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Research Article

Patient Perception and Clinical Outcomes of Gingival Depigmentation: A Gender-Based Comparative Study

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Abstract

Background: Gingival hyperpigmentation is a common aesthetic concern that can negatively impact smile attractiveness and patient confidence. Gingival depigmentation procedures are widely performed; however, patient perception and outcomes may vary based on gender-related biological and psychosocial factors.

Aim: To evaluate gender-based differences in perception and clinical outcomes following gingival depigmentation.

Materials and Methods: This prospective observational study included 72 participants (36 males and 36 females) undergoing diode laser gingival depigmentation. Pain perception was assessed using the Visual Analog Scale at immediate, 24 hours and day 7 intervals. Healing was evaluated using a standardized wound healing index on days 3, 7 and 14. Patient satisfaction and perception were assessed using a Likert-scale questionnaire. Recurrence of pigmentation was evaluated at 3 and 6 months using the Dummett-Gupta Oral Pigmentation Index. Statistical analysis was performed using appropriate parametric and non-parametric tests, with significance set at $p<0.05$.

Results: Females reported significantly higher pain scores immediately and at 24 hours postoperatively ($p<0.05$), while no significant difference was observed at day 7. Early healing at day 3 was significantly better in males ($p<0.05$), but no differences were observed at later time points. Females demonstrated significantly higher satisfaction and aesthetic perception scores ($p<0.05$). Recurrence rates at 6 months were comparable between genders ($p>0.05$).

Conclusion: Gender influences early postoperative pain perception and subjective satisfaction following gingival depigmentation, with females showing higher aesthetic engagement. However, long-term clinical outcomes, including healing and recurrence, are not significantly affected by gender.

Keywords: Gingival Depigmentation; Gender Differences; Pain Perception; Patient Satisfaction; Melanin Pigmentation

Introduction

Gingival hyperpigmentation is a common aesthetic concern characterized by excessive deposition of melanin in the basal and suprabasal layers of the gingival epithelium. Although physiologic pigmentation is not a pathological condition, it can significantly affect smile aesthetics, particularly in individuals with a high smile line or excessive gingival display [1]. The demand for aesthetic dental procedures has increased substantially over the past decade, with patients seeking treatments that enhance not only dental alignment but also gingival appearance [2].

Various techniques have been employed for gingival depigmentation, including scalpel surgery, electrosurgery, cryosurgery and laser-assisted procedures such as diode, Nd:YAG and Er:YAG lasers. Among these, laser-assisted depigmentation has gained

popularity due to its advantages of minimal bleeding, reduced postoperative discomfort and improved patient acceptance [3,4]. Clinical outcomes of these procedures are typically evaluated based on parameters such as healing time, pain perception, recurrence of pigmentation and overall patient satisfaction [1,5].

Patient perception plays a crucial role in determining the success of aesthetic procedures. Factors such as pain tolerance, expectations, psychological profile and cultural perceptions of beauty can influence treatment outcomes and satisfaction levels [6]. Emerging evidence suggests that gender differences may significantly impact both the perception and outcomes of dental treatments. Studies have shown that females often report higher aesthetic concerns and may have greater sensitivity to postoperative discomfort compared to males [7]. Conversely, males may exhibit different thresholds for pain perception and varying expectations regarding aesthetic outcomes [8].

Despite the growing emphasis on patient-centered care in dentistry, limited research has specifically explored gender-based differences in gingival depigmentation procedures. Understanding these differences is essential for tailoring treatment approaches, improving patient communication and optimizing clinical outcomes. Additionally, incorporating gender-specific insights may enhance shared decision-making and lead to more personalized aesthetic dental care [9].

Therefore, the present study aims to evaluate gender-based differences in perception and clinical outcomes following gingival depigmentation procedures, with a focus on parameters such as pain perception, healing response, patient satisfaction and recurrence rates.

Materials and Methods

Study Design and Setting

This study was designed as a prospective observational analytical study conducted for over a period of 12 months. Ethical approval was obtained from the Institutional Ethics Committee and the study adhered to the principles outlined in the Declaration of Helsinki (2013 revision) [10]. Written informed consent was obtained from all participants prior to enrollment.

Study Population

Patients presenting with gingival hyperpigmentation and seeking aesthetic correction were screened. Individuals aged 18-45 years with physiologic melanin pigmentation in the anterior maxillary region were included. Patients with systemic diseases affecting healing, tobacco use, prior depigmentation therapy, pregnancy or lactation and those on medications influencing pigmentation or healing were excluded.

