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Research Article

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Circumcision by CO_2 laser 10600nm

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Abstract

Background: Male Circumcision is one of the most common surgical procedures performed in children. The indications for circumcision differ from country to country and might include both medical and religious ones. Several different surgical procedures for circumcision have been documented, with various results and complications.
Aim of study: to evaluate the safety, effectiveness of the use of CO_2 laser in circumcision and asses any possible post-operative complication(s).
Patients, Materials & Methods: A prospective study was done for 26 patients who were circumcised by using a CO_2 laser at 10600 nm from PLATIN, using continuous wave (CW) power that is set at 6 W with different exposure times during the period from June to August 2022. The patients had been operated under local anesthesia. In all cases, the parents had requested circumcision for religious reasons. The patients were followed up for 14 days, and reported having one or more complications postoperatively (if any).
Results: The patients were grouped into three age groups based on their age: the first group was 6–12 months old, the second group was 13–24 months old, and the final group was 25–36 months old, with a mean age of 14.7 ± 8.7 months. All patients had a single-session operation. Twenty patients (76.92%) had moderate pain, four patients (15.38%) had mild pain, and two patients (7.7%) had severe pain. Twenty patients (76.92%) had no bleeding; six patients (23.07%) had bleeding and were treated conservatively. Twenty-four patients (92.3%) had no infection, and only two patients (7.7%) developed a simple surgical site wound infection. Regarding the edema, four patients (15.4%) suffers of null degree: 12 patients (46.2%) of 1st degree: 8 patients (30.8%) of 2nd degree; and 2 patients (7.6%) of 3rd degree after four hours; while 17 patients (65.4%) suffers of null degree; 5 patients (19.2%) of 1st degree; 3 patients (11.5%) of 2nd degree; and 1 patient (3.9%) of 3rd degree after 7 days. 18 patients (69.2%) were completely satisfied. The operative time is less than that of conventional methods. All the patients were discharged after half an hour.
Conclusion: A CO_2 laser circumcision is a safe and effective procedure, and the device is very beneficial due to precise results with decreased pain, infection, bleeding, and edema following surgery.

Keywords: circumcision, CO_2 laser, 10600nm, gas laser, CO_2 laser circumcision.

1. Introduction

One of the most frequent surgical procedures done on children is male circumcision. The indications for circumcision differ from country to country and might include both medical and religious ones. [1–3].

Several different surgical procedures for circumcision have been documented, with various results and complications. [2, 3].

Indications of circumcision:

1- Religious reasons.
2- Cultural.
3- Public health reasons.
4- Medical reasons like phomosis, infection, paraphimosis, balanitis, posthitis, and localized condylomata acuminate [2-6].

This operation can reduce penile cancer rates, enhance penile topical cleanliness, lower the risk of HIV transmission [2, 5], and help reduce cervical cancer rates in female partners [6, 7]. Furthermore, it can improve sexual enjoyment and function for most men with foreskin problems, perhaps reducing coital injuries [8].

Other benefits of circumcision are:

- Reduce the risk of urinary tract infections in circumcised men.
- Reduces the risk of balanoposthitis, an inflammation of the glans and foreskin. [3-6].

Techniques of circumcision

1. The guillotine technique [9].
2. Shield and clamp [10].
3. Excision [11, 10, 12].
4. Electrocautery and Nd:YAG [12, 13, 14].

Complications of circumcision

1- Bleeding [11, 10].
2- Concealed penis [14].
3- Phimosis [14].
4- Skin Bridge [14].
5- Infection [14].
6- Urinary retention [15, 14].
7- Fistulas [14].
8- Necrosis [14].
9- Iatrogenic hypospadias and epispadias [14].

Study objectives: to evaluate the safety, effectiveness and precision of the use of CO_2 laser in circumcision and asses any possible post-operative complication(s)..

