



# Phimosis and Circumcision: Concepts, History, and Evolution

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## Abstract

Phimosis is classically characterized by the impossibility of completely withdrawing the foreskin and exposing the glans. A distal preputial narrowing occurs, which may be congenital or acquired. Excess foreskin and the presence of balanopreputial adhesions may be components of this spectrum. Circumcision corresponds to foreskin excision, one of the most commonly performed surgeries in boys, whether for medical or religious reasons. Such a procedure is considered sacred by many peoples around the world as a symbol of faith or even as a ritual of tribal emancipation. The appearance of the procedure in several places and times allowed the development of the surgical technique, today adapted to minimize complications and provide evident medical benefits. We present fundamental physiological and histological concepts, classically described, knowing the natural history of a potential disease. We discuss the emergence and development of surgical techniques still used today and identify factors that interfere with the disease and influence the treatment.

**Keywords:** Phimosis, Foreskin, Male Circumcision

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## Introduction

The concept of circumcision, defined as the resection of part of the penile foreskin, has existed for more than 4000 years and still provides for discussions and divergences. The procedure involves the removal of a sensitive and intimate anatomical region, which evokes strong emotional reactions. Several studies have already shown the value of circumcision in geographical regions with a high prevalence of human immunodeficiency virus (HIV), sexually transmitted diseases (STDs), and genital cancers; yet the extrapolation of public health benefits worldwide has not been proven.<sup>1</sup>

## Phimosis

Phimosis, whether congenital or acquired, is a condition in the penis characterized by natural balanopreputial adhesions, excess foreskin, and various degrees of constriction in its opening, which prevent the total or partial exteriorization of the glans.<sup>2</sup>

Gairdner<sup>3</sup> emphasizes that “true phimosis is rare in the child” and equally affects all races, but few are born without phimosis. For this condition to be better understood, it is necessary to know the anatomy of the tissues involved and related to phimosis.

The male genitourinary organ ends with a conical and smooth shape called the glans. The skin that covers it is called

the foreskin and extends in a loose fold that extends beyond and covers the glans. The inner portions of the prepuce, lined with mucosa, is in close contact with the glans and, at birth, are adhered.<sup>2</sup>

## The Foreskin

According to Öster,<sup>4</sup> there are three fundamental dates in the history of the foreskin: 1713 BC, when Abraham was circumcised as a sign of his covenant with God; 43 AD, when the apostle Paul stated that circumcision of the heart and not that of the flesh was the only way to salvation; and AD 1949, when Gairdner published, first hand, the typical preputial development. The first 2 events are historically notable and have influenced millions of people, while the third seems not to have been so remarkable so far.

Despite the reference to Douglas Gairdner's classic work of 1949, with some regret, by Jakob Øster in 1968, it was these publications that opened the eyes of the scientific world to the study of the foreskin and its physiological development. In addition, after correctly understanding preputial embryology and physiology, many English-speaking countries drastically reduced the incidence of neonatal male circumcision.

The embryological development of the prepuce begins when the embryo measures about 65 millimeters, and when it reaches 100 millimeters, the prepuce completely covers the

glans. The inner surface of the foreskin and the surface of the glans receive a common epithelium that separates at the time of birth or later.<sup>5,6</sup> This common epithelium is erroneously called “adhesion”, and, in the same way, separation is termed “adhesion resolution”. Like the separation of the eyelids, the preputial release occurs through mechanisms of apoptosis and keratinization of cells under the influence of androgens.<sup>4</sup>

According to Carnevale et al,<sup>6</sup> from the embryological point of view, preputial development occurs between the third and fifth month of gestation. In the fourth month, the epithelial lining of the tip of the penis sends a circular invagination called the preputial epithelial lamina, which undergoes a cleavage process shortly before birth, separating the glans from the foreskin (Figure 1).

The release of balanopreputial adhesions occurs slowly in the years following birth. Classically, it is postulated that the foreskin should be fully retractile around three years of age; however, there is great variability in time for this event. The separation can occur from the first months of life in a few boys, up to 9 or 10 years in others, and until after puberty for still others<sup>7</sup>.

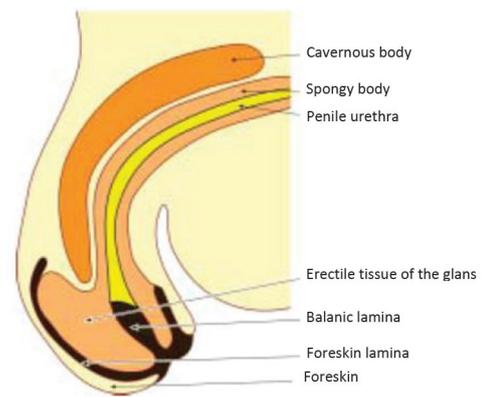
In a precise account of the foreskin anatomy, Naimer et al<sup>8</sup> describe preputial, continuous coverage of that which follows along the pubic, scrotum, and perineum. The skin that covers the penis is continuous along the penile body to the lap, forming the outer layer or skin of the foreskin, covering the glans. In the penial colon, the slightly protruding region folds over itself to form the inner layer of the prepuce, the preputial mucosa. In the ventral region of the penis, only the inner layer of the foreskin joins the lower part of a depressed region of the median raphe forming the “balanopreputial frenulum”.

As described by Taylor et al,<sup>9</sup> the inner layer of the foreskin is divided into 2 regions, “corrugated” and “smooth” (Figure 2). The first is a transversely corrugated mucosal zone with 10-15 mm in the prepuce which is not retracted. The “wavy” area is usually flat against the glans, and when retracted, it is always present in the body of the penis. The rest of the preputial tissue between the “wavy” area and the glans is smooth and relaxed. The “wavy” zone presents a marked increase in vascularization and the markings are deeper in younger individuals.

