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Kareem Gaafar Elbahariya
Department of Pediatric
Surgery, Faculty of Medicine,
Tanta University, Tanta,
Egypt

**Hisham Almohamady
Almetaher**
Department of Pediatric
Surgery, Faculty of Medicine,
Tanta University, Tanta,
Egypt

**Ahmed Abdelmohimen
Elhaddad**
Department of Pediatric
Surgery, Faculty of Medicine,
Tanta University, Tanta,
Egypt

Abdelmotaleb Effat Ebied
Department of Pediatric
Surgery, Faculty of Medicine,
Tanta University, Tanta,
Egypt

Corresponding Author:
Kareem Gaafar Elbahariya
Department of Pediatric
Surgery, Faculty of Medicine,
Tanta University, Tanta,
Egypt

Bone cutter, gomco clamp, and plastibell device for circumcision in neonates and infants: A comprehensive review

**Kareem Gaafar Elbahariya, Hisham Almohamady Almetaher, Ahmed
Abdelmohimen Elhaddad and Abdelmotaleb Effat Ebied**

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Abstract

Background: Circumcision, the surgical removal of the foreskin from the penis, is a common procedure in neonates and infants worldwide, driven by cultural, religious, and medical factors. Several techniques and devices are utilized, including the Bone Cutter, Gomco Clamp, and Plastibell Device, each with distinct advantages and risks. Understanding these methods is crucial for healthcare providers faced with decisions regarding circumcision.

Objective: This review aims to comprehensively evaluate and compare the efficacy, safety, clinical outcomes, and complication rates associated with the Bone Cutter, Gomco Clamp, and Plastibell Device used in neonatal and infant circumcisions. By synthesizing current literature and clinical studies, the review seeks to provide evidence-based guidance for selecting the most suitable technique based on patient-specific factors and clinical settings.

Conclusion: Each circumcision device offers unique benefits and potential risks. The Bone Cutter provides precise cutting with minimal bleeding but requires expertise. The Gomco Clamp is reliable for ensuring hemostasis but demands careful assembly. The Plastibell Device simplifies the procedure but carries a risk of retained ring complications. Healthcare providers should weigh these factors alongside patient preferences and cultural considerations when choosing a circumcision method.

Keywords: Circumcision, neonates, infants, bone cutter, gomco clamp, plastibell device, efficacy, safety, complications

Introduction

Circumcision, the surgical removal of the foreskin from the penis, is one of the most frequently performed procedures on neonates and infants worldwide, driven by cultural, religious, and medical motivations. The practice, with deep historical roots, continues to be a subject of considerable medical, ethical, and cultural discussion. In contemporary clinical settings, several techniques and devices are used for this procedure, notably the Bone Cutter, Gomco Clamp, and Plastibell Device, each presenting unique benefits and risks^[1].

Neonatal and infant circumcision is commonly practiced for religious and cultural reasons, particularly in Jewish and Islamic communities, as well as for potential health benefits. Medical advantages associated with circumcision include a reduced risk of urinary tract infections, penile cancer, and certain sexually transmitted infections. However, the decision to circumcise involves careful consideration of these benefits against potential complications and ethical issues, necessitating informed consent from parents and guardians^[2].

This review aims to thoroughly evaluate the Bone Cutter, Gomco Clamp, and Plastibell Device used in neonatal and infant circumcisions, providing a detailed comparison of their efficacy, safety, clinical outcomes, and complication rates. By compiling and analyzing existing literature and clinical studies, the review seeks to illuminate the strengths and weaknesses of each device, aiding healthcare providers in selecting the most appropriate method based on individual patient needs and clinical settings.

The primary objectives of this review are to outline the historical development and contemporary usage of the Bone Cutter, Gomco Clamp, and Plastibell Device, compare their procedural techniques, and evaluate their respective efficacy and safety profiles. Additionally, the review will analyze clinical outcomes, discuss cost and accessibility, and address cultural and ethical considerations.