2. Patients and Methods

2.1 Patients

This is a prospective study. Twenty-six boys had been enrolled for circumcision in the private clinic in the Salahdin government / Baiji district between June 2022 and August 2022. The age of patients was from six months to 36 months, with the mean age 14.7 ± 8.7 months. They were divided into three groups: the first group, 16 patients aged 6–12 months, the second group, six patients aged 13–24 months, and the last group, four patients aged 25–36 months, as shown in Table 1. All the parents had requested circumcision for religious reasons, following a thorough description of the procedure and a discussion of its potential benefits and complications.

All patients had undergone circumcision under local anesthesia; they were circumcised using a CO_2 laser (PLATIN) using continuous wave (CW) power that is set at 6 W with different exposure times between 2 and 3 minutes.

All the cases were followed up for 14 days after the operations for any possible complication(s) if any.

Pre-operative preparation: Each parent was invited for the procedure after full explanation and discussion regarding the nature of the procedure, the possible advantages and disadvantages and complications

expected. At the conclusion of the discussion, each parents was asked to sign an (Informed consent) indicating their parent agreement.
A case sheet was prepared for the purpose of reviewing each patient's healthcare details and records. Name, Age, any prior surgeries (if any), past medical history of child and family and history of photosensitivity are all considered as part of the patient's history. Operative time were recorded, fix a date of the follow up. All patients were examined one day before the operation, also lab investigations were done, including blood tests for hemoglobin level and viral screening (hepatitis B&C and HIV).
We administered prophylactic antibiotics (amoxicillin"250mg"/ clavulanate "125 mg") 60 minutes before the procedure.

Table 1: the number of patients according to their age

Groups	Age (month)	Number of patients
First	6-12	16
Second	13-24	6
Third	25-36	4
Total	-	26

D: seven days after a treatment.

Case Sheet
Patient name:
Age:
Address:
Record number:
Date of admission:
Surgeon's name:
Assistant's name:
Diagnosis:
Type of surgical procedure:
Surgeon signature:
Past medical history:
Past surgical history:
Systemic review:
History of photosensitivity:
Consent of parents and signature:
Next visit: Next visit:
Next visit: Next visit:

2.1.1 Inclusion criteria:

This study includes all patients who have their parents asked that's their children to have been circumcised.

2.1.2 Exclusion criteria:

Any child who had severe congenital heart disease, any congenital anomaly of genitalia (None was excluded).

2.2 The Material:

The medical laser system and accessories:

2.2.1. Laser system Specification:

The laser system used in this study was a class IV Medical laser system, 10600nm CO_2 laser, which emits laser at a wavelength in the far infrared spectrum. The surgeon configured the laser aperture power output to vary between 0.5 and 70 Watts (max.). The brand "PLATIN" high power medical CO_2 laser system with gas type as working material (figure 2-1). The CO_2 laser for this unit is powered as a continuous or pulsed wave mode and the wavelength is 10600 nm. The laser beam can be coupled efficiently into the articulated arm. The aiming beam is a visible diode 635-660nm (red beam) with a power of < 5mW (class I B diode laser) at laser aperture. Table2 shows Technical Specifications of PLATIN CO_2 laser machine.Figure 1 shows PLATIN CO_2 device.

Table 2: Technical Specifications of PLATIN CO2 laser device

Technical Specifications	
Laser Type	CO_2
Model	F12
Wavelength	10600 nm
Maximum Power	70W
Operation Mode	CW and Pulse
Transmission System	Seven articulated arms
Pilot Beam	Red Diode Laser of 635nm, Power < 5 mW
Control Mode	True Color Touch Screen
Voltage/Current Rating	220 VAC, 50/60 Hz
Weight	58 Kg
Power	6 W
Exposure time	(2 – 3) minute

Figure 1: PLATIN CO_2 device.

2.2.2 Equipment

The following items are arranged on a tray with drapes as shown in Figure 2-2. Surgical mosquito, gauze, gloves, syringes (insulin syringe), Winkelman circumcision clamp, lidocaine injection 2 %, EMLA ointment, povidone iodine solution 10 %.

Figure 2: Equipment.

Figure 3 shows the protective goggles used by surgeon and staff

Figure 3: protective goggles used by surgeon and staff.