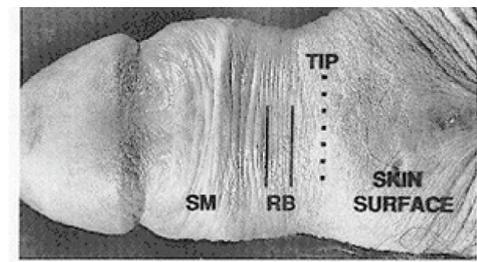
The inner surface of the foreskin is covered by a keratinized squamous epithelium similar to that of the esophagus, with the presence of nerves, Schwann cells, lymphoid and capillary cells. The preputial mucosa does not have hair follicles, lanugo, sebaceous glands, or sweat glands. The presence of myelinated nerve fibers inside the papillae confirms the extremely sensitive nature of the “wavy” region of the foreskin.<sup>9</sup>

It is classically postulated that the foreskin protects the glans, although it is equally likely that the glans forms and protects the foreskin. This exchange guarantees great sensitivity to the glans and penile body.<sup>9</sup>

After discussing the classic works published almost 50 years earlier by Gairdner and Øster,<sup>3,4</sup> Wright<sup>10</sup> points out that the release of balanopreputial adhesions must be performed instinctively by the child himself and occurs around three or four years of age without discomfort or unnecessary trauma.



**Figure 1.** Balanic and Preputial Epithelial Blades.  
Source: Carnevale et al.<sup>6</sup>



**Figure 2.** Retracted Foreskin in a Young Adult Showing Smooth Mucosa (SM), a Wavy Zone (RB) Well Defined, and the Surface of Continuous External Skin With the Skin of the Penis Body. The Dotted Line Indicates the Tip of The Retrieval Foreskin.  
Source: Taylor.<sup>9</sup>

### Concepts and Classifications

The simple fact that the foreskin is not fully retractable should not be synonymous with phimosis. This concept should be related to the age and associated symptomatology. Phimosis is considered physiological in early childhood, since the foreskin functions as a natural protection to the developing glans against both mechanical and chemical traumas, specifically diapers and urine. However, when it perpetuates to the end of childhood, it should be considered abnormal, or true phimosis, and in need of treatment. Thus, distal preputial stenosis associated with obstruction of the urinary stream with “ballooning” or inflammatory or infectious symptomatology is considered “true phimosis”, regardless of age, as well as the persistence of distal foreskin stenosis until the end of childhood.<sup>10</sup>

According to Braz<sup>2</sup>, phimosis is also considered to be cases in which the foreskin can be completely retracted when forced downward, but after exteriorizing the glans, there is a stenosis or constriction of the foreskin in the body of the penis; in general, it can be reduced to the previous situation.

Ballooning is characterized by the temporary accumulation of urine in the subpopulation region, which is slowly emptied during urination. This phenomenon is usually not painful, nor does it require immediate treatment, but it does signal a partial obstruction to the urinary stream.<sup>7</sup>

The glans and internal preputial mucosa secrete substances

that accumulate between the foreskin and the glans, forming a greasy yellow material called smegma. This substance is composed of about 27% fats and 14% proteins. It is compatible with necrotic epithelial remains and considered inert to the individual, requiring no targeted therapy. Sometimes mistaken for cysts or collections of pus, when spontaneous sub-preputial retraction occurs, this material is released.<sup>7,11</sup>

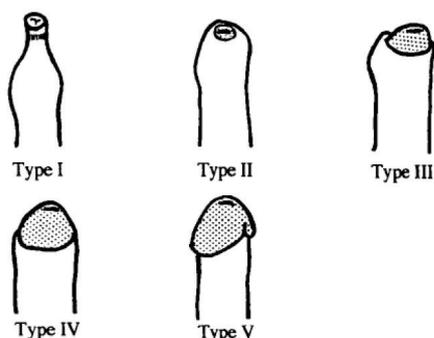
In the newborn, the orifice of the foreskin presents several degrees of aperture, from the tiny punctiform to the complete, which allows the glans to partially or totally externalize; this second situation only occurs when there is no balanopreputial adherence. The degrees of opening of the preputial meatus allowed the emergence of classifications, which may serve to guide the treatment and formulate more objective criteria to obtain the cure.<sup>2</sup>

Classifications are presented with three to five anatomic types, according to the degree of narrowing and aspect of the foreskin; however, the sequence of numbering the degrees varies between authors. The most commonly used classification in our setting is undoubtedly the one developed by Kayaba et al<sup>12</sup> when analyzing the preputial retractability and presence of preputial stenotic ring in 603 Japanese boys aged between zero and fifteen years.

Kayaba et al analyzed the degree of retractability of the foreskin and categorized it as follows: type I: total absence of preputial retraction; type II: exposure only of the external urethral meatus; type III (intermediate): partial retraction, with exposure from the apex to the middle of the glans; type IV: exposure to above the crown of the glans with presence of adhesions with the foreskin; and type V: exposure of the entire glans after retraction<sup>12</sup> (Figure 3).

Most children are born with physiological phimosis. With growth during the first years of life, a progressive distal preputial enlargement occurs in most boys and is associated with the spontaneous release of the balanopreputial adhesions, allowing complete preputial retraction and exposition of the glans. However, when there is persistence of adherence leading to functional difficulties, it may be considered congenital. In cases in which the congenital phimosis has somehow broken down, the sub-occlusion of the preputial meatus is renamed as acquired phimosis.<sup>3,13</sup>

According to Laurini et al,<sup>14</sup> the conditions leading to



**Figure 3.** Kayaba Classification as to Retratability and Prepuical Narrow Grade.

Source: Kayaba et al.<sup>12</sup>

phimosis to be considered acquired are related to factors that promote balanoposthitis or postitis by chemical, inflammatory, or traumatic irritation followed by fibrosis tissue formation, subsequent cicatricial stenosis, and preputial meatus sub-occlusion.

