Invited Review Article

Phimosis in children: an unfinished story

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Abstract

Phimosis is a condition in which prepuce cannot be fully retracted behind the glans of the penis, which is common in boys and can occur at any age. Physiologic phimosis is a normal condition that occurs at birth and generally resolves with age as a child grows, which may take until adolescence to be completely retracted. In most cases, external hygiene is adequate care. Whereas pathologic phimosis is a condition in which the foreskin cannot be retracted at an age when retraction normally should be possible or when a previously retractable foreskin becomes non-retractable. This type of phimosis usually occurs in older children and possible ballooning of the foreskin when voiding. It can result from lichen sclerosus, recurrent episodes of balanitis or balanoposthitis, and inappropriate retraction of the foreskin. Topical corticosteroids can loosen the tissues in non-scarred prepuce in approximately 80% of cases. Phimosis can cause complications such as obstructed voiding, urinary tract infection, paraphimosis, and penile cancer. Various classifications; Kikiros, Kayaba, and Sookpotarom, have been developed to assess the severity of phimosis, making it easier to understand and compare the condition across different patients. If a patient experiences complication from phimosis that do not resolve with topical steroids, circumcision should be considered as an option. While pediatric circumcision has been shown to offer benefits in reducing the risk of urinary tract infections, HIV, sexually transmitted diseases, and penile cancer, routine neonatal circumcision is not recommended. Newborn circumcision while controversial is a familial decision and should be based on informed consent.

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Introduction

Phimosis is a condition in which prepuce cannot be fully retracted behind the glans of the penis. It can occur in both children and adults. Phimosis is either physiologic or pathologic.

Physiologic phimosis is a normal condition which occurs at birth. Only 4% of male newborns have retractile foreskins.[1] Inner epithelial lining of the prepuce fuses with the glans of the penis, but the boys still void normally without prepuce ballooning. As the boys grow into

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adolescence, keratinization of the inner prepuce and intermittent penile erection cause the foreskin to gradually become retractile. Only 10% of 3-year-old boys have fully retractile foreskins.[2] Although physiologic phimosis usually resolves as the boys grow up, it can cause complications like balanoposthitis, urinary tract infection, and penile cancer in some cases. Thus, parents and adult patients need to be aware of the risk of malignancy if the phimosis is left untreated.[1,2] However, penile cancer is rare, as the incidence is about 1% of all male cancers over the age of 60 in the Western population. The incidence of penile cancer in Thailand reported in 2014 was 0.2-2.3/100,000 in ages between 35-60 and 3.2 -7/100,000 in ages over 60 years.[3] The cause of penile cancer is largely attributed to poor hygiene.

Pathologic phimosis (true phimosis) is a condition in which the foreskin cannot be retracted at an age when retraction normally should be possible or when a previously retractable foreskin becomes non-retractable. This type of phimosis, which usually occurs in older children, looks like a contracted fibrous ring around the preputial outlet with possible ballooning of the foreskin when voiding. It can result from balanitis xerotica obliterans, also known as lichen sclerosus[4], after recurrent episodes of balanitis or balanoposthitis, and from inappropriate retraction of the foreskin before the age when physiologically appropriate. The incidence of the pathologic phimosis is unknown. Topical corticosteroids can loosen the tissues in non-scarred prepuce in approximately 80% of cases.[2]

History taking and physical examination

Symptoms that children present with include inability to retract the prepuce, tight foreskin, obstructed voiding, ballooning when voiding, and urinary tract infections.5 Although these conditions are mostly benign, physicians should be alert to possible emergency conditions such as paraphimosis.[2,5]

Physicians should review the history of the following phimosis complications.

