



Pilonidal Sinus Excision Using Carbon Dioxide Laser 10600 nm

Muhammad A. Albahadili⁽¹⁾ and Lutfi G. Awazli⁽²⁾

(1) Azyziah hospital, Wasit health directorate, Wasit, Iraq.

(2) Institute of laser for postgraduate studies, university of Baghdad, Baghdad, Iraq.

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Abstract: Background: The current standard for treating pilonidal sinus (PNS) is surgical intervention with excision of the sinus. Recurrence of PNS can be controlled with good hygiene and regular shaving of the natal cleft, laser treatment is a useful adjunct to prevent recurrence. Carbon dioxide (CO₂) laser is a gold standard of soft tissue surgical laser due to its wavelength (10600 nm) thin depth (0.03mm) and collateral thermal zone (150mic).It effectively seals blood vessels, lymphatic, and nerve endings, Moreover wound is rendered sterile by effect of laser. Aim of this study was to apply and assess the clinical usefulness of CO₂ 10600nm laser in pilonidal sinus excision and decrease chance of recurrence. Design: For 10 patients, between 18 and 39 year old (28.5 ± 6.02), PNS excision under local anesthesia, using CO₂ laser continuous mode, power 10 W, all cases closed primarily. Using laser system (KLS MARTIN 50plus, 10600nm). Results: no pain during operation but mild during first week, the operative field was dry, mild edema in 80% in 1st. Week, infection in one case, its excellent overall satisfaction throughout 2-4 weeks postoperative follow-up. Conclusion: The CO₂ laser offers the following benefits; almost bloodless surgery; reduced risk of infection; less scarring; precisely controlled surgery, often faster than conventional approaches and therefore achieving short hospital stays.

Introduction

Pilonidal (nest of hair) sinus (PNS) is believed to arise from frictional impact on hair shafts in the intergluteal folds or sacrococcygeal cleft (figure 1), (Kosaka, et al., 2007). It's acquired condition, usually seen in young adults, manifest by midline pits in the natal cleft and associated with hair (Kosaka, et al., 2007). The underlying pathophysiologic feature is enlarged hair follicles due to midline vacuum and pulling forces; when plugged with hair or keratin, the follicles rupture, leading to a foreign-body reaction within the presacral subcutaneous tissue and subsequent acute and chronic abscess (figure 1). (Aldean, et al., 2005 and Nivatvongs 2007) PNS was first described by Hodges in 1880 (Hodges 1880).

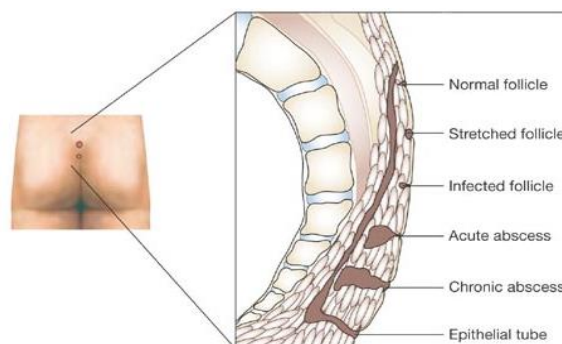


Fig. (1): Location of pilonidal sinus. (Nature Clinical Practice Gastroenterology &Hepatology (2009).

PNS occurs close to ten times more often in men than in women, (Oram et al., 2010, Aslam et al., 2009) this may be attributed to the presence of more hair in men than in women,

usually occurs after puberty. (Kareem 2006) it is more likely to occur in obese people and in those with thick, stiff body hair. Although the upper natal cleft is the most common site, may occur in other sites especially where there is irregularity of skin surface with pressure applied to that region. (Eryilmaz 2005, Aydin and Mengi 2010, Abdulwahab and Harste 2010, O'Neill, et al., 2009, Grant I and Mahaffey 2001, Palmer 1957 and Sunkara, et al., 2010). Symptoms vary from a small dimple to a large painful mass. Often the area will drain fluid that may be clear, cloudy or bloody. With infection, the area becomes red, tender, and the drainage (pus) will have a foul odor. The infection may also cause fever, malaise, or nausea. PNS rarely develops

