

How to Cite:

Alobead, Z. A., AlMesfer, A., & Assiri, A. (2021). Laser treatment for rhinophyma: A systematic review. *International Journal of Health Sciences*, 5(S1), 1341–1352.
<https://doi.org/10.53730/ijhs.v5nS1.15244>

Laser treatment for rhinophyma: A systematic review

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Abstract--Background & objectives: Rhinophyma is a severe subtype of rosacea that leads to significant cosmetic and functional issues, greatly affecting patients' quality of life. Traditional surgical options for rhinophyma, though effective, often come with drawbacks such as scarring and long recovery times. This review aims to evaluate the effectiveness, safety, and patient outcomes of laser treatments for managing rhinophyma. **Methods:** A thorough search across four databases identified 400 relevant publications. After removing duplicates using Rayyan QCRI and screening for relevance, 55 full-text articles were reviewed, with 8 studies ultimately meeting the criteria for inclusion. **Results:** Of the 8 studies, 5 were case series and 3 were retrospective cohort studies. Four studies focused on CO₂ lasers, showing positive aesthetic improvements, high levels of patient satisfaction, and minimal side effects. Er:YAG lasers, discussed in three studies, were noted for their precision, lower complication rates, and quicker recovery times compared to CO₂ lasers. One study explored a combination of both lasers and reported effective outcomes with minimal bleeding and improved cosmetic results. **Conclusion:** CO₂ and Er:YAG lasers appear to be safe and effective alternatives to surgery for treating rhinophyma, with both techniques offering high patient satisfaction and fewer complications. CO₂ lasers are favored for their cosmetic outcomes, while Er:YAG lasers may provide better precision and quicker recovery. However, the high cost of laser treatments and the lack of robust, large-scale trials highlight the need for further research to better assess long-term effectiveness and cost-efficiency.

Keywords---Rhinophyma, Management, Laser CO₂, Er:YAG, Systematic review.

Introduction

The benign skin condition known as rhinophyma results in the sebaceous glands in nasal tissue being enlarged. "Phyma" (growth) and "rhis" (nose) are the Greek terms from which the name rhinophyma is created. Although Daniel Sennert performed the first rhinophyma surgery in 1629, Hebra coined the term in 1845 [1]. A severe type of rosacea called rhinophyma affects the soft tissues of the nose, causing disruption to the nasal architecture, blockage of the airway, and disfigurement of the nasal aesthetic components. The characteristics of rhinophyma include erythema, telangiectasias, nodules, and bulbous-appearing lobules in the nasal soft tissues [2]. The etiology of rhinophyma is still unclear. The majority of afflicted individuals are male Caucasian in their fifth or seventh decades of life; Asian and African populations are less likely to experience it [3, 4]. In patients with rhinophyma, the male-to-female ratio varies from 12:1 to 30:1 [3, 5].

Dilated pores in the distal part of the nose are the initial clinical sign of rhinophyma with severe cases, the nose's connective tissue and sebaceous glands overgrow, leaving the distal nose covered with enormous nodules. Rhinophyma has two histopathologic forms: a fibrous, telangiectatic form with an abundance of blood vessels, connective tissue, and lymphatics, and a hypertrophic, sebaceous, glandular type [6, 7].

Both rhinophyma and rosacea have complicated pathophysiologies and etiologies. It is believed that rosacea is a complicated condition. Exacerbating variables such as heat, stress, UV radiation, smoking, alcohol, spicy meals, and hot beverages have been discovered [8]. Temporary erythema may be caused by microorganisms like *Helicobacter pylori*, which generate chemicals that dilate blood vessels, such as nitrous oxide or serum gastrin. The development of papulopustular rosacea may be facilitated by antibodies directed against collagen VII, elastin, and the *Demodex folliculorum* mite [8, 9]. Studies show that rhinophyma develops and advances through a pattern of fibrosis and ongoing inflammation. The presence of Factor XIIIa-positive fibroblasts and the upregulation of TGF- β 2 and its related receptors in immunohistochemistry are indications that fibrosis contributes to its pathogenesis [7, 10].