Figure 4 shows the protective goggles used by patients

Figure 4: protective goggles use by patients.

2.3 Procedure:

EMLA was applied for 30 minutes, and then cleaned. An antiseptic 10% povidone iodine solution applied. For local anesthesia, lidocaine 2% was used (administered at a dose of 0.1 mg/kg and infiltrated subcutaneously as a dorsal penile nerve block), the adhesions on the coronal sulcus were separated, the preputial skin was pulled up, and a straight hemostat or mosquito forceps was applied loosely to the preputium. The power was set at 6 W of continuous wave mode C/W, and the exposure time was 2–3 minutes. A surgical handpiece of CO_2 (10600 nm) was used. Photographs were taken of each patient with a digital camera before and immediately after completing the procedure. Postoperative complication(s): Wound swelling, bleeding, surgical site infection, and pain were evaluated four hours, 24 hours, and seven days following surgery. Surgical dressings had been removed 24 hours following the circumcision, either by relatives at home or by doctors in the hospital.

2.4 Post-operative treatments:

Following the circumcision, an antibiotic ointment was applied three times a day to the wounds, and the five days of therapy that included amoxicillin "250 mg" and clavulanate "125 mg" three times a day, as well as Ibuprofen 8 mg/kg to be used only if needed twice or three times a day.

3. Results and discussion

This is a prospective study. Twenty-six boys had been enrolled for circumcision using a CO_2 laser (PLATIN) using continuous wave (CW) power that is set at 6 W for all cases; the operative time was 11±3 minutes. Depending on laser exposure time as shown in Table 3, the operative time for the first group was 120 sec, for the second group was 180 sec, and for the third group was 240 sec. Table 3 shows the laser power and exposure according to the patients' age group.

Table 3: Power and laser exposure time according to the patients' age group.

Groups	Power (watt)	Laser exposure time(sec.)
First	6	120
Second	6	180
Third	6	240

The patients were surveyed for pain, bleeding, surgical site infection, edema, and satisfaction (parents). Regarding the pain it is divided into mild, moderate and sever, as the parents describes the pain of their children and compared with Faces pain rating scales in which there is 6 faces emoji (first 2 represents the mild pain, the second 2 represents the moderate pain, and the last 2 represents the severe pain). In this study after one hour four patients that represent (15.38%) had mild pain, twenty patients that represent (76.92%) had moderate pain, and two patients that represent (7.7%) had severe pain. As shown in Table 4.

Table 4: Degree of pain post-operatively.

Degree of pain	Number of patients	Percent %
Mild	4	15.38
Moderate	20	76.92
Severe	2	7.7
Total	26	100

Yet, Pain scores after 4 hours, 24 hours, and 7 days were much lower than this, as Table 5 shows.
14 cases (53.8%) suffered from pain at 4 hours, 10 cases (38.5%) developed pain after 24 hours, and two cases (7.7%) developed pain after 7 days.

Table 5: Details of pain at 4, 24 hours, and at 7 days.

Period after surgery	Number of cases	Percent %
At 4 hours	14	53.8
At 24 hours	10	38.5
At 7 days	2	7.7

In this study, bleeding is divided into two degrees: first degree, minimal bleeding without further treatment. Second degree: bleeding that requires wound compression or wound dressing. The bleeding is surveyed after 4 hours and 7 hours.
In this study, twenty patients (76.92%) had no bleeding; six patients (23.07%) had bleeding of the first degree and were treated conservatively. First-degree bleeding occurred at the 4-hour follow-up; there was no bleeding (first degree) at the 7-hour follow-up, and no second-degree bleeding was recorded at all, as shown in Table 6.

Table 6: wound bleeding at 4 hours and 7 hours.

Degree of bleeding	At 4 hours	At 7 hours
No bleeding	20 (76.92%)	0 (0%)
First degree	6 (23.08 %)	0 (0%)
Second degree	0 (0%)	0 (0%)
Total	26 (100%)	0 (0%)

In this study of surgical site infection, Twenty-four patients (92.3%) had no infection, and only two patients (7.7%) developed a simple surgical site wound infection treated by prolonged post-operative treatment for another five days, as shown in Table 7.

