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Periodontal biotype influence on aesthetic outcomes of implant-supported prostheses

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Abstract:
The periodontal biotype influences peri-implant aesthetics, but prospective clinical evidence remains limited. This prospective comparative study evaluated 60 adults with thin or thick periodontal biotypes over 12 months using the Pink Esthetic Score, White Esthetic Score, mucosal recession and peri-implant papilla fill. The thick biotype achieved significantly higher Pink Esthetic Scores (11.8 ± 1.6 vs 9.4 ± 2.1; $p < 0.001$) and lower mucosal recession (0.11 ± 0.09 mm vs 0.38 ± 0.17 mm; $p < 0.001$), while white esthetic scores and implant survival were comparable. A thick periodontal biotype was associated with superior peri-implant soft tissue aesthetics and greater tissue stability after implant restoration. This study advances current knowledge by supporting routine biotype assessment to optimize aesthetic outcomes and treatment planning before implant placement.

Keywords: Dental implants, gingival biotype, gingival recession, periodontal phenotype, pink esthetic score (PES), white esthetic score (WES)

Background:
The aesthetic outcome of implant-supported prostheses is determined by a complex interplay of surgical, prosthetic and patient related factors, among which the pre-operative tissue architecture of the implant recipient site occupies a position of primary importance **[1].** Ochsenbein and Ross first described two principal forms of gingival morphology: the flat-thick biotype, characterised by a broad zone of keratinised tissue, dense fibrotic connective tissue and a flat gingival contour; and the scalloped-thin biotype, characterised by a narrow band of keratinised tissue, delicate translucent gingiva and pronounced scalloping **[2].** The 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions subsequently replaced the term biotype with periodontal phenotype, reflecting the multidimensional nature of the tissue architecture, including gingival thickness, width of keratinised tissue and the underlying bone morphotype **[3].** The thin periodontal phenotype has been associated with greater susceptibility to recession following surgical and restorative procedures, reduced tolerance of inflammatory challenge and a tendency towards crestal bone resorption following implant placement, whereas the thick phenotype demonstrates greater dimensional stability and resilience **[4].** In the context of implant therapy, the peri-implant mucosa is subject to wound healing dynamics that differ substantially from those around natural teeth, with the biologic width established de novo at each implant site and the soft tissue volume critically dependent on the pre-existing tissue architecture **[5].** Sites with a thin biotype are therefore at elevated risk of peri-implant mucosal recession, compromised papilla fill and suboptimal aesthetic outcomes, particularly in the anterior aesthetic zone **[6].** Objective evaluation of aesthetic outcomes around implant-supported restorations has been facilitated by the development of standardised scoring systems. The Pink Esthetic Score (PES assesses seven peri-implant soft tissue parameters, including mesial and distal papilla, soft tissue level, contour, colour and surface texture, providing a reproducible quantitative measure of the soft tissue aesthetic dimension **[7].** The White Esthetic Score (WES) assesses five parameters of the visible implant crown, complementing the PES to yield a composite evaluation of the overall aesthetic result **[8].** Together, these indices provide a validated framework for the comparative assessment of aesthetic outcomes across different patient subgroups and clinical protocols **[9].** Despite the acknowledged clinical relevance of periodontal biotype to implant aesthetic outcomes, prospective studies directly comparing standardised aesthetic indices between thin and thick biotype patients over a defined follow-up period remain limited in number, with most evidence derived from retrospective analyses or studies in which biotype is a secondary rather than a primary variable of interest **[10].** Therefore, it is of interest to evaluate the influence of pre-operative periodontal biotype on the aesthetic outcomes of implant-supported prostheses in the anterior aesthetic zone, with the PES and WES as the primary outcome measures over a 12-month follow-up.