The decision about the type of treatment seems not to be determined by the severity of the condition, but rather by the surgeon or practitioner. A more sophisticated and specialized skill set that is entirely dependent on the surgeon is required for laser therapy, subunit approach, and scalpel resection (Shaw and cold knife). The el-Azhary scale states that laser and excisional operations are effective treatments for small to moderate rhinophyma ; However, for the objectives listed and as a combination therapy for individuals with chronic functional nasal obstruction, the subunit approach is preferred [11].

Traditional treatments like surgery or dermabrasion have been used for years but can leave patients with scars and involve lengthy recovery periods. In recent times, laser treatments have gained attention as a promising alternative, offering more precision and potentially better cosmetic outcomes with quicker recovery. However, the effectiveness and safety of these laser treatments aren't fully understood, and there hasn't been a comprehensive review of the available research. A systematic review is needed to assess how well laser treatments work, how safe they are, and what their long-term outcomes might be. The purpose of this study is to thoroughly examine the literature on laser therapies for rhinophyma, assess their efficacy, safety, and long-term results. By comparing these treatments to traditional methods, this review aims to provide healthcare professionals with clear, evidence-based guidance on using laser therapy for rhinophyma. Additionally, the review will identify gaps in the current research that future studies can address.

Methods

Search strategy

The systematic review followed the PRISMA and GATHER criteria. A thorough search was conducted to find relevant studies describing laser therapy for rhinophyma. The reviewers looked through four digital databases: PubMed, Cochrane, Web of Science, and SCOPUS. Included were studies that were released up until September 2024. We removed any duplicates from the titles and abstracts that we entered into Rayyan after finding them through computerized searches. After that, all of the study materials that met the inclusion requirements according to the title or abstract were gathered for a thorough examination. Two reviewers separately evaluated the appropriateness of the extracted papers and addressed any inconsistencies via discussion.

Study population—selection

The PICO (Population, Intervention, Comparison, and Outcome) factors were implemented as inclusion criteria for our review: (i) Population: Patients diagnosed with rhinophyma, (ii) Intervention: Laser treatment, (iii) Comparator: Other laser treatments, traditional approaches, and surgical procedures, (iv) Outcome: effectiveness and safety of laser treatment. Only primary investigations studying the administration of laser treatment to rhinophyma were included.

Data extraction

Data from studies that satisfied the inclusion criteria were collected in a standardised manner by two impartial reviewers. The data listed below was obtained and noted: (i) First author (ii) Year of publication, (iii) Study design, (iv) Participants' number, (v) Age, (vi) Gender, (vii) Follow-up duration (in months) (viii) Type of laser, (ix) Comparator intervention if present, (x) Diagnostic tool of rhinophyma, (xi) Degree of rhinophyma, (xii) Main outcomes (Efficacy, safety, and complications).

Quality review

Because the ROBINS-I approach allows for a thorough examination of confounding, we used it to evaluate the risk of bias, which is significant because bias owing to omitted variables is common in studies in this field. The ROBINS-I tool is intended to evaluate non-randomized investigations and can be applied to cohort designs in which participants exposed to various staffing levels are monitored over time. Disagreements were settled through group discussion after each paper's risk of bias was evaluated independently by two reviewers[12].

Results

The designated search approach produced 908 publications (**Figure 1**). After removing duplicates (n =189), 211 trials were evaluated based on title and abstract. Of these, 156 failed to satisfy eligibility criteria, leaving just 55 full-text articles for comprehensive review. Four records were identified through citation search and only one was accepted into our review. A total of 8 satisfied the requirements for eligibility with evidence synthesis for analysis, including 5 case series, and 3 retrospective cohorts.