Sample Size Calculation

The sample size was calculated to detect a clinically significant difference in pain perception between male and female participants. Assuming a moderate effect size (Cohen's d = 0.5), significance level (α) of 0.05 and power ($1-\beta$) of 80%, the required sample size was determined using the standard formula for comparison of two independent means [11]:

$$n = \frac{2(Z_{\alpha/2} + Z_{\beta})^2 \sigma^2}{d^2}$$

Based on these assumptions, a minimum of 64 participants (32 per group) was required. Considering a 10% dropout rate, the final sample size was increased to 72 participants.

Clinical Procedure for Gingival Depigmentation

All procedures were performed by a single calibrated operator. Following administration of local anesthesia (2% lignocaine with 1:100,000 epinephrine), gingival depigmentation was carried out using a diode laser (810-980 nm) in contact mode. The pigmented epithelium was ablated layer by layer until complete removal of melanin pigmentation was achieved, as described in previous laser depigmentation protocols [12]. Postoperative instructions included maintenance of oral hygiene and use of 0.12% chlorhexidine mouthwash twice daily for one week.

Outcome Measures

Pain perception was assessed using the Visual Analog Scale (VAS), a validated tool for subjective pain measurement [13], immediately postoperatively, at 24 hours and on day 7. Healing was evaluated using a standardized wound healing index at days 3, 7 and 14 [14]. Patient satisfaction was assessed at one month postoperatively using a structured, self-administered questionnaire designed to capture patient-reported outcomes following gingival depigmentation. The questionnaire comprised items evaluating overall satisfaction, perceived aesthetic improvement, comfort during the postoperative period and willingness to undergo the procedure again if required. Responses were recorded on a 5-point Likert scale ranging from 1 (very dissatisfied/strongly disagree) to 5 (very satisfied/strongly agree). The one-month evaluation point was selected to allow sufficient time for soft tissue healing and stabilization of aesthetic outcomes, thereby enabling a more reliable assessment of patient perception.

Recurrence of pigmentation was evaluated at three and six months using the Dummett-Gupta Oral Pigmentation Index (DOPI) [15]. Standardized intraoral photographs were taken at baseline and follow-up visits for objective comparison.

Assessment of Gender-Based Perception

Perception of treatment was assessed using a structured, self-administered questionnaire incorporating Likert-scale items to evaluate key domains, including pain expectation, aesthetic concern, overall satisfaction and willingness to undergo retreatment. Each item was scored on a 5-point scale ranging from 1 (strongly disagree) to 5 (strongly agree). The questionnaire was administered preoperatively to assess baseline expectations and postoperatively at one month to evaluate perceived outcomes.

Data Collection and Reliability

All data were recorded in a standardized proforma. Examiner calibration was performed prior to the study and intra-examiner reliability was assessed using Cohen's kappa coefficient, which is a standard measure for agreement in clinical studies [16].

Statistical Analysis

Data analysis was performed using IBM SPSS Statistics version 26.0 and R software version 4.3. Continuous variables were expressed as mean ± standard deviation and categorical variables as frequencies and percentages. Normality was assessed using the Shapiro-Wilk test. Independent t-test or Mann-Whitney U test was used for intergroup comparisons, while repeated measures ANOVA was used for longitudinal data. Chi-square test was applied for categorical variables. A p-value <0.05 was considered statistically significant.

Results

Table 1 presents the baseline characteristics of the study participants stratified by gender. The mean age of male participants (27.8 ± 5.6 years) and female participants (26.9 ± 5.2 years) did not differ significantly (p=0.412), indicating age-matched groups. Similarly, baseline pigmentation severity assessed using the DOPI score was comparable between males (2.86 ± 0.62) and females (2.91 ± 0.58) (p=0.673). Gingival display and the proportion of participants with a high smile line were also statistically similar across both groups (p>0.05).

Variable	Male (n=36)	Female (n=36)	p-value
Age (years)	27.8 ± 5.6	26.9 ± 5.2	0.412
Baseline DOPI Score	2.86 ± 0.62	2.91 ± 0.58	0.673
Gingival Display (mm)	3.4 ± 1.1	3.6 ± 1.2	0.521
High Smile Line (%)	41.7%	55.6%	0.214

Table 1: Baseline characteristics of study participants.

Table 2 illustrates the comparison of postoperative pain perception between males and females at different time intervals. Females reported significantly higher pain scores immediately after the procedure (5.1 ± 1.4) compared to males (4.2 ± 1.3) (p=0.008). This difference persisted at 24 hours, with females reporting higher VAS scores (3.9 ± 1.2) than males (3.1 ± 1.1) (p=0.012). However, by day 7, the difference in pain perception between the two groups was no longer statistically significant (p=0.178), with both groups reporting minimal discomfort.