Phimosis, once installed, may lead to several balanoposthitis outbreaks, creating a vicious circle that leads to a greater narrowing of the preputial orifice, causing difficulty in urination.<sup>15</sup>

### Complications of Phimosis

Complications related to phimosis can occur throughout life, and their surgical indications depend on the type of lesion present in the foreskin as well as no spontaneous resolution or through clinical treatments. Examples of complications related to phimosis are balanoposthitis, difficulty urinating, urinary retention, dysuria, urinary tract infection (UTI), tenesmus, enuresis, priapism, paraphimosis, preputial brake laceration, balloon synechia, BXO; and affections and infections of adult life.<sup>15,16</sup>

Inflammatory balanopostite occurs with chemical irritation when the child remains in the diaper, causing ammoniacal dermatitis; sometimes it causes the proliferation of fungi, with the aggravation of the inflammation; it can also occur because of the retention of smegma and secondary inflammation due to a lack of hygiene of the internal area of the foreskin. Traumatic balanopostite comes from a forced attempt to enlarge the orifice of the foreskin to retract it and thus promotes formation of fissures with bleeding and pain, followed by cicatrization with fibrosis, which will contract the hole where the glans should pass and prevent exteriorization. In addition, because handling causes pain, it will create fear in the child. As a result, the child will no longer allow hygienic activities to be done. It is important to emphasize that these exercises or massages should be avoided in the attempt to roll up the foreskin to treat phimosis.<sup>2</sup>

The clinical treatment for balanopostitis can be performed by some methods adopted alone or together, such as hygiene with antiseptic soap; topical antibiotic therapy with bacitracin cream, neomycin, or garamycin associated with each other, with or without corticoid; and oral anti-inflammatory. However, when there is purulent secretion, systemic antibiotic therapy is instituted. In cases of recurrent balanoposthitis with thickening of the skin and progressive narrowing of the preputial meatus, surgical treatment is usually indicated. In patients with only ammoniacal dermatitis on the foreskin, with or without ulceration, the simplest and most effective method is to keep the child clean with the diaper dry, changing the diaper more frequently; hygiene with antiseptic soap, use of a protective base containing zinc oxide sometimes associated with nystatin if there is moniliasis.<sup>2</sup>

BXO is an infiltrative skin disease presenting with distal sclerotic and whitish foreskin. It may also involve the glans and cause meatus stenosis even after surgery. Circumcision is indicated immediately, with 0.05% clobetasol cream being added preoperatively and postoperatively. According to Wilkinson et al,<sup>17</sup> despite a small risk of relapse, another

therapeutic modality that may be considered is prepuceplasty combined with the intralesional injection of triamcinolone. This treatment may even reduce the incidence of meatal stenosis.

In a patient with phimosis who, through forced maneuvers, can make the preputial retraction, the stenotic ring can lead to constriction of the foreskin in the corpora cavernosa, making it difficult to reduce it again to cover the glans. If this situation is not reversed, the cavernous bodies may be strangled; consequently, blood stasis, edema, and cyanosis of the distal extremity can occur, characterizing paraphimosis. This is the most frequent accident in children with phimosis, both in the act of masturbation and soon after doing the hygiene of the balanopreputial groove.<sup>14</sup>

According to Braz<sup>18</sup> the treatment of paraphimosis is rarely surgical and should be done by manual reduction of the foreskin, which has been successful in more than 90% of cases with general anesthesia. Otherwise the dorsal incision in the foreskin or the postectomy will be indicated, if the foreskin conditions allow. Uson and Lattimer<sup>19</sup> recommend infiltrating the foreskin with xylocaine before reducing paraphimosis and following by expression to reduce foreskin edema. However, the procedure is most often painful, can be dispensable, and usually becomes ineffective.

The technique used is progressive manual reduction by pulling up the foreskin between the index and middle fingers of both hands and pushing the glans down with thumbs. Systemically prescribed anti-inflammatory medication must be taken. Post-mortem is indicated after regression of edema.<sup>2</sup>

### Clinical Treatment

In cases of true phimosis, circumcision is classically considered the treatment of choice. However, the emergence of less invasive therapeutic modalities in recent years, such as topical steroid use, represents an advance in disease management,<sup>20</sup> with success rates of 67%-95%.<sup>21</sup>

Conservative treatment is accomplished with local use of steroid creams (0.05% clobetasol propionate or 0.05% betamethasone valerate associated with or without hyaluronidase or triamcinolone, among others), which is applied daily by rubbing it directly into the preputial meatus until it is completely opened. Treatment time varies between studies, lasting from one to three months, but will depend on the collaboration of the parents and the child. The effectiveness of this method is still quite questionable in clinical practice and it is difficult to know whether the results will be definitive and whether surgery can be avoided when this method is used. The degree of the preputial narrowing is directly dependent on parental collaboration and may influence the results.

Studies of the last decade suggest a good response to topical corticosteroids, including lower treatment costs; however, despite some well-designed, randomized, double-blind, and placebo-grouped studies, the results of the comparison of types of corticoids have never been analyzed from each type of phimosis. According to the Kayaba classification, for example, milder degrees of preputial constriction are more

likely to be resolved with clinical treatment, and spontaneous resolution may even be seen. Despite biases, recent studies have shown 60%-90% resolution, depending on the type of corticosteroid used and whether the response was partial or complete. However, long-term recurrence may be frequent and often requires re-treatment or circumcision.<sup>20-26</sup>

As reported by Braz,<sup>2</sup> however, "If this attempt is made to avoid surgery, if it cannot cure phimosis, at least it can make it tenuous and thus make surgery easier."

### The Circumcision or Postectomy

Circumcision, which corresponds to the excision of the distal prepuce, is considered one of the most frequently performed surgeries in children worldwide. In 1997, the incidence of circumcision was 62.8% in the United States and 35% in certain regions of Canada. On the other hand, it is infrequent in Asia, Central and South America, and many countries in Europe, especially among Scandinavians.<sup>27</sup> According to Moses et al,<sup>28</sup> globally, about one quarter of men are circumcised for medical and non-medical reasons or simply at their parents' option.