Sociodemographic and clinical outcomes

We included eight studies with a total of 252 rhinophyma patients and the majority were males 233 (92.5%). In the USA, three studies were conducted [15, 16, 18], two in the UK [17, 19], one in Egypt [14], one in Austria [20], and one in Brazil [21]. The follow-up duration in this study ranged from 1 month to 41.6 months. Four studies investigated CO₂ laser as the main intervention [16, 19, 20, 21], three discussed Er: YAG laser [14, 15, 18], and one discussed combined Erbium-YAG/CO₂ Laser [17].

CO₂ laser

Patients who used CO₂ laser reported an improvement in the esthetic look of their noses [16], and improved patients' happiness and self-esteem [21]. Treatment offers a minimal risk of adverse effects and is connected to great patient acceptance and satisfaction [16, 19]. One earlier study revealed that CO₂ laser is pricey and this cost does not justify the convenience of its usage, accuracy, and precision [20]

YAG laser

YAG laser provided a successful instrument for treating mild to severe rhinophyma with fast postoperative recovery, high satisfaction, and no complications when compared to traditional surgeries [14, 15, 18]. Compared to a CO₂ laser, it offers better ablation precision, a decreased risk of complications, less discomfort, and a quicker recovery time[15]. According to one study that combined the two methods, an efficient vaporization device made of an erbium: For accurate nose shaping and aesthetically pleasing results, a practically bloodless field is created using a YAG laser and a CO₂ coagulation laser [17].