Time Point	Male	Female	p-value
Immediate	4.2 ± 1.3	5.1 ± 1.4	0.008*
24 hours	3.1 ± 1.1	3.9 ± 1.2	0.012*
Day 7	1.2 ± 0.6	1.4 ± 0.7	0.178
*p < 0.05 significant			

Table 2: Comparison of pain perception between genders (VAS Score).

Fig. 1 demonstrates the trend of pain perception across the postoperative period for both genders. The graph shows a consistent decline in VAS scores from the immediate postoperative period to day 7 in both groups, indicating progressive pain resolution. Notably, females exhibited higher pain scores at all early time points, with a steeper decline observed over time. By day 7, the curves for males and females converge, reflecting comparable pain levels.

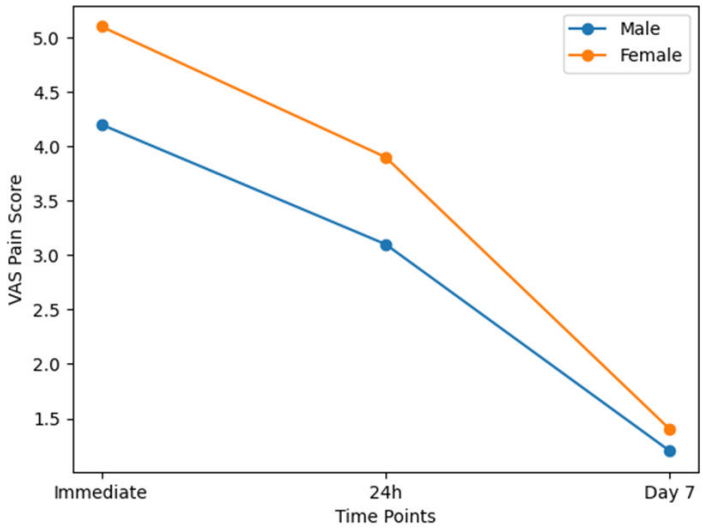

Figure 1: Pain perception over time by genders.

Fig. 2 depicts the healing index scores over time for both male and female participants. At day 3, males demonstrated significantly better healing (3.8 ± 0.6) compared to females (3.3 ± 0.7), indicating faster early tissue recovery. However, by day 7, the difference narrowed and by day 14, both groups achieved near-complete healing with comparable scores. The graphical representation shows parallel upward trends for both genders, suggesting that although initial healing may vary, the overall healing outcome is similar.

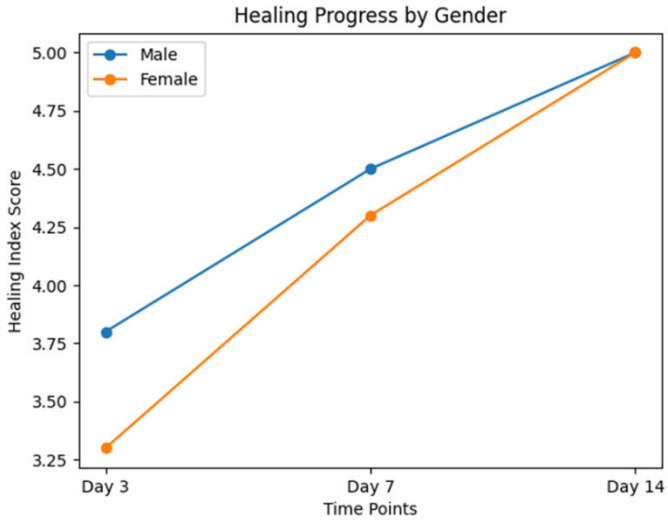

Figure 2: Healing progress by gender.

Table 3 presents patient satisfaction outcomes following gingival depigmentation. Females reported significantly higher overall satisfaction scores (4.6 ± 0.5) compared to males (4.2 ± 0.7) (p=0.015). Similarly, perceived aesthetic improvement was greater among females (4.7 ± 0.5) than males (4.3 ± 0.6) (p=0.009). Although a higher proportion of females expressed willingness to undergo the procedure again (91.7%) compared to males (83.3%), this difference was not statistically significant (p=0.284).

Parameter	Male	Female	p-value
Overall Satisfaction	4.2 ± 0.7	4.6 ± 0.5	0.015*
Aesthetic Improvement	4.3 ± 0.6	4.7 ± 0.5	0.009*
Willingness for Repeat	83.3%	91.7%	0.284

Table 3: Patient satisfaction scores (Likert scale).

