Light and Laser-based Treatments for Hidradenitis Suppurativa: A Systematic Review

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ABSTRACT

Background: Hidradenitis suppurativa (HS) is characterized by painful, recurrent lesions occurring mainly in intertriginous areas. The pain, odor, and disfigurement caused by HS significantly impacts quality of life and is challenging to treat. A comprehensive systematic review evaluating the use of light and laser-based treatments for HS is lacking.

Methods: We performed a systematic review by searching Cochrane, MEDLINE and Embase. Title, abstract and full text screening, and data abstraction were done in duplicate.

Results: Forty studies met the inclusion criteria, representing a total of 821 patients. Included studies were comprised of 5 randomized within-patient controlled trials, 1 randomized controlled trial, and 34 case series. Overall, treatments with the most reported cases were laser surgery, photodynamic therapy (PDT), and laser field treatments which showed a response in 80% (n=344/431), 73% (n=122/167) and 71% (n=84/101) of treated patients respectively. The pooled response rate for psoralen plus ultraviolet A was 69% (n=9/13).

Conclusion: Our results suggest that laser surgery using carbon dioxide (CO2) laser or a combination of CO2 and Nd:YAG lasers has a moderate response rate for HS with the most reported cases. Laser for field treatment and PDT also had moderate response rates with a large number of reported cases. However, extrapolation of these results may be limited due to the majority of the studies being case series, lack of standardized outcomes being assessed, and insufficient long term follow up results.

INTRODUCTION

Hidradenitis suppurativa (HS) is characterized by painful, recurrent papules and nodules occurring mainly in intertriginous areas. The pain, odor, and disfigurement caused by HS significantly impacts patients' quality of life and is associated with increased rates of anxiety and depression.1-3 Moreover, the symptoms of HS can be physically limiting and interfere with employment and personal functioning.4, 5 Early diagnosis and management of HS reduces the risk of disease progression.6 Treatment for HS are often multimodal and include medical, surgical, and laser and light-based therapies. Although treatment with tumor necrosis factor inhibitors, interleukin-1 inhibitors, antibiotics and others have been reported, these...
treatments may be associated with significant cost, adverse effects, declining efficacy, and possible drug-drug interactions. In practice, patients may express the preference to avoid systemic treatments if possible. Light and laser-based management is known to be a safe and effective treatment option for many dermatological conditions. Furthermore, light and laser-based treatment provides the advantage of avoiding the adverse effects and drug interactions associated with systemic therapies. Light and laser-based treatments commonly employed for HS include psoralen plus ultraviolet A (PUVA), photodynamic therapy (PDT), neodymium-doped yttrium aluminum garnet (Nd:YAG) laser, carbon dioxide (CO₂) laser, and others. These treatments are thought to reduce HS lesions by debulking tissue and by reducing the amount of hair follicles, sebaceous glands, and bacterial load. Although laser and light-based treatments for HS have been reported, little is known about their comparative effectiveness. The aim of this systematic review is to summarize outcomes for light and laser-based treatments used for HS, enabling physicians to better predict clinical response.

METHODS

A systematic review of the literature was conducted adhering to PRISMA reporting guidelines. The study protocol was registered in the PROSPERO database (CRD42020223612).

Study eligibility criteria

Eligibility criteria for this review were:

- Population: individuals of any age and sex with HS
- Intervention (exposure): Nd:YAG laser, PDT, CO₂ laser, intense pulse light (IPL), PUVA
- Comparator: patients with HS not exposed to intervention
- Outcomes: pain, lesion count, hidradenitis severity score (HSS), visual analogue scale (VAS), dermatology life quality index (DLQI), recurrence, healing time, physician global assessment (PGA), sartorius score, lesion area and severity index (LASI), patient satisfaction, clinical response
- Study design: cohort, cross-sectional, and case-series

Literature search and screening

MEDLINE, Embase, the Cochrane Database of Systematic Reviews, and PubMed were searched on June 12, 2020 using variations of the keywords “hidradenitis suppurativa” and “light” (Tables S1-S4). No date or language restrictions were applied. Title, abstract, and full-text screening were conducted by two independent reviewers (I.M., S.M.) using Covidence online systematic review software (www.covidence.org). Any conflicts between reviewers were resolved by discussion until a consensus was reached.

Data extraction

Data extraction was completed by three independent reviewers (I.M., S.M., S.K.) on a standardized extraction form.

Level of evidence assessment

Level of evidence was assessed using a modified hierarchy proposed by Guyatt and Sackett, where: (1) prospective controlled trial; (2) retrospective study or large case series; (3) small case series.

Data synthesis
After data collection, we determined that quantitative evidence synthesis was not feasible due to differences between the studies included in our review. Specifically, differences in study design, HS severity, heterogeneity in treatment modalities, patient populations, and outcome measurement. Instead, our results are presented in narrative form for each outcome.

### Study selection

Our literature search yielded 460 articles, 405 of which were excluded based on title and abstract review (Figure 1). Of the 55 studies retrieved for full text screening, 15 were excluded. A total of 40 studies were ultimately included in the review, 6 of which were conference abstracts.

The included studies were published between 1987 and 2020 and included 5 randomized within-patient controlled trials, 1 randomized controlled trial, and 34 case series (Table 1). The majority of studies were conducted in Spain (n=7), North America (n=6), United Kingdom (n=5), and Italy (n=4) (Table 1).

### Patient characteristics (age/sex)

In total, our pooled analysis includes 821 patients, 87% (n=623/716) females, with mean age of 33 years, ranging from 15 to 73 years of age.

### Targeted phototherapy

A total of 22 studies included in our review reported on targeted phototherapy using lasers and energy-based devices in patients with HS, representing a sample size of 724 patients with a mean age of 37.2 years (range: 14-73), and 76.3% (n=497/651) were female. Overall, targeted phototherapy improved lesions in 77.6% (n=413/532) of HS patients. Adverse effects were reported in 22.9% (n=122/532) of treated patients (Table 2).

#### CO₂

CO₂ laser was employed in 10 studies (n=396), with 78.5% (n=311/396) of patients showing improvement (Table 2). Adverse events were reported in 26.2% of cases (n=103/393). All 10 studies found that CO₂ laser was an effective treatment modality. In a study of 24 patients, Lapins et al. showed that CO₂ laser treatment with healing by secondary intention was safe, beneficial, and rapidly effective with a mean resolution period of 4 weeks. The majority of patients (91.7%, n=22/24) experienced no recurrence in treated areas. Overall, all patients reported satisfaction with this treatment modality. The treatments were well tolerated in all patients, and average healing time post procedure was 8.8 weeks.

