

The use of 810 nm diode laser versus intense pulsed light (filter 695 nm) in axillary epilation: a comparative study

Estudo comparativo de uso de Laser de diodo (810nm) versus luz intensa pulsada (filtro 695nm) em epilação axilar

ABSTRACT

Introduction: Diode laser and intense pulsed light are among the most frequently used technologies for epilation.

Objective: To compare diode laser with intense pulsed light in axillary epilation.

Methods: Patients with phototypes II and III ($n = 15$) were subjected to 3 regular sessions of intense pulsed light (695 nm) - Quantum HR® Platform (Lumenis, Yokneam, Israel) in the right axilla and diode laser (810 nm) - Light Sheer® (Lumenis, Yokneam, Israel) in the left axilla. The number of axillary hairs were counted before and after treatment, and patients were administered a questionnaire about adverse effects, pain and satisfaction.

Results: Both techniques provided a similar and significant reduction in hair density. The pain score and degree of inflammation were significantly higher for intense pulsed light ($p < 0.01$ and $p = 0.03$, respectively). There was a significant correlation between the fluence employed, the severity of pain, and the degree of inflammation for the two techniques ($p < 0.05$). The patients considered the final results to be similar, however more side effects were attributed to intense pulsed light. There was no difference in the proportion of preference between the two methods ($p = 0.80$).

Conclusion: The two techniques produced similar results, but the diode laser caused less pain and fewer side effects compared to intense pulsed light.

Keywords: hair removal; hair; lasers.

RESUMO

Introdução: Laser de diodo e luz intensa pulsada estão entre as tecnologias mais utilizadas para fins epilatórios.

Objetivo: Comparação entre essas técnicas na epilação axilar.

Métodos: 15 pacientes de fototipos II e III foram submetidas a três sessões regulares de luz intensa pulsada (695nm) - Plataforma Quantum HR® (Lumenis, Yokneam, Israel) na axila direita e Laser de diodo (810nm) - Light Sheer® (Lumenis, Yokneam, Israel) na axila esquerda. Foi realizada contagem de pelos pré e pós-tratamento, além de aplicado questionário sobre efeitos adversos, dor e satisfação das pacientes.

Resultados: O escore de dor foi significativamente maior para a luz intensa pulsada, assim como o grau de inflamação ($p < 0,01$ e $p = 0,03$). Houve correlação significativa entre a fluência utilizada, a dor atribuída e o grau de inflamação para as duas técnicas ($p < 0,05$). Ambas as técnicas proporcionaram redução significativa e semelhante na densidade de pelos. As pacientes consideraram o resultado final similar, porém à luz intensa pulsada foram atribuídos maiores efeitos colaterais. Não houve diferença na proporção de preferência entre os diferentes métodos ($p = 0,80$).

Conclusão: Na amostra estudada, com os parâmetros descritos, houve menor dor e incidência de efeitos colaterais com o uso do Laser de diodo em comparação à luz intensa pulsada, e eficácia semelhante entre as duas técnicas.

Palavras-chave: epilação; pelos; lasers.

Original Article

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INTRODUCTION

Undesired hair growth is a common cosmetic problem for women and men. Removing hair through physical – tweezing or shaving – or chemical methods is frequently painful or irritating, and requires frequent and regular sessions. In the last few years, photoepilation has emerged as a highly effective alternative with lasting results and few side effects. The technique is based on the selective thermal destruction of a specific target: hair follicles germinative cells.¹

Given that melanin is the main chromophore of hair follicles, light wavelengths between 600 and 1,100nm can be used in the selective photothermolysis process of such hairs, safely and effectively.^{1,2} By applying the thermokinetic selectivity concept, in which target structures of larger volumes take longer to transmit absorbed energy to adjacent structures than smaller volumes, we concluded that the ideal duration of pulse for epilation would be approximately 10-50ms.²

Several intense pulsed light (IPL) and laser systems have already been shown to be effective for epilation. Among lasers we cite: ruby (695nm), alexandrite (755nm), diode (800nm) and Nd:YAG (1,064nm).⁴⁻¹⁴ Multiple sessions (3 to 8) are necessary to obtain satisfactory results, with average rates of reduction in hairs ranging from 70 to 90%.¹

Diode lasers (DL) emit energy in the band ranging between 800 and 810nm of the electromagnetic spectrum. Several studies have demonstrated the efficacy of this technology in epilation.^{4,5,7,8,10,11,13,20,22,24,25,27}

Equipment that emits IPL has been used with rates of efficacy similar to those of lasers. IPL is a non-coherent light of between 550 and 1,200nm. In addition to the structure and composition of the light emitted by the two methods, another significant difference is the duration of the pulse. The IPL pulse does not match the extension and emission uniformity provided by the DL. To compensate for this "deficiency," more modern IPL equipment programs the emission of the fluence in a series of shorter pulses rather than in a single pulse.^{2,3}

Dermatologists have easy access to DL and IPL technologies, which are among the more popular epilatory options. However few studies have compared the efficacy and safety of the two methods in the axillary epilatory treatment in a paired manner.^{3,14-27} The objective of this prospective and comparative study in the same patient was to compare the efficacy, side effects, and degree of satisfaction of the two technologies.

