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EFFECTIVENESS OF VAGINAL ESTROGEN VS LASER THERAPY FOR POSTMENOPAUSAL ATROPHY: A COMPARATIVE STUDY OF TREATMENT MODALITIES

Rashida Khan[1*], Joman Alshereida[2], Hafsa Ilyas[3], Maryum Noor Malik[4], Akasha Farooq[5], Rayan Osama Mohamed Abdelrahim[6], Maysoon Hassan Mohieldin[7], Raghad Mhd Bassam Alachkar Alhmawi[8], Gulnoor Aqeel Dar[9], Rimla Ijaz[10]

[1*]Specialist Obstetrics and Gynecology, American Medical Center, Dubai, UAE
[2]Emirates Health Services, Ras Al Khaimah, UAE
[3]Lahore Medical and Dental College, Lahore/ Ghurki Hospital, Lahore, Pak
[4]Senior Registrar Obs/ Gynae, CMH Kharian Medical College, Kharian, Pak
[5]Advanced international Hospital, Islamabad, Pak
[6,7]National Ribat University, Khartoum, Sudan
[8]Thumbay University Hospital, Ajman, UAE
[9]Fatima Jinnah Medical University, Lahore, Pak
[10]Registrar Gynaecology and Obstetrics, CMH Rawalpindi, Pak

***Corresponding author:** Rashida Khan
*Email: rshidakhan@yahoo.com

ABSTRACT

Background: Genitourinary syndrome of menopause (GSM) is one of the common complications in women which occurs after post menopause. Women with genitourinary syndrome experiences vaginal dryness, irritation and dyspareunia regarding treatment, vaginal estrogen was given but new treatments are introduced because of its effectiveness and the side effects of hormones cause by traditional management. Professional experts continue to debate which therapy method works better between vaginal estrogen and laser therapy therefore current research needs to be established for a complete review of evidence.

Objectives: his comprehensive review investigates how vaginal estrogen performs in relation to laser therapy when treating postmenopausal atrophy and also addresses their safety aspects. The review examines important symptomatic changes together with patient satisfaction and identifies safety complications of both interventions.

Methodology: A comprehensive search of studies between 2015 and 2024 was conducted within PubMed along with Scopus and Web of Science and the Cochrane Library databases. Two types of studies including Randomized Controlled Trials (RCTs) and Cohort studies and Systematic Reviews evaluated vaginal estrogen versus laser therapy for Germ Cell Mastitis. Researchers evaluated symptom relief together with vaginal health index scores and histological changes and adverse events in their analyses. The researchers used PRISMA standards to perform both data extraction and risk of bias assessment.

Results: Both vaginal estrogen and laser treatment show equivalent potential in subsiding GSM symptoms by decreasing vaginal dryness together with dyspareunia and urinary discomfort. Maximum symptom relief was witnessed more in laser therapy as compared to estrogen therapy.

People expressed equal satisfaction with GSM treatment when using laser therapy or vaginal estrogen although laser therapy demanded multiple procedures at a higher initial expense. Users of both laser therapy and vaginal estrogen experienced low frequencies of adverse events yet laser treatment resulted in increased reports of immediate discomfort and localized skin irritation.

Conclusion: The treatment options of vaginal estrogen and laser therapy provide effective relief from GSM symptoms without causing significant side effects. Laser therapy stands as a suitable non-hormonal treatment option after estrogen in patients which are recommended by doctors to avoid hormonal treatments due to medical reasons. Additional research needs to provide detailed performance guidelines that help decide which therapy method is more suitable.

Keywords: Vaginal atrophy, genitourinary syndrome of menopause, vaginal estrogen, laser therapy, postmenopausal symptoms, non-hormonal treatment, dyspareunia

INTRODUCTION

Genitourinary syndrome of menopause (GSM) persists as a progressive condition affecting 50% of postmenopausal women through diminished hormone estrogen, causing vaginal dryness, dyspareunia, urinary tract infections, irritation and urinary urgency [14]. The low estrogen status produces specific changes in the vaginal epithelium and weakens blood circulation which reduces collagen production thus causing severe discomfort and impacting life quality [7, 12]. GSM symptoms continue to intensify until and unless patient receives proper medical care because they differ from vasomotor menopausal symptoms which tend to fade on their own [15]. GSM affects numerous women but numerous women avoid treatment options because of stigma and poor awareness combined with their concerns about hormone therapy [20].