Societies that practice circumcision routinely fall into 2 groups. The first includes Muslims, Jews, and some ethnic groups in Africa and Latin America where circumcision is purposed to unify society, religiously or culturally. The second group includes mainly the Anglo-Saxon countries, where circumcision has a preventive purpose.<sup>26</sup>

The surgery for correction of phimosis is given several names. In the vocabulary of the religious and laity, it is known as circumcision (from the Latin: circumcisu or circumcison - "To cut around"); in medical nomenclature, it has the denominations of: peritomia (from the Greek: peritomé - "to cut in turn"), postectomia (from the Greek: posthé - prepuce; ektomé - resection), postoplasty (from the Greek: plastes or plastic - that forms), or the combination of both, postectoplasty.<sup>18</sup>

Circumcision is considered sacred by many peoples throughout the world as a symbol of faith or even of tribal emancipation. The cultural bias has allowed for the technical improvement, minimization of complications and provision of obvious medical benefits.<sup>29</sup>

### Historical Context and Surgical Indications

Ancient Egypt, the Near East, some islands of Polynesia, South Pre-Columbia, Central America, Aboriginal Australia, and sub-Saharan Africa are some of the likely cradles of circumcision, recognized by literature as responsible for introducing and developing the technique. The procedure would have been initiated independently and for multiple reasons, medical or non-medical.<sup>30</sup>

Circumcision, in many cases, served as a ritual of introducing boys to war and marriage. History has shown that, despite the surgical indications for cultural or social reasons, the surgery has shown clear medical benefits, proven even by ancient peoples, which remain today.<sup>29</sup>

Studies have revealed that there is a routine indication of circumcision among certain peoples, only varying in the time

of execution: in Madagascar, Malagasy perform circumcision between one and 2 years. The murgin, in Australia, perform it on boys between the ages of 6 and 8 years. The Javanese practice it at the ages of 5, 10, or 14. The Ndembu perform it at the onset of puberty. Traditionally, to be considered Arusha and Masai in Tanzania and Gisu in Uganda, the initiate must undergo circumcision. Being a religious factor, the Israelites perform their baptism or Brit Milah, literally “covenant of circumcision” or “covenant of Abraham with God”, with circumcision on the eighth postnatal day. Among Islamists, it can be done on the seventh day of birth or, in Muslim law, between the ages of 7 and 13.<sup>14</sup>

Herodotus, who visited Egypt in 440 BC, reported that the mark of circumcision was associated with the Egyptian priests of the time, a sacred honor granted to a few, a fact subsequently reiterated by other historians. However, at another time in Egyptian history, circumcision came to represent the mark of slavery, one of the multiple forms of mutilation of captured slaves. Between 175-164 BC, with the expansion of the Alexandrian Empire and the transformation of Jerusalem into a Greek city-state, religious freedom was abolished. In this period, circumcision, once a covenant symbol with God, became a mark of exclusion for the Jews. Already with the expansion of the Roman empire, circumcision became illegal, and punishment for the guilty was generally death. Overall, for centuries, circumcision was rarely performed in the West, being associated with religious minorities, and largely ignored and opposed by the majority.<sup>29,31-33</sup>

Only in the eighteenth century did circumcision become prominent in the West, particularly in England. Initially as a public health measure, since, according to Victorian doctors, it would be fundamental for the prevention of masturbation and, consequently, the acquisition of venereal diseases, and later, becoming a symbol of wealth and power.<sup>34</sup>

Shortly afterwards, similarly, through Dr. Lewis Sayre, circumcision entered the United States initially as a public health strategy, and was used for various reasons ranging from a cure for mental disorders to the prevention of various types of illness. Over time, circumcision became a symbol of the American nation, being performed routinely in the neonatal period, with indices superior to all countries in the world.<sup>29,30</sup>

Phimosis, being a congenital anomaly or acquired disease, is a well-defined clinical entity. However, from 2300 BC, among the ancient Egyptians, to the present time, many factors including traditional, socioeconomic, political, tribal, racial, religious, cultural, and medical ones have influenced circumcision. In the latter case, there has been divergence among specialists.<sup>3</sup>

According to Richwood and Walker,<sup>13</sup> there seems to be an exaggeration in the indication of circumcision, presuming that there should only be an economic interest and observing that in those countries where medicine is socialized, the occurrence of circumcision is less than in those countries where costs are reimbursed by insurance companies or by the parents themselves.

From the traditional, cultural, and medical perspectives, in North American hospitals, 80% to 90% of newborns are systematically circumcised without distinction of race

or creed. In England, 70% of all circumcisions performed annually are for patients under the age of 15 years, while in other regions, such as Finland and Scandinavian countries, circumcision is rarely performed.<sup>13,14</sup>

There are still pediatricians who do not indicate surgery in those who do not maintain sphincter control, even when they present with urinary symptoms. These doctors prefer to clinically treat the preputial affection until the removal of the diapers and then indicate surgical treatments.<sup>2</sup>

It is always difficult to decide whether a child or baby should undergo circumcision. Thus, according to Concépcion et al,<sup>35</sup> circumcision should be considered only in children with true phimosis associated with inflammatory or infectious symptoms, such as dysuria and relapsing balanoposthitis; in cases where paraphimosis develops, there are very few cases of children requiring circumcision for the sole reason that there is little preputial retratillation.

Authors disagree as to the primary indication of postectomy. Although there are many medical indications for circumcision, phimosis appears to be the most frequent. Some studies have identified the redundant foreskin as the most frequent indication. Some complications related to phimosis or its formation also represent surgical indications. BXO leads to the development of phimosis, also requiring circumcision. Paraphimosis is a urologic emergency requiring preputial reduction using surgical methods or other methods. It represents, according to some authors, the second main indication for circumcision. The recurrent and postite balanitis (inflammation of the foreskin), foreskin neoplasms, and brake changes are other medical indications for circumcision.<sup>36-39</sup>

### Contraindications

According to Dewan,<sup>36</sup> there are no specific contraindications for circumcision; however, the options of individuals with active infection, possible penile carcinoma, or anatomical alterations of the external genitalia (hypospadias, penis bending without hypospadias, or micropenis) should be carefully weighed. The foreskin can be used for surgical correction of congenital penile anomalies.

However, according to Laurini et al<sup>14</sup>, there are formal contraindications that prevent or delay circumcision in the neonate: weight less than 2500 g, prematurity, less than five days of life, localized or generalized convulsions, anuria, hemophilia, jaundice, diarrhea, fever, vomiting, skin diseases, oral mycosis, inflammation of the eyes, changes in cardiorespiratory dynamics, diseases and clinical and surgical conditions, single umbilical artery, and congenital anomalies, especially in the external or life-threatening genitalia.

