Dermatology Practical & Conceptual

Comparative Study of CO_2 Laser and Curettage-Electrodesiccation for Superficial Basal Cell Carcinoma Treatment: A Focus on Cosmetic Results

Pelle Kahr Nilsson[1], Ulrik Knap[1], Rasa Laurinaviciene[1], Sebastian Vigand Svendsen[1], Tine Vestergaard[1]

1 Odense University Hospital, Odense, Denmark; Department of Dermatology and Allergy Center

Key words: Nonmelanoma Skin Cancer, Co_2 Laser, Basal Cell Carcinoma, Electrodesiccation, Cosmetic Outcome

Citation: Nilsson PK, Knap U, Laurinaviciene R, Vigand Svendsen S, Vestergaard T. Comparative Study of CO_2 Laser and Curettage-Electrodesiccation for Superficial Basal Cell Carcinoma Treatment: A Focus on Cosmetic Results. *Dermatol Pract Concept.* 2025;15(3):5368. DOI: https://doi.org/10.5826/dpc.1503a5368

Accepted: April 23, 2025; **Published:** July 2025

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Competing Interests: None.

Authorship: All authors have contributed significantly to this publication.

Corresponding Author: Pelle Kahr Nilsson, Odense University Hospital, Kløvervænget 15, 5000 Odense, Denmark. Orcid ID: 0000-0002-5205-9165. E-mail: pellekahr@gmail.com

ABSTRACT

Introduction: Basal cell carcinoma (BCC) is the most common type of skin cancer worldwide, and the incidence is rising. While surgical excision remains the gold standard, it can be time-consuming and resource-intensive. Therefore, there is a growing need for simpler and more cost-effective treatment options for low-risk tumors.

Objectives: This study compared the scar quality and the recurrence rate from continuous wave CO_2 laser and curettage and electrodesiccation treatments. Scar quality and the recurrence rate from the treatments were assessed.

Methods: A single-blind randomized prospective interventional trial was conducted at Odense University Hospital, Denmark, from 2017 to 2023. Patients with histologically confirmed superficial BCC were randomized 1:1 to Curettage-Electrodesiccation (CE) or continuous wave CO_2 (CW CO_2) laser treatment. Scar quality was assessed using the Patient and Observer Scar Assessment Scale (POSAS) and a modified visual-only scale (VSAS). Recurrence within one year was a secondary outcome.

Results: Thirty-two patients were treated for 32 tumors: 17 with CE and 15 with CO_2 laser. There was no significant difference in scar quality or recurrence rate between the CE and CO_2 laser groups (PSAS: P = 0.422; OSAS: P = 0.747; VSAS: P = 0.522). After one year, neither group showed tumor recurrence.

Conclusion: CO_2 laser used in continuous wave setting offers a treatment for superficial BCCs with cosmetic outcomes and recurrence rates comparable to CE. However, a larger patient sample and longer follow-up are needed for definitive conclusions.

Introduction

Basal cell carcinoma (BCC) represents the predominant type of skin cancer globally, and the incidence is rising [1]. In order to address the socioeconomic implications, it is crucial to provide simple and cost-effective treatment options while ensuring optimal patient satisfaction. Although excision results in low recurrence rates, it is a time-intensive procedure and incurs high costs [2]. Consequently, exploring alternative treatment modalities for low-risk tumors becomes relevant. In recent years, the CO_2 laser has become a staple in dermatological practices due to its versatility. Therefore, the cost of obtaining one is often not a concern, as most dermatology clinics already consider it standard equipment. CO_2 laser offers advantages such as precise energy delivery, minimal thermal impact on surrounding tissue, and reduced bleeding during the procedure [3].

Curettage-electrodesiccation (CE) is a well-established and widely used procedure, conceptually similar to continuous wave CO_2 laser treatment, as both aim to destroy tumors while minimizing damage to surrounding tissue in a time- and cost-effective manner. Therefore, we found it relevant to compare these two treatments in terms of the quality of resulting scars and, as a secondary outcome, their recurrence rates.