1. Balanoposthitis, infection of the prepuce and glans
2. Preputial pain or pain in erection
3. Weak urine flow or painful urination
4. Acute urinary retention
5. Urinary tract infection
6. Previous history of paraphimosis

By physical examination, a normal prepuce should appear healthy, with pink mucosa. Scar tissue or white fibrotic ring on the prepuce could indicate balanitis xerotica obliterans. Erythema or edema could be infection or inflammation. The smegma, a thick white sebaceous secretion with desquamated epithelial skin cells, collects underneath the foreskin and can form lumps. Such lump can accumulate between the foreskin and shaft and are referred to as Keratin pearls. Physicians should also inspect for signs of paraphimosis.[4]

Prevalence of the phimosis

Previous studies found that the prevalence of phimosis in older boys was higher in Asian countries than in Western countries.[6] In the U.K., 15% of boys at age 6 months, 50% at age 1 year, 80% at age 2 years, and 90% at age 3 years could fully retract their prepuce. Similarly, 90% of Danish boys could retract their prepuce at age 3 years. In contrast, in Japan, 61.6% of boys at age 3 years could not fully retract the prepuce, and 35% were completely un-retractable. In Taiwan, 50% of boys at age 7 years still had phimosis.[6] In Thailand, 68% of boys at age 3-4 years had phimosis, 54% at age 5-6 years, and 40% at age 11-12 years.[7]

The preputial development

When a fetus is 8 weeks old, prepuce is formed as a thickening ring of epidermis, which then grows forward to cover the base of the glans penis. At 12 weeks, the frenulum develops. At age 16 weeks, the prepuce grows forward to the tip of the glans penis. The epidermis of the inner part of the prepuce fuses with the epidermis of the glans which is lined with squamous epithelial cells. Desquamation and rearrangement of the squamous cells create a space between the glans penis and the prepuce. The degree to which these developmental processes have progressed at the time of birth varies, but complete separation between the glans and the prepuce at birth is uncommon, which is why a normal newborn's prepuce is non-retractable.[8,9]

Normal separation may be complete at any age up to adolescence, often around the age of 5 years. It is affected by histological changes, hormones, and stretching caused by erections. In

addition to these factors, penile growth and the effect of smegma as it moves distally between the glans and foreskin aids in natural separation. If the foreskin is redundant, erections may not be able to stretch it, resulting in prolonged phimosis.[10] Smegma accumulating under the prepuce can become a risk factor for penile cancer.[8] If retracted forcefully, the glans and prepuce might tear, which can lead to bleeding, infection, and pathologic phimosis. Older boys who cannot completely retract the prepuce may have just a few strands of tissue connecting it to the glans, in which case a slight force is sufficient to complete the separation.

Lichen sclerosus and phimosis

Lichen sclerosus, also known as blanitis xerotica obliteran (BXO) is a chronic inflammatory dermatitis which produces whitish scars around the opening of the prepuce, and white plaque on the glans and urethral meatus. It can cause phimosis, meatal obstruction, and obstructive voiding symptoms. The degree of phimosis does not indicate the presence of lichen sclerosus, but histology revealing homogenized collagen and subepidermal lymphocytes does; physical examination is insufficient for diagnosis.[11] Steroid treatment is the mainstay medicine treatment but over 40% recurrence rates are known despite aggressive medical therapy, so this group of patients need surgery.[12] In the worst cases, Lichen sclerosus may invade the urethra to cause stricture disease requiring surgical reconstruction.

Classification of severity of phimosis

1. *Kikiros and Woodward classification* (Fig. 1)

Kikiros and Woodward defined 6 classifications of phimosis severity. Type 0 is full and easy retraction, not tight behind the glans. Type I is full retraction but tight behind the glans. Type II is partial exposure of the glans. Type III is partial retraction which exposes only the meatus. Type IV is slight retraction but neither meatus nor glans are exposed. Type V is no retraction at all.[13]

2. *Kayaba classification* (Fig. 2)

Similarly, Kayaba defined 5 classifications of phimosis severity. Severity is evaluated by gently retracting the prepuce without traumatic force when the patient is in the supine position. Type I cannot be retracted at all. Type II exposes only the urethral meatus when retracted. Type III exposes the glans halfway to the coronal sulcus. Type IV exposes the glans above the coronal sulcus. Type V exposes the whole glans. Meanwhile, physicians need to identify the tight ring that prevented the prepuce from being retracted or constricted around the glans or penile shaft during retraction. In a study of Japanese boys, Kayaba found that almost 50% of boys younger than 6 months were Type I and none were Type IV. Less than 10% of boys older than 5 years were Type I or II. Only 60% of boys 11-15 years old were Type IV.[14]

3. *Sookpotarom classification* (Fig. 3)

In Thailand, Sookpotarom et al. defined grades of phimosis. Grade 0 is foreskin can be fully retracted. Grade 1 is foreskin can be fully retracted but has a phimotic ring behind the glans.