In general, Souza<sup>40</sup> categorized contraindications for circumcision into absolute and relative types. Absolute contraindications include penile anomalies, since the foreskin is the preferred source of skin for the correction of numerous penile and urethral abnormalities, with inadequate operation in patients with hypospadias or penile bowing; or the built-in penis, when removal of an excessive amount of penile skin can cause imprisonment of the penis in supra-pubic fat. Hemorrhagic diathesis and all coagulopathies, comorbidities,

and prematurity are considered relative contraindications and should be evaluated and corrected in the preoperative period. Elective surgery should be postponed and scheduled for a time when risks are controlled.

In countries where circumcision is a tradition, the procedure performed in a hospital environment may allow the diagnosis of many previously undetected genital abnormalities and their corrective treatment, the investigation of other associated malformations, and the circumcision associated with surgical correction of other diseases of the inguinal and genital regions, such as hernias, hydroceles, and cryptorchia.<sup>41,42</sup>

### Circumstances and HIV

The prevention of STDs through circumcision is controversial. According to Silva et al,<sup>39</sup> the increased risk has been attributed to small lacerations in the brakes during sexual intercourse and to the large mucosal surface in uncircumcised men. However, this increased incidence of STIs has been attributed to demographic factors.

To control the HIV pandemic, 2 work fronts are critical and currently not yet in balance. While access to antiretroviral therapy has grown considerably throughout the world improving quality of life and reducing morbidity, programs to prevent the spread of the virus, especially in areas of higher incidence, are still far short of what is needed.<sup>43</sup>

Three randomized trials evaluated the role of male circumcision in HIV transmission and demonstrated a reduction in female-to-male transmission by up to 60%.<sup>44-46</sup>

In a multicenter study in Africa, non-circumcision was considered an independent risk factor for HIV, and an inverse proportional relationship between circumcision and mean HIV prevalence was identified. It was observed that in countries with circumcision rates below 30%, HIV prevalence reached 17%, but did not reach 3% in countries with more than 90% circumcised men.<sup>47-49</sup>

This data points out that male circumcision, performed as a public health program, specifically in regions with high HIV rates in Africa, could drastically reduce the HIV burden on that continent with immediate benefits for circumcised men but mainly long-term benefits with reductions in infection rates and mortality.<sup>50</sup>

As a result, many male voluntary male circumcision programs have been developed across Africa in the form of public health programs, recruitment of HIV-negative men, standardized medical screening, and associated neonatal circumcision. At the same time, prospective studies were developed and data analyzed with the aim of confirming current impact studies.<sup>51-56</sup>

### The Benefits of Circumcision

Although limited by selection bias, several observational studies and meta-analyses point to the inversely proportional relationship between circumcision and STD acquisition, evidencing circumcision as a protective factor.<sup>57-59</sup>

Three clinical trials conducted in Africa randomized eleven thousand HIV-negative adult men for circumcision. Based on observations, it was concluded that the preputial procedure

ensured a reduction in STD acquisition with a protective effect of approximately 60% for HIV, reduction of *Trichomonas* infection vaginalis, genital ulcers, herpes simplex virus, and human papilloma virus (HPV).<sup>1,45,46,52</sup>

Classically the literature relates to phimosis and uncircumcised patients as main risk factors and those most affected by penile cancer, respectively, with an incidence estimated to be up to 22 times higher than in circumcised patients. Brazil has one of the world's highest incidences of invasive penis cancer, also noted as primarily related to uncircumcision. However, recent studies bring to the discussion a new view of the subject. The main idea relates the development of cancer not to the foreskin alone, but to the conditions related to it. In countries with good preputial hygiene, even uncircumcised patients have a low incidence of penile cancer. Similarly, other authors pointed out the presence of uropathogens in the foreskin of circumcised and uncircumcised patients with no phimosis effect on colonization.<sup>1,60-64</sup>

Although the literature points to HPV infection as one of the main risk factors for penile cancer closely related to uncircumcised patients, there is no indication of circumcision in the neonatal period to minimize these risks. Other preventive strategies should be used, such as vaccination for HPV and allowing the informed individual to make an informed decision about the surgery.<sup>1,63,65</sup>

Cancer of the cervix has also been associated with uncircumcision. Some authors consider circumcision to be a protective factor for HPV penile infection and cervical cancer. Recent data indicates a robust association between phimosis and the prevalence of genital HPV in men and a significant frequency of high-risk HPV.<sup>57,66</sup>

The incomplete separation of the prepuce may be responsible for colonization by pathogenic microorganisms, causing balanoposthitis and UTI. However, lack of hygiene is a more frequent cause of balanitis than the said balanopreputial adhesions.<sup>35</sup>

Despite the controversies among authors regarding the relationship between UTI and circumcision and their surgical indications, studies point to a UTI risk up to 12% higher in the first three months of life for uncircumcised patients. This lower incidence of UTI in circumcised children could be a positive argument, but never justification for indiscriminate neonatal circumcision, as there is no data in the literature demonstrating that the micro-organisms responsible for UTIs are the same as those that colonize the foreskin. According to some authors, 80 to 195 neonatal circumcisions would be necessary to prevent an UTI.<sup>39,60,68,-71</sup>

In a recent systematic review using a risk-benefit analysis, Morris et al<sup>72</sup> demonstrated that the benefits of circumcision exceeded surgical risks by as much as 200 to 1. He estimated that more than 50% of uncircumcised men will experience some medical problem related to the prepuce. The American Academy of Pediatrics confirms circumcision as a justifiable procedure, with calculated risks and obvious and superior benefits. It also guides the detailed explanation of the procedure to the parents and recommends the realization

only by qualified and competent professionals under aseptic techniques and effective analgesic management. The Canadian Society of Pediatrics has recognized circumcision as beneficial in specific situations relating to population and high-risk circumstances.<sup>73</sup>

Societies in Europe, Australia, and the United Kingdom have similar criteria; however, none of them believe that the benefits shown are strong enough to institute routine circumcision, nor that the evidence of harm is convincing enough to enforce a complete ban. Although opinions are apparently diverse, we can move forward in discussions if we focus on minimizing the damage associated with circumcision, ensuring free and informed parental consent, and regulating circumcision regarding the use of anesthesia and analgesia.<sup>74</sup>