Among patients with recurrent HS, Mikkelsen et al. found that CO₂ laser surgery with healing by secondary intention was effective with high patient satisfaction rates (94.8%, n=55/58). Improvement was reported as great in 75.8% (n=44/58) of patients and mild in 19.0% (n=11/58). Overall, 91.4% (n=53/58) of patients stated they would recommend the procedure.

#### Nd:YAG

Four studies consisting of 92 patients reported on the use of Nd:YAG in HS. Among studies with reported outcomes, 85% (n=30/35) of treated patients showed improvement (Table 2) and adverse events were reported in 15% of cases (n=8/53). Overall, 3 of the 4 studies found that Nd:YAG laser...
Nd:YAG/CO₂ combined

Two studies combined Nd:YAG and CO₂ laser treatment (n=58), with both reporting a benefit in HS (Table 3). In a study comparing Nd:YAG laser with combined CO₂ and Nd:YAG lasers in 20 patients, combination treatment resulted in better outcomes compared to Nd:YAG alone (mean improvement in CO₂ and Nd:YAG: 90% ± 20.52 vs mean improvement in Nd:YAG: 70.68% ± 23.55).

Other lasers

Two studies (n=31) reported on the use of ‘other’ lasers, including PEHT (Pediatric Endoscopic Hidradenitis Treatment) and diode laser in HS patients. Collectively, treatment showed improvement in 93.5% (n=29/31) of patients studied. In a study by Esposito et al., PEHT was found to be an effective treatment for HS and patients reported satisfaction with results. Recurrence in untreated locations was reported in only 18% (n=2/11) of patients, which were successfully resolved using the same treatment. In a study by Fabbrocini et al., diode laser reduced Sartorius score, improved HiSCR, and reduced DLQI. Overall, 90% of patients experienced improvement, with 5% (n=1/20) having complete response, 35% (n=7/20) good response, 50% (n=10/20) partial response.
and 10% (n=2/20) no response. The Sartorius score improved from 28.6 ± 13.0 at baseline to 19.8 ± 12.3 post-treatment.¹⁸

**IPL**

Four studies (n=83) in our review assessed the use of IPL for the treatment of HS. Overall, IPL led to improvement in 65% (n=54/83) of patients and adverse events were reported in 25% (n=16/64) (Table 2).²², ³⁰, ³¹, ³⁵ Highton et al., reported that IPL treatment resulted in long-term clinical improvement of lesions in 17 HS patients in an intra-individual controlled trial. Clinical improvement was also corroborated by independent analysis of clinical photographs and patient reported satisfaction.²² Another study of 25 HS patients found that IPL was useful as an adjuvant treatment for HS patients with mild to moderate disease, and 52% (n=13/25) of patients reported reduced disease activity.³¹

**Photodynamic therapy (PDT)**

17 studies⁸, ³⁶-⁵¹ reported on the use of PDT in patients with HS (n=167). The mean age was 33.3 years (range: 17-62) and 68.9% (n=115/167) were female. Overall, PDT was effective in 70.7% (n=118/167) of patients. Adverse events were screened for in 38.3% (n=64/167) of the PDT cohort, and were reported in 35.9% (n=23/64).

A number of photosensitizers were used in PDT. Ten studies (n=121)⁸, ³⁷, ⁴³-⁴⁶, ⁴⁸-⁵¹ reported on PDT for HS with the photosensitizer aminolevulinic acid (ALA). In this cohort, 78.5% (n=95/121) of treated patients responded. Suarez-Valladares et al. found that in a series of HS patients treated with intralesional ALA-PDT, 76.3% (n=29/38) achieved complete remission.⁸ In a smaller study of five Hurley stage II or III HS patients with recalcitrant disease, no significant improvement was seen, despite mild improvements in Sartorius score, VAS, and DLQI in all patients (mean change from baseline to post-treatment: Sartorius = -1.6, VAS = -0.3, DLQI = -6.4%). Swelling and blistering was present in 40% (n=2/5) of patients after the first treatment for 8-10 days.⁵²

Other photosensitizers utilized for PDT in HS include methylene blue, methyl amino levulinate, and tetracycline. Overall, four studies consisting of 28 patients were included in this cohort.⁶, ³⁶, ⁴¹, ⁴² Of those that reported individual patient outcomes, 94.4% (n=17/18) of patients reported improvement. Adverse effects were screened in 72.2% (n=13/18) of patients and of these, adverse effects were reported in 92.3% (n=12/13). Agut-Busquet et al. followed 7 HS Hurley stage II and III patients treated with PDT and methylene blue. PDT and methylene blue treatment improved DLQI and reduced lesion size in 85.7% (n=6/7) of patients after 1 month.³⁶ Relapse was reported in 28.6% (n=2/7) at 7 and 12 weeks post-treatment.

**Psoralen plus ultraviolet A (PUVA)**

PUVA to treat HS was examined in a single retrospective chart review.⁷ A total of 13 patients were treated with a regimen involving a 15 min bath containing 30 mL of 1-2% 8-methoxypsoralen lotion followed by broadband ultraviolet A. Treatments were performed twice weekly, with a median of 25 (range: 3–57) treatments. Overall, five patients were reported to have ‘clear or near clear’ HS, four patients reached ‘moderate clearance’, and four showed ‘no to minimal’ improvement. Overall, bath PUVA was effective in 69% (n=9/13) of patients in this series and was well tolerated. Adverse events were recorded for two patients and included erythema and claustrophobia.

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DISCUSSION

The studies included in our review reported on patients with both moderate and advanced disease. Many of the studies included in our review utilize laser-based treatments for surgery of affected sites in patients with advanced disease resistant to other therapies. Our results suggest that laser-based surgery is associated with a moderate response rate based on a large sample of pooled patients. Furthermore, many of the studies employing laser devices for surgery of HS lesions included patients with long standing and recalcitrant disease, suggesting that these treatment modalities can be employed as adjuncts with success even in patients with advanced disease.

Likewise, treatment modalities that utilize laser-based field therapy of affected areas using Nd:YAG, IPL, or diode laser were associated with a mild response rate based on a large sample of pooled patients. Laser field treatments for HS were employed in patients with both early and advanced disease, suggesting that this treatment modality is appropriate both to treat advanced disease and as a prophylactic therapy to target follicular inflammation and prevent disease progression.