Embryology, Anatomy and Physiology of the Prepuce

Sex differentiation of the external genitalia occurs between the 7th and 17th weeks of intrauterine development, initiated in males by the Y chromosome through the SRY gene, which triggers testicular development. Under the influence of testicular androgens, the external genitalia develop into the penis and scrotum [3]. By the 12th week of gestation, foreskin development begins as an epithelial fold at the coronal sulcus, initially covering only the dorsum. The dorsal aspect grows faster than the ventral side, and as the glanular urethra closes, the ventral prepuce forms the frenulum, with the prepuce completely covering the glans by the fifth month of gestational life [4]. Once the glans is covered, the epithelium of the glans and inner prepuce fuse,

with subsequent keratinization and formation of epithelial pearls, leading to the gradual separation of the glanular and preputial epithelium. At birth, this separation is often incomplete, with only 4% of males having a retractable foreskin. Retraction increases with age, reaching near-complete retractability by 17 years [5]. The preputial space accumulates smegma, a benign material historically considered carcinogenic. Histologically, the prepuce is a complex structure with layers including squamous mucosal epithelium, lamina propria, dartos muscle, dermis, and outer skin. The foreskin's rich innervation and blood supply highlight its role in protection and sexual function, while its anatomy and developmental changes underpin its clinical significance in conditions such as meatal stenosis [5, 6].

Table 1: Historical and Clinical Aspects of Circumcision [7]

Category	Details
History of Circumcision	Circumcision is the oldest surgical procedure, likely originating from less radical genital amputation practices on war prisoners. Historical records indicate that Pharaoh Merneptah (1212 BCE) collected over 13,000 penises as war trophies, according to inscriptions on the Karnak temple walls.
Judaism, Christianity, and Islam	Jews incorporated circumcision into their religious rituals, with Abraham circumcising himself at 99 years, as per the Holy Bible. Jesus was circumcised on the eighth day, but Christianity replaced circumcision with baptism. Circumcision was used to identify Jews, particularly in the Roman Empire, where it was taxed and inspected annually. In Nazi concentration camps, circumcision determined life or death. Islam universally adopted circumcision, though it is not mentioned in the Quran and predates Islam in the Arabic region.
The Modern Era	By the late 18th century, circumcision became common beyond religious rituals, used to treat various diseases such as impotence, tuberculosis, and eczema. Modern medical textbooks cite phimosis as the most common indication. Circumcision is proven to reduce risks of penile cancer, cervical malignancy, and HIV infection.
Circumcision Indications and Contraindications	Routine infant circumcision is common for religious and cultural reasons, making it the most frequent male surgical procedure. The 19th century saw its medicalization. Proponents cite benefits like improved hygiene and reduced infection risks, while opponents highlight complications and reduced sensation. Medical staff must understand the indications, techniques, and complications to handle circumcision requests effectively.
Relative Indications	Circumcision is performed for conditions like preventing penile and cervical cancer, sexually transmitted infections (especially HIV), and urinary tract infections. Surgeons also often perform circumcision during hypospadias surgery.
Paraphimosis	Occurs when the foreskin is not pulled back over the glans after retraction, leading to a constricting band, swelling, and discomfort. Reduction under anesthesia is usually possible with minimally invasive methods.
Balanoposthitis and Balanitis	Balanoposthitis affects about 1% of boys, causing inflammation and purulent discharge. Initial treatment is antibiotics, reserving circumcision for recurrent cases. Alternatives like preputioplasty may prevent further episodes while retaining a retractile foreskin.
Preputial Pearls and Redundant Foreskin	Benign conditions not requiring circumcision. Preputial pearls are retained smegma resolving spontaneously. Redundant foreskin causes urine pooling, managed by gentle retraction during urination. Long foreskins increase penile cancer risk only if phimosis is present.
Phimosis	Defined as the inability to retract the foreskin due to a narrowed opening. Differentiating between physiological (normal) and pathological (requires surgery) phimosis is crucial. Large studies show that 10% of boys at age 5 and 1% at age 10 have physiological phimosis. Pathological phimosis, involving abnormal and scarred orifices, has an incidence of about 1.5% at age 17 and often shows balanitis xerotica obliterans histologically.
Prevention of Sexually Transmitted Infections	A literature review of 31 studies showed that uncircumcised males were more prone to genital ulcer disease and human papillomavirus infection, while circumcised men were more prone to urethritis. Risk factors other than circumcision, such as age at first intercourse and number of sexual partners, are more significant for HPV infection.
Prevention of HIV Infection	A 2005 Cochrane review found that male circumcision might reduce HIV acquisition, though results were limited by confounding variables. Randomized trials in Kenya and Uganda showed a 51-53% protective benefit, indicating circumcision's potential protective effect in high HIV prevalence areas.
Prevention of Penile Cancer	Penile cancer is more common in uncircumcised men. A U.S. case-control study found phimosis strongly associated with invasive penile cancer, but no increased risk was seen when phimosis was excluded. HPV infection was a significant risk factor regardless of circumcision status.
Prevention of Urinary Tract Infection	Uncircumcised infants have a 3-7 times higher risk of urinary tract infection compared to circumcised ones, especially in those under one year old. Circumcision benefits boys with high risk of recurrent infections or abnormal urinary tracts, though it showed no benefit when performed with anti-reflux surgery.