Materials and Methods:
This prospective comparative study was conducted at the Department of Periodontology, School of Dental Sciences, Krishna Vishwa Vidyapeeth, and Karad and associated

institutional sites. Systemically healthy adults aged 18 to 65 years requiring single-tooth implant replacement in the anterior aesthetic zone (maxillary incisors, canines, or premolars) were recruited consecutively. Ethical approval was obtained from the Institutional Ethics Committee (Ref: IEC/KVV/2023/056) and written informed consent was obtained from all participants prior to enrolment. The study was conducted in accordance with the principles of the Declaration of Helsinki and is reported in accordance with STROBE guidance. Sample size was estimated to provide 80% power to detect a clinically meaningful between-group difference of 1.5 units in total PES at a two-tailed alpha of 0.05, assuming a standard deviation of 2.2 units, yielding a minimum of 25 participants per group, rounded to 30 per group to accommodate an anticipated dropout of approximately 15%. Inclusion criteria were: a missing single tooth in the anterior zone with a healed site of at least three months, adequate bone volume for implant placement without simultaneous augmentation, absence of active periodontal disease and availability for 12-month follow-up. Exclusion criteria included heavy tobacco use (≥ 10 cigarettes per day), uncontrolled diabetes mellitus, current bisphosphonate therapy, pregnancy or lactation and bruxism. Periodontal biotype was assessed pre-operatively at each implant site using calibrated transgingival probing with a periodontal probe at the mid-facial aspect: a biotype was classified as thin when gingival thickness was less than 1.5 mm and as thick when it was 1.5 mm or greater, consistent with the criteria proposed by Claffey and Shanley **[11].** The width of keratinised tissue was also recorded with a millimetre-graduated probe. Participants were allocated to the thin biotype group (n = 30) or thick biotype group (n = 30) on the basis of this pre-operative measurement. All implants were placed using a standardised surgical protocol under local anaesthesia by experienced implant surgeons. A submerged healing period of eight to twelve weeks was observed before abutment connection. All implant sites were restored with lithium disilicate crowns fabricated using a standardised digital workflow and cemented with resin-modified glass ionomer cement. Standardised oral hygiene instruction was provided at each clinical visit. Aesthetic outcomes were assessed at baseline (definitive crown cementation) and at 6 and 12 months by a single calibrated examiner blinded to the biotype group. The Pink Esthetic Score (PES) was recorded across seven parameters (mesial papilla, distal papilla, soft tissue level, soft tissue contour, alveolar process deficiency, soft tissue colour and soft tissue texture), each scored on a 0–2 scale yielding a maximum total PES of 14. The White Esthetic Score (WES) was recorded across five parameters (tooth form, tooth volume and outline, colour, surface texture and translucency), each scored on a 0–2 scale yielding a maximum WES of 10. Mucosal recession was measured as the distance from the crown margin to the mid-buccal soft tissue crest and papilla fill was assessed using the Nordland and Tarnow classification. Peri-implant probing depth was recorded at six sites per implant as a secondary outcome. Standardised periapical radiographs were obtained at baseline and 12 months for marginal bone level assessment. Statistical analysis was performed using IBM SPSS Statistics version 27.0. Normality was tested with the Shapiro–Wilk test. Continuous variables are expressed as mean ± standard deviation and categorical variables as frequencies and percentages. Between-group comparisons used the independent samples t-test or Mann–Whitney U test as appropriate and categorical outcomes were compared using the chi-square or Fisher exact test. Within-group changes over time were assessed using repeated-measures analysis of variance with Bonferroni correction. A two-tailed p-value of less than 0.05 was considered statistically significant.

Results:

All 60 participants (30 thin biotype, 30 thick biotype) completed the 12-month follow-up. Baseline demographic and site-related characteristics were comparable between groups **(Table 1).** Mean pre-operative gingival thickness was 1.12 ± 0.19 mm in the thin biotype group and 1.89 ± 0.23 mm in the thick biotype group. Width of keratinised tissue was 2.4 ± 0.7 mm and 4.1 ± 0.9 mm respectively. Aesthetic outcomes at 6 and 12 months are presented in **(Table 2).** Total PES at 12 months was significantly higher in the thick biotype group (11.8 ± 1.6 versus 9.4 ± 2.1; $p < 0.001$). The sub-scores driving this difference were principally the soft tissue level ($p = 0.001$) and mesial and distal papilla sub-scores ($p = 0.008$ and $p = 0.011$ respectively). Total WES did not differ significantly between groups at 12 months (8.9 ± 1.1 versus 8.7 ± 1.3; $p = 0.481$). Mucosal recession was significantly greater in the thin biotype group at both 6 and 12 months **(Table 3)**. At 12 months, mean mucosal recession was 0.38 ± 0.17 mm in the thin biotype group versus 0.11 ± 0.09 mm in the thick biotype group ($p < 0.001$). Recession of 0.5 mm or more was observed in 11 of 30 sites (36.7%) in the thin biotype group compared with 2 of 30 sites (6.7%) in the thick biotype group ($p = 0.003$; Fisher exact test). Complete papilla fill (Nordland–Tarnow Class 0) was present at 12 months in 18 of 30 thick biotype sites (60.0%) and 9 of 30 thin biotype sites (30.0%; $p = 0.017$). Marginal bone loss over 12 months was 0.29 ± 0.15 mm in the thin biotype group and 0.22 ± 0.12 mm in the thick biotype group; this difference approached but did not reach statistical significance ($p = 0.051$). Peri-implant probing depth was comparable between groups **(Table 3).** All 60 implants remained in function at 12 months, representing a survival rate of 100% in both groups. The rates of minor biological and mechanical complications were low and comparable between groups **(Table 4).**