A number of adverse events were reported in the studies included in our review. Overall, PDT was associated with the highest rates of reported adverse events (36%). Laser field treatments had less reported adverse events compared to lasers employed for surgical treatment of HS lesions (18% vs 25%). A number of factors may contribute to this observed difference, including differences in study quality and reporting of adverse events, given that only 105 out of 424 patients treated with laser surgery for HS had adverse events recorded. Some of the adverse events reported for laser surgery included pain, infection, hypertrophic scaring, contracture and wound dehiscence. Side effects associated with PDT included pain, erythema, blistering, burning. Bath PUVA was generally well tolerated, although two patients reported erythema and claustrophobia. Collectively, these findings suggest that while light therapy is a moderately effective treatment modality, adverse events are not uncommon, and patients should be counselled on the risks and benefits of light therapy.

While the mechanism underlying the effectiveness of light-based treatments for HS are not well understood, several possibilities have been suggested. CO₂ laser vaporization and excision removes epithelial sinus tracts which may contain debris and bacteria that can lead to relapse. Non-ablative lasers cause thermal damage to the dermis, which may initiate a wound-healing response with upregulation of procollagen mRNA, matrix metalloproteinases, and cytokines that contribute to wound healing.

Our study has several limitations. Many studies did not report on the side effects of light-based therapies, which restricts our analysis on treatment tolerability. Secondly, some studies reported aggregate data and outcomes for individual patients could not be extracted. Moreover, different outcome measures were used in the studies included in our review, further challenging comparisons between studies. Finally, the majority of the included studies were case series, which limits the generalizability of our analysis.

CONCLUSION

Despite these limitations, our review provides important information that must be...
interpreted in a clinical context. First, light-based treatments show moderate benefit in both early and advanced disease. Second, laser devices and PDT have moderate clearance rates for patients with HS, however access to the technology and impractical treatment delivery (especially with extensive disease) may be a barrier. Third, adverse events are not uncommon with light therapy and patients should be counselled on these risks. Though randomized control trials would be the ideal way to validate our findings, studies with treatment comparators are needed to further delineate the therapeutic ladder for HS.

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| Author, year | Location | Study design, LOE | Intervention | N[^a] | Mean age (±SD/range) | F: M | Key findings |
|-------------|----------|------------------|--------------|-------|----------------------|------|--------------|
| Abdel Azim, 2018 | Egypt | RCT[^1] | Nd:YAG CO^2+Nd:YAG | 20 | 29.7 (5) | 11:9 | Higher satisfaction and lower recurrence rates using combined CO^2 and Nd:YAG |
| Agut-Busquet, 2016 | Spain | Case series (3) | PDT | 7 | 28.9 | 3:4 | Good results using PDT with intraleosional MB |
| Andino Navarrete, 2014 | Chile | Case series (3) | PDT | 5 | 26 (5) | 4:1 | 5-ALA and 635nm light improved quality of life and reduced disease severity |
| Belotto, 2013 | Brazil | Case series (3) | PDT | 5 | NS | 5:0 | PDT improved inflammation and drainage |
| Braunberger, 2018 | USA | Case series (3) | CO^2 | 38 | 37.5 | NS | CO2 laser excision is a safe and effective treatment |
| Bu, 2017 | China | Case series (3) | PDT | 7 | 24.4 | 0:7 | Surgery combined with PDT improved DLQI and VSS scores |
| Calzavara-Pinton, 2013 | Italy | Case series (3) | PDT | 6 | 34 (10.9) | 5:1 | MAL-PDT was effective and well tolerated |
| Crocco, 2015 | Brazil | Case series (3) | CO^2 | 3 | 29.3 | 2:1 | CO^2 laser effective in Hurley III HS |
| Darlymple, 1987 | UK | Case series (3) | CO^2 | 6 | NS | 5:1 | CO^2 laser was effective with minimal scarring |
| Esposito, 2020 | Italy | Case series (3) | PEHT | 11 | 15.7 | 9:2 | PEHT was effective with low recurrence rates |
| Fabbrocini, 2018 | Italy | Case series (3) | Diode laser | 20 | 26.6 (7.84) | 14:6 | 1064nm intraleosional diode laser reduced Sartorius score and DLQI, increased HISCR |
| Fadel, 2015 | Egypt | RCT[^1] | PDT | 10 | 27.1 (5.09) | 7:4 | Significant reduction in HS-LASI with PDT |
| Finley, 1996 | USA | Case series (3) | CO^2 | 7 | (20-46) | NS | CO^2 laser is effective with low recurrence rates |
| Giacaman, 2019 | Spain | Case series (3) | PDT | 8 | NS | 43:34 | Adalimumab and PDT decreased lesions and pain |
| Gold, 2004 | USA | Case series (3) | PDT | 4 | 27.8 (19-46) | 4:0 | ALA-PDT is effective in HS patients who did not respond to medical therapy |
| Grimstad, 2019 | Norway | Case series (2) | CO^2 | 156 | 39.3 (9.91) | 191:6 | Better response with surgical versus medical treatments. CO^2 laser was most effective. |
| Hazen, 2010 | USA | Case series (3) | CO^2 | 61 | 38.5 (21-73) | 42:19 | CO^2 laser excision and marsupialization is effective for persistent or late-stage HS |
| Highton, 2011 | UK | Case series (3) | IPL | 17 | 34 (17-50) | 14:3 | IPL reduced Sartorius scores compared to control with good patient satisfaction |
| Jain, 2012 | India | Case series (3) | CO^2 Nd:YAG | 4 | (30-40) | 4:0 | Derofing with CO^2 laser combined with Nd:YAG was effective with no recurrence |
| Lapins, 1994 | Swedene | Case series (3) | CO^2 | 24 | 36 (22-57) | 21:3 | CO^2 laser was effective for patients with chronic HS with low recurrence rates |
| Lapins, 2002 | Swedene | Case series (3) | CO^2 | 34 | 33.9 (11.0/15-55) | 31:3 | Scanner-assisted CO^2 laser ablation improved scarring and had high patient satisfaction |
| Madan, 2008 | UK | Case series (3) | CO^2 | 9 | 39 (27-52) | 8:1 | CO^2 laser was an effective treatment for patients with recalcitrant HS |
| Study, Year | Country | Study Design | Treatment | Lesion Count | LOE | Key to Evidence |
|-------------|---------|--------------|-----------|--------------|-----|----------------|
| Mahmoud, 2010 | USA | RCT^ (1) | Nd:YAG | 22 | 41 (19-72) | Nd:YAG + topical BPO & clindamycin better than topical BPO & clindamycin alone |
| Mikkelsen, 2015 | Denmark | Case series | CO2 | 58 | 37.8 (21-54) | CO2 laser treatment effective for recurrent HS |
| Naouri, 2020 | France | RCT (1) | Nd:YAG | 31 | NS | Nd:YAG laser for hair removal has no effect on disease flares |
| Passeron, 2009 | France | Case series | PDT | 4 | NS | PDL-PDT not effective in treating HS |
| Piccolo, 2014 | Italy | Case series | IPL | 2 | 32 (26-38) | IPL completely resolved HS lesions |
| Rodriguez-Prieto, 2013 | Spain | Case series | PDT | 3 | 47 (36-62) | No recurrence after ALA-PDT |
| Rucker-Wright, 2009 | USA | Case series | Nd:YAG | 20 | NS | Nd:YAG laser reduced HS-LASI scores |
| Shareef, 2011 | UK | Case series | PUVA | 13 | 35 (25-66) | PUVA is an effective treatment in some patients |
| Sotiropou, 2009 | Greece | Case series | PDT | 5 | 33.6 (25-43) | No significant improvement after ALA-PDT |
| Strauss, 2005 | UK | Case series | PDT | 4* | NS | No significant improvement after ALA-PDT |
| Suarez-Valladares, 2018* | Spain | Case series | PDT | 5 | NS | Resolution with no recurrence after ALA-PDT |
| Suarez-Valladares, 2017 | Spain | Case series | PDT | 38 | 36 (30-44) | Complete response in most patients after ALA-PDT |
| Theut Riis, 2018 | Denmark | Case series | IPL | 25 | 39.2 (10.9/17-63) | IPL effective as an adjuvant treatment in a subset of patients |
| Valladares-Narganes, 2015 | Spain | Case series | PDT | 27 | 30.3 (19-62) | ALA-PDT effective in most patients and improved Sartorius score |
| Vilarrasa, 2019* | Spain | Case series | PDT | 28 | 46 | ALA-PDT improved DLQI and pain |
| Vossen, 2018 | The Netherlands | Case series | Nd:YAG | 15 | 34.1 (10.1) | Nd:YAG reduced number of flares and reduced disease severity |
| Wilden, 2019 | Germany | RCT (1) | IPL + radiofrequency | 41 | 38 (23-57) | IPL and radiofrequency reduced lesion count and DLQI compared to either treatment alone |
| Xu, 2011 | USA | RCT^ (1) | Nd:YAG | 19 | 37 (23-54) | Nd:YAG improved HS-LASI score |
| Zhang, 2016 | China | Case series | PDT | 3 | (17-38) | ALA-PDT ineffective for late-stage HS |

