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Thermo-Cautery versus Suturing Technique in Circumcision

MO'MEN I. ALMINYAWI, M.D.; MAHER F. BADR, M.D. and MOHAMED A. DORBOK, M.D.

The Department of General Surgery, Damanhour Teaching Hospital, Damanhour, El Beheira

Abstract

Background: Circumcision is among the oldest and most common surgical procedures, usually performed for religious and traditional reasons. While many methods of circumcision are defined in the literature, there is no consensus on one ideal method.

Aim of Study: To compare thermo-cautery versus suturing techniques for infant circumcision under local anesthesia regarding operative time, intraoperative bleeding and complications.

Patients and Methods: The study was carried out in General Surgery Department at Damanhour Teaching Hospital in the period between February 2024 and June 2025. It included 120 infants aged under 6 months. Infants were randomly divided into two equal groups (60 infants each); Group A underwent circumcision by thermo-cautery and Group B underwent circumcision by the conventional method (scalpel cutting and suturing for hemostasis).

Results: The mean duration of surgery was significantly shorter in Group A. Intraoperative blood loss was nil in Group A compared to a measurable 2.24mL average loss in Group B. The analgesic requirements during the first two postoperative days were significantly higher in Group A. The overall complication rates were comparable between both groups.

Conclusion: Using thermo-cautery for cutting foreskin in infant circumcision is feasible, reliable and effective. It is superior to the conventional method of foreskin cutting by scalpel. It is associated with an accepted slightly higher incidence of penile edema and requires more doses of postoperative analgesia.

Key Words: *Circumcision – Thermo-cautery – Suturing technique.*

Correspondence to: Dr. Mohamed A. Dorbok,
E-Mail: mead12091987@gmail.com

Introduction

CIRCUMCISION is defined as surgical excision of the prepuce. In ancient Egypt, circumcision was performed to improve hygiene. Later, routine male infant circumcision was done due to religious causes in the Jewish and Muslim faiths that continue to this day. In Muslim societies, all boys are candidates for circumcision **[1]**.

Uncircumcised individuals have a higher risk of balanitis than circumcised ones **[2]**.

Boys who remain uncircumcised are at a greater risk for developing urinary tract infection **[3]**. Circumcision may also reduce the risk of contracting sexually transmitted diseases **[4]**.

Male circumcision does not seem to negatively affect penile sexual sensitivity or sexual satisfaction **[5]**.

However, occasionally, complications like bleeding or infection may occur with circumcision. The reported occurrence of post-circumcision bleeding varies widely, ranging from 0.1% to 35%, with up to 6% of those requiring a secondary surgical intervention. Several methods are employed to mitigate bleeding risk including compression dressing, epinephrine-soaked gauze, silver nitrate, suturing, and electrosurgery **[1]**.

In newborns, the common circumcision techniques are as follows: Bone-cutting forceps (Guillotine technique), Mogen clamp technique, Gomco clamp technique, Plastibell technique and dorsal slit technique. The excess foreskin is conventionally cut with a scalpel. The use of diathermy on the penis remains controversial, primarily due to concerns regarding the potential risk of injury from the electric current and generated heat **[6]**.

Every surgeon targets optimal wound healing with minimal sequelae and superior cosmetic results. The aim of all the various methods of circumcision is a fast, safe and effective surgery. Recently, thermo-cautery has been introduced into circumcision procedures to meet these objectives, and its use is becoming increasingly prevalent [7].

Aim of the study:

To compare thermo-cautery versus suturing techniques for infant circumcision under local anesthesia regarding operative time, intraoperative bleeding, complications and outcome.

Patients and Methods

This was a prospective study on 120 consecutive infants aged under 6 months who were candidates for elective circumcision under local anesthesia between February 2024 and June 2025 at Damanhour Teaching Hospital, Damanhour, El Beheira, Egypt.

An informed consent was taken from the parent of each infant according to the ethical committee of the hospital.

Inclusion criteria:

Male infants aged under 6 months whose families requested circumcision.

Exclusion criteria:

- Bleeding disorders.
- Congenital urethral anomalies.
- Undescended testis.
- Congenital inguinal hernia.
- Skin infection at injection site of local anesthesia.
- Excess suprapubic fat.

Preoperatively, all infants were subjected to a thorough clinical examination and routine laboratory investigations (complete blood picture and coagulation profile).