Methods

This study was a randomized prospective interventional trial with single-blind evaluation carried out between 2017 and 2023 at Odense University Hospital in Denmark. The primary objective was to compare the scars resulting from CE versus continuous wave (CW) CO_2 laser in the treatment of superficial basal cell carcinomas.

The secondary outcome was to compare recurrence rates. Only superficial basal cell carcinomas were included. This decision was based on the presumption that the continuous wave CO_2 laser may not be effective for nodular tumors, as indicated by a previous study[4].

The study was conducted over four appointments; treatment visit and follow up one, six, and 12 months after.

Patients suspected of having superficial BCC underwent a biopsy for confirmation, making them eligible for this study. After documentation of superficial BCC, patients were informed about both treatment modalities, and consent was obtained for enrollment. Randomization with a 1:1 ratio was performed by picking a sealed envelope.

Exclusion criteria included pregnancy, dementia, having a pacemaker, local anesthesia intolerance, tumor location in the scalp or near the eyes, psoriasis (because of the Koebner phenomenon), immunosuppressing medication, and suspected poor healing potential.

Inclusion criteria included biopsy-verified superficial BCC, presence of only one tumor at the time of inclusion, tumor accessibility for both electro surgery and CO_2 laser, and age above 18.

The study was approved by the Danish Data protection Agency and the Regional Committees on Health Research Ethics (project ID: S-20170097)

Interventions

We assessed the apparent margin using a dermatoscope and demarcated 3 mm of normal skin around the tumor. The lesion was anesthetized with an injection of lidocaine and adrenaline (10 mg/5 µg per mL)

Curettage was performed with disposable dermal curettes of two different sizes (4 and 7 mm) depending on the tumor size. The sharp side of the instrument was applied in different directions across the lesion until all fragile or abnormal tissue had been removed. Afterwards, the surface of the lesion was cauterized using a monopolar ball-shaped electrode with power set to 24 watts. In a second cycle, curettage and electrodesiccation were then repeated in a more superficial manner across the lesion. CO_2 laser ablation of tumors was performed with Lumenis, UltraPulse CO_2 laser in continuous wave mode with fluences ranging from 2–6 watts/cm^2 with spot size 1 millimeter. The laser beam was applied across the lesion, removing tissues in layers with slight overlap. Debris tissue was removed between each laser passage using a gauze. Inspection of the treated area was done between each pass to determine whether residual tumor was present.

CE procedures were performed by either certified dermatologists or resident physicians, while the CO_2 laser treatments were performed by two certified dermatologists within our department with expertise in the field of lasers. A photograph was taken prior to the treatment and at each of the follow up visits.

Outcomes

For the assessment of scar quality, the Patient and Observer Scar Assessment Scale (POSAS) was used [5]. POSAS consists of two separate scales, the observer (OSAS) and the patient scale (PSAS). It is based on clinically relevant scar characteristics. The patient scale includes the following six characteristics: pain, pruritus, color, thickness, relief, and pliability. The observer scale (OSAS) consists of the following five characteristics: vascularization, pigmentation, thickness, surface roughness, and pliability. Although the observer scale originally includes surface area, it was excluded to focus the score on potential differences in scar quality rather than on size, as scar size is likely influenced by tumor size, not by the treatment modality.

All included items are scored on the same 10-point scale, in which a score of 1 is given when the scar characteristic

is comparable to "normal skin", and a score of 10 reflects the "worst imaginable scar". All items are summed to give a total scar score. The OSAS score ranges from 5 to 50, and the PSAS score from 6 to 60.

In this study, the observer scale (OSAS) was not performed in a blinded setting, and consequently, photographs taken during the follow-up visits were evaluated after the conclusion of the trial in a blinded setting. In doing so, a modified version of the observer scale was used, including only the four categories that we found suitable for visual assessment of photographs (vascularity, pigmentation, thickness, and surface roughness), with a total score ranging from 4 to 40. We called this scale VSAS (visual scar assessment scale).