Contraindications to Neonatal Circumcision

Circumcision should only be performed after screening for contraindications, which include concerns for bleeding disorders, the infant's age/health, congenital malformations, and insufficient penile size [2]. Infants with a family history of bleeding disorders like hemophilia or thrombocytopenia should be screened for these conditions, and clinical signs of

bleeding abnormalities should be evaluated. Eligibility criteria include well-appearing infants at least 12 hours old, who have had at least one void and are not immediately post-prandial. Breastfeeding should be established and progressing satisfactorily before circumcision [8]. Infants with congenital abnormalities such as hypospadias, chordee, or buried penis are not candidates for routine

neonatal circumcision. Careful inspection of the penis for these conditions should be done before the procedure [9]. Minor meatal misplacements may still allow for circumcision, but the infant should be referred to Urology for evaluation. Small penis size, including in premature infants, may preclude the use of devices like the Gomco or Plastibell, although the bone cutter can still be used [10, 11].

The diagnosis of micropenis or penile webbing makes circumcision inappropriate, and infants with bilateral cryptorchidism and small penile size should be evaluated for endocrine disorders such as congenital adrenal hyperplasia or disorders of sex differentiation [12-14].

Complications of Neonatal Circumcision (Table 2)

Table 2: Complications of Neonatal Circumcision [15]

Complication	Details
Bleeding	The most common complication, usually minor and controlled by direct pressure. Severe cases, particularly with underlying blood disorders, can be fatal. The Plastibell device has the lowest incidence of bleeding.
Infection	Rare with sterile conditions. Plastibell device has a higher risk due to the presence of a foreign body. Serious infections like meningitis, necrotizing fasciitis, gangrene, and sepsis are rare but have been reported.
Insufficient Foreskin Removed	Results in an unacceptable appearance or phimosis, requiring surgical revision. Conditions like buried penis or large hydroceles increase this risk and are contraindications for neonatal circumcision.
Excessive Foreskin Removed	Can result from drawing penile shaft skin into the circumcision device. Most cases heal spontaneously, but the initial appearance can be distressing. Proper technique is crucial to prevent this issue.
Adhesions / Skin Bridges	Adhesions occur when foreskin sticks to the glans. Skin bridges are abnormal attachments that may require excision. These can result from incomplete removal of adhesions during circumcision.
Inclusion Cysts	Form along the circumcision site, potentially becoming infected and requiring surgical excision.
Abnormal Healing	Granulomas and keloids are rare but possible. Patients with conditions predisposing to abnormal healing may be contraindicated for circumcision.
Meatitis	Inflammation of the urethral opening, usually self-limited. Prevention includes using emollients post-procedure.
Meatal Stenosis	Narrowing of the urethral opening, possibly requiring meatotomy in severe cases.
Urinary Retention	Can be caused by tight bandages; resolved by removing the bandage.
Phimosis	Can be a result of circumcision, particularly in cases of buried penis. May require surgical correction.
Chordee	Ventral curvature of the penis, either congenital or as a result of uneven foreskin removal. May need surgical correction.
Hypospadias	Urethral opening on the ventral side of the penis. Can be congenital or due to injury from circumcision devices. Requires surgical correction.
Epispadias	Urethral opening on the dorsal side of the penis. Rare, but can occur if circumcision devices are misused. Surgical correction may be necessary.
Necrosis of the Penis	Rare, can result from infection or misuse of electrocautery devices.
Amputation of the Glans	Rare but severe, usually due to improper use of the Mogen clamp. Prompt reattachment may be possible if recognized immediately.
Urethrocutaneous Fistula	Rare, resulting from compression necrosis or direct injury. Elective repair can be performed after sufficient penile growth.