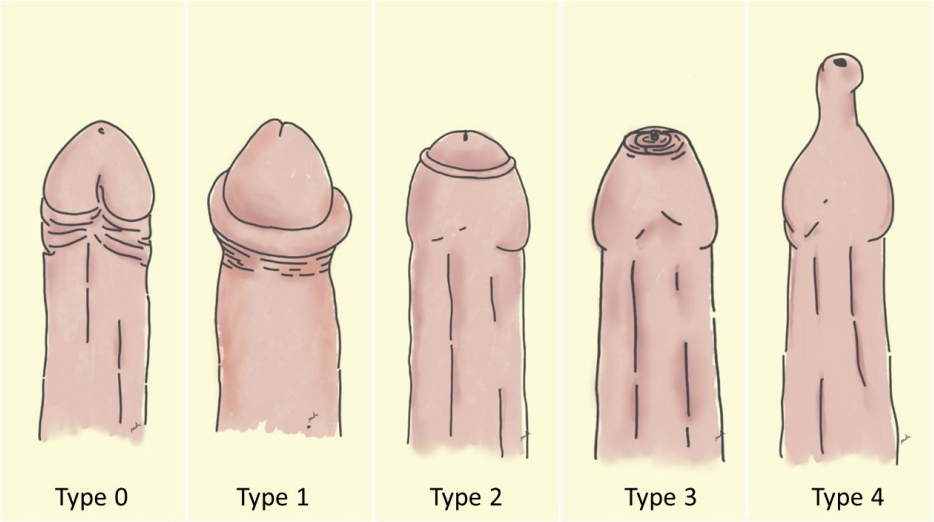

Figure 1. Kikiros and Woodward classification

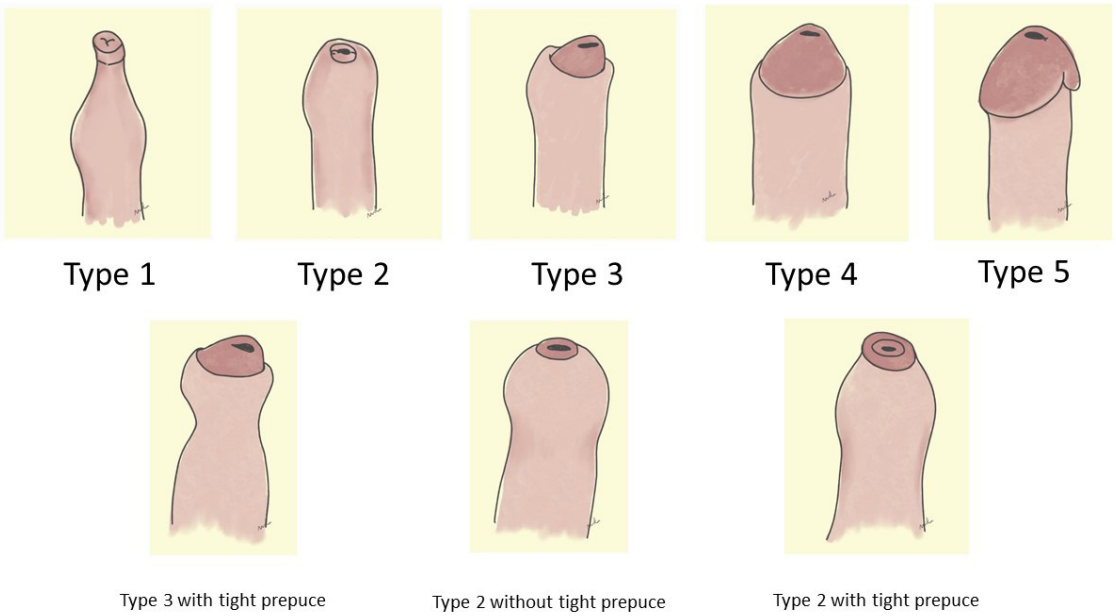

Figure 2. Kayaba classification

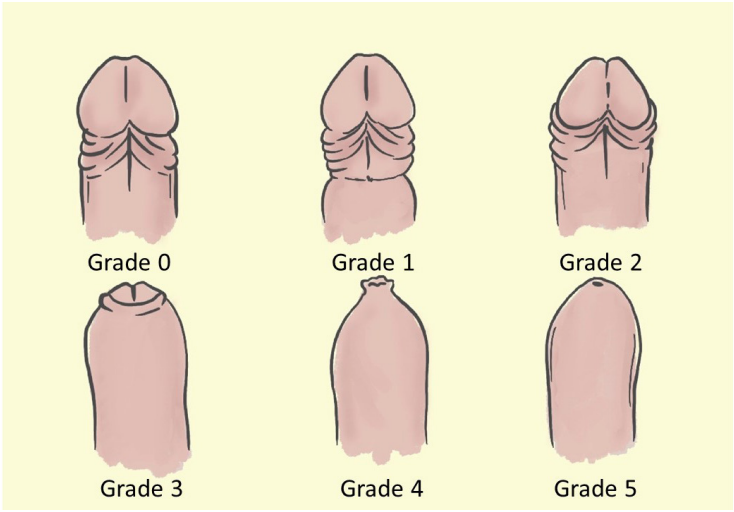

Figure 3. Sookpotarom classification

Grade 2 is foreskin can be partially retracted exposing most of the glans. Grade 3 is foreskin can be partially retracted but exposes only meatus. Grade 4 is foreskin can be retracted very little with puckering and cannot expose meatus. Grade 5 is foreskin cannot be retracted.[15]

Management

Appropriate preputial hygiene care

For an uncircumcised penis, the prepuce should be left alone until it shows ability to be retracted. Before reaching this time, it is not necessary to clean underneath the prepuce and the prepuce should not be forcefully retracted, which can cause pain, bleeding, and scars. The American Academy of Pediatrics recommends cleaning only the external skin. When the prepuce can be retracted, parents should gently retract it as far as possible without pain, and clean during bathing, and they should teach their children to do it themselves.[2]

Topical corticosteroid with gently manual retraction

Jorgensen and Svensson[16], and Kikiros and colleges[13] reported benefits of topical steroids in phimosis treatment in 1993. Many recent studies have demonstrated that topical corticosteroid with gentle manual retraction of the foreskin was 66-96% successful after 4-8 weeks of treatment.