MATERIAL AND METHODS

Female patients, older than 18, who demonstrated interest in long-term epilation were selected from the dermatology outpatient clinic. The exclusion criteria were: Fitzpatrick phototypes IV, V and VI; patients using photosensitizing medications, oral or topical steroids in the areas analyzed; as well as patients who were tanned or did not agree in taking part of the study. The study had the approval of the Institution's Medical Research Ethics Committee.

All patients were instructed not to use tweezing depilation methods (tweezers, waxing, threading) for at least 1 month

before epilation and to interrupt the use of razors 15 days before the session.

Standardized pictures of the axillae were taken, and the area containing hairs was measured and later depilated with razor blades. Patients received epilatory treatment in the right axilla with IPL (695nm) – Quantum® HR platform, with parameters established for phototype and hair color. In the left axilla, patients received treatment with DL (810nm) – Light Sheer®, with the same parameters for phototype and hair color.

The sessions were conducted at regular intervals ranging between 5 and 8 weeks, with both axillae treated at the same time with the respective equipment. Immediately after each session, patients were asked about the pain, inflammation and any adverse effects experienced during the procedure. From the second session, they were also asked about the degree of improvement since the previous session, choosing from the following options: worse, regular, good and excellent. Five weeks after the third and last treatment session, new pictures were taken and the patients were asked to select the treatment they thought was the most effective, the one with the fewest side effects, and the one they preferred. A visual count of hairs using, magnified digital images, was conducted by a single evaluator.

For the statistical analyses of central tendency, Mann-Whitney, Student's t, and Wilcoxon tests for dependent and independent samples were employed, with the data described by the respective medians or means. The normality of the distributions was determined by the Shapiro-Wilk test. The Pearson test and the Spearman non-parametric test were used to analyze the correlations. The proportions were assessed with the Chi-square and Fisher's Exact tests. Analysis of the differences in the hair count before and after treatment was accomplished using a linear generalized model (ANCOVA). P-values < 0.05 were considered significant.

RESULTS

Female patients (n = 15) aged between 18 and 45 (mean 26), with phototypes II (5 patients) and III (10 patients) were included. The right axilla's median area was 48cm², while for the left axilla it was 46cm², with a strong correlation between the measures on the two sides (Spearman's Rho = 0.73; p < 0.01). The pre-treatment mean hair count in the right and left axillae were 358.4 and 355.9, respectively, translating into mean hair densities of 69.7hairs/cm² and 72hairs/cm² in the right and left axillae, respectively. There was also a high correlation between pairs of axillae (Pearson's r² = 0.89; p < 0.01).

The median fluence used in the IPL was 36J/cm², and for the DL it was 42J/cm² (p < 0.01). The parameters of pulse duration used for the IPL were short (20ms/2 pulses) or medium (40ms/3 pulses). For the DL, the median for the duration of the pulse was 25ms.

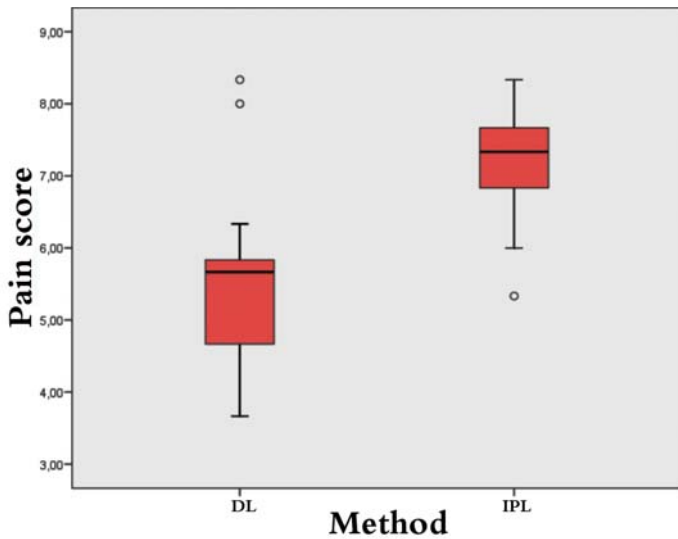
The median of the pain scores (7 x 6; p < 0.01, Wilcoxon), as well as the degree of inflammation (p = 0.03, tendency Chi-square) were significantly higher for the IPL (Graphs 1 and 2). In addition to the pain and inflammation described above, the

formation of crusts occurred in 5 IPL applications, but not in DL applications.