ALA: aminolevulinic acid, BPO: benzoyl peroxide, CO2: carbon dioxide, DLQI: Dermatology Life Quality Index, F: female, HiSCR: Hidradenitis Suppurativa Clinical Response, HS: hidradenitis suppurativa, HS-LASI: Hidradenitis Suppurativa Lesion, Area, and Severity Index, IPL: intense pulsed light, LOE: Level of evidence, MAL: methyl aminolevulinate, M: male, Nd:YAG: neodymium-doped yttrium aluminium garnet, NS: not specified, PDL: pulsed dye laser, PDT: photodynamic therapy, PEHT: pediatric endoscopic HS treatment, PUVA: psoralen and ultraviolet A, RCT: randomized controlled trial
^ Abstract only
* Number of participants included in analysis
\* 2 participants completed the study
^ Randomized within-patient controlled trial

Key to evidence-based support: (1) prospective controlled trial; (2) retrospective study or large case series; (3) small case series or individual case reports
### Table 2. Summary of treatment outcomes by phototherapy intervention for HS

| Light and Laser-based Treatment Modality (pooled n) | % Patients with Any Response (n) | % Adverse Events (n) |
|---------------------------------------------------|---------------------------------|---------------------|
| **Laser surgery:**                                  |                                 |                     |
| CO₂ laser, CO₂ + Nd:YAG, PEHT, intralesional diode laser (431) | 80 (344)                        | 25 (105/424)        |
| CO₂ (396)                                           | 79 (311)                        | 26 (103/393)        |
| CO₂ + Nd:YAG (4)                                    | 100 (4)                         | NR                  |
| PEHT (11)                                           | 100 (11)                        | 0 (0/11)            |
| Intraleisional diode laser (20)                     | 90 (18)                         | 10 (2/20)           |
| **Field treatment:**                                |                                 |                     |
| Nd:YAG laser, IPL, diode (101)                      | 71 (84)                         | 18 (24/134)         |
| PDT (169)                                           | 73 (124)                        | 36 (23/64)          |
| PUVA (13)                                           | 69 (9)                          | 15 (2/13)           |

n - number of patients with outcomes reported

CO₂: carbon dioxide, IPL: intense pulsed light, Nd:YAG: neodymium-doped yttrium aluminum garnet, PDL: pulsed dye laser, PDT: photodynamic therapy, PEHT: pediatric endoscopic HS treatment, PUVA: psoralen and ultraviolet A
Table 3. Results of included studies examining multiple outcome measures on hidradenitis suppurativa

