FRACTIONAL CO_2 LASER VS INTRALESIONAL CORTICOSTEROIDS IN ALOPECIA AREATA: A COMPARATIVE STUDY OF EFFICACY, SAFETY AND PREDICTIVE FACTORS

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Abstract
Objective: The aim of the present study was to compare the effectiveness of Fractional CO_2 laser with Intra lesional steroid injection in treament of alopecia areata. Methodology: This Clinical trial was carried out among 60 patients attending Outpatient department of Dermatology and Venereology of Combined Military Hospital, Dhaka within the defined period from January 2024 to June 2024. Permission was taken from the Administrative Head of the Hospital authority to collect data. Purposive sampling was done according to availability of the patients. Informed written consent was taken from each Participant. Privacy and confidentiality was maintained strictly. The collected data were entered into the computer and analyzed by using SPSS (version 20.1). Patient diagnosed with alopecia areata by qualified Dermatologists will be enrolled for the study. Result: The CO_2 laser group demonstrated superior outcomes, with 23 patients (76.7%) achieving clinically significant response (⩾ 50% regrowth) compared to 14 patients (46.7%) in the intralesional corticosteroid injection (ILC) group (p= 0.020). This represents a 30% absolute improvement and a 3.79- fold higher odd of treatment success with fractionated CO_2 laser therapy. Treatment failure was relatively higher 08 (26.7%) in ILC group, (p= 0.097) Conclusion: Fractional CO_2 laser could be a better therapeutic alternative for treating alopecia areata in comparison to traditional Intralesional corticosteroid injection due to less complication.

Keywords: Fractional CO_2, alopecia areata, steroid injection, effectiveness

ФРАКЦИОННЫЙ CO_2-ЛАЗЕР ПРОТИВ ВНУТРИОЧАГОВОГО ВВЕДЕНИЯ КОРТИКОСТЕРОИДОВ ПРИ ОЧАГОВОЙ АЛОПЕЦИИ: СРАВНИТЕЛЬНОЕ ИССЛЕДОВАНИЕ ЭФФЕКТИВНОСТИ, БЕЗОПАСНОСТИ И ПРОГНОСТИЧЕСКИХ ФАКТОРОВ

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Аннотация
Цель: Целью настоящего исследования было сравнение эффективности фракционного CO_2-лазера с внутриочаговыми инъекциями стероидов при лечении очаговой алопеции. Методология: Данное клиническое исследование проводилось среди 60 пациентов, посещавших амбулаторное отделение дерматологии и венерологии Объединенного военного госпиталя в Дакке в течение определенного периода с января 2024 года по июнь 2024 года. Разрешение на сбор данных было получено от административного руководителя госпиталя. Целенаправленная выборка проводилась в соответствии с доступностью пациентов. От каждого участника было получено информированное письменное согласие. Строго соблюдались конфиденциальность и защита персональных данных. Собранные данные были введены в компьютер и проанализированы с помощью программы SPSS (версия 20.1). В исследование были включены пациенты с диагнозом очаговой алопеции, установленным квалифицированными дерматологами. Результат: Группа, получавшая лечение CO_2-лазером, продемонстрировала лучшие результаты: у 23 пациентов (76,7%) был достигнут клинически значимый ответ (⩾ 50% роста волос) по сравнению с 14 пациентами (46,7%) в группе внутриочаговых инъекций кортикостероидов (p = 0,020). Это представляет собой абсолютное улучшение на 30% и в 3,79 раза более высокую вероятность успеха лечения при фракционной CO_2-лазерной терапии. Неудача лечения была относительно выше (26,7%) в группе внутриочаговой лобэктомии (p = 0,097). Вывод: Фракционная CO_2-лазерная терапия может быть лучшей терапевтической альтернативой для лечения очаговой алопеции по сравнению с традиционной внутриочаговой инъекцией кортикостероидов из-за меньшего количества осложнений.