malignant changes. If it happens, squamous cell carcinoma is the most common presentation it carries bad prognosis (Tirone, et al., 2009). For those patients who are truly asymptomatic, meticulous depilation and local hygiene are advised. It is not known what proportion of those who are asymptomatic go on to develop symptomatic disease, For the acute cellulitis that presents early, with pain that is tolerable and no evidence of abscess, broad spectrum antibiotics and depilation alone may be sufficient to resolve the immediate problem. Treatment of an acute exacerbation (abscess) If rest, baths, local antiseptic dressings and the administration of a broad-spectrum antibiotic fail to bring about resolution, the abscess should be drained through a small longitudinal incision made over the abscess and off the midline, with thorough curet- tage of granulation tissue and hair. This procedure may or may not be associated with complete resolution (Vahedian J et al., 2005). The current gold standard for treating pilonidal sinus (PNS) is surgical intervention with excision of sinus. Although surgical intervention is acutely effective, patients often experience secondary

complications and recurrence of pilonidal sinus (Stratigos, et al., 2003 and Shah et al. 2013). Recurrence of PNS can be controlled with good perineal hygiene and regular shaving of the natal cleft; however this can be difficult and awkward. Laser hair depilation is a useful adjunct to preventing recurrence. More than one kind of laser used for PNS treatment (Badawy and Kanawati 2009, Conroy, et al., 2008, Sadick and Yee-Levin 2006, Landa, et al., 2005, Benedetto and Lewis A 2005 and Lindholt, et al., 2008)

Carbon dioxide (CO₂) laser: The CO₂ laser is the Gold Standard of soft tissue surgical lasers due to its wavelength (10600nm). The extremely thin depth (0.03mm) at the CO₂ laser wavelength of 10,600 nm allows for unparalleled accuracy, while the extremely thin collateral thermal zone (150 microns) compare with electrocautery (figure 2), effectively seals blood vessels, lymphatic and nerve endings (Ryan, et al., 2010)

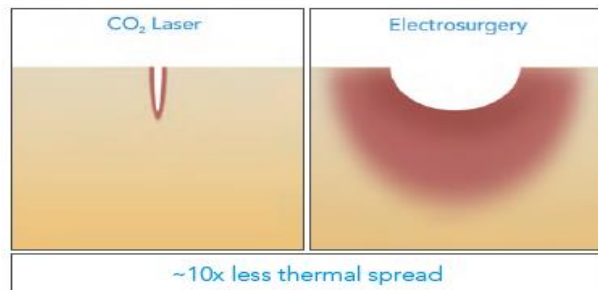


Fig. (2): Depth of laser effect (Ryan RW, et al., 2010)

The aim of this study was to apply and assess the clinical usefulness of the carbon dioxide 10600 nm laser in pilonidal sinus excision.

Patients, Materials & Methods

In this study the used laser system was KLS MARTIN, MCO 50plus (table 1).

Table (1): Laser system technical data

| Laser system | Manufacture | Wavelength | Laser Power at tissue level | Pilot light | laser | Laser beam delivery |
|--------------|-------------|--------------------|-----------------------------|-------------|-----------|---------------------|
| MCO 50 plus | KLS MARTIN | 10600nm (infrared) | 2-50 watt (W) | Diode 635nm | laser <5W | Articulated arm |

10 patients 18 to 39 years old with mean age of 28.5 years old (SD±6.02). All of them males with PNS recurrent after surgery selected for study. History of PNS after surgery was 6 months to 3 years. Patients were evaluated by clinical examinations and documented by digital photos. The details of the laser surgery procedures were explained to patients. Patients signed an informed consent for using laser in surgery, and patients were prepared for laser surgery and viral screen (HBsAg, HCV and HIV) was requested. The theatre prepared for laser surgery include highly reflective surfaces were removed from the field of operation, CO₂ laser system is set in a CW mode, Power of 10 W, power density was 7692 W/cm² for cutting and 4615 W/cm² for haemostasis and sterilization. Intraoperative precautions were undertaken; Surgeon, assistants and the patients' eyes and skin were protected, the same surgical technique was used in all patients, under local

anesthesia using injectable xylocaine 1%, in a maximum dose of 200mg, the dose depend on individual patient response and the size of the area.