| Author, Year | N | Mean age (±SD/ range) | Intervention | Outcome measure | Mean before (±SD) | Mean after (±SD) | Delta | Conclusion |
|--------------|---|-----------------------|--------------|-----------------|------------------|-----------------|-------|------------|
| Abdel Azim, 2018 | 20 | 29.7 (±5) | Nd:YAG and combined CO2/Nd:YAG | PGA | CO2/Nd:YAG: 20.6 | CO2/Nd:YAG: 16.9 | CO2/Nd:YAG: 3.7 | CO2+Nd:YAG superior to Nd:YAG alone. Combined treatment had a lower rate of recurrence and higher patient satisfaction. |
| Agut-Busquets, 2015 | 7 | 28.9 | I-PDT | VAS patient satisfaction | N/A | N/A | N/A | I-PDT is more effective for HS Hurley stage II than stage III. |
| Andino Navarrete, 2014 | 5 | 26 (±5) | PDT (5-ALA; 635nm light) | Sartorius | 35.4 (±4.9) | 18.2 (±8.1) | N/A | PDT improved QOL and reduced severity of disease. |
| Belotto, 2013 | 5 | N/A | PDTa | Inflammation, drainage, erythema, edema | N/A | N/A | N/A | PDT improves inflammation and drainage |
| Braunberger, 2018 | 38 | 37.5 | CO2 laser | Healing time in smokers | N/A | N/A | N/A | After CO2 excision – smoking did not affect healing time but diabetics had a prolonged healing time. |
| | | | | Healing time in diabetics | N/A | N/A | N/A | 3 patients experienced recurrence at a mean of 6 months post procedure. |
| Bu, 2017 | 7 | 24.4 | Surgery combined with PDT | Recurrence | N/A | N/A | N/A | Surgery in combination with PDT improved DLQI. No recurrence. Advantage of faster healing and less scarring. |
| Calzavara-Pintoni, 2013 | 6 | 34 (±10.9) | MAL-PDT | VSS | 4.6 (±2.4) | N/A | N/A | 2 of 6 patients had marked improvement, 3 had moderate improvement, and 1 had no/poor response with MAL-PDT treatment. |
| | | | | Clinical response | N/A | N/A | N/A | 3 patients experienced recurrence at a mean of 6 months post procedure. |
| | | | | Local reaction | N/A | N/A | N/A | Surgery in combination with PDT improved DLQI. No recurrence. Advantage of faster healing and less scarring. |
| Crocco, 2015 | 3 | 29.3 | CO2 laser | Clinical response | Patient 1: abscesses in axilla | Patient 1: successful treatment | Patient 1: successful treatment | CO2 laser effective in Hurley III HS. |
| Darlington, 1987 | 6 | (20-43) | CO2 laser | Wound healing | N/A | 3-7 weeks | N/A | Patients reported limited scarring. All patients were disease free at 9 months to 3 years follow up. All |
| Study                  | Patients   | Mean Age (Range) | Treatment Details                                                                 | VAS | Healing Time | Recurrence | Results                                                                 |
|-----------------------|------------|-----------------|----------------------------------------------------------------------------------|-----|--------------|------------|------------------------------------------------------------------------|
| Esposito, 2020        | 11         | 15.7            | Pediatric endoscopic hidradenitis treatment (PEHT)                                | 0.7 | 1.8 days     | N/A        | PEHT was effective with good patient satisfaction and results.         |
| Fabrocini, 2018       | 20         | 26.6 (±7.84)    | Diode laser 1064nm                                                              | N/A | 32.5 days    | N/A        | Sartorius score, improved HiSCR, and reduced DLQI.                     |
| Fadel, 2015           | 10         | 27.1 (±5.09)    | PDT (Niosomal methylene blue (NMB) vs. free methylene blue (FMB) as a photosensitizer to IPL) | N/A | 1.8 days     | N/A        | Photosensitization with NMB was more effective compared to photosensitization with FMB. |
| Finley, 1996          | 7          | (20-46)         | CO2 laser                                                                      | N/A | 6.6 weeks    | 1 patient 8 months post procedure                                   |
| Giacman, 2019         | 8          | 38 (median)     | I-PDT                                                                          | N/A | N/A          | N/A        | There was a decrease in inflammatory lesions and pain.                |
| Gold, 2004            | 4          | 27.8 (19-46)    | ALA-PDT and blue light                                                          | N/A | N/A          | N/A        | ALA-PDT and blue light phototherapy is an effective treatment for patients who did not respond to medical therapy. |

Note: VAS = Visual Analog Scale; HiSCR = Health Impairment Scale for Cutaneous Reactions; DLQI = Dermatology Life Quality Index; PDT = Photodynamic Therapy; HS-LASI = Health-related Quality of Life - Laser Acne Surgery Index; CO2 = Carbon Dioxide; ALA = 5-Aminolevulinic Acid; I-PDT = Intense Pulsed Dermabration.
| Author(s) | Year | CO2 laser | CO2 laser and topical clindamycin, CO2 laser and systemic antibiotic | Sartorius score | N/A | CO2 laser (n=156): 57; CO2 laser and topical clindamycin (n=5): 85; CO2 laser and systemic antibiotic (n=1): 123 | N/A | CO2 laser (n=156): -33; CO2 laser and topical clindamycin (n=5): -36; CO2 laser and systemic antibiotic (n=1): -87 | CO2 laser was the most effective intervention studied. Almost half of patients treated with a combination of surgical and medical treatments had a significant improvement in Sartorius score. |
|----------|------|-----------|---------------------------------------------------------------|----------------|-----|--------------------------------------------------|-----|--------------------------------------------------|--------------------------------------------------|
| Grims tad, 2019 | 15 6 (±9.91) | CO2 laser, CO2 laser and topical clindamycin, CO2 laser and systemic antibiotic | Sartorius score | N/A | CO2 laser (n=156): 14; CO2 laser and topical clindamycin (n=5): 14; CO2 laser and systemic antibiotic (n=1): 13 | N/A | CO2 laser (n=156): -5; CO2 laser and topical clindamycin (n=5): -6; CO2 laser and systemic antibiotic (n=1): 0 | CO2 laser excision & marsupialization effective therapy for persistent or late-stage HS (when scarring and sinus tract formation present). |
| Hazen, 2010 | 61 (21-73) | CO2 laser excision and marsupialization | Recurrence of disease | N/A | Recurrence in 2 patients. Average of 4.1 years without recurrence in treated areas (range of 1-17 years). | N/A | N/A | Reduction in severity of HS with IPL. Mean examination score was improved and maintained at 12 months. Improvement was also reported by independent analysis of clinical photographs. Patients reported high levels of satisfaction with treatment. Treated side had significant reduction in Sartorius score maintained at 12 months (p=0.001). |
| Highton, 2011 | 17 (17-50) | IPL (Harmony laser; 2x/week for 4 weeks on one area vs contralateral side not treated - served as control) | Sartorius score | N/A | 3 months post treatment: -56%. 6 months: -44%. 12 months: -33%. Control side - 3 months: -10%. 6 months: -10%. 12 months: 3%. | N/A | Significant reduction in HS exam score on treated side (p<0.001). Significant difference between treated and control sides (p<0.001). | Patient satisfaction | N/A | Treatment side Disease clearance: 1 patient Excellent results: 2 patients Good results: 10 patients 4 patients: fair results Control side: No change: 15 patients Slight improvement: 1 patient Slight decline: 1 patient |
| Jain, 2012 | 4 (30-40) | Nd:YAG and CO2 laser | Recurrence of disease | N/A | No recurrence | N/A | Deroofing with CO2 laser combined with Nd:YAG laser is effective in treating HS, with no recurrence observed up to 3 years. | | |