This method was most successful in patients aged 4-8 years, which can reduce the psychological effect of circumcision in this phallic period. Patients with a history of previous balanoposthitis had lower success rates. This method is safe and cost-effective. It may increase the long-term cure of phimosis at least 6 months after treatment. Meta-analysis showed that this method had higher efficacy than placebo with manual retraction. The success rate of topical steroid in the meta-analysis was about 84%. The risk of adverse effects was not different between corticosteroid, placebo, and no treatment.[17,18]

Topical corticosteroids are usually applied 1-3 times daily (less frequently with high-potency formulations) for 4-6 weeks, at the junction of the prepuce and the glans of the penis, followed by gentle retraction.[19] The potency of topical corticosteroids ranges from most potent (class I) to least potent (class VII). Steroids can cause skin atrophy, striae, telangiectasia, acneiform eruptions, hypertrichosis, contact dermatitis, and pigmentation changes. Moreover, steroids can promote fungal growth when used for over 1 month, particularly on the thinner skin of the face, axillae, and genitalia. High-potency steroids may cause adrenal suppression by suppressing the hypothalamic-pituitary-adrenal axis when applied on an extensive skin surface, using occlusive dressings, or for long periods, especially in children. However, skin atrophy and systemic side effects of long-term high dose topical corticosteroid are rare.[20]