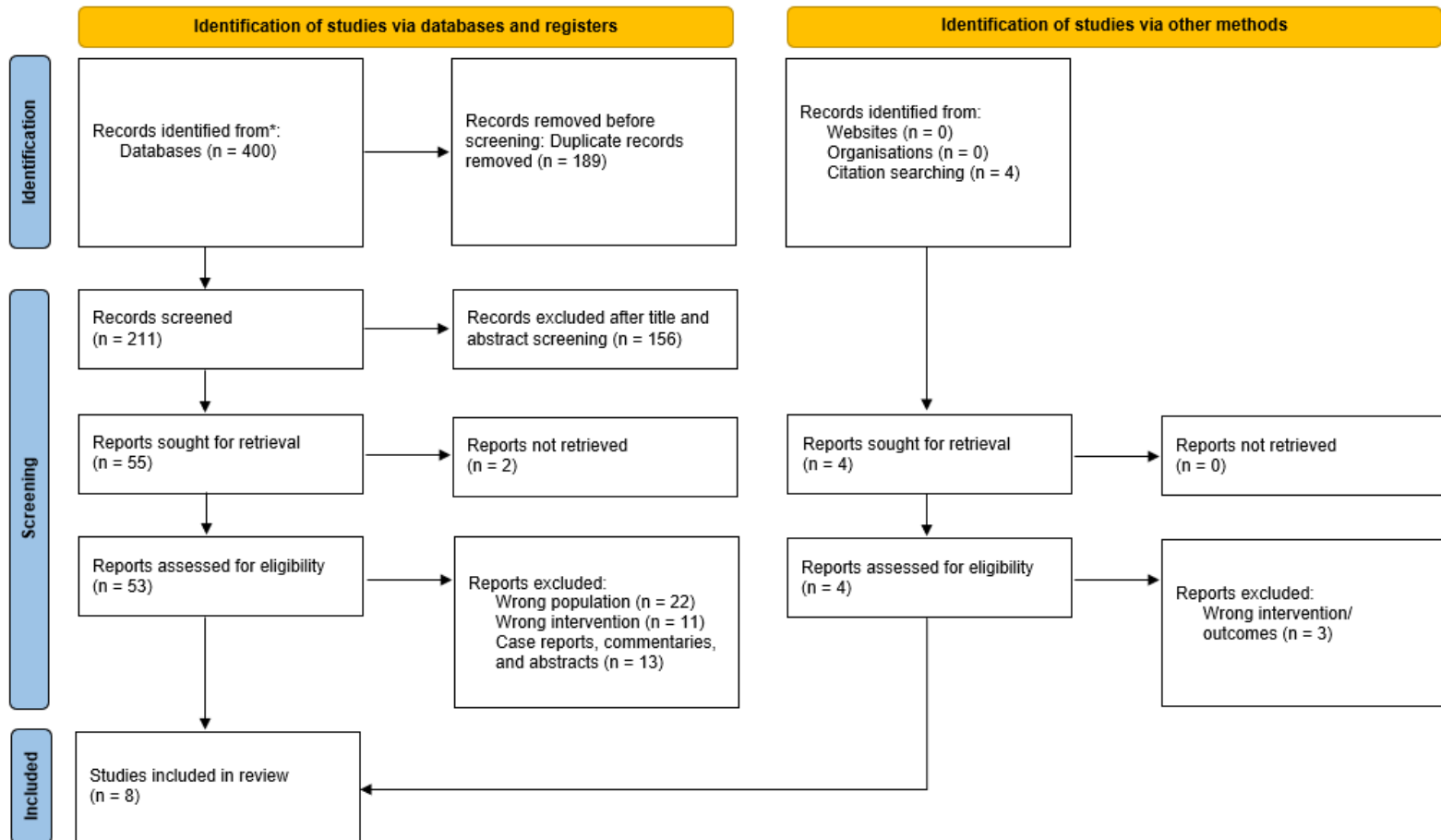


Figure (1): PRISMA flowchart [13]

Table (1): Outcome measures of the included studies

Study ID	Country	Study design	Sociodemographic	Follow-up (months)	Laser type	Comparison	Diagnostic tool	Rhinophyma degree	Main outcomes
Osman, 2019 [14]	Egypt	Case-series	N=8 Mean age: 57.8 Males: 5 (62.5%)	6	Er:YAG laser	Traditional procedures	Fitzpatrick skin phototype	Mild to moderate	When compared to conventional operations, the pattern ablative Er:YAG laser with the PS01 handpiece and parameters used in this study is an effective tool for treating mild to moderate rhinophyma with a quick recovery after surgery.
Mathis & Ibrahim, 2019 [15]	USA	Case-series	N=11 Males: 11 (100%)	1	Er:YAG laser	CO ₂ laser	Fitzpatrick skin phototype	Mild to severe	For patients with mild-to-severe rhinophyma, the Er:YAG laser is a great therapeutic option since it offers better ablation precision than a CO ₂ laser, a reduced risk of complications, less discomfort, and a quicker recovery time.
Ali & Streitman, 1997 [16]	USA	Case-series	N=18 Mean age: 64.8 Males: 18 (100%)	41.6	CO ₂ laser	NA	NM	NM	Following rhinophyma excision using CO ₂ laser, all 18 patients reported an improvement in the esthetic look of their noses. Over the last ten years, the CO ₂ laser has been shown to be a relatively reliable and efficient technique for treating this difficult lesion.
Goon et al., 2004 [17]	UK	Case-series	N=6 Males: 6 (100%)	12	Combined Erbium-YAG/CO ₂ Laser	NA	Clinically	Severe forms	An effective vaporization tool consisting of an erbium:YAG laser and a CO ₂ coagulation laser produces a nearly bloodless environment for accurate nose shaping and results in an aesthetically attractive outcome.

