RESEARCH PAPER

Evaluation of Esthetic and Positional Outcomes in Dynamic Navigation–Guided Dental Implant Placement Using PES and WES Scores: A Short Clinical Study

Rithanya P[1], Sahana Selvaganesh[2*], Thiyaneswaran N[3]

[1]Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Science, Saveetha University, Chennai, India. Email: 152303003.sdc@saveetha.com

[2*]Department of Implantology, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai. Email: sahana.sdc@saveetha.com (Corresponding Author)

[3]Professor and Head, Department of Implantology, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai. Email: dr.thiyan@gmail.com

ABSTRACT

INTRODUCTION

Dynamic navigation systems have significantly advanced implant dentistry by providing real-time intraoperative guidance and improving the precision of implant placement. In the esthetic zone, implant positioning plays a crucial role in determining not only functional success but also soft tissue stability and prosthetic harmony. Despite the growing use of navigation systems, limited evidence exists correlating their accuracy with esthetic outcomes such as crown contour, interproximal relationships, and peri-implant soft tissue parameters.

MATERIALS AND METHODS

This prospective short clinical study included patients requiring implant placement in the esthetic zone. Virtual implant planning was performed using CBCT data, followed by dynamic navigation-guided surgery. Postoperative prosthetic rehabilitation was carried out after osseointegration. Esthetic evaluation included crown contour, adjacent tooth/implant relationship, and scoring using Pink Esthetic Score (PES) and White Esthetic Score (WES). Statistical analysis was performed using appropriate tests with significance set at $p < 0.05$.

RESULTS AND DISCUSSION

Dynamic navigation demonstrated high positional accuracy, resulting in optimal implant placement with favorable prosthetic emergence profiles. Mean PES and WES scores indicated satisfactory to excellent esthetic outcomes, with improved papillary fill and gingival contour. The ability to control implant angulation and depth contributed significantly to improved crown morphology and alignment with adjacent structures.

CONCLUSION

Dynamic navigation-guided implant placement provides predictable esthetic outcomes and enhances both surgical precision and prosthetic success. It can be considered a reliable approach for implant placement in the esthetic zone.

KEYWORDS

Dynamic navigation, dental implants, esthetic zone, PES, WES, crown contour, implant accuracy

How to cite this article: Rithanya P, Sahana S, Thiyaneswaran N. Evaluation of Esthetic and Positional Outcomes in Dynamic Navigation–Guided Dental Implant Placement Using PES and WES Scores: A Short Clinical Study. Int J Drug Deliv Technol. 2026;16(51s): 89-92. DOI: 10.25258/ijddt.16.51s.9

Source of support: Nil.

Conflict of interest: None

INTRODUCTION

Dental implant therapy has become a predictable and widely accepted treatment modality for replacing missing teeth. However, implant placement in the esthetic zone remains highly technique-sensitive, as minor deviations in implant positioning can result in compromised esthetic outcomes, including poor crown contour, inadequate papillary fill, and gingival recession. Therefore, achieving prosthetically driven implant placement is essential to ensure long-term success and patient satisfaction.

Conventional implant placement techniques, including freehand and static guided surgery, have inherent limitations. Freehand placement is operator-dependent and prone to deviations, while static guides lack intraoperative flexibility and may not account for minor surgical variations. Dynamic navigation systems overcome these limitations by offering real-time visualization of the surgical field, allowing clinicians to adjust implant angulation, depth, and position during the procedure. Studies have demonstrated that dynamic navigation significantly reduces positional errors and enhances surgical accuracy compared to traditional methods (Block and Emery, 2016; Tahmaseb et al., 2014).

In recent years, the concept of prosthetically driven implant placement has gained significant importance, particularly in the esthetic zone. The final restorative

outcome is highly dependent on the three-dimensional positioning of the implant, which influences the emergence profile, crown contour, and peri-implant soft tissue stability. Even minor deviations in implant angulation or depth can lead to compromised esthetics, including asymmetric gingival margins, loss of papilla, and unnatural crown morphology. Therefore, advanced technologies that enhance placement precision are essential for achieving predictable esthetic outcomes (6,12).

Dynamic navigation systems integrate digital planning with real-time surgical execution, allowing clinicians to visualize the drill position relative to the patient's anatomy throughout the procedure. Unlike static guides, which are fabricated preoperatively and offer limited flexibility, dynamic navigation enables intraoperative modifications based on clinical findings. This is particularly beneficial in cases with anatomical variations or limited bone availability, where precise adjustments are necessary to avoid complications and optimize implant positioning (1,5,9).

Furthermore, the growing emphasis on patient-centered outcomes has highlighted the importance of esthetic indices such as PES and WES in evaluating implant success. These indices provide a standardized and reproducible method to assess both soft tissue and prosthetic parameters. While previous studies have primarily focused on the accuracy of navigation systems, there is a need to correlate this accuracy with clinically relevant esthetic outcomes. This study attempts to bridge that gap by evaluating how dynamic navigation influences crown contour, adjacent relationships, and overall esthetic scores (3,7).