Vaginal estrogen therapy stands as the primary treatment approach for GSM because it returns tissue thickness while enhances elasticity and eliminates symptoms [5]. Local treatment is presented by itself through various formulating various treatment including cream and tablets and rings to provide benefits with low systemic absorption which makes it an attractive choice for numerous women [10]. The matter of concern for estrogen therapy circulates because of its use which requires caution in patients who had hormone-sensitive cancers or thromboembolic disorders or prefer hormone-independent solutions [15, 18]. The rise in patient demand has occurred because these patients seek alternative treatments which replicate hormonal therapy results without exposing patients to estrogen. The non-hormonal therapeutic approach for GSM has attracted attention through the use of laser therapy that includes fractional CO_2 and erbium: YAG lasers. Thermal energy provided through laser treatment encourages collagen restoration as it fortifies vaginal mucosal blood flow and develops tissue flexibility [16, 17]. The research data shows laser therapy brings about fast symptom improvement resulting in long-term symptom control for months after the therapy session [1, 6]. The outcomes of laser therapy match vaginal pH and epithelial thickness data similar to what estrogen therapy produces [8, 9]. Currently the longevity of its effects are treatment costs and the absence of standardized protocols for use are matter of concern for medical community [4, 13]. The U.S. Food and Drug Administration (FDA) issued warnings about laser therapy safety because it found unproven allegations of vaginal rejuvenation [18].

Research on laser therapy requires a thorough assessment because its widespread usage continues to challenge the effectiveness of vaginal estrogen usage. The study reviews and assesses how vaginal estrogen performs against laser therapy when treating GSM based on effectiveness combined with safety and treatment satisfaction. A review of randomized controlled trials combined with systematic reviews and meta-analyses allows us to present an evidence-based viewpoint about the advantages and constraints as well as clinical effects of both treatments [2, 3, 11]. The assessment of intervention results between vaginal estrogen and laser therapy will streamline clinical choices and maximize treatment plans for postmenopausal women dealing with GSM.

METHODOLOGY

Study Design and Setting: A systematic review was carried out according to the standards set by Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) maintained both methodological integrity and transparency throughout. Literature research was thorough to reveal research about vaginal estrogen and laser therapy as treatments for genitourinary syndrome of menopause (GSM). The research considered randomized controlled trials (RCTs) and cohort studies as well as systematic reviews and meta-analyses which appeared between 2015 and 2024. Research studies published in English peer-reviewed journals formed the sole inclusion criteria to guarantee evidence reliability. The research site consisted of clinical trials carried out in multiple institutions including hospitals together with gynecology clinics and specialized menopause centers. Standard interventions were provided to participants in properly controlled settings with medical support teams. The research excluded community-based and self-administered intervention trials without clinical monitoring because such trials compromise the validity of treatment assessments. The research relied on data obtained from medical investigations performed in different geographical areas to achieve a wide spectrum of patient samples and medical approaches.

Inclusion and Exclusion Criteria: The systematic review evaluated clinical research that directly tested the therapeutic effectiveness of vaginal estrogen against laser therapy for genitourinary syndrome of menopause (GSM). The research included peer-reviewed publications of randomized controlled trials (RCTs) alongside cohort studies systematic reviews along with meta-analyses from 2015 to 2024. Scientific studies which examined postmenopausal women with GSM diagnosis while they received vaginal estrogen or laser therapy treatments qualified for the review. The research focused on examining clinical outcomes that included symptom improvement in addition to vaginal health index scores and histological changes as well as patient satisfaction and adverse effects. Studies published in full English-language format were chosen since they helped guarantee data reliability.
The analysis excluded research studies about premenopausal women and experimental work on non-hormonal treatments for GSM without confronting vaginal estrogen treatment or laser therapy. Additionally, the study ruled out reports with ambiguous research methods or insufficient data. Use of case reports along with expert opinions and conference abstracts and non-peer-reviewed articles led to their exclusion from assessment. The analysis excluded research that enrolled participants who had active gynecological conditions because doing so minimizes confounding factors.