Ключевые слова: Фракционная CO_2-терапия, очаговая алопеция, инъекция стероидов, эффективность

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Introduction

Alopecia areata is a common, nonscarring, autoimmune disease that can affect any hair-bearing area. It is a cosmetic concern for the majority of patients. The disease can present as a single, well demarcated patch of hair loss, multiple patches, or extensive hair loss in a form of total loss of scalp hair (alopecia totalis) or loss of entire scalp and body hair (alopecia universalis). A number of treatments can induce hair regrowth in alopecia areata but do not change the course of the disease. Treatment is more effective in patchy alopecia areata than in alopecia totalis/alopecia universalis.1 Clinical efficacy of steroid in alopecia areata (AA) is still controversial. Positive clinical results have been obtained using steroid but this approach has variable patient compliance. Pain, Erythema, discomfort are common side effect of steroid. Telangiectasia and atrophy, hypopigmentation, may develop rarely. The reported relapse rate is 37%–63%. 2 Telangiectasia and skin atrophy rarely developed but the relapse rate was common when stopped and even with continuation of therapy. 3 Fractional CO_2 laser therapy, traditionally employed in dermatological procedures for skin resurfacing, has recently gained attention as a potential treatment for alopecia areata. A multicenter prospective, randomized, controlled, investigator-blinded trial showed a more than 75% hair regrowth rate in 61% of patients using Fractional CO_2 laser in comparison with 27% in

betamethasone valerate group. 4 One study reported their findings on the use of steroid in patients with alopecia areata. These researchers found that 11 patients with alopecia areata affecting 10 to 75 % of the scalp with an average duration 6 years had no terminal hair growth in response to steroid. 5 By comparing these two approaches, the study aims to differentiate the effectiveness of Fractional CO_2 laser with Intra lesional steroid injection in treament of alopecia areata.

Materials & method

A clinical trial was carried out to assess the efficacy of Fractional CO_2 laser (Quanta system, Italy) and steroid in the treatment of alopecia areata. The study was conducted in the department of Dermatology and Venereology, CMH, Dhaka, Bangladesh for duration of January 2024 to June 2024. Total sixty patients of alopecia areata were enrolled and divided into group A and group B. Thirty of group A patients were treated by Fractional CO_2 laser and thirty of group B patients were treated by steroid (Starting with 5mg for 1 cm square area) 4 weeks apart for 12 weeks. The inclusion criteria were asymptomatic, non-scarring, patchy hair loss over scalp and elsewhere, patients age range 12 to 50 years in both sexes who never received treatment for hair loss. The exclusion criteria were extreme ages (<12 or >50 years), pregnancy or lactation, extensive (more than 3 patches) or atypical alopecia areata (alopecia totalis, alopecia universalis, diffuse). The effects of treatment were evaluated using photographs of the patients before and after the study and evaluation of patient's assessment. Side-effects were assessed during treatment and in each follow up period. Sampling method was convenient type. Informed written consent was taken from each patient. Data analysis was performed by Statistical Package for Social Science (SPSS), version-23.

Results

Paediatric patients (⩽ 15 years) represented 23.3% of Group A and 26.7% of Group B, while adult patients (>15 years) comprised 76.7% and 73.3%, respectively. The two groups were comparable at baseline, with no significant difference in age categorization (X^2 value = 0.089, p= 0.766).This demographic balance supports the validity of between group treatment comparisons (Table 01).

• *Table 1. Distribution of age among study groups (n=60)*

Age in Groups	Group A (CO_2 Laser)	Group B (ILC)	Total
⩽ 15years	07 (23.3%)	08 (26.7%)	15 (25.0%)
>15 years	23 (76.7%)	22 (73.3%)	45 (75.0%)
Total, N	30 (100.0%)	30 (100.0%)	60 (100.0%)
[a]X^2 value = 0.089, df = 1. p = 0.766[ns]			

[a]Chi-square test was done.
ns= not significant.

Males constituted 46.7% (n=14) in Group A versus 43.3% (n=13) in Group B, while females accounted for 53.3% (n=16) and 56.7% (n=17) respectively, (X^2 value = 0.067, P= 0.796). This homogeneity at baseline affirms successful randomization and mitigates potential confounding by sex in subsequent efficacy analysis (Table 2).

• *Table 2: Distribution of study groups by gender. (n=60)*

Sex	Group A (CO_2 Laser)	Group B (ILC)	Total
Male	14 (46.7%)	13 (43.3%)	27 (45.0%)
Female	16 (53.3%)	17 (56.7%)	33 (55.0%)
Total, N	30 (100.0%)	30 (100.0%)	60 (100.0%)
[a]X^2 value = 0.067, df = 1. p = 0.796ns			

[a]Chi-square test was done.
ns= not significant.