Infants were randomly divided into two equal groups (60 infants in each group):

- In Group A, circumcion was done using bone-cutting forceps, with the foreskin cut by thermo-cautery.
- In Group B, circumcion was done using bone-cutting forceps, cutting the foreskin with a scalpel and achieving hemostasis with suturing technique.

Surgical technique:

- Skin preparation with Povidone-Iodine solution.
- Disposable sterile draping.
- Local anesthesia: A dorsal penile nerve block using 2% Lidocaine HCl was administered 5 minutes prior to circumcision, with a maximum dose of 3mg/kg. The anesthetic was injected in a sufficient amount into the spaces deep to the fascia on both sides of the suspensory ligament. A small amount of local anesthetic was first injected at the dorsum of the base of the penis. The needle was then withdrawn and redirected to a point approximately 5 mm laterally and deeper to the symphysis pubis. To ensure safety, aspiration was performed before local anesthetic infiltration. The contralateral side was injected using the same technique. Since the dorsal nerve block typically does not achieve the required anesthesia for the ventral aspect, additional anesthetic injection was required at the base of the ventral penis.
- Retraction of the foreskin from the glans with cleaning of any smegma and debris.
- Marking of skin at the level of coronal sulcus.
- To determine the length of foreskin to be cut, pressure was applied from penile base to pubic bone.
- The foreskin was lifted with two mosquito forceps at 6 and 12 o'clock positions.
- Squeezing to the level of skin mark with the lower edge of bone-cutting forceps at an angle of 15-20 degrees.
- In Group A, thermo-cuatery was used for cutting excess foreskin and hemostasis.
- In Group B, a scalpel was used for cutting excess foreskin. Hemostasis was done by ligating the bleeding vessels with 5-0 absorbable sutures (chromic catgut). Skin was approximated to mucosa with interrupted sutures using the same suture material.
- In all cases no dressing was applied.
- Postoperative analgesia (paracetamol 15mg/kg) was given orally on demand (infant continuous crying or refusing feeds) with a maximum of 4 doses per day. Parents were asked to record the number of daily doses needed in the first five postoperative days.
- After the procedure, parents were instructed to apply topical gentamicin sulfate cream twice daily for 5 days.
- Oral antibiotics were not given as a routine. A warm bath was given daily, with no antiseptics used.

Parents were asked to follow-up on the next day then after one week, one and three months postoperatively to detect complications and evaluate the outcome.