Table 1: Baseline characteristics of the study cohort (60 participants)

Variable	Thin biotype (n = 30)	Thick biotype (n = 30)
Age (years), mean ± SD	38.4 ± 9.1	40.2 ± 10.3
Female, n (%)	19 (63.3)	17 (56.7)
Maxillary anterior site, n (%)	24 (80.0)	23 (76.7)
Gingival thickness (mm)	1.12 ± 0.19	1.89 ± 0.23
Width of keratinised tissue (mm)	2.4 ± 0.7	4.1 ± 0.9
Baseline PES, mean ± SD	10.1 ± 1.8	10.3 ± 1.7

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Table 2: Aesthetic outcomes (PES and WES) at 6 and 12 months

Parameter	Time point	Thin biotype (Mean ± SD)	Thick biotype (Mean ± SD)	p-value
Total PES (max 14)	6 months	9.7 ± 2.0	11.5 ± 1.7	0.001*
Total PES (max 14)	12 months	9.4 ± 2.1	11.8 ± 1.6	<0.001*
Total WES (max 10)	6 months	8.6 ± 1.2	8.8 ± 1.1	0.519
Total WES (max 10)	12 months	8.7 ± 1.3	8.9 ± 1.1	0.481

**Statistically significant (p < 0.05); independent samples t-test*

Table 3: Mucosal recession, papilla fill, probing depth and marginal bone loss at 12 months

Outcome	Thin biotype	Thick biotype	p-value
Mucosal recession (mm), mean ± SD	0.38 ± 0.17	0.11 ± 0.09	<0.001*
Recession ≥ 0.5 mm, n (%)	11 (36.7)	2 (6.7)	0.003*
Papilla fill Class 0, n (%)	9 (30.0)	18 (60.0)	0.017*
Probing depth (mm), mean ± SD	2.3 ± 0.5	2.2 ± 0.5	0.384
Marginal bone loss (mm), mean ± SD	0.29 ± 0.15	0.22 ± 0.12	0.051

**Statistically significant (p < 0.05); Fisher exact test / independent samples t-test*

Table 4: Implant survival and complications at 12 months

Outcome	Thin biotype n (%)	Thick biotype n (%)
Implants surviving at 12 months	30/30 (100)	30/30 (100)
Minor biological complications	3 (10.0)	2 (6.7)
Minor mechanical complications	1 (3.3)	1 (3.3)

Discussion:

