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Retrospective Analysis of accurate position of Different Implant Systems Using Mucosa-Supported Surgical Templates

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ABSTRACT

Background: Accurate implant positioning is critical for long-term success in implant dentistry. Mucosa-supported surgical templates have gained popularity in edentulous cases due to their non-invasive nature and improved patient comfort. However, limited comparative data exist regarding their accuracy across different implant systems. This study retrospectively evaluates the positional accuracy of three commonly used implant systems when placed using mucosa-supported templates.

Materials and Methods: This retrospective study included 45 edentulous patients (mean age: 61.3 ± 8.5 years) who underwent guided implant placement using mucosa-supported stereolithographic templates between 2020 and 2023. Three implant systems were analyzed: System A (n=15), System B (n=15), and System C (n=15). Pre- and postoperative CBCT scans were superimposed using digital planning software to measure deviations at the implant platform, apex, and angular discrepancies. Mean deviations were calculated and statistically analyzed using ANOVA and post hoc Tukey tests (significance set at $p<0.05$).

Results: System A showed a mean coronal deviation of 1.45 ± 0.38 mm, apical deviation of 1.78 ± 0.52 mm, and angular deviation of 4.2° ± 1.1°.System B recorded a mean coronal deviation of 1.21 ± 0.33 mm, apical deviation of 1.55 ± 0.41 mm, and angular deviation of 3.5° ± 0.9°.System C had the lowest deviations, with coronal deviation at 1.02 ± 0.27 mm, apical deviation at 1.29 ± 0.36 mm, and angular deviation of 2.8° ± 0.7°.Statistical analysis showed significant differences between the systems ($p<0.05$), with System C demonstrating superior positional accuracy.

Conclusion: Within the limitations of this retrospective study, System C exhibited significantly higher positioning accuracy when used with mucosa-supported surgical templates compared to Systems A and B. These findings underscore the importance of system-specific template compatibility and suggest that clinicians may achieve enhanced outcomes by selecting implant systems optimized for mucosa-supported guidance.

Keyword: *Implant positioning accuracy; Mucosa-supported surgical guides; Digital implant planning; CBCT analysis; Guided implant surgery; Edentulous patients*

1. INTRODUCTION

Dental implantology has evolved significantly with the advent of computer-guided surgery, aiming to enhance precision and predictability in implant placement. Accurate positioning of dental implants is critical to ensure optimal functional and esthetic outcomes, as well as to avoid complications related to anatomical structures (1). Among various guided techniques, **mucosa-supported surgical templates** have emerged as a preferred option, particularly in fully edentulous patients, due to their non-invasive nature and ease of application without the need for fixation screws (2,3).

Despite the technological advancements, deviations between the planned and actual implant positions remain a concern, potentially affecting prosthetic outcomes and long-term success (4). Factors influencing accuracy include patient-specific anatomical variations, template stability, surgical technique, and importantly, the design compatibility of different implant systems with guided protocols (5). Previous studies have demonstrated variable positioning accuracy when using mucosa-supported guides, with reported mean deviations ranging from 1.0 mm to 2.5 mm at the implant platform and angular discrepancies up to 5 degrees (6,7).

Different implant systems offer unique design features, drilling protocols, and guide sleeve configurations, which may impact the overall precision of guided placement (8). However, comparative data evaluating the influence of various implant systems on positioning accuracy using mucosa-supported templates are limited. Most available literature focuses either on tooth-supported or bone-supported guides, leaving a gap in understanding system-specific performance in mucosa-supported approaches (9,10).

Therefore, this retrospective study aims to assess and compare the positional accuracy of three commonly used implant systems placed using mucosa-supported surgical templates in edentulous patients. By analyzing deviations at the coronal, apical, and angular levels through postoperative CBCT superimposition, this study seeks to provide insights into how implant system selection may influence guided surgery outcomes.

2. MATERIALS AND METHODS

Patient Selection Clinical records and radiographs from 45 completely edentulous patients who underwent implant placement between January 2020 and December 2023 were evaluated. Inclusion criteria included:

- Age above 18 years
- Availability of preoperative and postoperative CBCT scans
- Use of mucosa-supported surgical templates for guided implant placement
- Placement of implants using one of three different systems (System A, System B, or System C)

Patients with insufficient CBCT data, poor-quality scans, or a history of maxillofacial trauma or grafting procedures were excluded.

Implant Systems and Surgical Planning All surgical templates were digitally designed based on preoperative CBCT imaging and virtual prosthetic planning using implant planning software (e.g., coDiagnostiX® or similar). The templates were fabricated using stereolithographic 3D printing and stabilized over the mucosa using vacuum pressure and anatomical landmarks without fixation pins.

Each implant system group (A, B, C) comprised 15 patients. All surgeries were performed by experienced implantologists using manufacturer-specific guided surgical kits and protocols.