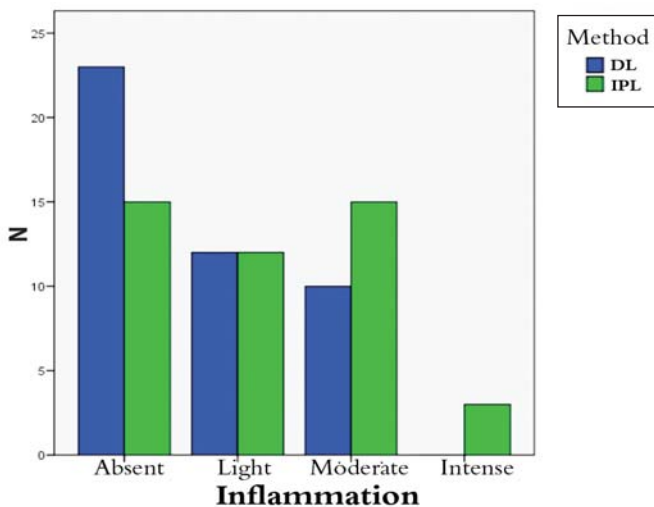
In both IPL and DL, there was a significant correlation among the fluence applied, the pain score, and the degree of subsequent inflammation (Tables 1 and 2). The duration of the pulse in the IPL, adjusted for the fluence, did not correlate significantly with the pain score. On the other hand, in the corresponding evaluation for the DL, there was an inverse correlation between pulse duration and pain ($p < 0.01$, ANCOVA).

There was a significant reduction in hair density for both methods ($p < 0.01$, paired Student's *t*), with a mean reduction of 75.6% for IPL and 70.5% for DL ($p=0.17$, Wilcoxon) (Graphs 3 and 4).

In the multivariate analysis carried out with the generalized linear model (ANCOVA), the correlation of the



Graph 1 - Comparison between DL and IPL regarding the pain score



Graph 2 - Comparison between DL and IPL regarding the degree of inflammation

Table 1: Correlations between pain, inflammation and fluence in IPL method			
Intense Pulsed Light (N=45)	Correlation - Spearman's Rho (p)		
	Pain	Inflammation	Fluence
Pain	-	0,52 (< 0,01)	0,50 (< 0,01)
Inflammation	0,52 (< 0,01)	-	0,30 (0,04)
Fluence	0,50 (< 0,01)	0,30 (0,04)	-

Table 2: Correlations between pain, inflammation and fluence in DL method			
Laser de diodo (n = 45)	Correlação - Rho de Spearman (p)		
	Dor	Inflamação	Fluência
Dor	-	0,56 (< 0,01)	0,49 (< 0,01)
Inflamação	0,56 (< 0,01)	-	0,35 (0,02)
Fluência	0,49 (< 0,01)	0,35 (0,02)	-

final hair density was analyzed in relation to the initial density ($p = 0.04$) and the fluence ($p = 0.01$). The hair removal method did not correlate significantly with final hair density in this analysis.

There was no significant difference between techniques regarding the subjective impressions of the final result ($p = 0.33$, tendency Chi-square) (Graph 5). However, subjective impressions were inversely correlated with final hair density (Spearman's Rho = -47.3; $p < 0.01$).

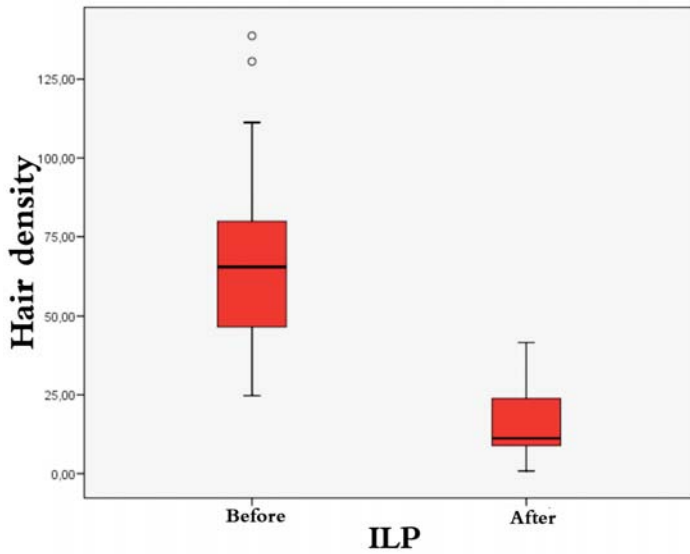
Eight patients preferred the DL, while seven favored the IPL technique ($p=0.80$, binomial test). The pain score did not significantly influence this preference ($p = 0.23$, Mann-Whitney).