The principal finding of this prospective comparative study was that the pre-operative periodontal biotype exerts a clinically and statistically significant influence on the aesthetic outcomes of implant-supported prostheses in the anterior zone, with participants presenting a thick biotype demonstrating markedly higher total PES scores, lower mucosal recession and better papilla fill at 12 months compared to those with a thin biotype, while the prosthetic aesthetic dimension assessed by WES and implant survival were equivalent between groups. These findings confirm the importance of biotype assessment as a pre-operative prognostic determinant in aesthetic implant dentistry. The significantly lower PES scores in the thin biotype group in the present study are consistent with the observations of Fürhauser *et al.* **[12],** who introduced and validated the PES and reported that the soft tissue level and papilla sub-scores were the most sensitive to tissue volume and stability. The present data extend this framework to a biotype-stratified analysis, showing that the tissue level and papilla sub-scores specifically accounted for the majority of the PES difference between thin and thick biotype participants, which is mechanistically plausible given that thin tissue is less capable of maintaining dimensional stability around the prosthetic emergence profile. The higher incidence of mucosal recession in the thin biotype group (36.7% versus 6.7%; p = 0.003) accords with the systematic review by da Silva *et al.* **[13],** who reported that a thin gingival phenotype represented a significant risk factor for additional bone loss and peri-implant mucosal complications, noting that five of six cases of peri-implantitis in their reviewed cohort were associated with a thin phenotype. The present results further corroborate the prospective findings of Link evicius *et al.* **[14],** which showed that thin mucosal tissue at the time of implant placement was associated with significantly greater marginal bone resorption, attributed to the inability of thin tissue to accommodate the full supracrestal connective tissue attachment without crestal bone loss. Although the between group difference in marginal bone loss in the present study approached but did not reach significance, the directional trend was consistent with this mechanism. The absence of a significant difference in WES between biotype groups is noteworthy and in alignment with the findings of Agarwal *et al.* **[15],** who reported that the pink esthetic score was primarily influenced by the soft tissue architecture rather than the prosthetic crown quality and that crown-related aesthetic parameters were largely independent of biotype classification. The present prospective data, with a biotype-stratified design, provide more direct evidence that thick biotype is associated with significantly better papilla fill at 12 months. This finding highlights the role of the interproximal tissue volume in determining the final aesthetic outcome and suggests that sites with a thin biotype may benefit from connective tissue augmentation prior to or at the time of implant placement to improve the likelihood of complete papilla fill. The 100% implant survival rate in both groups confirms that periodontal biotype does not influence the osseointegration or structural success of the implant and that the biotype effect is confined to the aesthetic and soft tissue dimensions. The study has several limitations. The 12-month observation period captures the early aesthetic response; longer follow-up is required to determine whether the biotype-related aesthetic differences persist, widen, or converge over time. The sample was drawn from multiple sites with alternating allocation rather than randomisation and although baseline characteristics were comparable, residual confounding cannot be excluded. Assessment of aesthetic outcomes using PES and WES, while validated, retains an element of subjectivity. Additionally, the study did not include a biotype modification arm, which would have allowed comparison of augmented thin biotype sites with native thick biotype sites.

Conclusion:

Periodontal biotype significantly influenced the aesthetic outcomes of anterior implant-supported prostheses over 12 months. Thick biotype showed higher Pink Esthetic Scores, reduced mucosal recession and superior papilla fill. Pre-

operative biotype assessment may guide aesthetic planning, warranting further trials on soft tissue augmentation.

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Conflict of interest:
The authors declare no conflict of interest.

Data availability:
The datasets generated and analysed during the current study are available from the corresponding author on reasonable request.

References:

[1] Kois JC. *Compendium of Continuing Education in Dentistry*. 2004 **25**:898. [PMID: 15643769]
[2] Ochsenbein C & Ross S. *Dental Clinics of North America*. 1969 **13**:847. [PMID: 5249439]
[3] Herrera D *et al. Journal of Clinical Periodontology*. 2018 **45**:S162. [PMID: 29926493]
[4] Claffey N & Shanley D. *Journal of Clinical Periodontology*. 1986 **13**:654. [PMID: 3531244]
[5] Berglundh T & Lindhe J. *Journal of Clinical Periodontology*. 1996 **23**:971. [DOI: 10.1111/j.1600-051X.1996.tb00520]
[6] Tomina DC *et al. J Clin Med.* 2023 **12**:4275. [PMID: 37445310]
[7] Veena KM *et al. J Prosthet Dent.* 2026 **135**:e12. [PMID: 41290445]
[8] Sharma T *et al. European Journal of Dental and Oral Health*. 2024 **5**:9. [DOI: 10.24018/ejdent.2024.5.2.212]
[9] Sadilina S *et al. Clin Oral Implants Res.* 2025 **36**:1382. [PMID: 40833238]
[10] Parihar AS *et al. J Pharm Bioallied Sci.* 2025 **17**:S555. [PMID: 40510985]
[11] Mansoor N *et al. CME Journal Geriatric Medicine.* 2026 **18**:136. [DOI: 10.61336/cmejgm/2026-03-33]
[12] Fürhauser R *et al. Clinical Oral Implants Research*. 2005 **16**:639. [PMID: 16307569]
[13] da Silva DM *et al. Evid Based Dent.* 2025 **26**:119. [PMID: 39910219]
[14] Linkevicius T *et al. Clin Implant Dent Relat Res.* 2015 **17**:497. [PMID: 24103157]
[15] Agarwal A *et al. Journal of Esthetic and Restorative Dentistry*. 2025 **37**:2459. [PMID: 40667857]

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