Operation done as day case, the patient was put in prone position, Line was drawn for incision, PNS tract was marked with methylene blue injection, preparation of the site and cleaning with povidone iodine 10% was done and xylocaine 1% infiltration of the area was performed, The laser system was adjusted as recommended, the hand piece was hold in perpendicular position, non-contact, with tissue and started the incision following the marking line, retraction of the edges done by silk suture until the end of excision, the site of the operation was irradiated with CO₂ laser for haemostasis, asepsis. All cases closed primarily. (Figure 3)

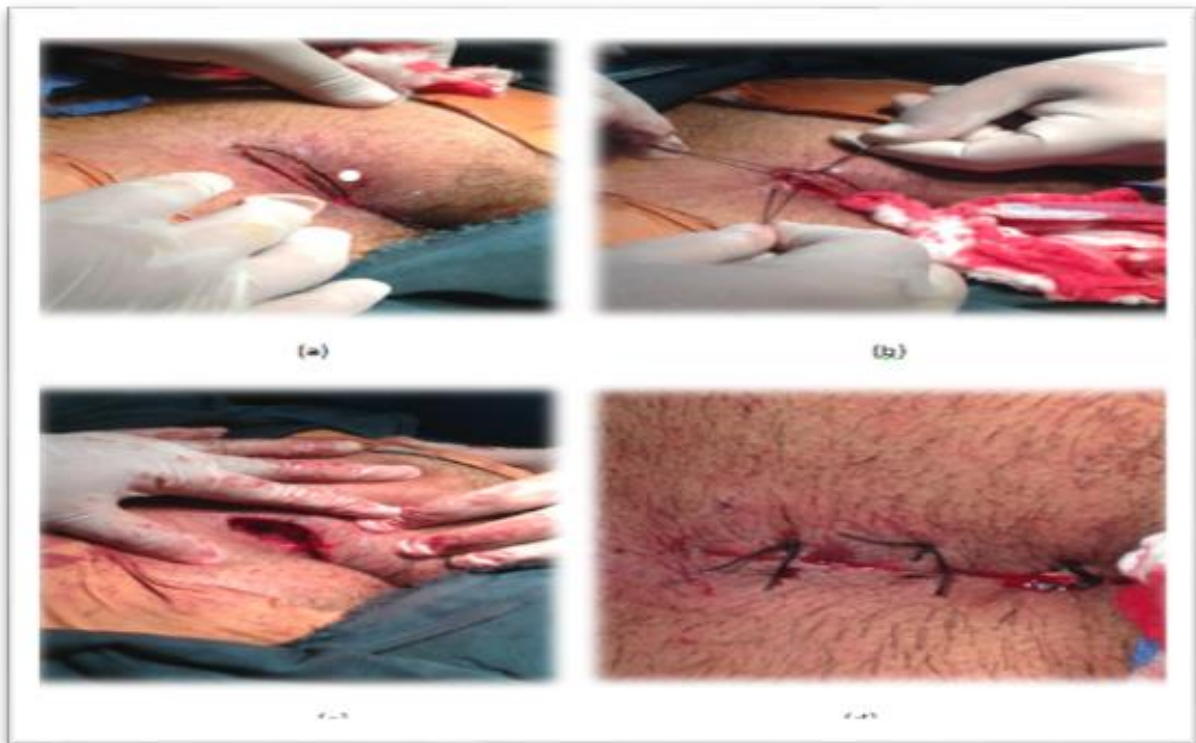


Fig. (3): Pilonidal sinus excision steps

After surgery, all patients were given verbal instructions that:

- Avoid change dressing for 1week.
- Patients were asked to fill in a questionnaire chart for the study.

All patients were examined at 1st. wk., 2nd wk., 3^d wk. and 4th wk. after surgery to assess pain, bleeding, edema, infection and overall satisfaction.