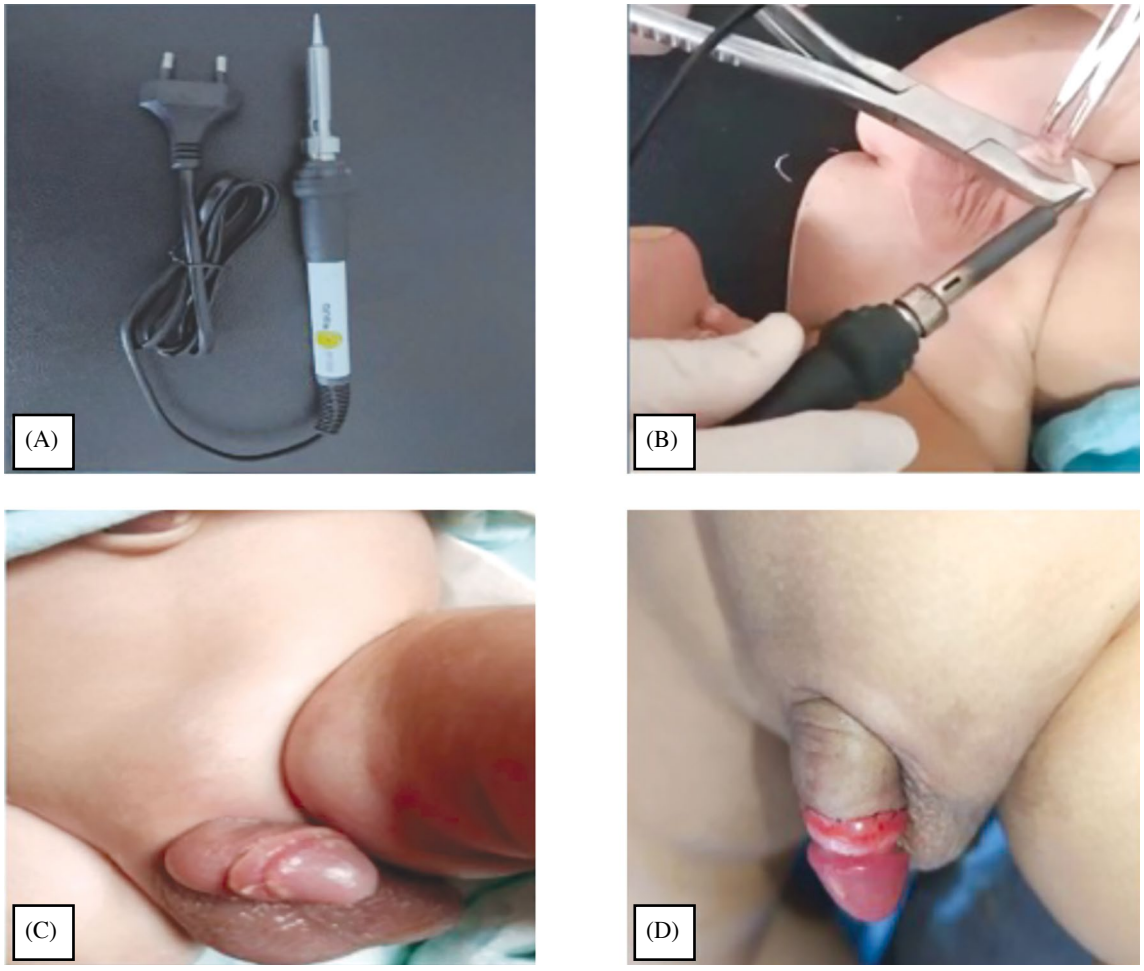

Fig. (1): (A) The thermo-cautery device. (B) Circumcision by thermo-cautery. (C) A case of penile edema after thermo-cautery circumcision. (D) A case of conventional circumcision with suturing.

Measurements:

The following parameters were recorded:

- Demographic data; age (months) and weight (kg).
- Duration of surgery from start of surgical intervention till end of procedure.
- Incidence of intraoperative complications e.g. bleeding or glans injury.
- Incidence of postoperative complications e.g. bleeding requiring surgical intervention, penile edema, surgical site infection, glans injury, phimosis or meatal stenosis.
- Postoperative pain assessment: Parents were asked to record the number of analgesic doses given each day for the first 5 postoperative days.

The primary outcome variable was the number of doses of postoperative analgesic.

The primary endpoint was 3 months postoperatively.

Ethical approval:

This research was approved by General Organization for Teaching Hospitals and Institutes, Cairo, Egypt. (IRB approval number: HD000191, approval date: February 14, 2024).

Sample size calculation and randomization:

After reviewing the literature, we used a two tailed independent t-test to detect difference of 1 (i.e. $\delta = 1$) in the number of postoperative paracetamol doses as the primary outcome variable with standard deviation of 1.5 (i.e. $\sigma = 1.5$), difference level of 5% (i.e. $\alpha = 0.05$), a power of 95% (i.e.1-$\beta = 0.95$) and an effect size of 0.6 (i.e. $d = 0.6$). At least 50 infants were required per group. For better reliability of our findings, a total of 120 patients were enrolled (60 per group). The G*Power program, version 3.1.9.6, 2020, institute fur Experimentelle Psychologie, Heinrich-Heine-Universal, Dusseldorf, Germany, was used to calculate the required sample size.

By using the online application (https://www.randomizer.org), the infants were randomly assigned into two equal groups (60 each).

Statistical analysis:

The statistical analysis utilized IBM SPSS software (version 20.0, released 2011). Categorical data were summarized using numbers and percentages. Comparisons between the two groups were primarily made using the Chi-square test. The Fisher Exact test was substituted when over 20% of cells had an expected count less than 5. Continuous data were described by mean ± standard deviation. The Kolmogorov-Smirnov test assessed for normality. Group comparisons for normally distributed variables used the Student *t*-test, while the Mann Whitney test was applied to non-normally distributed variables. Results were considered statistically significant at a *p*-value <0.05, with a *p*-value <0.001 denoting high statistical significance.

Results

Statistically, both groups did not differ significantly in age or body weight.

A highly statistically significant difference was found in the surgical duration, with Group A having a mean of 7.8 minutes and Group B a mean of 15.5 minutes (Table 1).

Regarding intraoperative blood loss, it was not observed in all cases of Group A, while in Group B, the mean estimated blood loss was 2.42mL measured by weighing the gauze pieces. That was highly statistically significant (Table 1).