Table 4 summarizes the recurrence of gingival pigmentation at six months postoperatively. The proportion of participants with no recurrence was similar between males (75.0%) and females (72.2%), with no statistically significant difference (p=0.781). Mild and moderate recurrence rates were also comparable across both groups. These findings indicate that gender does not significantly influence the long-term stability of depigmentation outcomes and the recurrence pattern appears to be independent of gender-related factors.

Outcome	Male	Female	p-value
No Recurrence	75.0%	72.2%	0.781
Mild Recurrence	19.4%	22.2%	
Moderate Recurrence	5.6%	5.6%	

Table 4: Recurrence rates at 6 months.

Fig. 3 presents gender-based differences in perception scores across domains such as aesthetic concern, pain expectation and satisfaction. Females demonstrated significantly higher scores in aesthetic concern (4.7 ± 0.4 vs 4.1 ± 0.6) and pain expectation (4.5 ± 0.5 vs 3.9 ± 0.7), indicating greater psychological engagement with the procedure. The graph highlights a consistent trend of higher perception scores among females, suggesting that gender influences not only clinical outcomes but also preoperative expectations and postoperative experiences.

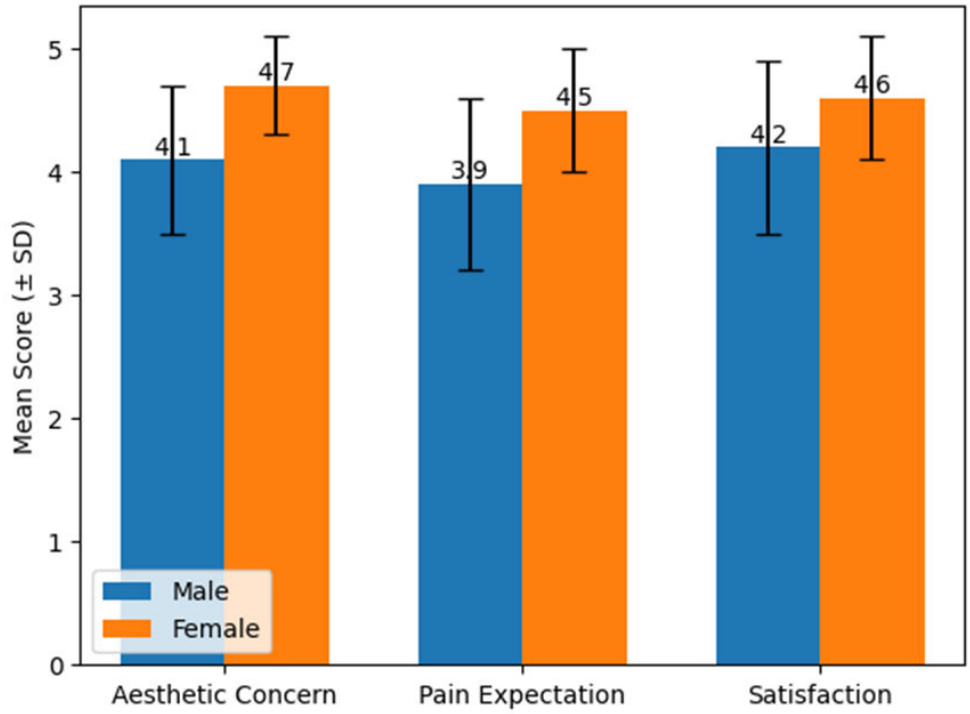

Figure 3: Perception scores by gender.

Discussion

The present study evaluated gender-based differences in perception and clinical outcomes following gingival depigmentation. The findings demonstrated that females reported significantly higher pain perception in the early postoperative period, exhibited greater aesthetic concern and satisfaction, while no significant differences were observed in long-term healing and recurrence rates. These findings highlight the multifactorial nature of patient-reported outcomes and emphasize the importance of incorporating gender perspectives in aesthetic periodontal procedures.

One of the key findings of this study was the significantly higher pain perception reported by female participants in the immediate postoperative period and at 24 hours. This observation is consistent with broader biomedical literature, which indicates that females tend to report higher pain sensitivity and lower pain thresholds compared to males due to both biological and psychosocial factors. For instance, a comprehensive review by Pain research researchers has demonstrated that sex-related differences in pain perception are influenced by hormonal variations, central pain processing and psychosocial conditioning [17]. These differences are reflected in clinical settings, where females often report greater postoperative discomfort than males.