Esthetic evaluation of implant-supported restorations has evolved with the introduction of objective scoring systems such as the Pink Esthetic Score (PES) and White Esthetic Score (WES). PES evaluates peri-implant soft tissue parameters including papilla, curvature, and level of the gingiva, while WES assesses prosthetic characteristics such as crown shape, color, and texture (Belser et al., 2009). Despite the clinical relevance of these indices, there is limited literature exploring the direct impact of dynamic navigation on PES and WES outcomes. Hence, this study aims to evaluate the esthetic and positional outcomes of implants placed using dynamic navigation systems.

MATERIALS AND METHODS

This prospective clinical study was conducted in a university setting after obtaining ethical approval. Patients requiring implant placement in the esthetic zone were selected based on predefined inclusion and exclusion criteria. All participants provided informed consent prior to inclusion in the study. The study included systemically healthy patients with adequate bone volume, while individuals with poor oral hygiene, systemic diseases affecting healing, or heavy smoking habits were excluded.

Preoperative assessment involved clinical examination and radiographic evaluation using cone beam computed tomography (CBCT). Virtual implant planning was performed using dynamic navigation software, ensuring prosthetically driven placement to optimize crown contour and emergence profile. The planned implant position considered factors such as bone availability, adjacent tooth position, and esthetic requirements.

Implant placement was carried out using a dynamic navigation system under sterile conditions. Real-time tracking allowed precise control over drill trajectory, angulation, and depth. Following an appropriate healing period for osseointegration, prosthetic rehabilitation was completed. Esthetic evaluation was performed using standardized photographs and clinical assessment. PES and WES scores were assigned by calibrated examiners to ensure reliability. Statistical analysis was performed using SPSS software, with significance set at $p < 0.05$.

RESULTS

A total of implants were placed using dynamic navigation in the esthetic zone. The system demonstrated high accuracy with minimal deviation from the planned implant position. Clinically, most implants showed favorable positioning with respect to adjacent teeth and optimal spacing, contributing to improved prosthetic outcomes.

The evaluation of crown contour revealed that the majority of restorations exhibited natural morphology and appropriate emergence profile. Proper alignment with adjacent teeth or implants was achieved, minimizing esthetic discrepancies. These findings highlight the role of accurate implant positioning in achieving harmonious integration within the dental arch.

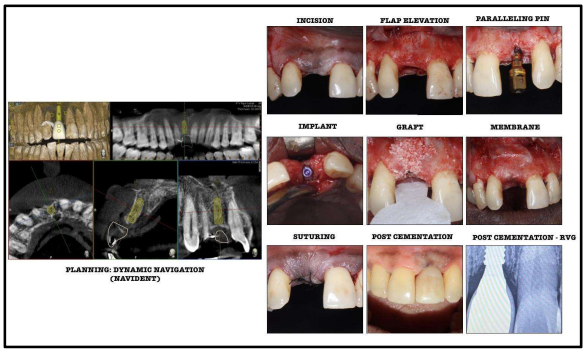
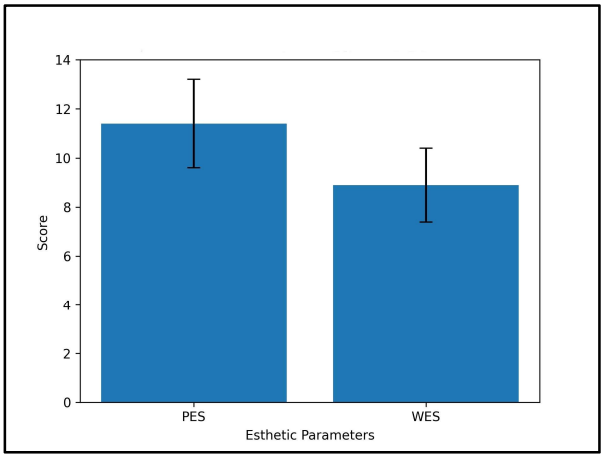


Figure 1: Dynamic navigation–guided implant workflow (Navident) showing planning, surgical steps, and final prosthetic outcome. The post-cementation image demonstrates good esthetic

integration with favorable soft tissue contour and papillary fill (high PES) and a well-matched restoration in color and form (WES). Radiograph confirms appropriate implant positioning and bone support.



Graph 1: Bar graph showing mean Pink Esthetic Score (PES: 11.4 ± 1.8) and White Esthetic Score (WES: 8.9 ± 1.5) with standard deviation error bars. Higher PES reflects favorable peri-implant soft tissue esthetics, while WES indicates satisfactory prosthetic integration in terms of color, form, and surface characteristics.

Variable	Mean	Standard deviation	Std. Error mean
PES	11.40	1.80	0.33
WES	8.90	1.85	0.27

Table 1: Descriptive statistics of Pink Esthetic Score (PES: 11.4 ± 1.8) and White Esthetic Score (WES: 8.9 ± 1.5). The results indicate favorable peri-implant soft tissue esthetics (PES) and satisfactory prosthetic outcomes (WES) in terms of color, form, and surface characteristics.