Intraoperative complications as considerable bleeding or glans injury were not recorded in either group.

Three infants, one of them in Group A (1.7%) and two in Group B (3.3%), experienced early postoperative bleeding within the first 24 hours after surgery. They were managed by hemostatic sutures. Blood transfusion was never needed. No statistically significant difference in postoperative bleeding was observed between the groups.

During the first follow-up visit (in the first postoperative day), penile edema was noticed in 12 infants; eight in Group A (13.3%), and only four in Group B (6.7%). All cases showed good response to medical treatment, and the difference was not statistically significant.

Wound infection occurred in six infants overall: Two in Group A (3.3%) and four in Group B (6.7%). All cases were successfully treated with systemic and local antibiotics, and the difference between groups was not statistically significant.

During the 3 months follow up period, there were two cases of secondary phimosis in Group A (3.3%) and one in Group B (1.7%). They were managed by surgical repair with no statistically significant difference. Meatal stenosis was not recorded in any case of either group.

As an indicator for postoperative pain, Analgesic requirements in the first two postoperative days were significantly higher in Group A. However, no statistically significant difference was noted between the two groups over the subsequent three days (Table 2).

Table (1): Demographic data, duration of surgery, intraoperative and postoperative complications.

	Group A (n=60)	Group B (n=60)	Test of Significance	*p*
Age (months)	3±2.1	2.9±1.96	*t*=0.270	0.788
Weight (grams)	5850±1220	5750±1140.8	*t*=0.464	0.644
Duration of surgery (minutes)	7.8±1.77	15.5±2.44	*t*=19.786*	<0.001*
Intraoperative blood loss (mL)	0	2.42±2.07	U=450.0*	<0.001*
Significant intraoperative bleeding	0 (0.0%)	0 (0.0%)	–	–
Glans injury	0 (0.0%)	0 (0.0%)	–	–
Postoperative bleeding	1 (1.7%)	2 (3.3%)	$\chi2$=0.342	^{FE}p=1.000
Penile edema	8 (13.3%)	4 (6.7%)	$\chi2$=1.481	^{FE}p=0.224
Wound infection	2 (3.3%)	4 (6.7%)	$\chi2$=0.702	^{FE}p=0.679
Meatal stenosis	0 (0.0%)	0 (0.0%)	–	–
Secondary phimosis	2 (3.3%)	1 (1.7%)	$\chi2$= 0.342	^{FE}p=1.000

t: Student *t*-test. U: Mann Whitney test. $\chi2$: Chi square test. FE: Fisher Exact.
p: *p*-value for comparing between the two groups. *: Statistically at $p \leq 0.05$.

Table (2): Analgesic doses in the first five postoperative days.

	Group A (n=60)	Group B (n=60)	$\chi 2$	MCp
First day:				
Nil	0 (0.0%)	0 (0.0%)	10.985*	0.007*
1 dose	22 (36.7%)	40 (66.7%)		
2 doses	30 (50.0%)	15 (25.0%)		
3 doses	5 (8.3%)	3 (5.0%)		
Extra dose	3 (5.0%)	2 (3.3%)		
Total (0/1/2/3/4)	0/22/30/5/2	0/40/15/3/2		
Second day:				
Nil	3 (5.0%)	10 (16.7%)	12.826*	0.008*
1 dose	24 (40.0%)	35 (58.3%)		
2 doses	28 (46.7%)	12 (20.0%)		
3 doses	3 (5.0%)	2 (3.3%)		
Extra dose	2 (3.3%)	1 (1.7%)		
Total (0/1/2/3/4)	3/24/28/3/2	10/35/12/2/1		
Third day:				
Nil	20 (33.3%)	25 (41.6%)	3.201	0.561
1 dose	23 (38.3%)	22 (36.7%)		
2 doses	14 (23.3%)	13 (21.6%)		
3 doses	2 (3.3%)	0 (0.0%)		
Extra dose	1 (1.7%)	0 (0.0%)		
Total (0/1/2/3/4)	20/23/14/2/1	25/22/13/0/0		
Fourth day:				
Nil	35 (58.3%)	39 (65.0%)	3.085	0.365
1 dose	18 (30.0%)	19 (31.6%)		
2 doses	6 (10.0%)	2 (3. 3%)		
3 doses	1 (1.7%)	0 (0.0%)		
Extra dose	0 (0.0%)	0 (0.0%)		
Total (0/1/2/3/4)	35/18/6/1/0	39/19/2/0/0		
Fifth day:				
Nil	46 (76.7%)	48 (80.0%)	2.715	0.366
1 dose	11 (18.3%)	12 (20.0%)		
2 doses	3 (5.0%)	0 (0.0%)		
3 doses	0 (0.0%)	0 (0.0%)		
Extra dose	0 (0.0%)	0 (0.0%)		
Total (0/1/2/3/4)	46/11/3/0/0	48/12/0/0/0		