Two patients found the IPL to have the fewest side effects, 3 patients considered the two treatments to be similar in this respect, and 10 reported that the DL method had fewer side effects ($p=0.03$, binomial test).

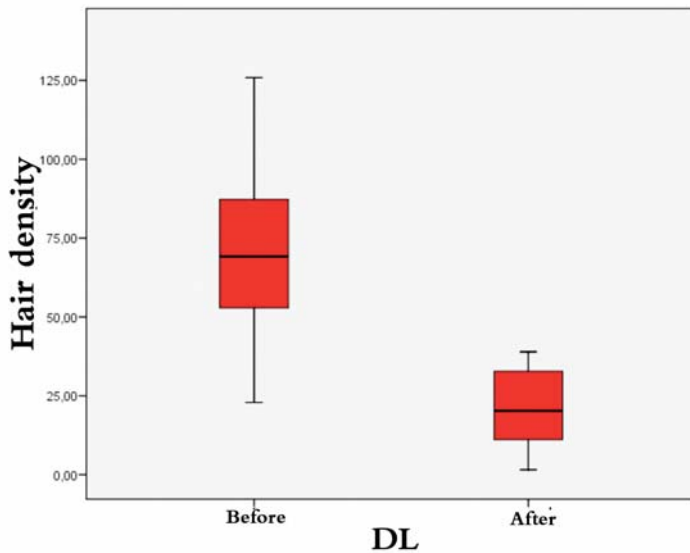
DISCUSSION

Light Sheer® (Lumenis, Yokneam, Israel) and Quantum® (Lumenis, Yokneam, Israel), DL and IPL technologies, respectively, are commercially available options that enjoy great popularity among dermatologists. This study evaluates the therapeutic efficacy of these methods, through hair count and patient satisfaction. The application of both techniques in the same patient allows an evaluation with a smaller number of biases, once individual opinions are neutralized, in addition to allowing the use of more sensitive statistical tests. Since the areas of the axillae and the hair density were considerably similar, both methods faced comparable epilatory tasks.

The pain, as well as the inflammation grade, was significantly greater for the IPL. As expected, the greater the fluence employed, the greater the attributed pain and



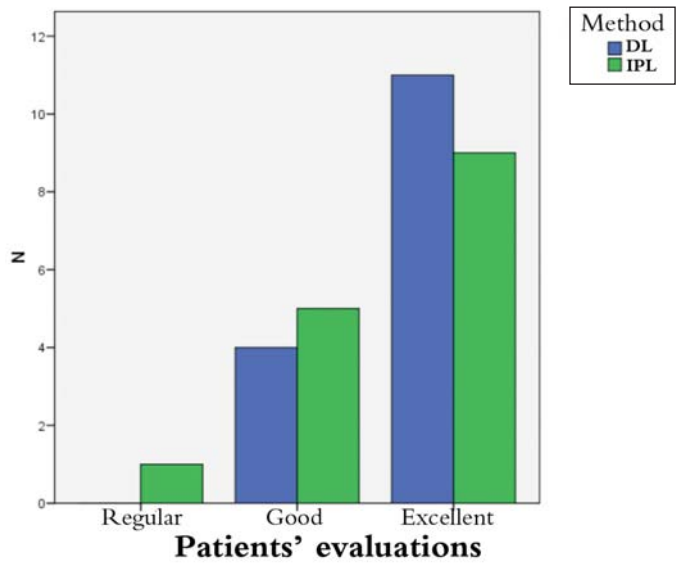
Graph 3 - Comparison between hair density before and after 3 IPL sessions



Graph 4 - Comparison between hair density before and after 3 DL sessions

inflammation. There was a significant inverse correlation between the pulse duration and pain score for the DL. The shorter the duration of the pulse, the greater the pain felt by the patient, which could be linked to the more intense heating of the target, as is expected when the theory of thermal relaxation is applied.

