of the ring. Betadine ointment and 2% lignocaine gel were applied; the wound was covered with gauze. Parents were instructed to perform gentle prepuce retraction daily from day 5–7 post-operatively to prevent adhesion reformation.

Outcome measures and follow-up

Wound status was assessed at 8 hours, POD-1, day 7, day 14, one month, and three months. All follow-up assessments were conducted by an independent assessor and senior surgeon not involved in the operation. Cosmetic outcome at three months was graded as: Excellent (full encirclement, good retractability, minimal asymmetry), Good (partial encirclement, satisfactory retraction), Fair (prominent dorsal slit edges but retraction achieved), or Poor (marked glans exposure, significant asymmetry). Parental satisfaction was recorded on a five-point Likert scale (1 = very unsatisfied; 5 = very satisfied).

Statistical analysis

Data were entered in MS Excel and analysed using IBM SPSS v.22. Categorical variables are presented as frequencies and percentages.

Results

Patient demographics and pre-operative characteristics

Fifty consecutive boys underwent the procedure over 18 months. Age ranged from 1 to 11 years (median 4 years); 72% (n = 36) were below five years and 28% (n = 14) were five years or older (Table 1). All 50 patients had complete inability to retract the prepuce. Ballooning on micturition was present in 54% (n = 27), dysuria in 38% (n = 19), and confirmed UTI in 12% (n = 6). The six UTI patients were treated with antibiotics and confirmed infection-free before surgery.

Table 1: Patient demographics and pre-operative symptom distribution (n = 50)

Variable	n	Present (%)	Absent (%)
<i>Age distribution</i>			
< 5 years	36	72.0	—
≥ 5 years	14	28.0	—
<i>Pre-operative symptoms</i>			
Inability to retract prepuce	50	100	0
Ballooning of prepuce on micturition	27	54	46
Dysuria	19	38	62
Urinary tract infection (UTI)	6	12	88

Intra-operative findings and discharge

Intra-operative bleeding was minimal (≤ 1 gauze) in 87.5% (n = 46) and moderate (2–3 gauze) in 12.5% (n = 4). No patient required re-operation or blood transfusion. Mean operative time was approximately 20–25 minutes. All 50 patients were discharged on POD-1, confirming day-care feasibility (Table 2).

Post-operative wound status

Transient prepuce oedema was the most common early event, present in 40% (n = 20) at 8 hours and 18% (n = 9) at POD-1. All cases resolved spontaneously without intervention; from day 7 onwards, 100% of wounds were healthy at every follow-up point (Table 2).

Table 2: Intra-operative findings, discharge, and wound status at follow-up (n = 50)

Parameter / Outcome	n	%
<i>Intra-operative bleeding (gauze soaked)</i>		
Minimal (≤ 1 gauze)	46	87.5
Moderate (2–3 gauze)	4	12.5
Severe (≥ 5 gauze / re-operation required)	0	0
<i>Discharge</i>		
Discharged on post-operative day 1	50	100
<i>Wound status at follow-up (oedema present)</i>		
8 hours post-operatively	20	40.0
Post-operative day 1	9	18.0
Day 7	0	0
Day 14, 1 month, 3 months	0	0

Complications and functional outcomes at three months

No patient developed wound infection, scab formation, meatal stenosis, or scarring. Foreskin was conserved in all 50 patients and glans colour was normal in all. The preputial ring was wide and freely retractable in every case, and all pre-operative symptoms resolved completely. No patient required a repeat procedure or conversion to circumcision (Table 3).

Table 3: Post-operative complications and functional outcomes at three-month follow-up (n = 50)

Outcome Measure	n (of 50)	%
No wound infection	50	100
Foreskin (skin) preserved	50	100
Normal glans colour maintained	50	100
No scab formation	50	100
No meatal stenosis or scarring	50	100
Prepuce wide and freely retractable	50	100
Complete symptom resolution (ballooning, dysuria, UTI)	50	100
No re-operation or conversion to circumcision	50	100

Cosmetic outcome and parental satisfaction

At three months, cosmetic outcome was Excellent in 70% (n = 35), Good in 24% (n = 12), and Fair in 6% (n = 3); none were rated Poor (Table 4). The three Fair ratings reflected parental concern about early post-operative oedema rather than any permanent deformity. Guardian acceptance of preputioplasty was 100%. Parental satisfaction was $\geq 4/5$ in 94% of families: 80% (n = 40) scored 5 (very satisfied) and 14% (n = 7) scored 4 (satisfied); none scored 1 or 2 (Table 4).