In the context of gingival depigmentation, previous studies evaluating pain using the Visual Analog Scale (VAS) have shown a progressive reduction in pain over time, irrespective of the technique used. A clinical study comparing diode laser, scalpel and ceramic bur techniques reported significant differences in pain scores at early follow-up (12 hours), but no differences at later stages such as day 4 and day 7 [18]. This aligns closely with the present findings, where gender-based differences were prominent initially but diminished by day 7. Similarly, other studies have suggested that laser-assisted procedures may reduce postoperative pain due to sealing of nerve endings and formation of a coagulum layer, which acts as a biological dressing [18].
Another important observation in this study was the slightly better early healing response in males, particularly at day 3, although no differences were observed at later time points. Previous literature indicates that healing outcomes following gingival depigmentation are generally comparable across different treatment modalities. A study comparing laser, scalpel and ceramic bur techniques reported no statistically significant differences in wound healing and epithelialization across groups [18]. Furthermore, a recent investigation reported that although laser techniques may offer advantages in terms of reduced bleeding and discomfort, the overall healing outcomes remain similar across methods [19]. These findings suggest that while early inflammatory responses may vary, final healing outcomes are largely independent of procedural or patient-related factors such as gender.

The higher satisfaction and aesthetic perception observed among female participants in the present study is particularly noteworthy. This finding is consistent with the growing body of literature emphasizing the role of psychological and social factors in aesthetic dentistry [20,21]. Gingival depigmentation is primarily an elective cosmetic procedure and patient satisfaction is strongly influenced by subjective perception rather than purely clinical outcomes. Previous reports have highlighted that patient perception plays a critical role in determining treatment success in cosmetic periodontal procedures [22,23]. Females are generally reported to have greater aesthetic awareness and higher expectations regarding facial and dental appearance, which may explain the higher satisfaction scores observed in this study [24].

In addition, recent clinical trials assessing Patient-Reported Outcome Measures (PROMs) in gingival depigmentation have demonstrated that patient satisfaction scores are significantly influenced by perceived aesthetic improvement rather than objective clinical indices alone [25]. This aligns with the present findings, where females, despite reporting higher pain perception, expressed greater satisfaction, indicating that aesthetic outcomes may outweigh transient postoperative discomfort in determining overall treatment acceptance.

The absence of significant gender differences in recurrence rates in this study is also consistent with existing literature. Recurrence of gingival pigmentation is primarily attributed to the migration and reactivation of melanocytes rather than patient-related demographic factors. Studies evaluating long-term outcomes of gingival depigmentation have reported that recurrence is influenced by factors such as technique used, depth of ablation and genetic predisposition rather than gender differences [26]. Furthermore, clinical evidence suggests that most depigmentation techniques, including lasers and scalpel methods, achieve comparable reductions in pigmentation indices such as DOPI, with similar recurrence patterns over time [18].

The findings related to perception scores further reinforce the role of gender in influencing patient expectations and experiences. Females demonstrated significantly higher scores in domains such as aesthetic concern and pain expectation, indicating a greater psychological engagement with the procedure. This is supported by literature emphasizing that patient expectations and preoperative anxiety significantly influence postoperative perception and satisfaction in dental procedures.

From a clinical perspective, these findings have important implications for patient management. Understanding that females may experience higher initial pain perception but also derive greater satisfaction can help clinicians tailor communication strategies, provide appropriate counseling and manage expectations effectively. Similarly, recognizing that long-term outcomes such as healing and recurrence are not influenced by gender can reassure both clinicians and patients regarding the predictability of treatment outcomes.

The strengths of this study include its prospective design, standardized clinical protocol and inclusion of both clinical and patient-reported outcomes. However, certain limitations should be acknowledged. The study was conducted in a single center with a relatively modest sample size, which may limit generalizability. Additionally, psychological factors such as anxiety levels and cultural influences, which may significantly affect perception, were not quantitatively assessed. Future studies incorporating psychometric assessments and larger, multicentric populations may provide deeper insights into gender-based differences in aesthetic dental procedures.

Conclusion

The present study contributes to the growing evidence supporting the importance of patient-centered outcomes in periodontal aesthetics. While clinical parameters such as healing and recurrence remain consistent across genders, perception-based outcomes such as pain and satisfaction demonstrate significant gender-related variations. These findings underscore the need for a personalized approach in aesthetic dentistry, integrating both clinical excellence and patient perception to achieve optimal treatment outcomes.

Conflict of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

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None.

Data Availability Statement

Not applicable.

Ethical Statement

The project did not meet the definition of human subject research under the purview of the IRB according to federal regulations and therefore, was exempt.

Informed Consent Statement

Informed consent was taken for this study.

Authors' Contributions

All authors contributed equally to this paper.

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