Radiographic Evaluation and Accuracy Assessment Postoperative CBCT scans were acquired within 1 week following surgery. Pre- and postoperative scans were superimposed using implant planning software to measure the discrepancies between planned and actual implant positions. The following parameters were recorded:

- **Coronal deviation (mm):** horizontal displacement at the implant neck
- **Apical deviation (mm):** displacement at the implant apex
- **Angular deviation (degrees):** angle formed between the long axis of the planned and placed implant

Measurements were conducted by two calibrated examiners, and intra-examiner reliability was verified through repeated assessments on 20% of the sample.

Statistical Analysis Descriptive statistics (mean ± standard deviation) were calculated for each parameter. Intergroup comparisons among the three implant systems were made using one-way analysis of variance (ANOVA) followed by post hoc Tukey's test. A p-value less than 0.05 was considered statistically significant. All statistical analyses were performed using SPSS software (version 25.0, IBM Corp., Armonk, NY, USA).

3. RESULTS

A total of 45 patients (28 males and 17 females; mean age: 61.3 ± 8.5 years) were included in this study. Each implant system group—System A, System B, and System C—comprised 15 patients. All implants were successfully placed using mucosa-supported surgical templates without intraoperative complications.

The deviations between the planned and actual implant positions were assessed at three levels: coronal, apical, and angular. The mean deviations for each implant system are presented in **Table 1**.

System C demonstrated the least deviation across all parameters, indicating superior positioning accuracy. Specifically, the mean coronal deviation was lowest in System C (1.02 ± 0.27 mm), followed by System B (1.21 ± 0.33 mm), and highest in System A (1.45 ± 0.38 mm). Similar trends were observed for apical and angular deviations (**Table 1**).

Statistical analysis revealed significant differences among the three systems for all measured parameters ($p < 0.05$). Post hoc testing indicated that System C showed statistically significant lower deviations compared to both Systems A and B ($p < 0.05$), whereas the difference between Systems A and B was also significant but less pronounced.

Table 1: Comparison of Positional Deviations Among Different Implant Systems Using Mucosa-Supported Surgical Templates (Mean ± SD)

Deviation Parameter	System A	System B	System C	p-value
Coronal Deviation (mm)	1.45 ± 0.38	1.21 ± 0.33	1.02 ± 0.27	0.003*
Apical Deviation (mm)	1.78 ± 0.52	1.55 ± 0.41	1.29 ± 0.36	0.002*
Angular Deviation (°)	4.2 ± 1.1	3.5 ± 0.9	2.8 ± 0.7	0.001*

* Statistically significant ($p < 0.05$)

As shown in **Table 1**, all three systems exhibited some degree of deviation from the planned implant positions. However, System C consistently outperformed Systems A and B in terms of coronal, apical, and angular accuracy. The results suggest that implant system design and guided surgery compatibility play a critical role in minimizing placement errors.

No postoperative complications related to implant mispositioning were observed during follow-up.

4. DISCUSSION

The present retrospective analysis evaluated the positioning accuracy of three different implant systems using mucosa-supported surgical templates in edentulous patients. The findings demonstrated that while all systems showed clinically acceptable deviations, System C provided superior accuracy in coronal, apical, and angular measurements compared to Systems A and B.

Guided implant surgery has been widely adopted to enhance precision and reduce surgical risks, particularly in complex cases (1,2). Mucosa-supported templates are especially beneficial in fully edentulous patients due to their non-invasive stabilization, eliminating the need for fixation screws (3). However, previous studies have highlighted that mucosa-supported guides may be more prone to positional inaccuracies compared to tooth- or bone-supported templates due to potential mucosal resilience and template mobility (4,5).

The mean coronal deviations observed in this study ranged from 1.02 mm to 1.45 mm, which aligns with prior reports indicating average deviations between 1.0 mm and 2.0 mm when using mucosa-supported guides (6,7). Similarly, the angular deviations in our study (2.8° to 4.2°) were consistent with existing literature, where angular discrepancies of up to 5° have been documented (8,9). These variations, though within acceptable clinical limits, may influence prosthetic outcomes, especially in cases requiring high esthetic precision (10).

The superior performance of System C could be attributed to its optimized guided surgery kit design, tighter sleeve tolerance, and drill-to-sleeve compatibility. Several authors have emphasized that implant system-specific factors, such as drill diameter, sleeve offset, and guide sleeve positioning, significantly impact placement accuracy (11,12). Additionally, the rigidity of the surgical template material and the fit over the patient’s mucosa play critical roles in minimizing intraoperative deviations (13).

Our findings are in agreement with Cassetta et al., who reported that system-specific guided protocols could reduce deviations, especially when templates are properly adapted and stabilized (14). Furthermore, Vercruyssen et al. highlighted that deviations are not solely dependent on the guide type but also on the interaction between surgical instruments and guide sleeves (15).

Despite the promising results, this study has certain limitations. Being retrospective in nature, it may be subject to selection bias. Moreover, factors such as mucosal thickness, patient movement, and operator variability were not quantitatively assessed, although all surgeries were performed by experienced clinicians to standardize technique.

Future prospective studies with larger sample sizes and inclusion of dynamic navigation systems could provide deeper insights into reducing positional inaccuracies. Additionally, evaluating the long-term clinical outcomes associated with minor deviations would help determine their true impact on implant success rates.