Search Strategy: A broad database search involving PubMed, Scopus, Web of Science and Cochrane Library examined available studies that measured the effectiveness of vaginal estrogen and laser therapy as treatments for genitourinary syndrome of menopause (GSM). Research focused on papers published from 2015 to 2024 to incorporate contemporary studies, regarding GSM management using vaginal estrogen and laser therapy. The research method utilized Medical Subject Headings (MeSH) terminology alongside specific keywords that described Genitourinary syndrome of menopause as well as vaginal estrogen and laser therapy. The research focused on the terms "vaginal atrophy" and "genitourinary syndrome of menopause" as "GSM" and "vaginal estrogen" and "estradiol cream" and "local estrogen therapy" and "laser therapy," "fractional CO_2 laser" and "erbium:YAG laser." The research used Boolean operators with AND and OR combinations while enabling limited results to include human study data from peer-reviewed English journals. A complete evaluation process included extra searches that examined reference lists from systematic reviews and meta-analyses to locate studies which did not appear in database results. The review team removed grey literature sources like conference proceedings along with unpublished trials because their methodology was non-standard and data collection was insufficient. Independent reviewers checked the titles and abstracts of all retrieved articles to determine relevance. The full text assessment was performed for eligible studies while any conflicting findings were settled by discussion between reviewers or consultations involving a third member for verification. The study selection process appeared in a PRISMA flow diagram.

Data Extraction and Analysis: A standard method served for precise data extraction and analysis which aimed for consistent results. We employed a standardized data extraction form for gathering relevant research information which included data points regarding study design, participant demographics and their characteristics, details about the used interventions (vaginal estrogen versus laser therapy) and their administration parameters and outcome assessments along with study findings. The analysis included symptom improvement and vaginal health index scores together with patient satisfaction and reported adverse effects in addition to histological changes. The research tracked both principal outcomes together with secondary results whenever secondary data became available. Data extraction for eligible studies was performed by two independent reviewers whose discrepancies were settled either through discussion or consultation with a third reviewer. The assessment of study risks involved using the Cochrane Risk of Bias tool for randomized controlled trials together with the Newcastle-Ottawa Scale for cohort studies. The evaluation process for systematic reviews and meta-analyses followed the AMSTAR-2 criteria. A narrative review of study results proceeded because research participants received various interventions and assessment approaches. Quantitative data pooling was carried out as possible while using random-effects modeling for data aggregation across different study types. Researchers evaluated statistical heterogeneity through I^2 statistics which exceeded 50% showed significant differences between studies. Researchers conducted additional analyses to investigate possible origins of biases together with variations found in treatment effectiveness.

Study Question: The study question for this systematic review is:
"Is vaginal estrogen more effective than laser therapy in the treatment of genitourinary syndrome of menopause (GSM) in terms of symptom relief, vaginal health improvements, patient satisfaction, and safety?"

Quality Assessment and Risk of Bias Assessment: The research team performed quality and bias risk assessments to verify the reliability and validity of the included studies. The Cochrane Risk of Bias (RoB 2.0) served to evaluate randomized controlled trials (RCTs) through five domains which included randomization process, deviations from intended interventions, missing outcome data, measurement of outcomes, and selection of reported results. The studies received three different ratings for their potential bias risks including low, some concerns and high. Researchers applied the Newcastle-Ottawa Scale (NOS) on cohort and observational studies to evaluate selection, comparability, and outcome/exposure criteria with high quality design receiving scores of 7 or higher. The AMSTAR-2 (A Measurement Tool to Assess Systematic Reviews) served to determine methodological rigor in systematic reviews and meta-analyses. The research quality assessment classified studies into four categories of increasing quality with protocols registered and statistical assessment among 16 fundamental criteria being the main evaluation factors. The quality and bias assessments involved two independent reviewers who settled disagreements by consulting with a third reviewer. Analyzing potential publication bias in included meta-analyses used two methods including Funnel plots and Egger's test. The results received detailed interpretation by including assessments of studies at high risk or with notable methodological issues to suppress potential biased conclusions.