Studies of the efficacy of various topical steroids have not yet determined the optimal active ingredients and dosage. Table 1 compares studies relating to the efficacy of topical corticosteroids on phimosis. Generally, parents are advised to apply steroid on the prepuce after maximal atraumatic retraction twice daily; in the morning and in the evening.[21] Previous studies demonstrated that medium to high potency topical steroids; such as Triamcinolone, Betamethasone, Mometasone, Clobetasone and hydrocortisone were effective.[22] The most popular, including in Thailand, was 0.05 % betamethasone valerate cream.[15] The success rates of high-potency topical steroids (e.g., betamethasone, clobetasol) were no higher than rates of low to medium-potency steroids.[18,23]

A few studies also demonstrated the effect of manual retraction without a topical steroid by observing placebo groups. The success rates were between 20-76%, which was lower than rates using topical steroids.[19]

The possible mechanisms of action of topical steroids to treat phimosis differ and are controversial. Firstly, glucocorticoids can inhibit humoral inflammatory response and affect the function of endothelial cells, granulocytes, and fibroblasts resulting in anti-inflammatory and immunosuppressive effects. Secondly, glucocorticoids can inhibit collagen synthesis and have antiproliferative effects on the epidermis, resulting in skin thinning.[24-26]

Although topical corticosteroid with manual retraction shows high efficacy and cost-effectiveness in the treatment of pediatric phimosis, the phimosis can recur after discontinuing the steroid. The recurrence may result from parents or children not continuing to perform daily manual retraction and poor genital hygiene.[24,27] After circumcision of the failure cases, the most pathological condition reported is dermal fibrosis.

Circumcision

Routine neonatal circumcision is not recommended, but current evidence suggests that the health benefits outweigh the associated risks. The benefits of this procedure support providing access to the procedure for families who decide to pursue it. Therefore, when counseling families, physicians should explain risks and benefits without bias and emphasize that neonatal circumcision is an elective procedure. Physicians must ensure that parents understand all risks and benefits thoroughly before making the decision. Parents should practice good penis hygiene whether or not they opt for circumcision.[28]

Pediatric circumcision: myth or fact?

Outside the cultural and religious significance, true benefits of newborn circumcision are still controversial. Neonatal circumcision can prevent balanoposthitis, urinary tract infection, some sexually transmitted diseases, and cervical and penile cancer, but it can cause pain requiring local or general anesthesia, bleeding, wound infection, or devastating complications like glansectomy. Similar benefits can be achieved through good genital hygiene and protection during sex. Moreover, a child who loses his prepuce loses his chance to use the prepuce for urogenital recon-

struction, such as for urethral stricture, in the future. The ethics of performing circumcision on infants raises questions about consent and autonomy. Balancing parental rights and a child's future choices is a critical aspect of the circumcision debate. Knowledge about phimosis would eliminate unnecessary circumcision in children. Physicians should explain this to parents.[29] The family decision should be based on appropriate counseling regarding the pros and cons.

The benefit of circumcision as a prophylactic treatment

Prevent urinary tract infection

Phimosis causes colonization of pathogens underneath the prepuce which can result in balanoposthitis and urinary tract infection. A previous study demonstrated that boys whose urethral meatus was tightly covered by prepuce had a higher incidence of urinary tract infection. Circumcision may reduce the incidence of urinary tract infections during the first year of life.[6] Wiswell et al.'s study reported an increased risk of UTI in uncircumcised boys 9.91-fold higher for ages 0 to 1 year, 6.56-fold higher for ages 1 to 16 years, and 3.41-fold higher for ages over 16 years. The estimated risk during the entire lifetime is 3.65-fold higher for uncircumcised males. The number needed to treat was 4.29.[30]

Prevent sexually transmitted diseases (STD)

Pediatric circumcision was found to reduce the risk of HIV infection, however, the reduction in risk of other STDs is controversial. Previous studies revealed that male circumcision may reduce the risk of syphilis, gonorrhea, and chancroid, but not genital herpes.[6]

Prevent Human Immunodeficiency Virus (HIV)