Assessment of pain

Subjective assessment of pain was done using the following scale

| Pain | No pain | Mild pain | Moderate pain | Sever pain |
|------|---------|-----------|---------------|------------|
| | 0 | 1 | 2 | 3 |

Assessment of bleeding

Subjective assessment of bleeding was done using the following scale.

| Bleeding | No bleeding | Mild bleeding | Moderate bleeding | Sever bleeding |
|----------|-------------|---------------|-------------------|----------------|
| | 0 | 1 | 2 | 3 |

Assessment of postoperative edema

Clinical assessment of the wound edema using the following scale.

| Edema | No edema | Mild edema | Moderate edema | Sever edema |
|-------|----------|------------|----------------|-------------|
| | 0 | 1 | 2 | 3 |

Assessment of infection

| infection | No infection | Redness | Redness + swelling | Discharge of pus |
|-----------|--------------|---------|--------------------|------------------|
| | | 0 | 1 | 2 |

Assessment of overall satisfaction of patients

At the follow-up appointments, each patient participated in assessment of overall satisfaction about the treatment using following scale. The results were collected from the operation notes and clinical observations at follow-up appointments at one week, two weeks, three weeks and four weeks as well as the data collected from questionnaire sheets at each follow-up visit. Clinical observation and evaluations of results include examination that including pain, bleeding, edema, infection, and overall satisfaction.

| Overall Satisfaction | Poor (0-25) % | Fair (26-50) % | Good (51-75)% | Excellent (76-100) % |
|----------------------|---------------|----------------|---------------|----------------------|
| | 0 | 1 | 2 | 3 |

Results

(Table. 2): Patients' observation

| Patient No. | Follow up | | | | | | | | | | | | | | | | Overall satisfaction | | | |
|-------------|-----------|---|---|---|----------|---|---|---|-------|---|---|---|-----------|---|---|---|----------------------|---|----|----|
| | Pain | | | | Bleeding | | | | Edema | | | | Infection | | | | 1 | 2 | 3w | 4w |
| 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 3 | 3 |
| 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 3 | 3 |
| 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 3 | 3 |
| 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 3 | 3 |
| 5 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 3 | 3 |
| 6 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 1 | 0 | 0 | 0 | 2 | 3 | 3 | 3 |
| 7 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 3 | 3 |
| 8 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 3 | 3 |
| 9 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 3 | 3 |
| 10 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 3 | 3 |

Pain: All surgical operations done under local anesthesia, the patients were experiencing no pain during the surgical operation, but all of them experience mild pain during first week treated by oral analgesia (diclofenac); otherwise no patient experience pain between 2nd week and 4th week postoperatively.

Bleeding: The operative field was dry and the wound closed primarily. No primary or secondary bleeding.

Edema: There was mild edema in 8 (80%) cases during first week otherwise no patient showed edema between 2nd week and 4th week postoperatively.

Infection: There was a sign of infection (redness) in one case (10%), need treatment for one w

Overall Satisfaction: patients were experience mild pain in two patient (20%) reveal fair (26-50) and eight (80%) reveal good (51-75) in first week but all patients; 10(100%); showed excellent overall satisfaction throughout 2nd week and 4th week postoperatively

Discussion

Photothermal interaction with tissue is the basic concept of carbon dioxide Surgical Laser. Laser light within the tissue was converted to thermal energy, that when appropriately applied, can produce reaction ranging from incision, vaporization, to coagulation. This wavelength (10600 nm) has an affinity for water which is present in all cells in body. Surgical Laser creates a wound that can be characterized as thermal injury, but the thermal effect is 1/10 of depth of electro cautery (Ryan, et al., 2010). Thermal effects can be induced by either continues wave (CW) or pulsed laser radiation. Temperature is certainly the governing parameter of all thermal laser tissue interactions. Therefore the temperature raise originates from the transfer of light photon energy into kinetic energy. In other word, the thermal effects have their origin in bulk absorption of laser light (Markolf, 2007). The CW Mode produced relatively deep and wide, almost straight-sided incisions. Thus, this mode can cut or ablate large amounts of tissue quickly and effectively in a controlled fashion. However, the proximity of underlying or adjacent bone or other heat-

sensitive structures must be considered. Thus, this laser configuration is well-suited to applications requiring skilled surgical hands, or where the properties of adjacent and underlying tissues stipulate minimal thermal disturbance.