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| **Lapins, 1994** | 24 | 36 (22-57) | CO₂ laser with healing by secondary intention | Recurrence of disease | N/A | Recurrence: 2 | No recurrence: 22 | N/A | CO₂ laser treatment with secondary intention for patients with chronic HS is beneficial, safe, and quick, leaving patients with good cosmetic and functional results. |
| **Healing time** | N/A | 4 weeks (3-5 weeks) | N/A |
| **Scarring/cosmetic appearance** | N/A | All patients satisfied with scar appearance. | N/A |
| **Patient satisfaction** | N/A | Patients found this method favourable, willing to repeat procedure if required. | N/A |
| **Lapins, 2002** | 34 | (±11.0/15-55) | Scanner-assisted CO₂ laser ablation | Recurrence | N/A | Recurrence: 4 | No recurrence: 30 | N/A | CO₂ laser with scanner is a fast and efficient treatment of HS, with satisfactory cosmetic and functional results. |
| **Healing time** | N/A | 4 weeks (3-5 weeks) | N/A |
| **Pain in post-op period** (Scale from 0-3) | N/A | Classified as 3: 4 | N/A |
| **Patient satisfaction** | N/A | Condition better than pre surgery: 31 patients | N/A |
| **Madan, 2008** | 9 | 39 (27-52) | CO₂ laser excision (prophylactic oral antibiotics for 2 weeks post-op) | Recurrence of disease | N/A | No recurrence: 6 | Active HS at untreated sites adjacent to treated sites: 2 | N/A | CO₂ laser is an effective treatment for patients with recalcitrant HS, with patients reporting high satisfaction scores. |
| **Patient satisfaction** | N/A | Generally satisfied: 55/58 patients | N/A |
| **Wound healing time** | N/A | 2 weeks (range of 1-4) | N/A |
| **Mhammad, 2010** | 22 | 41 (19-72) | Nd:YAG laser (combined with topical benzoyl peroxide wash and clindamycin lotion; benzoyl peroxide and clindamycin alone used as control) | Modified Sartorius score (HS Lesion Area and Severity Index) | At baseline for all sites combined: 31 (SD: 14.9) | At 6 months treated sites: 7.6 (SD: 4.1) | Average improvement over all anatomic sites was 72.7% on laser treated side and 22.9% on control side (p<0.05). | Nd:YAG laser & topical benzoyl peroxide + clindamycin are associated with progressive improvement of HS lesions, and are more effective than topical benzoyl peroxide + clindamycin alone. Overall high level of patient satisfaction with treatment. |
| **Patient satisfaction - Pain associated with HS** | N/A | Pain significantly less: 77% | N/A |
| **Patient satisfaction** | N/A | Generally satisfied: 55/58 patients | N/A |
| **Mikkelson, 2015** | 58 | 37.8 (21-54) | CO₂ | Patient satisfaction | N/A | 94.8% (n=55/58) of patients reported a small (n=11) or great improvement (n=44) | N/A | CO₂ laser surgery is an effective treatment for symptomatic HS lesions. Patient satisfaction is high despite a moderate number of recurrences. |
| Study                          | Year | Study Design | Treatment | Lesion Count | Response Measurement | Results |
|-------------------------------|------|--------------|-----------|--------------|----------------------|---------|
| Naouri, 2020                  |      | Nd:YAG laser (4 treatments at 6 week intervals) | | Week 0 | Proportion of disease | 29.3% (n=17/58) of patients reported recurrence of disease in treated areas. |
|                               |      |              |           | Week 22 |                       | Weeks 0-30 Untreated: 6.67. Treated: -8.45. |
|                               |      |              |           |         | Proportion of treated and control sides: 52.6% | No significant difference in number of flares between treated and untreated sites at 1 and 3-month follow-up. |
|                               |      |              |           |         | VAS                   | Pain was high during treatment. Mean: 8 (6-9). |
|                               |      |              |           |         | Sartorius score       | 30 (24-36) |
|                               |      |              |           |         | Recurrence            | HS pustular papules resolved post treatment |
|                               |      |              |           |         | Recurrence of disease | No recurrence post intralesional PDT in all 3 patients. |
|                               |      |              |           |         |                      | Bath PUVA is possibly an effective treatment modality for some people with HS. |
|                               |      |              |           |         |                      | No significant improvement post treatment. |

| Study                          | Year | Study Design | Treatment | Lesion Count | Response Measurement | Results |
|-------------------------------|------|--------------|-----------|--------------|----------------------|---------|
| Passe, 2009                   |      | PDL-PDT (ALA, only one side of axilla or groin was treated – the other used as control) | | PDL-PDT side: 11.25 Control side: 11 | Proportion of responders to Hidradenitis Suppurativa Clinical Response (HiSCR) | 1-month post tx Treated side: 73.7% Control side: 52.6% (P=0.29). 3-month post tx Both treated and control sides: 52.6% |
|                               |      |              |           |              | Sartorius score       | Baseline to month 3 PDL-PDT side: -2.25 Control side: -2.33 |
|                               |      |              |           |              |                      | HS lesions were completely resolved, along with achieving hair removal. |
|                               |      |              |           |              | VAS                   | N/A |
|                               |      |              |           |              | Sartorius score       | 30 (24-36) |
|                               |      |              |           |              | Recurrence            | N/A |
|                               |      |              |           |              | Recurrence of disease | N/A |
|                               |      |              |           |              |                      | Patient 1: No recurrence at 9 months Patient 2: No recurrence after 14 months Patient 3: resolution of symptoms after 7 months |
|                               |      |              |           |              |                      | No recurrence post intralesional PDT in all 3 patients. |
|                               |      |              |           |              |                      | Bath PUVA is possibly an effective treatment modality for some people with HS. |
|                               |      |              |           |              |                      | No significant improvement post treatment. |