Fincher et al., 2004 [18]	USA	Case-series	N=6 Age range: 37-73 Males: 5 (83.3%)	3	Er:YAG laser	NA	El-Azhary criteria	Mild to severe	Using a dual-mode Er:YAG laser, this series demonstrates excellent outcomes with no issues and high patient satisfaction percentage. This laser is the finest for repairing rhinophymas because of its many benefits, including its dual-mode capabilities that allow the operator to sculpt even sensitive cosmetic units.
Madan et al., 2009 [19]	UK	Retrospective cohort	N=124 Mean age: 63 Males: 111 (89.5%)	3	CO ₂ laser	Traditional procedures	Clinically	Mild to severe	One effective and long-lasting therapy for rhinophyma is the CO ₂ laser. The treatment is associated with great patient satisfaction and acceptance with a minimal risk of adverse effects.
Lazzeri et al., 2013 [20]	Austria	Retrospective cohort	N=67 Mean age: 61 Males: 67 (100%)	3-18	CO ₂ laser	Tangential excision	Clinically	Mild to moderate	Compared to the more straightforward cold blade tangential excision, the CO ₂ laser has greater costs and requires more cash. The simplicity of use, accuracy, and precision that lasers offer do not outweigh their greater cost.
Amaral et al., 2019 [21]	Brazil	Prospective cohort	N=12 Mean age: 66 Males: 10 (83.3%)	12	CO ₂ laser	NA	El-Azhary criteria	Mild to moderate	The management of rhinophyma with a fractional CO ₂ laser improves patient happiness and self-esteem.

Table (2): Risk of bias assessment using ROBINS-I

Study ID	Bias due to confounding	Bias in the selection of participants into	Bias in the classification of interventions	Bias due to deviations from the intended interval	Bias due to missing data	Bias in the measurement of outcomes	Bias in the selection of reported result	Overall bias
Osman, 2019 [14]	Mod	Mod	Low	Low	Low	Mod	Mod	Moderate
Mathis & Ibrahim, 2019 [15]	Low	Low	Low	Low	Low	Mod	Low	Low
Ali & Streitman, 1997 [16]	Low	Low	Low	Low	Low	Mod	Low	Low
Goon et al., 2004 [17]	Low	Low	Low	Low	Low	Mod	Low	Low
Fincher et al., 2004 [18]	Mod	Mod	Low	Low	Low	Mod	Low	Moderate
Madan et al., 2009 [19]	Mod	Mod	Low	Low	Low	Low	Mod	Moderate
Lazzeri et al., 2013 [20]	Crit	Low	Low	Low	Mod	Mod	Low	Critical
Amaral et al., 2019 [21]	Crit	Low	Low	Low	Low	Mod	Low	Critical

Discussion

This review included 252 rhinophyma patients and the vast majority were males 233 (92.5%). Rosacea is more common in women. But white males over 50 are the most commonly found to have rhinophyma, with a male-to-female ratio varying from 5 to 30 to 1. Although it is rare, the phenomenon among Asian or African American men has been reported in the literature. Androgenic factors may predispose guys to rhinophyma formation [22, 23].

We found that patients who used CO₂ laser reported an improvement in the esthetic look of their noses [16], and improved patients' happiness and self-esteem [21]. Low side effect rates are associated with high patient acceptance and satisfaction with treatment [16, 19]. Skin can be burned and melted by CO₂ laser therapy. Because water absorbs the majority of the laser's 10600 nm wavelength, penetration can occur up to 5 mm below the layer that is clearly burnt. Sebum is expelled as the laser destroys the sebaceous glands, and this serves as a proxy marker for depth as scarring may be avoided by compressing the skin during surgery and leaving it without apparent sebum ejection. It has a lower risk of scarring, needs less postoperative care, produces a bloodless surgical site, and consumes less heat energy than electrocautery and electrosurgery. For more precise contouring, the surgeon may combine bulk scalpel removal with a CO₂ laser. Tissue is available for histopathologic analysis following the initial scalpel reduction performed prior to using the CO₂ laser. Some common side effects include hypopigmentation, dilated pores from the removal of sebum-producing fibrosed glands and cyst sites in the follicles, expensive equipment expenses, and prolonged recovery periods. Reepithelization takes about three weeks [24, 25].