The use of laser in the treatment of chronic sinus disease appears to hasten and aid healing; however this needs further evaluation and investigation. A number of studies have found that laser hair removal considerably reduces the recurrence rate of PNS (Marza 2013)

CO₂ laser able to seal lymphatic and blood vessels up to 1mm diameter and can reduce intraoperative bleeding and the occurrence of postoperative swelling (Israel 2007 and Natarajan et al. 2014) it's also offers more comfort to patients by reducing intraoperative bleeding and postoperative edema, facilitating the process of wound healing after surgery. Moreover, wounds can be treated in a sterile manner because of high-temperature evaporation of tissue lesions (Markolf Niemz, 2007)

In this present study, the use of CO₂ 10600 nm laser allowing increased surgical precision and accuracy, thereby reducing unnecessary damage to underlying tissues, and the procedure was with no bleeding in all cases, resulting in improving visualization of the surgical field, eliminating the need for electro-cautery which can cause more damage and increase chance of infection which needed in case of scalpel surgery, (Garcia et al. 2009), also shorten the operation time, probably the efficiency of the laser allows sealing lymphatic and blood vessels that renders a bloodless surgical field even operation done in infected pilonidal sinus and all operation done under local anesthesia so no need electrocautry for haemostasis (Natarajan et al. 2014) Kaplan I, et al. Reported that in a study 70 patients were treated for pilonidal sinus disease in a Multi-Specialty Military Clinic. All were managed as outpatients under local anesthesia. When an abscess was involved, the surgical procedure included incision, drainage, curettage, peroxide irrigation, and CO₂ laser therapy. Morbidity was minimal. Healing time ranged from 14 days to 8 weeks, yet most sinuses healed in 4 weeks (Testini et al. 2001) Jain, et al. mention that the deroofting with CO₂ laser along with hair follicle removal with long pulse Nd:YAG laser is an effective minimally invasive tissue saving surgical intervention for the treatment PNS lesions (Jain et al., 2012).

The main goals of the management of pilonidal sinus disease should be determining the ideal medical or surgical treatment, which includes minimal inconvenience to the patient, a short period of hospitalization, and most importantly, a low risk of recurrence. In our study in spite of small number of cases, the operation done as day case i.e. no need for admission to hospital, no infection, no significant pain that limit activity after first week. All cases primarily closed, and no recurrence in this short period (one month) of follow up.

Surgical treatment of pilonidal sinus disease of the natal cleft has a significant failure rate, because of infection and recurrences. No method satisfies all requirements for the ideal treatment quick healing, no hospital admission, minimal patient inconvenience, and low recurrence. Early excision of the pilonidal pit at the time of treatment of pilonidal abscess reduces the high (40 per cent) risk of subsequent sinus (Landa et al. 2005). In this study bloodless field give good view to remove all tracks of the PNS, decrease chance of recurrence (Chiniforush et al. 2012). Raymond Hinshaw, et al. Mention that "Excision of contaminated and purulent wounds with the carbon dioxide laser makes it safe to close the wounds primarily when certain steps are observed during the operation. The contaminated surface is sterilized with the defocused beam. The surgeons' and assistants' hands should not touch the contaminated areas, and both should wear two pairs of rubber gloves to protect against accidental contamination. All infected tissue is excised completely, and the wound cleansed by copious irrigation and the defocused laser. The wound may then be safely closed by simple sutures, skin graft, or by the rotation of a vascularized musculocutaneous flap (Hinshaw, et al. 2008).

Patient postoperative satisfaction after laser excision was greater when compared with those who had traditional excisions. Postoperative pain was less, as was the pain experienced during the first week of recovery, (Kaplan et al., 1990). Chegin, et al. Reported that continuous-wave CO₂ laser treatment advantages minimal tissue damage, prophylaxis of local dissemination of infection, hemostatic and sterilizing effects have been proved experimentally. Laser utilization in clinical trial (360 cases) made it possible to obtain significantly improved outcomes and marked shortening of treatment. (Jain et al. 2012,

Tuncer, et al., 2010 and Hamadah and Thomson 2009).