Both methods achieved a significant reduction in hair density, with no difference in efficacy (Figure 1). The use of higher fluences correlated with a greater reduction in hairs. Although lower fluence parameters were used in the IPL, differences in the two technologies mean that the use of lower fluences in IPL does not necessarily imply less thermal damage. It is worth noting that the fluence and duration of pulse are determined by the equipment operator, and the results



Graph 5 - Comparison between DL and IPL regarding patients' evaluations

obtained, as well as the other parameter profiles used in this study, cannot be extrapolated to other areas of the body.

The patients considered the quality of the final results similar in both methods; this evaluation correlated significantly with the reduction in hair density. Although IPL was reported to have a greater incidence of side effects including pain, there was no statistical significance in the preference for one method over the other.

Our findings conflicted with a 2008 study carried out by Cameron and colleagues, when pain and inflammation were reported to be less in IPL. That study evaluated the effects of the DL and IPL methods – using Light Sheer® (Lumenis, Yokneam, Israel) and Luminette® (Lynton, Cheshire, United Kingdom) devices, respectively – on the limbs (n = 9). The Cameron study employed a mean IPL fluence of 32J/cm², compared to 36J/cm² in the present study; for DL, Cameron used 20–45J/cm² while in the present study the fluence ranged from 30–48J/cm². Cameron found the DL to be more effective in the objective reduction of hairs and in patients' evaluation, while in our study the two technologies had similar efficacies and preferences.²⁷ Such differences can be attributed to the different types of IPL equipment and parameters used, in addition to the differences in the areas of the body treated.

In 2006, Amin and colleagues published a comparative study of 4 different sources of light, tested in 10 patients. Two were IPL platforms: Starlux Rs® (Palomar, Burlington, Canada) (65J/cm², 100ms), Starlux Y® (Palomar, Burlington, Canada) (35J/cm², 100ms); one was the DL version Light Sheer® (Lumenis, Yokneam, Israel) (28J/cm², record 14ms); and the remaining was the GentleLase® (Candela, Wayland, USA) (18J/cm², 3ms (preset) DCD 30/30). The treated areas were legs and the same patients' dorsum. All methods resulted in effective epilation, with no statistically significant differences among the technologies regarding the reduction of hairs¹⁷.

In 2006, Toosi and colleagues conducted a non-paired,



Figure 1 - **A.** Before IPL treatment; **B.** After 3 IPL sessions; **C.** Before DL treatment; **D.** After 3 DL sessions

comparative study with 232 patients, analyzing Palomar's DL (810nm; fluence 40–64J/cm²; 12.5ms), Cynosure's Alexandrita laser (755nm; 16–20J/cm², 2ms), and Medical Bio Care's IPL (650 nm; 22–34J/cm²; 20ms, Newport Beach, California, USA) in different groups of patients who received a single type of treatment. The areas studied included the face and neck. Patients reported a greater incidence of side effects with the DL. The efficacy was similar, however the number of sessions varied in the different methods.¹⁸

In the present study, the adverse effects included pain, inflammation (evaluated individually) and the appearance of crusts (with IPL). The observed low incidence of adverse effects can be attributed to the exclusion of higher phototypes and to the fact that the treatment area had no photoexposure. Neither hypo nor hyperpigmentation were verified, and there were no secondary infections or blisters. Although reported elsewhere, this study found no paradoxical increase in hair growth or scar formation.^{3,4,7,16,28–30}

The length of the interval between sessions was recommended by the manufacturer, and was used in previous studies.^m The final hair count evaluation was limited to 5 weeks after the last session. Long-term results were not evaluated, which can be considered a limitation of this study. The fluence followed parameters set by the equipment manufacturer and was also based on clinical experience, although several studies omit this detail.

Although photoepilation is an already established method, the specific individualized parameters used in its application make it difficult to compare different studies. There is no standardized minimum or maximum fluence for each of the technologies, let alone the level of individualization required depending on the area to be treated, the phototype, and response to the previous session.

It is worth noting that the various equipments, in spite of offering similar technological options, are different in practice. For instance, IPL devices present diverse pulse configurations and cooling techniques. Such differences should be taken into consideration when evaluating the results of comparative studies.

CONCLUSION

Based on the studied sample, and according to the described parameters, the DL caused less pain and fewer side effects compared to the IPL. Both methods significantly reduced hairs, and neither method proved more effective than the other. Broader investigations that can provide more objectivity in the definition of treatment parameters are necessary. The present study has shown that it is difficult to determine which technologies are more effective. Since the number of photoepilation alternatives is increasing, it is important to choose the best therapy based on objective safety and efficacy evidence. ●

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