### Surgical Techniques

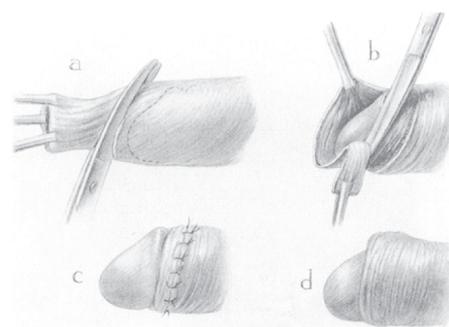
It was in the middle of the 19th century that the first surgical reports describing circumcision began to appear in medical teaching books. Despite the lack of technical details, it is possible to infer the use of the scalpel for the resection of the excess foreskin and, probably, the absence of sutures, since it was advised that the bleeding should be “stagnant with iodoform and boric”.<sup>75</sup>

In this context, with the progressive evolution of anesthetic and antiseptic techniques, there was an accelerated development in surgical practices. It was no different for circumcision. Held for the first time at St. Bartholomew’s Hospital in London in 1865, only thirteen years later it became the most common procedure advocated as a curative therapy for a myriad of illnesses.<sup>76-78</sup>

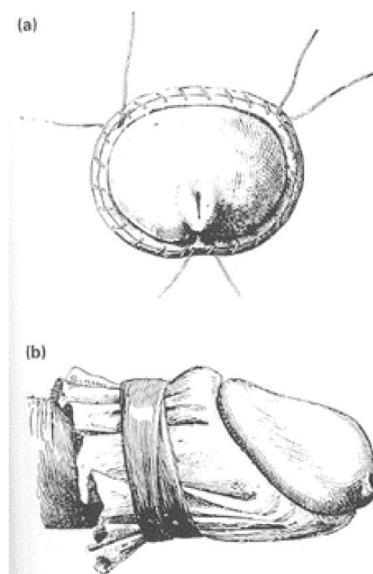
With the turn of the century, in the early 1900s, circumcision gained its technical foundation, from the detailed descriptions of Frederick Treves. He names features still used today, such as interrupted suture with absorbable suture yarn, and provides guidance on technical care to avoid complications, such as avoiding continuous sutures and excessive resection of the foreskin. Other recommendations remain as learning, although they are no longer performed in our day, such as preputial resection with scissors (Figure 4) and ligation of the frenulum artery.<sup>79,80</sup>

Another key name in the development of the surgical technique of circumcision is that of the French surgeon Doyen. His technique was characterized by a continuous tri-radiated suture with silk thread number 1, in which the threads were not tied and a compressive dressing aided in the maintenance of hemostasis (Figure 5).<sup>81,82</sup>

According to Silva et al,<sup>39</sup> the most current and appropriate circumcision technique in adults or older children is the sleeve or conventional excision. With the foreskin fully retracted, an incision is drawn about 1 centimeter from the crown, which should pass through the base of the brake. The incision should section the dartos fascia deep into the superficial lamina of Buck’s fascia. The second incision should be performed with a relaxed foreskin, visualizing the segment of preputial skin to be resected, which can be guided by the crown and balanopreputial marks. After the incisions are made and



**Figure 4.** The Technique With Scissors Described by Sir Frederick Treves.<sup>79</sup>  
Source: Dunsmuir.<sup>81</sup>



**Figure 5.** (A) The Tri-radiated Continuous Suture of Doyen.<sup>82</sup>. (B) Treated Compressive Curative.  
Source: Dunsmuir.<sup>81</sup>

the incised area is removed by separating the subcutaneous cellular tissue between the Buck fascia and the foreskin, the hemostasis with electrocoagulation and, afterwards, the re-approximation of the skin borders is done. The brake is approached first, as it may be a site of more intense bleeding. A “U” point is used, which provides a good aesthetic effect and is effective in controlling bleeding. The foreskin’s extremities are sutured with multiple single stitches using vicril 4.0 or 5.0 (or other absorbable material) and spaced 4-7 mm apart.

The “dorsal slit” is characterized as an auxiliary technique or as simply a surgical step component of other techniques. Cosmetically unacceptable alone, this is used only in special situations, such as acute inflammation or edema related to paraphimosis. The technique is based on traction of the distal foreskin at 10h and 1h, with a longitudinal incision of about 1 cm in the dorsal foreskin, sectioning the inner and outer layers and transverse suture with absorbable wire.<sup>83</sup>

The development of circumcision techniques in adult patients, the paradigm shifts related to procedures in the

West in the early twentieth century, and the demand for the procedure in the neonatal period led to the creation of specific surgical techniques for this age range. It was observed that among neonates, simple manual pressure can control bleeding, without tying the frenulum artery. With this knowledge, the bases of hemostatic devices for circumcision were laid. The first one was the Doyen's Ecraseur (1920), in which the surplus foreskin was crushed and sectioned with little or almost no bleeding<sup>81</sup> (Figure 6).

Already in the 1930s, with the spread of the surgical technique with the use of hemostatic devices, numerous instruments appeared for use in the neonatal period. However, at the time, serious recommendations on the dangers related to the glans were raised and guided the creation and development of safer devices.<sup>83</sup>

Winkelman's hemostatic device was introduced in 1935 and remains similar today (Figure 7). In the 1950s, the hemostatic device called Plastibell was developed (Figure 8). It was reported by Miller and Snyder in 1953 and in 1956 by Kariher and Smith, and several favorable accounts followed those. Created for the neonatal public, its use has now spread to all pediatric ranges. The device is characterized by a plastic bell with a groove in its lower part. It is introduced between the glans and the foreskin after the detachment of the

balanopreputial adhesions, and an unabsorbable suture thread is rolled and tightly tied around the groove, compressing the foreskin against the groove. Excess foreskin is resected and the ring falls in 7 to 10 days. Except for the occasional proximal ring migration, complications are few and are related to their inappropriate use, such as wrong choice of device size and suture not tight enough. Other plastic devices were also introduced, such as the Glansguard and the variations of Gomco, Bronstein, and Mogen.<sup>81,83-86</sup>