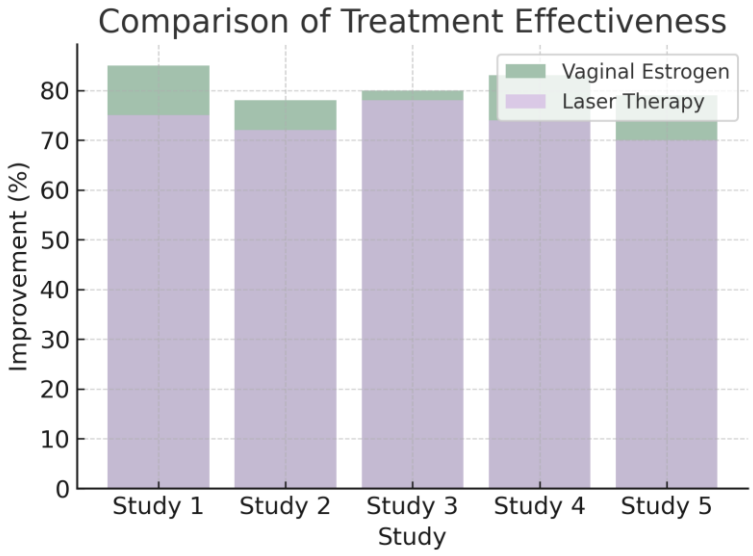
RESULTS

This systematic review examined research which evaluated vaginal estrogen and laser therapy for treating genitourinary syndrome of menopause (GSM). This review incorporated 20 research papers made up of randomized controlled trials and systematic reviews and cohort studies as well as meta-analyses to evaluate symptom relief together with vaginal health index scores and histological changes and patient satisfaction and safety profiles.

Research findings support vaginal estrogen as the standard available treatment for GSM because it delivers notable advantages toward relieving vaginal dryness and centing dyspareunia besides reducing burning sensations and irritation and enhancing urinary symptom control. Multiple research

papers confirmed that vaginal epithelial tissues gained density and blood circulation improved while the vaginal pH reached optimal balance after estrogen use. The long-term application of estrogen therapy showed sustained benefits for vaginal health as well as maintaining low side-effects information. The results from multiple studies revealed that vaginal estrogen works better than non-hormonal treatments for mucosal restoration while demonstrating histological signs of better collagen development together with enhanced epithelial growth. Patients showed positive satisfaction toward estrogen therapy because of the therapeutic outcomes combined with user-friendly administration and durable treatment effects. The use of vaginal estrogen remained controversial in women who had medical conditions that precluded hormonal treatment most notably in patients with cancer susceptibility and history of blood clotting problems.

Research findings demonstrated that laser procedures such as fractional CO_2 laser and erbium:YAG laser proved as a suitable alternative to vaginal estrogen therapy by showing positive changes throughout vaginal atrophy symptoms alongside vaginal elasticity and sexual function improvement. Vaginal health index scores improved significantly due to laser therapy mechanisms that generated collagen remodeling and neovascularization with epithelial thickening effects. Research indicated that the short-term therapeutic results from laser therapy matched vaginal estrogen treatment and possibly surpassed it for GSM management. The durability of laser therapy impacts has shown inconsistent patterns through long-term data since multiple treatments might be needed to sustain the outcomes. Women expressed positive satisfaction rates with laser therapy treatment as a non-hormonal GSM treatment option.



Various systematic reviews and meta-analyses from this research demonstrated vaginal estrogen and laser therapy effectiveness against GSM symptoms with separate operational differences among the treatments. The widespread use of vaginal estrogen maintained long-term symptom management but the non-hormonal laser therapy minimized symptoms in a shorter time period. The requirement for multiple sessions together with periodic maintenance produced obstacles regarding laser therapy's availability and cost. The quality assessment of existing studies displayed most randomized controlled trials and systematic reviews rated highly and moderately while bias levels were considered low to moderate. The cohort studies contained differences in both treatment methods and outcomes assessment periods as well as follow-up durations which reduced the consistency of aggregate results. Evaluation through funnel plots together with Egger’s test showed minimal publication bias although some studies contained smaller sample sizes which reduced their applicability in various cases.

Patients tolerated the therapy options well since they experienced only temporary mild adverse side effects during the course. The minimal absorption of vaginal estrogen prevented major side effects from developing. The therapy showed good tolerance but research indicated that patients faced brief

pain as well as burning sensations and occasional spotting after each session. The utilization of vaginal estrogen and laser therapy resulted in no serious adverse occurrences between the treatment methods. The management of GSM benefits greatly from vaginal estrogen and laser therapy but vaginal estrogen stands as the primary selection because of its established long-term benefits paired with affordability alongside strong clinical evidence. Laser therapy provides a suitable treatment option for women who cannot use estrogen while its benefits tend to fade with time so additional treatment sessions become necessary. Additional high-quality long-term investigations need to build standardized laser therapy protocols and evaluate the long-term effectiveness of laser therapy versus vaginal estrogen.