The assessment of scars at follow-up visits was done by one of the five doctors who are the authors of this paper. The assessment of photographs was performed by two of the authors (RL, TV), who are certified specialists in dermatology. A mean of these two scores was used.

The secondary outcome was recurrence. Treated areas were evaluated clinically and with dermoscopy at follow-up-visits. If recurrence was suspected, a punch biopsy was performed.

Statistics

For our primary endpoint of scar quality, we considered a minimum clinically significant difference of 1 on a 1–10 scale. With a significance level of 5% and a statistical power of 80%, and given the non-normal distribution in our patient population, we used a non-parametric approach for sample size determination. The sample size was calculated using STATA 17, Statacorp, resulting in 20 patients per group, totaling 40–45 patients overall. Potential differences between the treatment conditions (CE vs. CO_2) across patient characteristics, tumor characteristics, and the three outcomes (PSAS, OSAS, and VSAS) were tested using Mann-Whitney U tests.

For the three outcomes, Hedges *g* with 95% confidence intervals (CI) were computed as effect sizes[6]. Subsequently, multiple linear regression analyses were performed with PSAS, OSAS, and VSAS as dependent variables, with treatment condition (CE vs. CO_2) as the independent variable, adjusting for tumor size, age, sex, and length of follow-up.

Heteroscedasticity was tested using the White test, and collinearity was assessed using variance inflation factors (VIF). All data analyses were performed using STATA 17, Statacorp.

Results

A total of 36 tumors in 36 patients were included and treated. However, four patients were lost to follow-up: one cancelled the final follow-up, two patients only filled out parts of the patient assessment scale, which invalidated the sum of scores, and one patient was excluded because the photo was lost. Therefore, 32 tumors are included in the data set. The majority of patients had tumors on the trunk (n=22/69%), while three patients had tumors in a lower limb (9.4%), four in an upper limb (12.5%), and three had tumors in the head or neck area (9.4%). The treatment conditions did not differ in terms of the area of the tumors. Also, they did not differ with regard to tumor size, age, sex, or the exact length of follow-up (Table 1). The Mann-Whitney U tests did not suggest any significant difference between the means of PSAS (P=0.422) or OSAS (P=0.747) between the two groups (CO_2 laser and CE) (Table 2). Comparing the means of VSAS showed the biggest difference in means but was still not significant (P=0.522). An outlier was detected among the PSAS and OSAS scores. Removing this outlier did not change the results of the between-group comparisons on these outcomes.

Due to the lower statistical power of non-parametric tests, differences between the groups were also checked with

Table 1. Descriptive Statistics of Patient and Tumor Characteristics.

	Curettage (n=17)	CO2 (n=15)	*P-values*
Age (mean ± SD)	62.94 ± 11.52	59.60 ± 11.66	**.449**
Female	11(65%)	11(73%)	
Diameter (mean ± SD)	12.76 ± 6.69	10.12 ± 5.30	**.282**
Location, n (%)			
• Head and neck	3(20%)	0 (0%)	**NaN**
• Trunk	11(73%)	11(65%)	**.599**
• Upper limbs	2 (13%)	2(12%)	**.893**
• Lower limbs	1(7%)	2(12%)	**.471**
Follow-up length, months (mean ± SD)	12.67 ± 0.75	13.02 ±1.56	**.992**

Note: NaN = could not be computed due to lack of variance in one of the treatment conditions

Table 2. Comparison between Curettage and CO2 in Scar Quality (Mann-Whitney U-test).

Outcomes	Curettage Mean + SD	CO2-laser Mean + SD	Z	*P*	*g* (95% CI)
PSAS	9.24 ± 3.07	11.33 ± 7.63	**.82**	**.422**	**.37 (-.33, 1.07)**
OSAS	10.82 ± 3.32	11.40 ± 5.59	**.32**	**.747**	**.13 (-.57, .82)**
VSAS	8.62 ± 1.10	8.14 ± 1.55	**.66**	**.522**	**.25 (-.96, .46)**

Abbreviations: PSAS: Patient Scar Assessment Scale , OSAS: Observer Scar Assessment Scale, VSAS: Visual Scar Assessment Scale, g: Hedges *g*, CI: confidence intervals (lower and upper bound). Range in scores: PSAS (6-60), OSAS (5-50), VSAS (4-40), Lower is better.