Male circumcision can reduce HIV transmission in heterosexuals by 55-76% because the HIV-1 receptors of the superficial Langerhans cells are more prevalent in the prepuce than in the penis. Moreover, a circumcised penis is less susceptible to minor trauma during intercourse.[6] However, routine male circumcision did not improve the prevalence rates significantly. The WHO currently recommends male circumcision as a key strategy for preventing heterosexual HIV transmission, but this advice is targeted specifically at regions with high HIV incidence and low circumcision rates.[31]

Prevent penile cancer

About 25-75% of penile cancer patients have phimosis. Penile cancer usually occurs in men who have poor penis hygiene. Smegma that accumulates underneath the prepuce can cause chronic irritation, which leads to penile cancer. Neonatal circumcision reduces the risk of penile cancer; however, previous studies demonstrated that hygiene is sufficient to reduce risk of penile cancer, and circumcision is not necessary. Therefore, routine neonatal circumcision to prevent penile cancer is not recommended. Adult circumcision differs because adults have been exposed to smegma longer.[6]

The indication of pediatrics circumcision

Absolute indications for circumcision are pathological phimosis related to lichen sclerosus which tends to resist topical steroids, recurrent balanoposthitis, or symptomatic therapy-resistant phimosis. Further indications are antenatal history of significant hydronephrosis, known reflux, etc. Another indication is boys at risk of urinary tract infections due to congenital upper tract abnormalities such as vesicoureteral reflux.[10] Preputial ballooning during voiding is not an indication for surgery. Absolute contraindications are infection, congenital anomalies of the penis such as hypospadias or epispadias, hooded foreskin, ventral curvature of the penile shaft, peno-scrotal webbing, prematurity, and congenital megaprepuce. Relative contraindications are concealed penis, bleeding disorders; hemophilia A, sickle cell disease, etc., and jaundice.[6] The severely concealed penis should not be treated at birth but surgical reconstruction with circumcision can be performed after 6 months of age if parents desire. From the author's perspective, if a 3-year-old boy with phimosis fails betamethasone treatment and is experiencing ballooning of the foreskin during urination or recurrent balanitis, we would recommend offering circumcision or a dorsal or ventral slit procedure (as described in the La Vega Slit technique) to address the issue.[32]

The circumcision techniques[6]

Sleeve technique

The external and internal prepuce is incised. Then, subcutaneous attachments are separated between Buck's fascia and the prepuce. Finally, the excess skin is excised.

Dorsal slit

The prepuce is cut along the midline, then cut circumferentially at 2-3 mm distal to the corona.

Plastibell

After the dorsal slit, a Plastibell device is placed between the glans and the prepuce. A Suture is looped around the prepuce at the groove of the plastibell, then tied tightly to stop the blood supply to the prepuce. Excess skin beyond the suture is cut off.

Mogen clamp

The prepuce is pulled toward the distal of the glans and a Mogen clamp is clamped at the prepuce. Then the prepuce is cut away from the clamp. It is critical to lyse all of the preputial adhesions and divide the frenulum to prevent inadvertent injury to the glans during the procedure.

Gomco clamp

After a dorsal slit is done, a clamp is placed around the prepuce and tightened to crush the prepuce leading to hemostasis. The prepuce is cut distal to the clamp.

For newborn circumcision, the author typically uses either a Gomco or Mogen clamp. After the procedure, the penis is dressed with a single wrap of Surgicel and lightly covered with Coban, which is removed within 24 hours. Vaseline is then applied during diaper changes. If there is a tendency for the penis to retract after circumcision, I instruct the family on how to expose the penis by pressing down with two fingers on each side (similar to forming a "V" shape). This allows direct application of ointment to the wound, helping to prevent postoperative adhesions and, in the worst cases, the formation of a cicatrix.

Pediatric circumcision is generally performed under general or local anesthesia. It is not recommended to use only sucrose and a pacifier. Non-pharmacologic techniques are inadequate for preventing peri-operative and post-operative pain. Some studies reported using tissue glue instead of suture to reduce operative time.[33]

For a free-hand circumcision, the author typically uses a dorsal and ventral slit technique. Then, place 5-0 Monocryl sutures at the 6 o'clock and 12 o'clock positions, splay the tissue, and mark the excess skin on each side. The excess skin is then carefully removed using cautery for hemostasis. Next, a 5-0 Monocryl was used for suturing in a continuous fashion on each side to complete the repair. Following the procedure, a gentle compressive bio-occlusive dressing was done and instruct the family to remove it if it hadn't come off within the first three days. If it remains, they can work it off gradually after each bath over the next four days. I recommend applying Vaseline during each diaper change and scheduling a follow-up visit in 6 weeks.