Many laser may be an effective tool in the treatment of pilonidal sinus disease. By eliminating the source of hair and hair fragments that course along the surface of the lower back and buttocks, interruption of the etiologic source for pilonidal sinus disease (Marza 2013), the infection is a cause of surgical failure of PNS for closed method but the use of CO₂ laser minimized the chance of the infection and give good results for the cost, hospital stay, bed rest, return to work (Marza 2013).

Conclusion

The CO₂ laser offers the following benefits; almost bloodless surgery; improved therapeutic results; reduced risk of infection; less scarring; precisely controlled surgery which limits injury to normal skin; and safe and effective recovery, often faster than conventional approaches and therefore achieving short hospital stays and low recurrence.

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استئصال الناسور العصعصي باستخدام ليزر ثاني أكسيد الكربون 10600 نانومتر

محمد عبد الرضا البهادلي (1) لطفى غلام عوازلي (2)

(1) وزارة الصحة ، مستشفى العزيزية ، واسط ، العراق
(2) معهد الليزر للدراسات العليا ، جامعة بغداد ، بغداد ، العراق

الخلاصة: المقدمة: الناسور العصعصي يعتقد أنه ينشأ من تأثير احتكاك الشعر الميت المتساقط في طيات بين الأليتين أو شق العجزي العصعصي ، بعد اختراق الأدمة، يؤدي الى رد فعل جسم التهابي قد يكون مزمن، المعيار الحالي لعلاج الناسور العصعصي هو التدخل الجراحي مع استئصال الجيوب (الناسور). تكرار الالتهاب يمكن السيطرة عليه بالنظافة الجيدة والحلاقة المنتظمة وبشكل دوري للشعر في منطقة العصعص، والعلاج بالليزر هو إضافة مفيدة لمنع تكرارها. ليزر ثاني أكسيد الكربون CO₂ هو الوسيلة الجراحية المثالية تقريبا بسبب طول موجته (10600 نانومتر) حيث يقطع بعمق (0.03 ملم) ومن الجانب (150 مايكرون)، يغلظ وبشكل فعال الأوعية الدموية، اللمفاوية، والنهايات العصبية، وعلاوة على ذلك تعقيم الجرح بواسطة تأثير الليزر. **المرضى، والمواد، والعمل:** جهاز ليزر KLS MARTIN 50plus، الأشعة تحت الحمراء، 10600nm، وطاقته 2-50 W. تم إجراء العملية على 10 مرضى، ما بين 18 و 39 سنة من العمر، تم استئصال الناسور العصعصي تحت التخدير الموضعي، وذلك باستخدام الوضع المستمر لليزر CO₂، وال طاقة 10 W، تم خياطة جرح العملية لجميع الحالات **النتائج:** التي تم جمعها من الملاحظات المرضية والملاحظات السريرية وتشمل الألم، والنزيف، وذمة، والعدوى، والرضا العام. لم يشعر أي مريض بأي ألم أثناء العملية ولكن الالام خفيفة الى معتدلة خلال الأسبوع الأول، اما النزيف فكانت العملية جافة تقريبا، والوذمة خفيفة في 80% من الحالات في الأسبوع الاول، والعدوى في حالة واحدة، اما الرضا العام فكان ممتاز في جميع الحالات خلال 2-4 أسابيع من المتابعة. **الخلاصة:** يقدم ليزر CO₂ الفوائد التالية؛ جراحة غير دموية تقريبا مقارنة مع المشروط التقليدي. تقليل خطر التعرض للعدوى. أقل تندب يكون القص بواسطة الليزر (CO₂) دقيق وبالتالي قليل الضرر على الانسجة المحيطة اذا ما قورن بالكاوية الحرارية (Electrocautery). الجراحه بالليزر غالبا أسرع من الأساليب التقليدية، وبالتالي تحقيق إقامة قصيره في المستشفى والعوده السريعه لمزولة الحياة الطبيعيه.