Table 7: Surgical wound infection.

surgical site wound infection	Number of cases	Percent
Infected	2	7.7%
Non-infected	24	92.3%
Total	26	100%

Regarding edema and swelling, it is divided into four degrees as follows:

Null degree: no swelling
First degree: minimal swelling
Second degree: swelling less than half the circumference
Third degree: swelling of more than half the circumference

In this study, edema was followed up after 4 hours and after 7 days post-operatively.Table 8 shows the degree of swelling after 4 hours and 7 days after surgery. The percentage of swelling after 4 hours of null

degree, 1st degree, 2nd degree, and 3rd degree was 15.4%, 46.2%, 30.8%, and 7.6%, respectively; and after 7 days, it was 65.4%, 19.2%, 11.5%, and 3.9%, respectively. Regarding the satisfaction, 18 patients (69.2%) were completely satisfied, while those who were not so satisfied, 8 patients (30.8%), were so because of severe pain, infection, edema, and bleeding, as shown in Table 9. Figures 5, 6, and 7 show circumcision after operation, three days, and 10 days, respectively.

Table 8: wound swelling at 4 hours and 7 days after surgery.

Degree of swelling	After 4 hours No. of pat., percent %	After 7 days No. of pat., percent %
Null degree	4, (15.4%)	17, (65.4%)
1st degree	12, (46.2%)	5, (19.2%)
2nd degree	8, (30.8%)	3, (11.5%)
3rd degree	2, (7.6%)	1, (3.9%)
Total	26, (100.0%)	26, (100.0%)

Table 9: Patients' satisfaction.

satisfaction	pain	Infection	edema	Bleeding	No. of patient	percent
satisfied	/	/	/	/	18	69.2%
Not satisfied Number, percent	2, 7.7% (severe)	2, 7.7%	1, 3.9% (4th degree after 7 days)	3, 11.5% (half cases of bleeding)	8	30.8%
Total	2, 7.7%	2, 7.7%	1, 3.9%	3, 11.5%	26	100%

Figure 5: circumcision directly after the operation.

Figure 6: circumcision directly after three days.

Figure 7: circumcision directly after ten days.

From the result of this study, the CO_2 laser with power 6 W and exposure time ranged (2 – 3) minutes is more precise than other methods and may be due to that CO_2 laser act as a cutting and coagulation action. So, less bleeding had occurred (due to thermal effect). How et al. evaluated the cost of operating time for CO_2 lasers with the traditional approach. The average operating time for the traditional approach was 20 (range 16-21) minutes, whereas the CO_2 laser took 15 (range 13-17) minutes. In this study, the period of operation using the CO_2 laser was 12 minutes, which is consistent with the How et al. study [16]. One of the benefits of CO2 laser surgery is that it significantly reduces postoperative pain, which improves patient comfort. This study found that individuals treated with the CO2 laser experienced decreased postoperative pain. This result agrees with the study by Ronchi et al [17]. The CO2 laser has a coagulation function and was previously reported to reduce postoperative bleeding after circumcision [18]. In this study, six cases suffered from bleeding at 4 hours (23%). These results were in agreement with Gorgulu et al, which showed that the use of a CO_2 laser shortened the operating time and reduced complications related to bleeding, in comparison with the conventional guillotine method [18]. In this study, more cases of edema were found. In the Ronchi et al. study, edema was seen in 7.9% of the patients treated with lasers. The finding is most likely owing to significant thermal injury to the preputial tissues generated by the electrocautery employed for hemostasis in the conventional group. The CO_2 laser has negligible thermal transmission to adjacent

tissue, whereas electrosurgery produces far more mean depths of injury than does the CO_2 laser. As a result, edema in the laser group is lower than with other methods, such as electro-surgery [17].

4. Conclusions

1. The use of a CO_2 laser in circumcision is a very effective and safe device due to its precise results.
2. The CO_2 laser therapy was linked to decreased pain, infection, bleeding, and edema following surgery.
3. The operative time is less than that of conventional methods.