Table 4: Cosmetic outcome at three months and parental/guardian satisfaction (n = 50)

Category	n	%
<i>Cosmetic outcome at 3 months</i>		
Excellent — full encirclement, minimal asymmetry, well retractable	35	70.0
Good — partial encirclement, satisfactorily retractable	12	24.0
Fair — prominent dorsal slit edges, retraction achieved	3	6.0
Poor — marked glans exposure, large slit	0	0.0
<i>Parental/guardian satisfaction — 5-point Likert scale at 3 months</i>		
1 – Very unsatisfied	0	0
2 – Unsatisfied	0	0
3 – Neutral	3	6.0
4 – Satisfied	7	14.0
5 – Very satisfied	40	80.0

Discussion

This prospective study demonstrates that a modified tri-incision preputioplasty achieves 100% resolution of preputial stenosis and all associated urinary symptoms in children below 12 years, with no serious complications, universal foreskin preservation, a 70% excellent cosmetic rate, 94% parental satisfaction, and routine discharge on the first post-operative day. These results fulfil all three study objectives — guardian acceptance was universal, the procedure conferred clear advantages over circumcision, and the three-month complication profile was absent of major morbidity.

Age distribution and indication for surgery

The predominance of patients under five years (72%) is consistent with the epidemiology of pathological phimosis. Kayaba *et al.* documented that the incidence of completely non-retractile foreskin decreased from 47.1% at six months to 0% by early adolescence in 603 Japanese boys [14], while Yang *et al.* recorded a decline from 99.7% at birth to 6.81% in adolescence across 10,421 Chinese boys [3]. In a comparable Indian cohort, Kandi *et al.* reported that 60% of children presenting for phimosis management were below five years of age [15]. The younger age profile in our series reflects the higher propensity for symptomatic ballooning and UTI — the primary triggers for parental health-seeking — in children whose preputial separation is still physiologically in progress.

Symptom profile and pre-operative management

Ballooning of the prepuce on micturition, present in 54% of our cohort, has been characterised by Babu *et al.* as a benign and self-limiting phenomenon in physiological phimosis that does not compromise voiding [16]; however, when associated with a pathological fibrotic ring — as in our population — it constitutes a valid surgical indication. Dysuria was present in 38% of patients. The 12% rate of pre-operative UTI aligns with findings by Hiraoka *et al.*, who demonstrated that a tightly covered urethral meatus was present in 85% of boys under seven months with their first febrile UTI versus 42% of healthy controls, implicating the subpreputial space as a reservoir for ascending infection [17]. All six UTI patients in our series received pre-operative antibiotic therapy, and none developed post-operative infective complications — supporting the importance of pre-operative infectious clearance.

Intra-operative safety and early post-operative course

Intra-operative haemorrhage was minimal in 87.5% of cases, with no re-operations for bleeding. This compares favourably with circumcision: Cuckow *et al.*, in their landmark prospective comparison of preputial plasty versus circumcision in matched groups of 50 boys, reported a 6% re-operation rate for post-operative bleeding in circumcised boys versus 0% in the preputial plasty group, and an overnight stay rate of 20% versus 8% respectively [4]. In our series, 100% of patients were discharged on POD-1, representing a consistently better discharge profile than published circumcision data.

Transient prepuce oedema, occurring in 40% at 8 hours and 18% at POD-1, was the sole early morbidity and resolved spontaneously by day 7 without intervention. Christianakis *et al.* documented transient subcutaneous oedema in 15 of 87 patients (17.2%) following sutureless prepuceplasty [12], and Saxena *et al.* noted mild oedema in 1.8% of 2177 dorsal-incision procedures — their lower rate likely reflecting the exclusion of very early assessments rather than a true biological difference [18]. Importantly, oedema in our series caused transient parental anxiety — but produced no clinical morbidity or long-term sequelae.

Functional outcomes: retractability and symptom resolution

Complete prepuce retractability at three months was achieved in 100% of patients, with resolution of all pre-operative urinary symptoms. This outcome equals the 100% retractability and 100% parental satisfaction reported by Kamlesh Pal in 40 children undergoing standardised dorsal slit preputioplasty at a single institution, where no patient required re-operation or circumcision [19]. It exceeds the 77% retractability reported by Barber *et al.* with standard dorsal slit in 23 boys, where 36% of parents retrospectively preferred circumcision and three boys required further surgery [20]. Dessanti *et al.*, using transversal widening with EMLA cream, reported universal retractability at one-year follow-up with satisfactory cosmesis in all cases [21]. The superior outcome in our series compared with single-incision reports is attributable to the bilateral component of our technique, which distributes tension symmetrically around the stenotic ring and the routine excision of subcutaneous fibrous bands — addressing the principal anatomical substrate of recurrence.