This review also found that the YAG laser provided a successful instrument for treating mild to severe rhinophyma with fast postoperative recovery, high satisfaction, and no complications when compared to traditional surgeries [14, 15, 18]. Compared to a CO₂ laser, it offers better ablation precision, a decreased risk of complications, less discomfort, and a quicker recovery time [15]. The wavelength of the usual infrared light produced by the Er:YAG laser, a solid-state laser, is 2940 nm, which is the peak wavelength absorbed by water. Its shorter wavelength of absorbance results in a more focused absorption spectrum and a lesser penetration depth per mass as compared to the CO₂ laser [26]. Every pass, the penetration depth has been found to be between 10 and 30 µm [27], It is either less than or equal to the normal depth of the epidermis. The solid-state neodymium:YAG laser emits continuous-wave infrared light with a wavelength of 1064 nm, which is absorbed by hemoglobin and damages blood vessels [28]. It distributes heat energy in an indiscriminate manner and penetrates 4-6 mm [29]. **Chauhan et al.** revealed that the recurrence, complication, and revision rates for patients receiving Er:YAG and Nd:YAG laser treatment were 0%. In patients undergoing Er:YAG laser treatment, re-epithelialization occurred in 1-4 weeks with minimal post-procedural erythema [11].

According to one research in this review, both methods are efficient vaporization tools that combine a CO₂ coagulation laser with an Er:YAG laser to create a practically bloodless field for accurate nose shaping and visually pleasing results. [17]. **Chauhan et al.** discovered that laser and excisional techniques are

frequently employed. When functional nasal problems accompany a significant rhinophyma, the subunit surgical approach is recommended, and it makes better structure and support possible. Following surgery, patients who get treatment consistently report improved appearance and functionality [11].

The results of this review emphasize how effective laser treatments, particularly CO₂ and Er lasers, can be in managing rhinophyma. Both lasers showed positive cosmetic results, with patients experiencing improvements in appearance and increased confidence after the procedures. CO₂ lasers, in particular, seem to be favored for their precision and minimal side effects, making them a good option for patients who want a faster recovery and better aesthetic outcomes. These findings suggest that laser treatments could offer a less invasive alternative to conventional surgeries, which tend to have longer recovery times and higher risks. However, it's important to consider the cost of laser treatments, particularly CO₂ lasers, which can be expensive. Clinicians will need to weigh the clinical benefits against the financial aspects to make sure patients receive the most appropriate care.

Strengths and Limitations

The review also covers various laser treatments—CO₂, Er, and a combination of both—giving a more comprehensive overview of how these technologies compare in practice. Another strength is the length of follow-up in some studies, which ranged from 1 month to over 3 years, offering valuable insight into both short- and long-term results. Patient satisfaction was consistently high across all the studies, particularly when it came to cosmetic improvements and recovery times, emphasizing the clinical value of laser treatments for this condition.

However, there are several limitations to consider. First, the total number of patients in the included studies is relatively small, using a mere 252 individuals, thereby reducing the validity of the findings. Another important limitation is the absence of randomized controlled trials (RCTs) in these studies, as most were case series or retrospective cohorts. Without RCTs, the findings may be subject to biases or other influencing factors that could skew the results. The cost of laser treatments, particularly CO₂ lasers, was mentioned in one study but not explored in detail across all of them, leaving a gap in understanding the financial burden on patients. Finally, the variability in follow-up durations among the studies could make it harder to compare long-term outcomes consistently, and some studies had relatively short follow-up periods, limiting insights into any delayed complications.

Conclusion

Laser treatments like CO₂ and Er: YAG lasers show great potential as effective, less invasive alternatives to surgery for treating rhinophyma. These treatments not only provide significant cosmetic improvements but are also associated with high patient satisfaction, faster recovery times, and fewer complications. While the Er:YAG laser stands out for its precision and quicker recovery, the CO₂ laser remains highly valued for its cosmetic outcomes and patient comfort. However, the high cost of some laser treatments and the lack of large-scale, high-quality

research suggest that more studies are needed to fully understand their cost-effectiveness and long-term results. As the field continues to evolve, laser therapy could become a key option in managing rhinophyma, but more research is necessary to refine treatment recommendations and ensure the best possible outcomes for patients.

Conflict of Interests: No conflict of interests is declared.

Fund: non-fundable.

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