Patients with acute alopecia areata (≤6 months duration) demonstrated superior outcomes with CO_2 laser therapy compared to ILC (88.9% vs 60.0% achieving ⩾ 50% regrowth, p= 0.037). In chronic AA (>6 months), response rates were low overall, with a non- significant trend favouring CO_2 laser (58.3% vs 40.0%, p= 0.182). The significant interaction term (p= 0.040) indicates the superiority of CO_2 laser is particularly pronounced in acute cases, suggesting early intervention with laser therapy may optimize outcomes. (Table 4.1, 4.2)

• *Table 4.1 Distribution of study groups by duration of illness*

Duration of Illness	Group A (CO_2 Laser)	Group B (ILC)
Acute (≤6 months	n = 18 (60.0%)	n= 10 (33.3%)
Mean ±SD	3.2 ±1.4 months	3.8 ± 1.6 months
Median (Range)	3 (1-6)	4 (1-6)
⩾50 % regrowth	16/18 (88.9%)	6/10 (60.0%)
ap- value 0.037s		
Chronic (>6 months)	n =12 (40.0%)	n= 20 (66.7%)
Mean ±SD	14.3±7.2 months	16.8± 8,5 months
Median (Range)	12 (7-36)	15 (7-36)
⩾50 % regrowth	7/12 (58.3%)	8/20 (40.0%)
ap- value 0.182ns		
Overall Comparison		
Mean ±SD	7.6±6.3 months	12.4±8.9 months
Median (Range)	5 (1-36)	10 (1-36)
⩾50 % regrowth	23/30 (76.7%)	14/30 (46.7%)

Independent t- test for continuous variables; Chi- square test for categorical outcomes
s= significant; ns= not significant.

• *Table 4.2. Multivariable analysis of Predictors*

Predictor	Odds Ratio (95% CI)	p- value
Treatment (CO_2 laser vs ILC)	3.25 (1.14-9.28)	0.027s
Duration (acute vs chronic)	4.87 (1.92-12.34)	0.001s
Interaction: Treatment × Duration	2.89 (1.05-7.96)	0.040s

Lesion number significantly influenced treatment outcomes and was unevenly distributed between groups. Single lesion patients comprised 73.3% of the CO_2 laser group versus only 46.7% of the ILC group (p= 0.039).Among single- lesion cases, CO_2 laser demonstrated superior efficacy (90.9% vs 64.3%achieving ⩾50 % regrowth , p= 0.047). However, in multiple-lesion cases, both treatments showed similarly modest efficacy (37.5% vs 31.3%, p= 0.734). This significant interaction (p= 0.031) suggests that CO_2 laser therapy may be particularly advantageous for limited, single- lesion alopecia areata. (Table 5.1, 5.2)

• *Table 5.1: Distribution of study groups according to number of lesion and treatment response.*

Number of Lesions	Group A (CO_2 Laser)	Group B (ILC)	Total
Single Lesion	22 (73.3%)	14 (46.7%)	36 (60.0%)
⩾50 % regrowth	20/22 (90.9%)	9/14 (64.3%)	29/36 (80.6%)
aP- value 0.047^s			
Multiple Lesions	08 (26.7%)	16 (53.3%)	24 (40.0%)
⩾50 % regrowth	3/8 (37.5%)	5/16 (31.3%)	8/24 (33.3%)
aP- value 0.734^{ns}			
Total	30 (100.0%)	30 (100.0%)	60 (100.0%)
$^aX^2$ value = 4.267, df = 1. p = 0.039^s			