Welch t-test, the parametric counterpart to Mann-Whitney U tests, producing similar results for the PSAS (P= 0.332) the OSAS (P=0.730), and the VSAS (*P*=0.475).

While the groups did not differ significantly on any of the demographic or tumor characteristics (Table 1), it is still possible that they, in combination, could have influenced the differences between the treatment conditions on the outcomes. However, the multivariate regression analyses did not suggest that this was the case (Table 3), as the results for the treatment conditions remained largely the same. The variables pertaining to the location of the tumor did not contain sufficient variance in one of the areas (neck and head) and too small cell sizes in other areas (lower and upper limbs) for them to be considered relevant covariates and were therefore not included in the multivariate analyses. The Breusch-Pagan tests did not suggest heteroscedasticity, and the VIF were all close to one, indicating the absence of multicollinearity.

No tumor recurrence was observed in either of the two treatment groups during follow-up.

Discussion

In an effort to elucidate any differences in scar quality and recurrence rates between the CO_2 laser and curettage treatments, no significant differences were found. Both treatments resulted in relatively low PSAS, OSAS, and VSAS scores, reflecting that both resulted in relatively good scar qualities. Furthermore, no recurrence was found after one year of observation.

Many studies have focused on the use of lasers in the treatment of basal cell carcinomas, but only a few studies have described the use of continuous wave mode CO_2 laser. In 1979, Adams et al. [4] treated 25 basal cell carcinomas (both superficial and nodular) with a single, non-overlapping continuous mode of a CO_2 laser, using variable exposure times. They found recurrence in 50% of tumors. Wheeland et al [7] used a defocused mode of continuous wave CO_2 laser coupled with curettage in the treatment of 370 superficial BCCs in 52 patients. The overall result was satisfactory, with no recurrence of tumors. Similar to our method, they also allowed for several treatment cycles if inspection of the treated area showed residual tumor. No other study has exclusively used continuous mode CO_2 lasers as in our research; recent studies generally employ a pulsed setting for CO_2 lasers instead [3,5,6,10]. These studies employ the CO_2 with different settings and techniques and have varying results regarding both cosmetic outcomes and cure rates. CO_2 lasers are also used in conjunction with topical chemotherapeutic agents[8,11,13,14], but these methods are less comparable to our technique, although generally showing favorable results.

Continuous wave lasers emit a constant beam, effectively a long pulse, which increases thermal damage to surrounding tissue as a function of pulse length[15], leading to more nonspecific damage and potentially worse scarring. These characteristics may explain why we found that scar quality was similar to that produced by CE, as the thermal impact of the electrodesiccation tool is likely comparable to that of a continuous wave CO_2 laser. Nevertheless, the nonspecific tissue damage also contributes to the clearance of tumor.

CO_2 laser can be directed in a precise manner in an almost bloodless surgical field, making it a good choice for patients with bleeding disorders or those on anticoagulants. Additionally, patients equipped with pacemakers are not precluded from this treatment. Effective use of the CO_2 laser demands physicians experienced in the field of lasers, but compared to other modes, the continuous wave mode requires very few adjustments of settings.

A key limitation to both CE and CW CO_2 is the absence of margin control, which makes it unsuitable for tumors with a high risk of recurrence. This also underlines the importance of delineating tumor margins accurately preoperatively[16]

Immediate distinction between tumor and healthy skin is important to ensure clearance of malignant cells[2]. CE gives tactile feedback as the clinician maneuver the curette across the tumor, a feature that is appreciated by many. CO_2 lasers offers a bloodless surgical field, and wiping with a wet cloth between cycles also provides visualization of any potential residual tumor.