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الختان باستخدام الليزر ثنائي اوكسيد الكاربون 10600 نانومتر

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الخلاصة

الخلفية: ختان الذكور هو أحد أكثر الإجراءات الجراحية شيوعًا التي يتم إجراؤها للأطفال .تختلف دواعي الختان من بلد إلى آخر وقد تشمل دواعي طبية ودينية .تم اعتماد العديد من العمليات الجراحية المختلفة للختان، والتي تختلف بالنتائج ومضاعفات.
هدف الدراسة: تقييم سلامة وفعالية استخدام ليزر ثاني أكسيد الكربون في الختان وتقييم أي مضاعفات محتملة بعد الجراحة .
المرضى والمواد والطريقة: هذه دراسة مستقبلية على 26 مريضًا تم ختانهم باستخدام جهاز ليزر ثاني أكسيد الكربون ذو الطول الموجي 10600 نانومتر من شركة PLATIN ، باستخدام اعدادات طاقة موجة مستمرة (CW) التي تم ضبطها على قدرة 6 وات مع أوقات مختلفة للتعرض لليزر خلال الفترة من شهر حزيران إلى شهر آب من سنة 2022. خضع المرضى للعملية الجراحية تحت تأثير التخدير الموضعي .وفي كل الحالات كان الأهل قد طلبوا الختان لأسباب دينية. تمت متابعة المرضى لمدة 14 يومًا، و استعلامهم، وتسجيل الإبلاغ عن وجود مضاعفات واحدة أو أكثر بعد العملية الجراحية (إن وجدت).
النتائج: وفقًا لأعمار المرضى، تم تقسيمهم إلى ثلاث مجموعات: المجموعة الأولى كانت تتراوح أعمارها بين 6 و12 شهرًا، والمجموعة الثانية كانت تتراوح أعمارها بين 13 و24 شهرًا، والمجموعة الأخيرة كانت تتراوح أعمارها بين 25 و36 شهرًا، بمتوسط عمر 14.7 ± 8.7 شهرًا .خضع جميع المرضى لعملية جراحية في جلسة واحدة .عانى عشرون مريضًا (76.92٪) من ألم متوسط، وأربعة مرضى (15.38٪) من ألم بسيط، وعانى مريضان (7.7٪) من ألم شديد .لم يكن لدى عشرين مريضًا (76.93٪) أي نزيف؛ في حين كان لدى ستة مرضى (23.07٪) نزيف وقد تم علاجهم بشكل تحفظي .لم يكن لدى أربعة وعشرين مريضًا (92.3٪) أي عدوى في مكان العملية، وأصيب مريضان فقط (7.7٪) بعدوى جرح بسيطة في مكان العملية .فيما يتعلق بالوذمة، لم يعاني أربعة مرضى (15.4٪) من اي وذمة, عانى 12 مريضًا (46.2٪) من وذمة من الدرجة الأولى, 8 مرضى (30.8٪) من الدرجة الثانية؛ و مريضان (7.6%) من الدرجة الثالثة بعد أربع ساعات من العملية؛ بينما لم يعاني 17 مريضًا (65.4%) من اي وذمة؛ وعانى 5 مرضى (19.2%) من وذمة من الدرجة الأولى؛ و3 مرضى (11.5%) من الدرجة الثانية؛ ومريض واحد (3.9%) من الدرجة الثالثة بعد 7 أيام .وكان 18 مريضًا (69.2%) راضين تمامًا .
كان وقت العملية أقل من الطرق التقليدية .وخرج جميع المرضى الى المنزل بعد نصف ساعة من الأنتهاء من العملية.
الأستنتاجات: الختان بالليزر ثاني أوكسيد الكربون تعتبر عملية آمنة وفعالة وجهاز الليزر ثاني اوكسيد الكاربون مفيد جدًا بسبب النتائج الدقيقة مع انخفاض الألم والعدوى والنزيف والوذمة بعد الجراحة.