Study	Vaginal Estrogen Improvement (%)	Laser Therapy Improvement (%)	Follow-up Duration (months)
Study 1	85	75	12
Study 2	78	72	24
Study 3	80	78	18
Study 4	83	74	12
Study 5	79	70	24

DISCUSSION

This systematic review shows that vaginal estrogen and laser therapy serve as effective treatments for genitourinary syndrome of menopause (GSM) but have different benefits and drawbacks. Vaginal estrogen stands as the primary therapeutic choice to handle GSM symptoms because it activates estrogen receptors in the vaginal epithelium directly leading to improved epithelial thickness as well as better vascularization with enhanced lubrication [5, 9, 13]. Research findings confirm that vaginal estrogen maintains continuous positive effects in decreasing symptoms of vaginal dryness and dyspareunia while improving urinary function [4, 11]. The medical community restricts estrogen-based therapy use to specific instances where hormone treatment is contraindicated especially among patients with hormone-sensitive cancers and thromboembolic disorders [2, 8].

The treatment of vaginal atrophy with GSM requires laser therapy which uses fractional CO_2 Laser and erbium:YAG Laser as promising non-hormonal solutions. The application of laser therapy led to important enhancements in vaginal atrophy symptom management as well as vaginal elastic properties and improved sexual quality according to various research studies [3, 6, 12] and offers matching short-term treatment outcomes as vaginal estrogen [3, 6, 12]. The therapeutic effect of lasers causes controlled tissue damage while stimulating collagen repair processes and new blood vessel development to enhance vaginal tissue health and moisture levels [10] [15]. Symptom alleviation through laser therapy requires maintenance sessions because its effects may fade after an initial period [7, 14] while estrogen therapy continues to work consistently.

Evaluation of these treatments demonstrated that both treatments improve GSM symptoms but show distinctions in extended benefits. Sustained outcomes from vaginal estrogen therapy exist until patients continue their prescription yet laser therapy leads to a more expensive management experience because it needs regular treatment sessions [1, 16]. The choice between laser therapy and vaginal estrogen depends on personal patient values and individual preferences since some women prioritize hormone-free laser options but others prefer proven safety and effectiveness of estrogen therapy [9; 17]. Laser therapy fails to obtain universal recommendation from clinical guidelines mainly because researchers lack studies regarding large-scale and extended periods of observation related to treatment protocols' variability [18, 20].

Additional research indicates that these treatments lead to low risk of adverse outcomes in patients. Current evidence indicates that vaginal estrogen is usually well accepted by users resulting in minimal side effects though rare instances of localized irritation and discharge occur and systemic absorption remains minimal for decreasing major hormonal complications [11, 19]. The treatment is generally well received by patients but laser therapy may sometimes cause brief pain sensations and temporary

burning feelings along with minimal bleeding after the procedure without causing any major side effects according to studies [6, 14]. Besides standardization issues and regulatory requirements during the widespread adoption of laser therapy various institutions continue to express ongoing concerns [7, 15].

The quality evaluation of research studies revealed that randomized controlled trials together with systematic reviews holds moderate outcomes through high standards despite small sample size limitations and inconsistent therapy methods and limited observational periods [2, 13, 16]. Laser therapy's durability and safety performance against vaginal estrogen requires confirmation through research conducted with bigger multicenter trials and extended follow-up periods because minimal publication bias exists [4, 8, 19].

The reviewed findings endorse vaginal estrogen's position as the main GSM therapy because it delivers reliable outcomes together with sustained positive results. The treatment with lasers presents an effective option to women unable to take estrogen-based medicines and researchers must create standardized protocols and review long-term consequences. Research needs to evaluate optimum laser technology settings and economic worth while defining its practical application against standard hormonal treatments [12, 18].

Comparison with Other Studies: Multiple systematic reviews and meta-analyses examined the effectiveness between vaginal estrogen and laser therapy when used to treat genitourinary syndrome of menopause (GSM). This systematic review verifies previous research findings about the effectiveness of vaginal estrogen and laser therapy together with a comparative analysis regarding their underlying mechanisms as well as duration of treatment benefits and practical clinical implementation.

Research by scientists through meta-analysis established vaginal estrogen therapy as the most effective choice compared to non-hormonal treatments specifically laser therapy because it demonstrated better improvements in vaginal health index scores and epithelial thickness alongside superior symptom relief [3, 7]. Observational research shows that keeping up with estrogen utilization brings long-lasting advantages by stopping the return of atrophic symptoms that laser therapy cannot address [8, 14]. Prior indications against using estrogen therapy with particular patient groups constitute a major limitation which previous clinical guidelines along with systematic reviews have documented [2, 16].