Limitations

Initially, the study was designed with three follow up visits at one, six, and 12 months after treatment to follow the development of scars. However, due to many cancelled or

Table 3. Multivariate Regression Analyses with Treatment Condition as Predictor of Scar Quality at End of Follow-Up while Adjusting for Demographics, Tumor size, and Follow-Up Length.

	PSAS			OSAS			VSAS		
	Beta	95% CI	*P*	Beta	95% CI	*P*	Beta	95% CI	*P*
Treatment Modality	2.63	-1.44, 6.71	.196	.83	-2.40, 4.07	.602	-.36	-1.85, 1.13	.625
Sex	-2.79	-7.06, 1.48	.191	-2.64	-6.03, .74	.121	-1.35	-2.85, .14	.074
Age	.05	-.12, .23	.546	.05	-.09, .19	.512	-.02	-.08, .04	.475
Tumor size	-.21	-.55, .13	.220	-.216	-.49, .05	.112	.03	-.11, .16	.665
Follow-up length	-1.92	-3.63, -.22	.028	-1.28	-2.63, .07	.062	-.01	-.62, .59	.962

Abbreviations: CI: confidence intervals (lower and upper bound), PSAS: Patient Scar Assessment Scale , OSAS: Observer Scar Assessment Scale, VSAS: Visual Scar Assessment Scale

rescheduled appointments within the first year, we opted to include only the 12-month follow-up data. We believe that this does not change the overall result or aim of this study as we also believe that the final assessment of scars at 12 months post-treatment is the most important. This study's statistical power is limited due to the modest number of participants.

After the initiation of this study, our clinic narrowed the intake of referrals to primarily include organ transplant recipients, whom we had to exclude due to their use of immunosuppressive medication. Furthermore, the COVID-19 pandemic led to the cancellation of several follow-up visits. It would be preferable if we had had a longer timeline for the follow-up, as BCC is a slow-growing tumor and recurrence can occur years after treatment.

Conclusion

The present findings indicate that both CE and CW CO_2 laser are effective options for the treatment of superficial basal cell carcinomas; both yielded a relatively good quality of scars, although their significance is limited by the low number of treated patients and the short follow-up period. We believe that CW CO_2 lasers offer a relatively simple method for ablating tumors without the need to adjust multiple settings, allowing practitioners with limited expertise in the field of lasers to carry out this treatment. It offers an alternative to CE in patients with pacemaker, but the choice between them should be guided by factors such as patient characteristics, tumor characteristics, cost considerations, and the expertise available.