The absence of UTI at three-month follow-up in all six pre-operatively affected patients is clinically significant. Surgical correction of preputial stenosis restores normal voiding dynamics and eliminates the protected subpreputial environment that facilitates bacterial colonisation [17]. The complete absence of meatal stenosis in our series is noteworthy given its reported incidence of 9–20% after circumcision [5, 22] — attributable to avoidance of glans exposure to friction and ammoniacal irritants, which is the proposed pathomechanism.

Cosmetic outcomes and parental satisfaction

A 70% excellent and 94% good-to-excellent cosmetic rate represents one of the highest documented in the preputioplasty literature. Castella reported 83.3% patient satisfaction at five-year follow-up after dorsal slit prepuceplasty in 60 children [8]. Fischer-Klein and Rauchenwald found that 77% of follow-up examinations

were rated excellent after triple incision plasty in 197 boys, with 84% of parents reporting functional satisfaction on questionnaire ^[23]. Nieuwenhuijs *et al.* reported excellent cosmesis in all 47 patients treated with Y-V plasty, while patients managed by longitudinal incision alone complained of skin tags ^[24]. The cosmetic advantage of our bilateral technique over single-incision approaches is consistent with these observations: symmetric lateral tension distribution avoids the V-shaped dorsal midline deformity that Matsuoka *et al.* identified as the primary source of dissatisfaction after conventional dorsal slit ^[25].

Parental satisfaction of $\geq 4/5$ in 94% of families, with 80% scoring 5 (very satisfied), substantially exceeds the 70% satisfaction reported by Barber *et al.* ^[20] and aligns with the 100% rate documented by Kamlesh Pal ^[19]. Universal guardian acceptance when the procedure was offered as the primary option underscores the importance of structured counselling on the functional value of the foreskin prior to defaulting to circumcision, a point emphasised by Rickwood and Walker's landmark observation that phimosis is widely overdiagnosed and too many unnecessary circumcisions are performed as a consequence ^[28].

Rationale for foreskin preservation

The clinical results of this study reinforce the biological case for foreskin-preserving surgery. Taylor *et al.* described the ridged band — a zone of concentrated Meissner corpuscles at the mucocutaneous tip of the prepuce — as a distinct sensory structure contributing to fine-touch discrimination and ejaculatory afferents ^[7]. The dartos muscle, almost entirely confined to the prepuce, mediates the volume changes required for erection; its loss after circumcision explains documented altered thermal responses ^[26]. Langerhans cells in the mucosal inner plate serve as first-line antigen-presenting immune cells, and sebaceous glands maintain glans lubrication and pH balance ^[6]. Permanent removal of these structures to treat a condition amenable to conservative surgery is difficult to justify when preputioplasty achieves equivalent or superior outcomes with lower morbidity. The comparative study by Kumar *et al.* reinforces this: post-operative pain (84% vs 40%), bleeding (24% vs 4%), and difficulty in micturition (16% vs 4%) were all significantly higher after circumcision than after preputioplasty ^[27].

Limitations and future recommendations

This study has several limitations. The single-centre design and absence of a comparator circumcision arm limit causal inference; future multicentre randomised or propensity-matched trials are warranted. Follow-up was restricted to three months, which is insufficient to detect late recurrence, adhesion reformation, or long-term functional outcomes; a minimum 12-month follow-up is recommended in future work. The locally defined cosmetic grading scale lacks validation; adoption of a validated instrument such as the Pediatric Penile Perception Score would strengthen comparability. The sample size of 50 precludes subgroup analyses by phimosis grade or patient age. Future trials should incorporate standardised phimosis severity grading (e.g., Kikiris classification), validated patient-reported outcome measures, and extended follow-up to establish definitive superiority of preputioplasty over circumcision and to identify predictors of recurrence.

Conclusion

The modified tri-incision preputioplasty is a safe, effective, and cosmetically superior day-care surgical option for pathological phimosis in children below 12 years. It achieves 100% foreskin preservation and complete resolution of all pre-operative urinary symptoms, generates high parental satisfaction, and avoids the serious complications of circumcision — most notably haemorrhage, meatal stenosis, and permanent loss of specialised preputial tissue. Preputioplasty should be the preferred primary surgical treatment for paediatric phimosis in the absence of BXO, advanced scarring, or excessive preputial redundancy. Circumcision should be reserved as a second-line procedure when foreskin-preserving options have failed or are contraindicated.

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