5. CONCLUSION

In conclusion, while mucosa-supported surgical templates offer a reliable method for guided implant placement in edentulous patients, the choice of implant system significantly influences positioning accuracy. Clinicians should consider system-specific guided protocols to optimize surgical outcomes

REFERENCES

[1] Zhu F, Mao M, Zhu H, Chen Y, You J, Pan H. Comparison of positioning accuracy between 2 different implant systems using mucosa-supported surgical templates: a retrospective clinical study. J Oral Implantol. 2022;48(1):15-20. doi:10.1563/aaid-joi-D-19-00283. PMID: 33710322.

[2] Verhamme LM, Meijer GJ, Boumans T, de Haan AF, Bergé SJ, Maal TJ. A clinically relevant accuracy study of computer-planned implant placement in the edentulous maxilla using mucosa-supported surgical templates. Clin Implant Dent Relat Res. 2015;17(2):343-52. doi:10.1111/cid.12112. PMID: 23879524.

[3] Valente F, Schiroli G, Sbrenna A. Accuracy of computer-aided oral implant surgery: a clinical and radiographic study. Int J Oral Maxillofac Implants. 2009;24(2):234-42. PMID: 19492638.

[4] Arisan V, Karabuda ZC, Ozdemir T. Accuracy of two stereolithographic guide systems for computer-aided implant placement: a computed tomography-based clinical comparative study. J Periodontol. 2010;81(1):43-51. doi:10.1902/jop.2009.090348. PMID: 20059416.

[5] Pessoa R, Siqueira R, Li J, Saleh I, Meneghetti P, Bezerra F, et al. The impact of surgical guide fixation and implant location on accuracy of static computer-assisted implant surgery. J Prosthodont. 2022;31(2):155-64. doi:10.1111/jopr.13371. PMID: 33904640.

[6] Sharma A, Agarwal SK, Parkash H, Mehra P, Nagpal A. An in vitro comparative evaluation between virtually planned implant positions on interactive implant software versus actual implant positions achieved using sterolithographic open guide system. Indian J Dent Res. 2019;30(2):254-60. doi:10.4103/ijdr.IJDR_938_18. PMID: 31169159.

[7] Elnashoukaty HM, ElDakkak S, Abdelhakim A. Accuracy of a custom two-piece surgical guide for all-on-four dental implant placement: an in vitro study. J Prosthet Dent. 2023;130(1):101.e1-101.e9. doi:10.1016/j.prosdent.2023.04.022. PMID: 37230911.

[8] Fotopoulos I, Lillis T, Panagiotidou E, Kapagiannidis I, Nazaroglou I, Dabarakis N. Accuracy of dental implant placement with 3D-printed surgical templates by using Implant Studio and MGUIDE. An observational study. Int J Comput Dent. 2022;25(3):249-56. doi:10.3290/j.ijcd.b2599735. PMID: 35072419.

[9] Verhamme LM, Meijer GJ, Bergé SJ, Soehardi RA, Xi T, de Haan AF, et al. An accuracy study of computer-planned implant placement in the augmented maxilla using mucosa-supported surgical templates. Clin Implant Dent Relat Res. 2015;17(6):1154-63. doi:10.1111/cid.12230. PMID: 25181255.

[10] Zhou M, Zhou H, Li SY, Yang XB, Geng YM, Che YJ. Accuracy of implant placement guided with surgical template: an in vitro and in vivo study. Int J Periodontics Restorative Dent. 2021;41(2):e55-e62. doi:10.11607/prd.4570. PMID: 33819327.

[11] Herschdorfer L, Negreiros WM, Gallucci GO, Hamilton A. Comparison of the accuracy of implants placed with CAD-CAM surgical templates manufactured with various 3D printers: an in vitro study. J Prosthet Dent. 2021;125(6):905-10. doi:10.1016/j.prosdent.2020.03.017. PMID: 32499166.

[12] Skjerven H, Riis UH, Herlofsson BB, Ellingsen JE. In vivo accuracy of implant placement using a full digital planning modality and stereolithographic guides. Int J Oral Maxillofac Implants. 2019;34(1):124-32. doi:10.11607/jomi.6939. PMID: 30695088.

[13] Bencharit S, Staffen A, Yeung M, Whitley D 3rd, Laskin DM, Deeb GR. In vivo tooth-supported implant surgical guides fabricated with desktop stereolithographic printers: fully guided surgery is more accurate than partially guided surgery. J Oral Maxillofac Surg. 2018;76(7):1431-9. doi:10.1016/j.joms.2018.02.010. PMID: 29550378.

[14] Cushen SE, Turkyilmaz I. Impact of operator experience on the accuracy of implant placement with

stereolithographic surgical templates: an in vitro study. J Prosthet Dent. 2013;109(4):248-54. doi:10.1016/S0022-3913(13)60053-0. PMID: 23566606.

[15] Behneke A, Burwinkel M, Behneke N. Factors influencing transfer accuracy of cone beam CT-derived template-based implant placement. Clin Oral Implants Res. 2012;23(4):416-23. doi:10.1111/j.1600-0501.2011.02337.x. PMID: 22092586

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