$\chi 2$: Chi square test. MC: Monte Carlo.

p: *p*-value for comparing between the two groups.

*: Statistically at $p \leq 0.05$.

Discussion

Circumcision is an extremely old surgery, dating back to ancient times. It is a widely practiced procedure, often performed due to religious and traditional considerations **[8]**.

Many scientific articles have affirmed that early infant male circumcision offers a variety of long-standing health benefits. Evidence indicates that male circumcision protects against numerous conditions, such as urinary tract infections, phimosis, inflammatory skin conditions, various sexually transmitted diseases, genital ulcers, and cancers of the penis, prostate, and cervix. Since adverse effects are rare, these findings demonstrate a favorable benefit-to-risk profile for the procedure **[2]**.

The worldwide prevalence of circumcision is about 38% while in Egypt it is as high as 94.7%. Due to this high prevalence, continuous investigation and search for a fast, safe and reliable method that does not have serious complications have no end **[9]**.

While many studies have investigated different circumcision techniques and their complications, the medical community has not yet reached a consensus regarding the safest method **[7]**.

Among the various circumcision methods, one of the most frequently used is the Guillotine method, using bone cutting forceps. The excess foreskin is conventionally cut with a scalpel [7].

As it causes less bleeding and allows the circumcision to be performed quickly, the thermo-cautery device has started to be used widely [10].

This study aimed to compare the outcomes between the thermo-cautery and suturing techniques in male infant circumcision.

In our study, the operative time was significantly shorter in the thermo-cautery group than in the suturing group, with a mean value of 7.8 minutes versus 15.5 minutes.

This is consistent with the results of Uysal who reported that the mean operative time was 7.4 minutes when thermo-cautery was used [11].

In another study by Demir et al., the mean operative time of thermo-cautery circumcision was 5.8 minutes [7].

Our colleagues, Abdalgaleil and Shaat, found that thermo-cautery circumcision needed about 5.6 minutes on average [9].

We believe that the short duration of surgery is one of the major advantages of this technique.

Regarding the estimated intraoperative blood loss, it was negligible in the thermo-cautery group while it ranged from 1 to 7mL in the conventional circumcision group, with an average of 2.42mL.

Thermo-cautery devices convert electrical energy into heat that simultaneously cuts and cauterizes tissue. This greatly minimizes, or even prevents, bleeding from the cut edges [7].

Unlike monopolar diathermy which transmits electrical energy into tissues that may result in penile damage, thermo-cautery device does not transmit electrical energy. Only heat is transmitted that, if sufficient, can cut and cauterize tissues [9].

Although there are numerous complications related to circumcision, major adverse outcomes such as urethral injury or loss of glans tissue (amputation or necrosis) are rarely observed [7].

Postoperative bleeding is one of the major concerns after circumcision [12].

In our study, the incidence of postoperative bleeding was lower in thermo-cautery group than in suturing group (1.7% versus 3.3%) with no statistically significant difference.

This result is consistent with that obtained by Abdalgaleil and Shaat [9].

In their study of complications of different circumcision techniques, Tuncer and Erten performed 1011 cases using the thermo-cautery method. Only 11 of them (1.08%) had postoperative bleeding [13].

Interestingly, Abdelhalim reported 0% incidence of postoperative bleeding after thermo-cautery circumcision of 331 boys [14].

In our study, the most frequent complication related to thermo-cautery technique was penile edema. It occurred in 12 infants out of 60 (13.3%). It can be explained as an inflammatory response to thermal trauma to penile skin. In all cases, edema improved with medical treatment and resolved within few days.

Abdalgaleil and Shaat reported a higher incidence of penile edema following thermo-cautery circumcision (20%) [9].

In his study on 331 boys aged less than 10 years with a mean age of 21.8 months, Abdelhalim found that penile edema occurred in only 8 cases (2.4%) [14].