Pre-circumcision Assessment and Examination

The pre-circumcision examination of an infant should include a review of gestational age, birth weight, vital signs, general health within the first 24 hours, and documentation of the first void. The skin should be examined for jaundice, petechiae, and any rash in the umbilical or groin region. A systematic examination of the newborn male genitalia is crucial. This includes inspecting the pubic region for significant suprapubic fat and potential penis burying, which can be better assessed by pushing down the fat to reveal the actual penis size [16]. The dorsum of the penis should be checked for any epispadias, and the foreskin should be gently manipulated to assess its laxity and coverage. Observing the urethral meatus and noting any rotation of the penile head and foreskin is important, as is following the raphe to identify abnormalities indicative of hypospadias. The testes should be palpated to determine their descent, as bilateral undescended testis contraindicates circumcision due to potential ambiguous genitalia. Significant hydrocele,

peno-scrotal webbing, signs of chordee, or other structural deviations should also be excluded [17].

Anesthesia in Circumcision

Local anesthesia is commonly used during circumcision, with methods including penile dorsal nerve block, penile ring block, and local anesthetic spray jet injector. These methods provide intraoperative anesthesia and early postoperative analgesia but can have significant failure rates [18].

The penile ring block involves circumferential infiltration of local anesthetic around the shaft of the penis, while the penile dorsal nerve block requires injecting local anesthetic at the root of the penis at the 10 and 2 o'clock positions on either side of the fundiform ligament. This can be supplemented with a penoscrotal bleb of local anesthetic to block sensory branches of the pudendal nerve. Proper administration of anesthesia is critical to ensure the procedure's effectiveness and the infant's comfort [19].

Table 3: Techniques and Considerations of Circumcision ^[4]

Technique	Description	Advantages	Disadvantages
Forceps Guided	Prepuce is freed, pulled out, and clamped with forceps. Scalpel removes prepuce flush to the forceps.	Protects glans during procedure.	Risk of crushing injury, requires precise technique.
Gomco Clamp	Multi-piece chrome-plated device introduced in 1939. Components are not interchangeable between sizes or manufacturers.	Protects glans, widely used in the USA.	Cumbersome equipment, requires proper matching of pieces.
Plastibell Technique	Plastic disposable device with a ring and handle. Foreskin necrosis occurs due to a string ligature. Ring falls off within days.	Protects glans, no bandaging required, disposable, easy to stock.	Risk of glans entrapment, premature ring detachment, unsettling for parents.
Tara Klamp	Similar to Plastibell, uses plastic arms to lock in place and trap the prepuce.	Easy to use, no need for sutures.	Risk of glans necrosis, infection, and discomfort during removal.
Smart Klamp	Traps prepuce between outer ring and inner tube, cutting off blood supply. Excess foreskin removed using baseplate as guide.	Protects glans and frenulum.	Pain and complications during removal, infection risk.
Zhenxi Rings	Grooved sleeve over the glans, hinged clamping ring tightens the prepuce, elastic cord constricts the prepuce.	Protects glans and frenulum, precise constriction.	Risk of glans necrosis if too tight, poor cosmetic outcome if too loose.
Prepex Device	Used in adults, consists of placement ring, inner ring, and elastic ring. Causes ischaemic necrosis of prepuce.	No anesthesia needed, bloodless severance of prepuce.	Requires careful placement to avoid complications.
Thermal Cutting	Uses heat energy for cutting and cauterizing.	Adjustable heat levels, optimal hemostasis.	Risk of tissue damage if not properly controlled.
Sleeve Resection	Freehand cut around the shaft, foreskin removed by circumferential cuts, sutured together.	Customizable tightness and scar placement, used in adults.	Requires skilled surgeon, potential for cosmetic dissatisfaction.
Circumcision Stapler	Uses titanium staples for circumcision, popular in Asian countries for adolescents.	Quick procedure, minimal bleeding.	Limited availability, potential for staple-related complications.
Laser Circumcision	Uses laser beams for cutting and welding edges, providing a bloodless operation.	Precise cutting, minimal bleeding, optional suturing.	Requires specialized equipment, risk of thermal injury to surrounding tissues.