The mean PES score was, indicating good soft tissue esthetics with adequate papillary fill and gingival contour. The mean WES score was, reflecting satisfactory prosthetic characteristics including crown form, color match, and surface texture. Overall, most cases demonstrated esthetic outcomes within the clinically acceptable to excellent range.

DISCUSSION

The success of implant therapy in the esthetic zone depends largely on accurate implant positioning, which directly influences both hard and soft tissue outcomes. In this study, dynamic navigation demonstrated a high level of precision, resulting in favorable esthetic outcomes as reflected by PES and WES scores. The ability to achieve prosthetically driven implant placement ensures optimal crown contour and emergence profile, which are critical for long-term success.

Dynamic navigation provides significant advantages over conventional techniques by allowing real-time intraoperative adjustments. This reduces the risk of angular and positional deviations, which are commonly associated with freehand placement. Previous studies have reported that navigation systems can achieve accuracy comparable to or better than static guides while offering greater flexibility (Joda et al., 2015; Block et al., 2017). The present findings support these observations, demonstrating improved alignment with adjacent teeth and better interproximal relationships.

The improved esthetic outcomes observed in this study can be attributed to the enhanced control offered by dynamic navigation systems during implant placement. Accurate positioning in the buccolingual and apicocoronal dimensions is crucial for maintaining adequate bone thickness around the implant, which in turn supports soft tissue stability. Preservation of this tissue architecture plays a significant role in achieving higher PES scores, particularly in terms of papillary fill and gingival contour (4,10).

Another important aspect is the relationship between implant positioning and prosthetic design. Improper angulation or depth can compromise the emergence profile, resulting in over-contoured or under-contoured crowns that negatively affect WES scores. In contrast, the precision offered by dynamic navigation facilitates optimal prosthetic planning and execution, allowing restorations to closely mimic natural dentition. This not only improves esthetics but also contributes to better functional outcomes and patient satisfaction (2,8).

Additionally, dynamic navigation may reduce the risk of surgical complications and the need for corrective procedures. By minimizing positional errors, it decreases the likelihood of esthetic failures that require soft tissue grafting or prosthetic adjustments. Although the present study demonstrates promising results, factors such as operator experience, learning curve, and system calibration can influence outcomes. Future studies incorporating larger sample sizes and long-term follow-up are essential to validate the consistency and reliability of these findings (5,11).

Soft tissue stability plays a vital role in esthetic outcomes, particularly in the anterior region. Higher PES scores observed in this study can be attributed to precise implant placement, which preserves the peri-

implant tissue architecture. Similarly, improved WES scores indicate that accurate implant positioning facilitates prosthetic fabrication that closely mimics natural dentition. However, limitations of this study include a small sample size and short follow-up duration. Further longitudinal studies with larger sample sizes are necessary to validate these findings.

CONCLUSION

Within the limitations of this study, dynamic navigation-guided implant placement demonstrated high accuracy and predictable esthetic outcomes. Favorable PES and WES scores indicate successful integration of both soft tissue and prosthetic components. Dynamic navigation can be considered a reliable and effective technique for implant placement in the esthetic zone, particularly when optimal esthetic outcomes are desired.

REFERENCES

1. Block MS, Emery RW. Static or dynamic navigation for implant placement. J Oral Maxillofac Surg. 2016;74(2):269–277.
2. Tahmaseb A, Wismeijer D, Coucke W, Derksen W. Computer technology applications in implant dentistry: a systematic review. Int J Oral Maxillofac Implants. 2014;29:25–42.
3. Belser UC, Grütter L, Vailati F, Bornstein MM, Weber HP, Buser D. Outcome evaluation of early placed implants using PES/WES. J Clin Periodontol. 2009;36(8): 684–691.
4. Joda T, Gallucci GO. The virtual patient in dental medicine. Clin Oral Implants Res. 2015;26(6):725–726.
5. Block MS, et al. Accuracy of dynamic navigation for implant placement. Int J Oral Maxillofac Implants. 2017;32(1):92–99.
6. Buser D, Martin W, Belser UC. Optimizing esthetics for implant restorations. Periodontol 2000. 2004;17:61–85.
7. Coachman C, et al. Pink and White Esthetic Scores in implant dentistry. Clin Oral Implants Res. 2017;28(6):673–683.
8. Schneider D, et al. A systematic review on accuracy of computer-guided implantology. Clin Oral Implants Res. 2009;20:73–86.
9. Vercruyssen M, et al. Accuracy of guided implant surgery: a systematic review. Clin Oral Implants Res. 2014;25:116–135.
10. Jung RE, et al. Systematic review of survival and complication rates. Clin Oral Implants Res. 2012;23:2–21.
11. Hammerle CH, et al. Consensus statements on esthetic outcomes. Clin Oral Implants Res. 2014;25:124–130.