| Study                          | Year | Study Design | Treatment | Lesion Count | Response Measurement | Results |
|-------------------------------|------|--------------|-----------|--------------|----------------------|---------|
| Piccolo, 2014                 |      | IPL (6 sessions) | | Week 0 | Proportion of disease | 29.3% (n=17/58) of patients reported recurrence of disease in treated areas. |
|                               |      |              |           | Week 22 |                       | Weeks 0-30 Untreated: 6.67. Treated: -8.45. |
|                               |      |              |           |         | Proportion of treated and control sides: 52.6% | No significant difference in number of flares between treated and untreated sites at 1 and 3-month follow-up. |
|                               |      |              |           |         | VAS                   | Pain was high during treatment. Mean: 8 (6-9). |
|                               |      |              |           |         | Sartorius score       | 30 (24-36) |
|                               |      |              |           |         | Recurrence            | N/A |
|                               |      |              |           |         | Recurrence of disease | N/A |
|                               |      |              |           |         |                      | Patient 1: No recurrence at 9 months Patient 2: No recurrence after 14 months Patient 3: resolution of symptoms after 7 months |
|                               |      |              |           |         |                      | No recurrence post intralesional PDT in all 3 patients. |
|                               |      |              |           |         |                      | Bath PUVA is possibly an effective treatment modality for some people with HS. |
|                               |      |              |           |         |                      | No significant improvement post treatment. |

| Study                          | Year | Study Design | Treatment | Lesion Count | Response Measurement | Results |
|-------------------------------|------|--------------|-----------|--------------|----------------------|---------|
| Rodriguez-Prieto, 2013        |      | PDT (intralesional 5-ALA and irradiated with diode laser) | | Week 0 | Proportion of disease | 29.3% (n=17/58) of patients reported recurrence of disease in treated areas. |
|                               |      |              |           | Week 22 |                       | Weeks 0-30 Untreated: 6.67. Treated: -8.45. |
|                               |      |              |           |         | Proportion of treated and control sides: 52.6% | No significant difference in number of flares between treated and untreated sites at 1 and 3-month follow-up. |
|                               |      |              |           |         | VAS                   | Pain was high during treatment. Mean: 8 (6-9). |
|                               |      |              |           |         | Sartorius score       | 30 (24-36) |
|                               |      |              |           |         | Recurrence            | N/A |
|                               |      |              |           |         | Recurrence of disease | N/A |
|                               |      |              |           |         |                      | Patient 1: No recurrence at 9 months Patient 2: No recurrence after 14 months Patient 3: resolution of symptoms after 7 months |
|                               |      |              |           |         |                      | No recurrence post intralesional PDT in all 3 patients. |
|                               |      |              |           |         |                      | Bath PUVA is possibly an effective treatment modality for some people with HS. |
|                               |      |              |           |         |                      | No significant improvement post treatment. |

| Study                          | Year | Study Design | Treatment | Lesion Count | Response Measurement | Results |
|-------------------------------|------|--------------|-----------|--------------|----------------------|---------|
| Sharef, 2011                  |      | PUVA (bath) | | Week 0 | Proportion of disease | 29.3% (n=17/58) of patients reported recurrence of disease in treated areas. |
|                               |      |              |           | Week 22 |                       | Weeks 0-30 Untreated: 6.67. Treated: -8.45. |
|                               |      |              |           |         | Proportion of treated and control sides: 52.6% | No significant difference in number of flares between treated and untreated sites at 1 and 3-month follow-up. |
|                               |      |              |           |         | VAS                   | Pain was high during treatment. Mean: 8 (6-9). |
|                               |      |              |           |         | Sartorius score       | 30 (24-36) |
|                               |      |              |           |         | Recurrence            | N/A |
|                               |      |              |           |         | Recurrence of disease | N/A |
|                               |      |              |           |         |                      | Patient 1: No recurrence at 9 months Patient 2: No recurrence after 14 months Patient 3: resolution of symptoms after 7 months |
|                               |      |              |           |         |                      | No recurrence post intralesional PDT in all 3 patients. |
|                               |      |              |           |         |                      | Bath PUVA is possibly an effective treatment modality for some people with HS. |
|                               |      |              |           |         |                      | No significant improvement post treatment. |

| Study                          | Year | Study Design | Treatment | Lesion Count | Response Measurement | Results |
|-------------------------------|------|--------------|-----------|--------------|----------------------|---------|
| Setiriou, 2009                |      | PDT (topical ALA) | | Week 0 | Proportion of disease | 29.3% (n=17/58) of patients reported recurrence of disease in treated areas. |
|                               |      |              |           | Week 22 |                       | Weeks 0-30 Untreated: 6.67. Treated: -8.45. |
|                               |      |              |           |         | Proportion of treated and control sides: 52.6% | No significant difference in number of flares between treated and untreated sites at 1 and 3-month follow-up. |
|                               |      |              |           |         | VAS                   | Pain was high during treatment. Mean: 8 (6-9). |
|                               |      |              |           |         | Sartorius score       | 30 (24-36) |
|                               |      |              |           |         | Recurrence            | N/A |
|                               |      |              |           |         | Recurrence of disease | N/A |
|                               |      |              |           |         |                      | Patient 1: No recurrence at 9 months Patient 2: No recurrence after 14 months Patient 3: resolution of symptoms after 7 months |
|                               |      |              |           |         |                      | No recurrence post intralesional PDT in all 3 patients. |
|                               |      |              |           |         |                      | Bath PUVA is possibly an effective treatment modality for some people with HS. |
|                               |      |              |           |         |                      | No significant improvement post treatment. |