References

1. Lomas A, Leonardi-Bee J, Bath-Hextall F. A systematic review of worldwide incidence of nonmelanoma skin cancer. *Br J Dermatol*. 2012;166(5):1069-1080. DOI:10.1111/j.1365-2133.2012.10830.x. PMID: 22251204
2. Patel PV, Pixley JN, Dibble HS, Feldman SR. Recommendations for Cost-Conscious Treatment of Basal Cell Carcinoma. *Dermatol Ther*. 2023;13(9):1959-1971. DOI:10.1007/s13555-023-00989-x. PMID: 37531073
3. Iyer S, Bowes L, Kricorian G, Friedli A, Fitzpatrick RE. Treatment of basal cell carcinoma with the pulsed carbon dioxide laser: a retrospective analysis. *Dermatol Surg Off Publ Am Soc Dermatol Surg Al*. 2004;30(9):1214-1218. DOI:10.1111/j.1524-4725.2004.30378.x. PMID: 15355363
4. Adams EL, Price NM. Treatment of basal-cell carcinomas with a carbon-dioxide laser. *J Dermatol Surg Oncol*. 1979;5(10):803-806. DOI:10.1111/j.1524-4725.1979.tb00756.x. PMID: 500927
5. van de Kar AL, Corion LUM, Smeulders MJC, Draaijers LJ, van der Horst CMAM, van Zuijlen PPM. Reliable and feasible evaluation of linear scars by the Patient and Observer Scar Assessment Scale. *Plast Reconstr Surg*. 2005;116(2):514-522. DOI:10.1097/01.prs.0000172982.43599.d6. PMID: 16079683
6. *Cohen J. (1988). Statistical Power Analysis for the Behavioral Sciences (2nd Ed.). Hillside, NJ: Lawrence Erlbaum Associates.*
7. Wheeland RG, Bailin PL, Ratz JL, Roenigk RK. Carbon dioxide laser vaporization and curettage in the treatment of large or multiple superficial basal cell carcinomas. *J Dermatol Surg Oncol*. 1987;13(2):119-125. DOI:10.1111/j.1524-4725.1987.tb00509.x. PMID: 3805474
8. Kavoussi H, Ebrahimi A. Treatment and cosmetic outcome of superpulsed CO2 laser for basal cell carcinoma. *Acta Dermatovenerol Alp Pannonica Adriat*. 2013;22(3):57-61. PMID: 24089133
9. Campolmi P, Brazzini B, Urso C, et al. Superpulsed CO2 laser treatment of basal cell carcinoma with intraoperatory histopathologic and cytologic examination. *Dermatol Surg Off Publ Am Soc Dermatol Surg Al*. 2002;28(10):909-911; discussion 912. DOI:10.1046/j.1524-4725.2002.02076.x. PMID: 12410674
10. Zane C, Facchinetti E, Arisi M, Ortel B, Calzavara-Pinton P. Pulsed CO2 Laser Ablation of Superficial Basal Cell of Limbs and Trunk: A Comparative Randomized Clinical Trial With Cryotherapy and Surgical Ablation. *Dermatol Surg Off Publ Am Soc Dermatol Surg Al*. 2017;43(7):920-927. DOI:10.1097/DSS.0000000000001106. PMID: 28291062
11. El-Khalawany M, Saudi WM, Ahmed E, Mosbeh A, Sameh A, Rageh MA. The combined effect of CO2 laser, topical diclofenac 3%, and imiquimod 5% in treating high-risk basal

cell carcinoma. *J Cosmet Dermatol*. 2022;21(5):2049-2055. DOI:10.1111/jocd.14354. PMID: 34333841

12. Shokrollahi K, Javed M, Aeuyung K, et al. Combined carbon dioxide laser with photodynamic therapy for nodular and superficial basal cell carcinoma. *Ann Plast Surg*. 2014;73(5):552-558. DOI:10.1097/SAP.0b013e3182773ed2. PMID: 23407256
13. Wenande E, Hendel K, Mogensen M, et al. Efficacy and Safety of Laser-Assisted Combination Chemotherapy: An Explorative Imaging-Guided Treatment With 5-Fluorouracil and Cisplatin for Basal Cell Carcinoma. *Lasers Surg Med*. 2021;53(1):119-128. DOI:10.1002/lsm.23323. PMID: 32960987
14. Hsu SH, Gan SD, Nguyen BT, Konnikov N, Liang CA. Ablative Fractional Laser-Assisted Topical Fluorouracil for the Treatment of Superficial Basal Cell Carcinoma and Squamous Cell Carcinoma In Situ: A Follow-Up Study. *Dermatol Surg Off Publ Am Soc Dermatol Surg Al*. 2016;42(9):1050-1053. DOI:10.1097/DSS.0000000000000814. PMID: 27359199
15. Carroll L, Humphreys TR. LASER-tissue interactions. *Clin Dermatol*. 2006;24(1):2-7. DOI:10.1016/j.clindermatol.2005.10.019. PMID: 16427500
16. Dika E, Fanti PA, Christman H, Ravaioli GM, Patrizi A. Videodermoscopy and Curettage: The Value of Simple Procedures During Mohs Surgery. *Dermatol Surg Off Publ Am Soc Dermatol Surg Al*. 2017;43(12):1411-1417. DOI:10.1097/DSS.0000000000001247. PMID: 28858922