Surgical procedures to resolve phimosis without removing the foreskin, known as preputioplasty, include Y-V plasty, transversal widening on the dorsal side, triple incision plasty, longitudinal incision and transverse closure, lateral preputioplasty, sutureless prepuce plasty, four V-flap repair, and Z-plasty reconstruction.[34] These methods result in good outcomes, but phimosis can potentially recur.

Complications from circumcision are uncommon, between 1-4% of cases, with bleeding being the most common. Risk of sexual dysfunction after circumcision is still controversial. Complications that have been reported are trapped penis, redundant foreskin, preputial adhesions, meatal stenosis, urethrocutaneous fistula, glanular necrosis, penile amputation, and hypospadias, but these complications are rare.[35] Pediatric circumcision can lead to psychological trauma in the phallic period, between 3-6 years old.[36]

Conclusion

Phimosis is a common genital occurrence in young boys. Physicians should explain phimosis to parents. Newborn circumcision while controversial is a familial decision and should be based on informed consent. Additionally, in the face of absolute indications, which are pathological phimosis related to lichen sclerosus, recurrent balanoposthitis, or symptomatic therapy-resistant phimosis, antenatal history of significant hydronephrosis, known reflux, boys who are at risk of urinary tract infections due to congenital upper tract abnormalities such as vesicoureteral reflux.

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Conflict of Interest

The authors declare no conflicts of interest.

Table 1. Demonstrates studies about the efficacy of topical corticosteroids on phimosis.

Study	Participant	Method	Classification of potency and duration	Result	Other
Jorgensen et al. (1993)[16]	54 boys with phimosis (mean age 6.9 years)	Open trial with 0.05% clobetasol propionate once daily for 1-3 months	Class I	Success rate 70%	No side effect
Kikiros et al. (1993)[13]	63 boys with phimosis	Steroid ointment: Betamethasone valerate 0.05% (42 patients), 1% hydrocortisone 1% (18 patients), 2% hydrocortisone (3 patients) was applied three times daily for 4 weeks	Betamethasone valerate 0.05%: class II 1% Hydrocortisone: class VII 2% Hydrocortisone: class VII	37 patients in 0.05% betamethasone valerate group showed an initial improvement. 2 patients using 2% hydrocortisone and 16 using 1% hydrocortisone ointment showed improvement, but 2 of the latter group ultimately required circumcision.	Recurrent 6 patients in 0.05% betamethasone group
Orsola et al. (2000)[37]	137 boys (median age 5.4 years)	0.05% betamethasone cream applied twice a day for 4 weeks. evaluated after 5 weeks and at 6 months. In primary phimosis ≤ 5 years, success 95.4% >5 years, success 82.3%	Class II	At 5 weeks, 82% had successful result, 12% had a partial response, and 6% were failures. 25 patients underwent a second course of treatment. At 6 months, 90% had a successful without recurrence. 13 patients had recurrent or persisted	In recurrent groups, non-compliant with the suggested daily foreskin care
Lund et al. (2000)[38]	137 boys	RCT to 0.1% betamethasone (n=66) vs placebo (n=71) twice daily for 4 weeks	Class V	Success rate 74% VS 44% at 4 weeks	Treatment effect persists for at least 18 months
Letendre et al. (2009)[24]	43 boys (age 3-12 years)	RCT of 2-month twice daily treatment with emollient cream (placebo) vs 0.1% triamcinolone	Class III-IV	Success rate 48% in placebo and 90% in triamcinolone group at 8 weeks. Success rate 39% in placebo group and 76% in the triamcinolone group at 12 weeks ($p<0.05$)	After long-term follow- up, recurrence is frequent with triamcinolone 47% at 2 months and 76% at 4 months but not statistically significant
Reddy et al. (2011)[39]	260 boys age up to 15 years (mean age 34 months)	Betamethasone dipropionate (0.05%) on gently stretched prepuce twice a day	Class II-III	91% showed a successful outcome at end of 4 weeks, which was maintained in 77% over a mean follow-up of 25.4 months. The long-term failure rate was 23%	42 (17.8%) boys had recurrence of phimosis, 24 (57.14%) of these occurred within 6 months, while others were seen as late as 34 months. No side effect