This may indicate that the incidence of penile edema after circumcision using thermo-cautery device is more in younger ages.

Regarding the incidence of wound infection, we found that it was insignificantly lower in the thermo-cautery group (3.3% versus 6.7%). All cases of wound infection were successfully managed with antibiotic treatment.

This result comes in agreement with that obtained by Abdelhalim who reported a 2.7% incidence of wound infection following thermo-cautery circumcision [14].

A slightly higher incidence (5%) was reported by Abdalgaleil and Shaat [9] and a much lower one was reported by Cakiroglu et al. (only 0.03%) [15].

No cases of post-circumcision meatal stenosis were recorded in our study.

Abdalgaleil and Shaat reported an incidence of 1.7% of meatal stenosis after either thermo-cautery or scalpel was used for cutting the foreskin [9].

Cakiroglu et al., in their larger population study, reported that meatal stenosis was recordrd in only 0.02% of the cases [15].

The most serious complication in our study was secondary phimosis. It was considered the most serious as it required surgical correction under general anesthesia.

Secondary phimosis results from incomplete excision of the inner mucosal layer of the prepuce.

The term trapped penis is also used to determine secondary phimosis from progressive closure and stricture of the skin over the glans penis **[16]**.

In our study, this occurred in 2 cases of the thermo-cautery group (3.3%) and in one of the conventional circumcision group (1.7%) with no statistically significant difference.

In the study of Abdalgaleil and Shaat, one case of secondary phimosis was recorded in the thermo-cautery group (1.7%) **[9]**.

In contrary, Saracoglu et al., reported an incidence of 1.8% of secondary phimosis in the conventional circumcision group and nil in the thermo-cautery group **[17]**.

As regard postoperative pain reflected by analgesic consumption, we found that the required number of analgesic doses in the first two postoperative days was significantly higher in thermo-cautery group than in conventional circumcision group.

This is similar to result reported by El-Asmar et al., who stated that postoperative pain and accordingly analgesic requirement is significantly higher in the first two postoperative days following thermo-cautery circumcision with no significant difference thereafter **[18]**.

Conclusion:

Using thermo-cautery for cutting foreskin in infant circumcision is feasible, reliable and effective. It is superior to the conventional method of foreskin cutting by scalpel regarding reduction of the surgery duration and prevention of intraoperative blood loss. It is associated with an accepted slightly higher incidence of penile edema and requires more doses of postoperative analgesia.

However, we recommend conducting further larger population studies with longer follow-up periods to get a more accurate evaluation.

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Conflicts of interest:

No conflicts of interest.

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مقارنة استخدام جهاز الكى الحرارى و الغرز الجراحية فى عملية الختان

الختان للذكور عادة قديمة عند المسلمين وتعتبر عملية الختان للذكور من العمليات الشائعة ولا توجد طريقة جراحية معينة متفق عليها وتسعى كل الطرق لتقليل النزيف أثناء وبعد عملية الختان وتقليل الألم والتورم بعد الجراحة ومنع إصابة العضو الذكرى.

الهدف من هذه الدراسة: هو دراسة نتائج استخدام جهاز الكى الحرارى والغرز الجراحية فى عملية الختان فى الأطفال الرضع تحت تأثير المخدر الموضعى لبحث أيهما سوف يكون أفضل من ناحية مدة العملية ومنع النزيف وتقليل المضاعفات أثناء وبعد الختان.

المرضى وطرق البحث: تم إجراء هذه الدراسة بقسم الجراحة العامة فى مستشفى دمنهور التعليمى على ١٢٠ طفل تحت سن ٦ شهور وتم تقسيمهم بالتساوى عشوائياً إلى مجموعتين وفقاً للتقنية الجراحية المستخدمة فى عملية الختان. فى المجموعة الأولى تم استخدام جهاز الكى الحرارى فى عملية الختان وفى المجموعة الثانية تم استخدام المشرط والغرز الجراحية وتم تقييم الوقت المستغرق فى الجراحة والنزيف أثناء وبعد الجراحة والألم والتورم بعد الجراحة.

الخلاصة: استخدام جهاز الكى الحرارى فى عملية الختان هو خيار آمن وفعال حيث يقلل بشكل كبير من مدة العملية، ويمنع النزيف أثناء الجراحة، ولكنه يتطلب اعطاء جرعات أكبر من المسكنات خلال أول يومين بعد الجراحة.