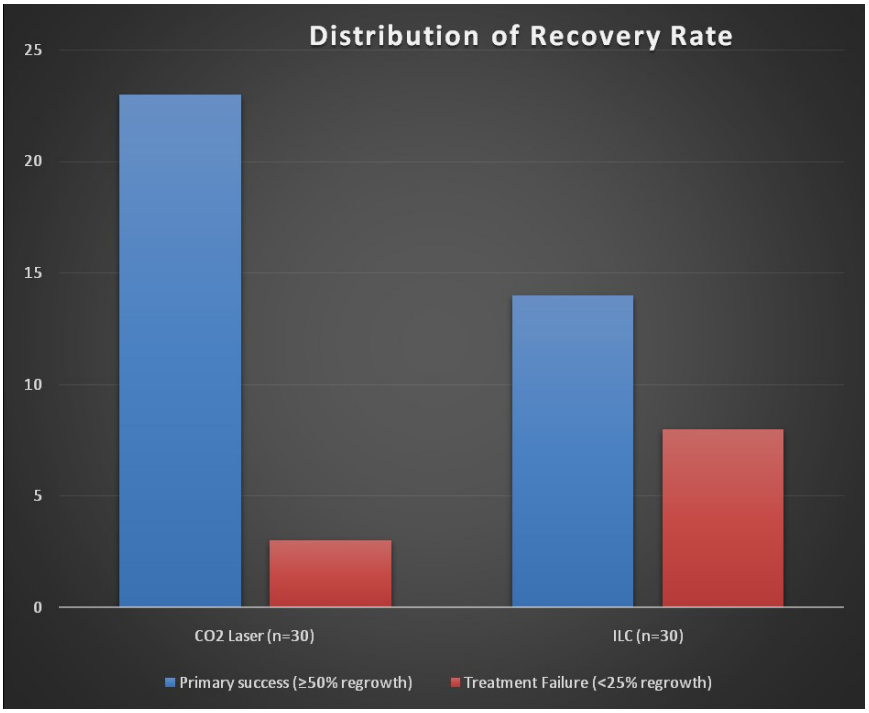
aChi-square test was done
s= significant; ns= not significant.

• *Table 5.2. Multivariable analysis including lesion number.*

Predictor	Odds Ratio (95% CI)	p- value
Treatment (CO_2 laser vs ILC)	4.12 (1.42-11.96)	0.009^s
Lesions (Single vs Multiple)	8.76 (2.94-26.10)	0.001^s
Interaction: Treatment ×Lesions	3.45 (1.12-10.64)	0.031^s

The CO_2 laser group demonstrated superior outcomes, with 23 patients (76.7%) achieving clinically significant response (⩾50 % regrowth) compared to 14 patients (46.7%) in the ILC group (p= 0.020). This represents a 30% absolute improvement and 3.79- fold higher odds of treatment success with fractionated CO_2 laser therapy. Treatment failure was relatively higher 08 (26.7%) in ILC group, (p= 0.097) (Figure 1)

• *Figure 1. Distribution of recovery rate among study groups*



Intralesional corticosteroid (ILC) was associated with significantly higher frequencies of most adverse effects compared to fractional CO_2 laser. Particularly notable were the near- universal rates of irritation (100% vs 50%, p<0.001), burning sensation (96.7% vs 23.3%, p<0.001), erythema (96.7% vs 33.3%, p<0.001), and pain (96.7% vs 13.3%, p<0.001) in the ILC group. Pruritus was also significantly more common with ILC (20.0% vs 3.3%, p= 0.037). Importantly, only the ILC group reported steroid specific adverse effects including skin atrophy (13.3% vs 0%, p=0.037) and talengiectasias (13.3% vs 0%, p=0.037). Hypopigmentation showed a non-significant trend toward higher incidence with ILC (13.3% vs 3.3%, p=0.157). These findings indicate that while both treatments cause adverse effects, CO_2 laser therapy presents a more favorable safety profile with significantly fewer and less severe adverse effects (Table 6).

• *Table 6. Immediate adverse effects in treatment groups*

Adverse Effect	Group A (CO_2 Laser) N=30	Group B (ILC) N=30	ap- value
Pruritus	01 (3.3%)	06 (20.0%)	<0.041s
Irritation	15 (50.0%)	30 (100.0%)	<0.001s
Burning Sensation	07 (23.3%)	29 (96.7%)	<0.001s
Erythema	10 (33.3%)	29 (96.7%)	<0.001s
Pain	04 (13.3%)	29 (96.7%)	<0.001s
Hypopigmentation	01 (3.3%)	04 (13.3%)	0.157ns
Atrophy	0 (0.0%)	04 (13..3%)	0.037s
Talengiectasias	0 (0.0%)	04 (13.3%)	0.037s

[a]Fischer's Exact test used for all comparisons due to expected cell counts <5 in some categories.
S= significant, ns= not significant.