Table 1. Demonstrates studies about the efficacy of topical corticosteroids on phimosis. (continued)

Study	Participant	Method	Classification of potency and duration	Result	Other
Lee et al. (2013)[40]	88 boys with Kikiros grade 4-5 (average age of 2.82±1.78 years)	0.05% clobetasol propionate cream was applied with massage and retracting the foreskin 20 times twice a day, after washing or bathing, for 4 consecutive weeks	Class I	Success rate 68%	No side effect
Sookpotarom et al. (2013)[15]	47 patients, 23 boys (average age of 16.65 ± 4.052 months (11-24 months)) were given 0.025 % betamethasone cream. Another 24 boys in control group (average age of 18.42 ± 5.030 months (10-24 months))	RCT between valerate 0.025 % betamethasone cream vs 0.05 % betamethasone valerate cream twice a day for 2 months	No classified for this regimen	Success rate in the half-strength group (0.025 % strength) was significantly lower than 0.05 % betamethasone group (p = 0.0003)	
Makhija et al. (2018)[22]	100 boys (mean age 3.9 (1.5-12) years old	0.1% mometasone applied three times a day for 6 weeks	Class IV-V	Success rate 84% at 6-weeks	
Chamberlin et al. (2019)[41]	46 boys (Mean age 5.9-6.6) with Sookpotarom grade 4-5	Randomized open-label trial comparing 1% hydrocortisone cream in 21 boys vs 0.1% triamcinolone cream in 25 boys for 12 weeks.	Hydrocortisone: Class VII Triamcinolone: Class VI	Successful treatment in the hydrocortisone group was 30.8% at 4 weeks, 53.8% at 8 weeks, and 61.5% at 12 weeks. Successful treatment in the triamcinolone group was 31.6% at 4 weeks, 52.6% at 8 weeks, and 68.4% at 12 weeks (p=0.99)	
Chung et al. (2021)[42]	45 boys with Kikiros grade 4-5 (Mean age 46.64 months)	24 boys received Methylprednisolone aceponate and 21 boys received Hydrocortisone butyrate for 4-8 weeks.	Methylprednisolone aceponate: No classified Hydrocortisone butyrate: Class V	77.8% success. Recurrence of phimosis in 8.6% which can show remission after additional topical steroid therapy. Success rate of the MPA group was higher than that of the HCB group (91.7% and 61.9% respectively, p=0.029).	No side effect

Table 1. Demonstrates studies about the efficacy of topical corticosteroids on phimosis. (continued)

Study	Participant	Method	Classification of potency and duration	Result	Other
Zhou et al. (2021)[43]	1499 boys (age 2-12) Kikiros grade 4-5	0.1% mometasone furoate twice a day for 4 weeks. Patients were re-evaluated at the end of weeks 2, 4, 8, and 6 months follow-up.	Class IV	71.1% responded at the end of week 4. The long-term success rate was 66.0% over a mean follow-up of 26.9 months.	No systemic side effects, 23 cases developed local erythema or burning sensation. 138 cases had recurrence of phimosis, of which 81 (58.7%) recurred within 8 weeks, while 57 (41.3%) recurred after 8 weeks
Zhou et al. (2022)[21]	1689 boys with Kikiros grade 4-5 and had complications of phimosis. Age 1.9 -13.2 years (mean 57-58 months)	798 patients were administered 0.1% mometasone furoate twice daily for 4 weeks. 797 patients were administered 0.1% mometasone furoate once daily for 4 weeks. Evaluate at 3 months.	Class IV	Success rate was 65.8%	No difference in efficacy between once daily and twice daily dose at 4 weeks.

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