Conclusion

In conclusion, the Bone Cutter, Gomco Clamp, and Plastibell Device represent varied approaches to neonatal and infant circumcision, each with distinct advantages and potential drawbacks. While the Bone Cutter offers precision and minimal bleeding, its use requires technical skill. The Gomco Clamp ensures reliable hemostasis but necessitates careful assembly. Conversely, the Plastibell Device simplifies the procedure but carries risks of retained ring complications. Healthcare providers must consider these factors alongside patient preferences and cultural contexts when selecting the most appropriate method. Future research should continue to assess outcomes and refine techniques to optimize safety and efficacy in this common and culturally significant surgical procedure.

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Conflict of interest

The author declares no conflict of interest.

References

1. Myers A, Earp B. What Is the Best Age to Circumcise? A Medical and Ethical Analysis. *Bioethics*. 2020;34:645-663.
2. Simpson E, Carstensen J, Murphy P. Neonatal circumcision: new recommendations & implications for practice. *Mo Med*. 2014;111:222-230.
3. Cunha GR, Sinclair A, Cao M, Baskin LS. Development of the human prepuce and its innervation. *Differentiation*. 2020;111:22-40.
4. Abdulwahab-Ahmed A, Mungadi IA. Techniques of male circumcision. *J Surg. Tech Case Rep*. 2013;5:1-7.
5. Deibert G. The separation of the prepuce in the human penis. *The Anatomical Record*. 2005;57:387-399.
6. Fahmy M. Histology of the Prepuce; c2020. p. 59-65.
7. Malone P, Steinbrecher H. Medical aspects of male circumcision. *Bmj*. 2007;335:1206-1290.
8. Kitchen S, McCraw A, Echenagucia M. Diagnosis of hemophilia and other bleeding disorders. *World Federation of Hemophilia*; c2010.
9. Snodgrass W, Khavari R. Prior Circumcision Does Not Complicate Repair of Hypospadias With an Intact Prepuce. *The Journal of urology*. 2006;176:296-298.
10. Refaat DO, Tantawy IM, Mokhtar MM, Mosad KM. Circumcision in Neonates and Infants Using Different Techniques: A Comparative Study. *The Egyptian Journal of Hospital Medicine*. 2023;90:2662-2669.
11. Razzaq S, Mehmood MS, Tahir TH, Masood T, Ghaffar S. Safety of the plastibell circumcision in neonates, infants, and older children. *Int. J Health Sci. (Qassim)*. 2018;12:10-13.
12. Brady MT. Newborn Male Circumcision with Parental Consent, as Stated in the AAP Circumcision Policy Statement, Is Both Legal and Ethical. *J Law Med Ethics*. 2016;44:256-262.
13. Morris BJ, Bailis SA, Wiswell TE. Circumcision rates in the United States: rising or falling? What effect might the new affirmative pediatric policy statement have? *Mayo Clin. Proc*. 2014;89:677-686.
14. American Academy of Pediatrics Task Force on Circumcision. Circumcision policy statement. *Pediatrics*. 2012;130:585-586.
15. Siroosbakht S, Rezakhaniha B. A comprehensive comparison of the early and late complications of surgical circumcision in neonates and children: A cohort study. *Health Sci. Rep*. 2022;5:e939.

16. Yosha A. Pre-circumcision Assessment and Exam. Surgical Guide to Circumcision: Springer; c2012. p. 71-75.
17. Halaseh SA, Halaseh S, Ashour M. Hypospadias: A Comprehensive Review Including Its Embryology, Etiology and Surgical Techniques. Cureus. 2022;14:e27544.
18. Altaş C, Küçükosman G, Yurtlu BS, Okyay RD, Aydın BG, Pişkin Ö, *et al.* Anesthesia methods used by anesthetic specialists for circumcision cases. National survey study for Turkey. Saudi Med J. 2017;38:75-81.
19. Bilgen S, Koner O, Menda F, Karacay S, Kaspar EC, Sozubir S, *et al.* A comparison of two different doses of bupivacaine in caudal anesthesia for neonatal circumcision. A randomized clinical trial. Middle East J Anaesthesiol. 2013;22:93-98.

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