Discussion

Our findings are in agreement with Yoo et al. (2010) treated a 35-year-old male, with multiple alopecia areata patches of 2 years duration, with fractional laser weekly for 24 weeks. Hair growth observed already after 1 month, while after 6 months; complete regrowth in all lesions with no relapse.6 Also Cho et al. (2013) who used non-ablative and/or ablative lasers in 17 patients with uncommon hair disorders as ophiasis, frontal fibrosing alopecia, and perifolliculitis abscedens el suffodiens, reported; 70.6% of patients showed clinical improvement including individuals with ophiasis.3 Moreover, Majid et al. (2018) treated 10 patients of resistant alopecia areata with F CO_2 laser 4 to 8 sessions 3 to 4 weeks interval followed by topical corticosteroid application, found seven of eight patients had complete recovery.7 Contradicting, Yalici-Armagan and Elcin (2016) treating 32 alopecia areata patients with F CO_2 laser 3-6 sessions, 2 week intervals, hair count was calculated using digital phototrichogram, reported no significant increase in mean hair count as compared to control patch. 8 Our study reported minimal side effects with F CO_2 laser similar to Cho et al. (2013), although Yoo et al. (2010) did not report any side effects.3,6 Regarding I/LCs efficacy in treatment of alopecia areata, our results are in agreement with Narahari (1996), Kassim et al.(2014) who only showed some benefits with I/LCs.5,9 In contrast, Kumaresan (2010), Kuldeep et al. (2011), and Amirnia et al. (2015) still considered I/LCs the safest and preferred method for treating most alopecia areata patients.10,11,12

Conclusion

Both Fractional CO_2 laser and Intralesional steroid when used individually were found to be equally effective in the treatment of alopecia areata, but Fractional CO_2 laser was found to be superior in efficacy than Intralesional steroid injection. Intralesional corticosteroid (ILC) was associated with significantly higher frequencies of complication compared to fractional CO_2 laser. Further multicenter, randomized, double-blind study should be conducted with large sample size.

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Conflict of Interest

Authors declare no conflict of Interest.

Reference

1. Kaur S, Mahajan BB, Mahajan R. Comparative evaluation of intralesional triamcinolone acetonide injection, narrow band ultraviolet B, and their combination in alopecia areata. Int J Trichol.2015;7(4):148-155.
2. Amirnia M, Mahmoudi S, Karkon-Shayan F, Alikhah H, Piri R, Naghavi-Behzad M. Comparative study of intralesional steroid injection and cryotherapy in alopecia areata. Niger Med J. 2015;56(4):015;47(5):433-440
3. Cho S, Choi MJ, Zheng Z, Goo B, Kim D, Cho SB. Clinical effects of non-ablative and ablative fractional lasers on various hair disorders: a case series of 17 patients. J Cosmet Laser Ther. 2013;15(2):74-79.
4. Kuldeep C, Singhal H, Khare A, Mittal A, Gupta L, Garg A. Randomized comparison of topical betamethasone valerate foam, intralesional triamcinolone acetonide and tacrolimus ointment in management of localized alopecia areata. Int J Trichol. 2011;3(1):20-24.
5. Narahari SR. Comparative efficacy of topical anthralin and intralesional triamcinolone in the treatment of alopecia areata. Indian J Dermatol Venereol Leprol. 1996;62(6):348-350.
6. Yoo KH, Kim MN, Kim BJ, Kim CW. Treatment of alopecia areata with fractional photothermolysis laser. Int J Dermatol. 2010;49(7):845-847.

7. Majid I, Jeelani S, Imran S. Fractional carbon dioxide laser in combination with topical corticosteroid application in resistant alopecia areata: a case series. J Cutan Aesthet Surg. 2018;11(4):217-221.
8. Yalici-Armagan B, Elcin G. The effect of neodymium: yttrium aluminum garnet and fractional carbon dioxide lasers on alopecia areata: A Prospective Controlled Clinical Trial. Dermatol Surg. 2016;42(4): 500-506.
9. Kassim JM, Shipman AR, Szczecinska W, et al. How effective is intralesional injection of triamcinolone acetonide compared with topical treatments in inducing and maintaining hair growth in patients with alopecia areata? Br J Dermatol. 2014;170(4):766-771.
10. Kumaresan M. Intralesional steroids for alopecia areata. Int J Trichol. 2010;2(1):63-65.
11. Kuldeep C, Singhal H, Khare A, Mittal A, Gupta L, Garg A. Randomized comparison of topical betamethasone valerate foam, intralesional triamcinolone acetonide and tacrolimus ointment in management of localized alopecia areata. Int J Trichol. 2011;3(1):20-24.
12. Amirnia M, Mahmoudi S, Karkon-Shayan F, Alikhah H, Piri R, Naghavi-Behzad M. Comparative study of intralesional steroid injection and cryotherapy in alopecia areata. Niger Med J. 2015;56(4):015;47(5):433-440

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