Among the hemostatic devices for circumcision, the ones most frequently used in the United States are Gomco, Plastibell, and Mogen. Of these, the earliest is Gomco (Figure 9), created in Buffalo, New York in 1935 by Hiram S. Yellen (a gynecologist and obstetrician) and Aaron A. Goldstein (an inventor). They used the pages of American medical journals to induce people of the need for early circumcision, to promote their product as the best and their method as the most efficient. Like other devices, Gomco is characterized by little or no bleeding, reduced surgical time and minimal learning curve with excellent aesthetic results. However, it is limited to the neonatal period, out of which the results are unsatisfactory, and the morbidity is increased.<sup>87,88</sup>

The Mogen hemostatic device (Figure 10) presents the

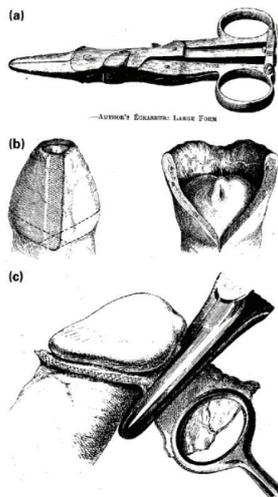


Figure 6. (A) The Doyen Écraseur,<sup>83</sup> Com (B) and (C) Showing the Management of the 4 Crushing Points. Source: Dunsmuir.<sup>81</sup>

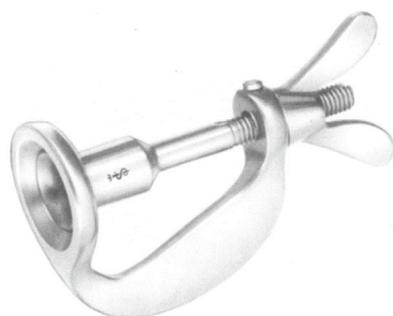


Figure 7. Winkelman Circumcision Apparatus. Source: Dunsmuir.<sup>81</sup>

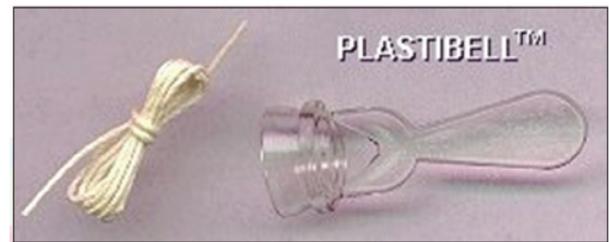


Figure 8. The Plastibell Hemostatic Device. Source: Abdulwahab-Ahmed.<sup>83</sup>

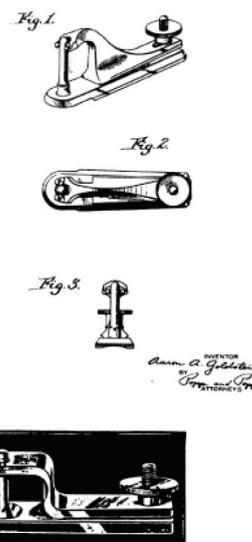


Figure 9. Gomco Appliance. The Illustration of Patent Design, Identical to The Propaganda of 1935. Source: Wan.<sup>88</sup>

simple surgical technique, without sutures, in which the surplus distal foreskin is put in traction and resected after the glans is protected. Because of the applicability of this device to large populations and the recommendation of circumcision as the main strategy for HIV prevention in some African countries, the United Nations has recently introduced randomized trials using hemostatic devices such as the Mogen in areas of difficult access by non-medical professionals, such as midwife nurses.<sup>83,89</sup>

Other less-used devices can be cited: Zhenxi Rings (Figure 11); Tara Klamp (Figure 12); Smart Klamp (Figure 13); and Shang Ring (Figure 14). The PrePex (Figure 15) is notable for its use in mass circumcision, without the need for anesthesia, for the prevention of HIV infection. Another device used for this purpose is the AccuCirc (Figure 16), which was already tested in procedures performed by non-medical professionals.<sup>83,90-93</sup>

During history, for different reasons mostly non-medical, several alternative surgical techniques have been developed for the treatment of phimosis and may be termed as preputioplasty. In the twentieth century, 2 of them stood out: the preputial excision in “V”, of Cloquet, that liberated the glans but maintained its natural cover; and the longitudinal incision in the stenotic distal foreskin followed by a transverse suture, attributed to Young’s and Davies’s Heinecke-Mikulicz.<sup>81</sup>



Figure 10. Mogen Apparatus. Source: Abdulwahab-Ahmed.<sup>83</sup>



Figure 11. Zhenxi Rings Device. Source: Abdulwahab-Ahmed.<sup>83</sup>



Figure 12. Tara Klamp Device. Source: Abdulwahab-Ahmed.<sup>83</sup>

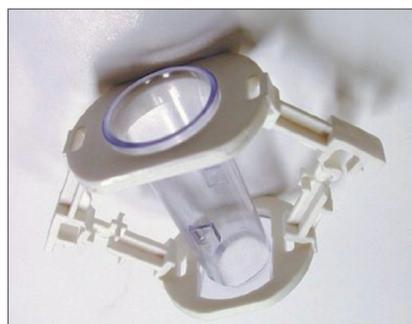


Figure 13. Smart Klamp Device. Source: Abdulwahab-Ahmed.<sup>83</sup>



Figure 14. Shang Ring Device. Source: Abdulwahab-Ahmed.<sup>83</sup>



Figure 15. Prepex.device. Source: Abdulwahab-Ahmed.<sup>83</sup>

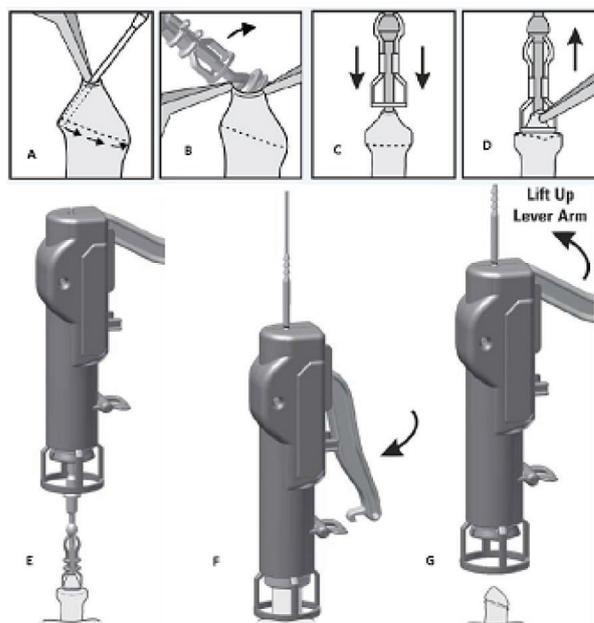


Figure 16. Accucirc. A To G: Stages of Circumcision. After release of adhesions and fixation of the device, hemostatic resection of excess foreskin occurs. Source: Plank<sup>94</sup>