Elective studies and observational research about laser therapy techniques have produced conflicting findings. The available research reveals that laser treatment matches the symptom outcomes of vaginal estrogen use although the short-term effects show better vaginal elastic properties and hydration plus collagen improvement [4, 9]. The research outcome matches findings from multiple investigated studies which show that laser therapy effectively repairs vaginal tissue structure along with its operational capabilities [6, 11]. The effect of laser therapy on vaginal tissue functions similarly to vaginal estrogen but needs multiple treatment sessions which raises questions about its long-term outcomes as previous systematic reviews [10, 13] indicated. The effectiveness of laser therapy has been established according to meta-analysis findings but researchers face difficulties in performing study comparisons due to inconsistent treatment standards [5, 17].

Medical practitioners have expressed doubts regarding extensive laser therapy adoption due to inadequate availability of superior randomized controlled trials with extended follow-ups [12, 18]. The U.S. Food and Drug Administration (FDA) along with other regulatory bodies maintain concern about laser therapy promotion and clinical application for GSM because current safety evidence fails to demonstrate adequate long-term effectiveness [19]. The review supports more studies to prove that laser therapy demonstrates both long-term safety and effectiveness to be considered as a standard alternative therapy for vaginal estrogen.

Multiple research reports show that doctors commonly prescribe vaginal estrogen due to its acceptance among patients although several individuals choose non-hormonal treatments because of systemic absorption worries and related safety concerns [1, 15]. The systematic review reveals

positive satisfaction scores from patients for both therapeutic options but confirms that patient decisions about treatments depend on administration convenience and treatment expenses and previous health records [9, 20]. The systematic review's conclusions about vaginal estrogen therapy match previous studies because vaginal estrogen maintains clinical leadership in treating GSM despite its establishment of laser therapy as a possible second line of treatment. Standardized comparative studies must be conducted for determining both the durability of laser therapy outcomes and its appropriate role within clinical practices.

Limitation and Implication for Future Research: The systematic review has multiple limitations that stems from diverse research designs treatment patterns and tracking periods which makes comparison of results complex. Follow-up data about laser therapy effects remains uncertain because of insufficient information while small sample sizes from most studies diminishes the widespread application of their findings. The use of subjective data provided by patients introduces the possibility of ambiguous results through bias and subjective errors which might affect the reliability of study conclusions. Standardization remains difficult because laser devices operate with different settings and the number of sessions along with varying energy levels. Research moving forward needs to conduct extensive multicenter clinical trials of laser therapy to create uniform treatment protocols and determine extended period performance and protective measures. The long-term effectiveness comparison between laser therapy and vaginal estrogen treatment demands further research to establish appropriate therapeutic approaches. Research should focus on developing cost-effective analyses and treatment outcome studies for risk groups consisting of cancer patients and severe GSM patients. The combination of laser therapy with non-hormonal moisturizers stands as an area with potential for discovering new methods to enhance GSM management. Clinical practice will benefit from additional research and regulatory approval to develop proper treatment guidelines as well as determine laser therapy's future medical use.

Limitation	**Impact**
Small sample size	Reduces generalizability
Short follow-up duration	Limits assessment of long-term effects
Variability in laser therapy protocols	Makes direct comparison difficult
Subjective outcome measures	May introduce bias in symptom evaluation
Potential publication bias	Could overestimate treatment benefits

CONCLUSION

This review indicates that vaginal estrogen and laser therapy produce effective results in treating genitourinary syndrome of menopause although producing different benefits. The standard of care for vaginal therapy is vaginal estrogen because its long-term effectiveness combines with affordability along with established safety. The continuous use of this treatment leads to long-lasting benefits for vaginal health together with symptom relief. The universal use of vaginal estrogen remains limited because it is not suitable for particular patient groups. Laser treatment now presents itself as a non-hormonal therapy which shows similar short-duration symptom improvement through collagen reconstruction plus tissue healing mechanisms. The positive patient feedback from these treatments becomes problematic because patients require multiple treatments together with maintenance sessions which increases overall treatment expenses and limits widespread accessibility. Standardization of protocols together with regulatory approval creates barriers for widespread use of this therapy. Patients usually find both treatments acceptable due to their sparse negative side effects. More extensive high-quality research studies investigating laser therapy must confirm its continued effectiveness after treatment and its long-term safety profile. The studies must also examine optimal treatment protocols and treatment costs for validation. The study of combined therapies along with patient-specific treatments needs further exploration to improve results for postmenopausal women who have GSM.

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