| Study                          | Year | Study Design | Treatment | Lesion Count | Response Measurement | Results |
|-------------------------------|------|--------------|-----------|--------------|----------------------|---------|
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|                               |      |              |           |         | Proportion of treated and control sides: 52.6% | No significant difference in number of flares between treated and untreated sites at 1 and 3-month follow-up. |
|                               |      |              |           |         | VAS                   | Pain was high during treatment. Mean: 8 (6-9). |
|                               |      |              |           |         | Sartorius score       | 30 (24-36) |
|                               |      |              |           |         | Recurrence            | N/A |
|                               |      |              |           |         | Recurrence of disease | N/A |
|                               |      |              |           |         |                      | Patient 1: No recurrence at 9 months Patient 2: No recurrence after 14 months Patient 3: resolution of symptoms after 7 months |
|                               |      |              |           |         |                      | No recurrence post intralesional PDT in all 3 patients. |
|                               |      |              |           |         |                      | Bath PUVA is possibly an effective treatment modality for some people with HS. |
|                               |      |              |           |         |                      | No significant improvement post treatment. |
| Study                           | Year | Patients | Study Design | Effect on hair | Disease Activity | Pain | Satisfaction | Resolution | Treatment comments |
|--------------------------------|------|----------|--------------|----------------|-----------------|------|--------------|------------|-------------------|
| Strauss, 2005                  |      | Not specified | PDT (topical 5-ALA) | Resolution of disease in 3/3 patients. No recurrence noted at follow up. | All patients achieved a complete response in the treated lesion | 7    | 5.3          | -1.7        | No significant improvement post treatment. Worsening symptoms for 2 patients. |
| Suarez-Valladares, 2018        | 5    | Not specified | Qualitative descriptions by investigators | A complete response (no lesions or symptoms) rate of 76.3%. I-PDT is a potential effective alternative treatment to HS. | Complete response: 29 patients | N/A  | N/A          | N/A        | DLQI Median = 10 (7-17) HSS Median = 28.5 (11.75-38.5) |
| Suarez-Valladares, 2017        | 38   | 36 (30-44) | Response to treatment | All patients reported partial resolution in 13/25 patients | Reduced disease activity: 13/25 patients | N/A  | N/A          | N/A        | IPL can be used as an adjuvant treatment for HS - in those with mild to moderate disease with minimal scar tissue. |
| Theut-Riis, 2018               | 25   | 39.2 (SD 10.9/1 7-63) | Patient reported disease activity | Patience preferred hair reduction | Effect on hair in 17/25 patients | N/A  | 20.67        | -11.86     | 21/27 patients had either a good or complete response to treatment. Intralesional application of PDT allows the light to reach various depths with the lowest amount of energy needed. It may be an effective treatment for HS. |
| Valladares-Narganes, 2015      | 27   | 30.3 (19-62) | Response to treatment | Complete response: 10 (37%) Good response: 11 (41%) Partial response: 5 (19%) | N/A                          | N/A  | 8.81         | -9         | Patient reported disease activity: 13/25 patients |
| Vilarrasa, 2019                | 28   | 46        | Number of HS flares/month (Questionnaire) | Severe pain (9): 1 Moderate (6-9): 4 Low (<6): 22 | N/A                          | N/A  | Resolution of lesions: 13 patients Partial resolution: 12 patients Poor: 3 patients | N/A        | All patients improved in DLQI and EVA scores 8 weeks post last treatment session. Ultrasound showed a resolution in the lesions of 13 patients, partial resolution in 12 patients, and poor in 3. |
| Vosse, 2018                    | 15   | 34.1 (10.1) | NRS disease severity (0-10) | Decrease in number of monthly flares (p<0.019). | N/A                          | N/A  | NRS 6.4 (±2.8) | N/A        | Laser hair removal can be used to prevent the progression of disease. Results include decrease in the number of monthly flares, average HS disease severity was significantly lower post treatment (NRS 6.4 ± 2.8 versus NRS 3.6 ± 3.5). Overall treatment satisfaction was rated with a NRS score of 6.7 ± 2.4. 2/3 patients would recommend the treatment. |

**Notes:**
- **VAS** – disease severity
- **VAS** - pain
- **PDT** (intralesional ALA)
- **I-PDT** (5-ALA)
- **PDT** (topical 5-ALA)
- **IPL**
- **DLQI** & **EVA** (pain visual scale)
- **ULTRASOUND**
| Author         | Study Years | Study Design | Study Population | Treatment | Lesion Area and Severity Index | Results                                                                 |
|----------------|-------------|--------------|------------------|-----------|-------------------------------|-------------------------------------------------------------------------|
| Wilde n, 2019  | 13          | 38           | N/A              | N/A       | N/A                           | Whole cohort on crossover to IPL+RF for 24 weeks: -3.6 (p=0.001).     |
|                |             | 923-57       | Active lesions count | N/A       | N/A                           |                          |                           |
|                |             |              | I -PDT: intralesional photodynamic therapy | RF group: -0.4 | RF group: -1.3 | Whole cohort on crossover to IPL+RF for 24 weeks: -3.6 (p=0.001). |
|                |             |              | VF                        | RF group: -1.3 | RF group: -6.6 | Whole cohort on crossover to IPL+RF for 24 weeks: -5.2 (p=0.003). |
|                |             |              | IPL                        | IPL group: -1.3 | RF group: -5.1 |                          |                           |
|                |             |              |                           | RF group: -5.1 | RP group: -6.6 |                          |                           |
|                |             |              |                           |                | IPL + RF group: -6.6 |                          |                           |
|                |             |              |                           |                | IPL + RF group: -5.2 |                          |                           |
|                |             |              |                           |                |                         |                          |                           |
| Wollin a, 2004 | 17          | (29-41)      | Transdermal CO₂         | Clinical response | N/A                        | Improvement of granulation and reduction of discharge and malodor 1-week post treatment |
|                |             |              |                           | N/A                      | N/A                        |                          |                           |
| Xu, 2011       | 19          | 37           | 1064nm Nd:YAG laser      | N/A                      | N/A                      | All sites: -31.6% (p<0.05)                                           |
|                |             |              | Lesion Area and Severity Index (LASI) | N/A                      | N/A                      | Axillary sites: -24.4% (p=0.08)                                       |
|                |             | 23-54        |                             | N/A                      | N/A                      | Inguinal site: -36.8% (p=0.001).                                      |
|                |             |              |                             |                          |                          | The percentage change in modified HS-LASI score after 2 months was -31.6% (p<.001) averaged over all anatomic sites. HS-LASI scores trended down from baseline to 1 month and 2 months after treatment for both axilla and inguinal sites. |
| Zhang, 2016    | 3           | (17-38)      | PDT (ALA)                 | DLQI                        | 26.67 (1.15)              | All sites: N/A                                                      |
|                |             |              |                           | Session 1: 24.67 | Session 2: 24.33          | No improvement for late-stage HS.                                     |
|                |             |              |                           | Session 3: 24.33 | N/A                      |                          |                           |

DLQI: Dermatology Life Quality Index; HSS: Hidradenitis severity score; MAL: methyl amino; N: number of participants; PDT: photodynamic therapy I-PDT: intralesional photodynamic therapy PUVA: psoralen plus ultraviolet A; US: ultrasonographic; VAS: visual analogue scale; VSS: Vancouver Scar Scale; QOL: quality of life
MCID: minimum clinically important difference NRS 30 – 30% reduction to baseline numerical rating score
# tetracycline used as a photosensitizer combined with 600nm red light