Other alternative techniques, however, developed more recently, arose mainly seeking to reduce the complications related to the procedures in force as well as to improve the aesthetic and cicatricial post-surgical results. These include the use of mono- or bipolar electrocautery, bipolar scissors, free suture techniques using tissue adhesives (N-butyl 2-cyanoacrylate, 2-Octyl cyanoacrylate), and "YV" preputioplasty, among others. Laser circumcision has its benefits related to the physical properties of precision and sealing of cutting surfaces. Some reports involve in hemophiliac patients, but the cases described in the medical literature are still rare.<sup>96-100</sup>

### Complications Related to Circumcision

The major postoperative complications related to circumcision are bleeding and infection. They vary according to the period of disease and severity and may be early and mild (mild bleeding and wound infections) or late and severe (profuse bleeding and septic shock). The literature shows complication rates around 1.5% to 5%, reaching extremes of 0.06% to 55%.<sup>101,102</sup>

The most frequent complication reported by most authors is bleeding. The large difference in incidence (0.1% to 35%) can be explained by the presentation spectrum. In the majority of discrete character, solved by the simple manual compression. Another conservative alternative is the use of local ice. There are rare cases in which surgical reinterventions, such as sutures or electrocoagulation, are required. Correct intraoperative hemostasis using the valuable and judicious aid of electrocautery minimizes most complications. Hemorrhagic cases requiring hemotransfusion are rare but may be related primarily to coagulopathies or anomalous blood vessels.<sup>102-104</sup>

The second most common postoperative complication is infection. Similar to bleeding, infection may also present as a spectrum ranging from mild, local wound infections to local inflammatory signs to severe cases such as deep infections such as necrotizing fasciitis and even systemic the septic shock. It is present in about 10% of the post-circumcised and may even manifest as pneumonia or meningitis. The operative wound acts as an entrance port which facilitates the spread of microorganisms. With the development of the infection it worsens morbidity and mortality related to the procedure.<sup>102</sup>

The nature of circumcision dictates how much foreskin should be removed. There is a controversy as to the final aesthetic aspect among both experts and lay people on this subject. Thinking like urologists, circumcision itself should completely remove the preputial excess, leaving the glans exposed and allowing proper cleansing. This is also the desired aspect when the procedure is performed for cultural rather than medical reasons. However, when the objective is only to resect the stenotic preputial segment and improve the final aesthetic aspect with partial coverage of the glans by the residual foreskin, some complications may arise. When the skin and residual preputial mucosa remain in excess, they may undergo circumferential healing, resulting in a true phimosis appearance. Studies in Australia and the United Kingdom have shown rates of recircumcision between 1%

and 10%.<sup>101,102,105-107</sup>

To treat fibrosis with post-surgical foreskin scarring, there are several behaviors, such as expectant, in the likelihood that fibrosis resorption will occur within three months. Another alternative is the application of corticoid cream, such as 0.05% clobetasol propionate, with application by friction in the scar with stenosis, one to three times a day for 30 days; no cure can be substituted by Contractubex<sup>®</sup> gel, anti-celoid based on cepalin, applied in the same way. The surgical reintervention should only be indicated if the other methods are not successful.<sup>2</sup>

Excess removal of the foreskin can be caused by traction of the foreskin on the glans during the operation. It is suggested that such lesions occur because of failure of lysis of adhesions between the ventral foreskin and the glans. As a fundamental part of the surgical technique, during circumcision, after opening the stenotic preputial ring, the delicate release of the balanopreputial adhesions should be performed, completely separating the preputial mucosa from the glans, until the coronal groove is visualized. Cases of penile denudation are very rare and usually due to local necrosis, caused by either infectious causes, accidents with electrocautery, or inadvertent injection of non-anesthetic solutions. Despite the severity of the lesions, conservative management guarantees functional outcome in most cases.<sup>108,109,110</sup>

Complications presenting frequently and often going underdiagnosed are meatite and meatal ulcer, with an incidence rate of 8% to 20%. They occur by continual exposure of the glans to physical and chemical trauma from contact with the diaper and urine. The perpetuation of the lesion for long periods may even lead to urethral meatus stenosis, a late complication, predisposition to urinary infections.<sup>102,111</sup>

Although rare, amputation of the glans is the most serious post-circumcision complication. It should be promptly corrected by an experienced surgeon familiar with reconstructive techniques. The association of a tissue with good distal vascularization and an adequate surgical technique guarantee, in most cases, graft success.<sup>112</sup>

Another rare but described complication in the literature is the urethrocutaneous fistula. It results from an injury to the urethral wall, juxtaposed to the ventral portion of the penis, and leads to necrosis of the urethral wall and fistulous communication of the penile urethra. It is mainly related to the inadvertent use of electrocautery, sutures, and hemostatic devices.<sup>102</sup>

Cases of death in children undergoing circumcision are rare, but when described, they are usually related to hemorrhagic shock or anesthetic intoxication. Some authors warn about the potential risks of procedures performed in clinics, in places without emergency assistance 24 hours a day, as well as procedures performed by non-medical professionals<sup>113</sup>.

### Conclusions

The presence of a distal, non-retractable preputial meatus should be considered a problem worthy of medical evaluation only in the presence of complications or when the child reaches school age or pre-adolescence, even in the absence of

complications. Surgical treatment is widely known, but clearly over-indicated and underestimated. Despite the low rates of complications in trained hands, it may be associated with mutilations and physical and psychological sequelae.

### Authors' Contributions

All authors contributed equally to this study.

### Conflict of Interest Disclosures

The authors declare that they have no conflicts of interest.

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