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# ANALYSIS OF PERI-IMPLANT SOFT TISSUE REBOUND AROUND IMPLANT PROVISIONAL RESTORATIONS

by

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# ABSTRACT

Analysis of Peri-implant Soft Tissue Rebound Around Implant Provisional Restorations

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**Introduction:** Recording peri-implant soft tissue and provisional restoration contours is a crucial step for producing highly acceptable restorations. It has been documented that upon removal of a provisional restoration, the peri-implant tissues begin to collapse over time; however, it has not been studied whether the tissues return to its original position after replacement of the restoration. **Objective:** The purpose of this study was to determine whether the peri-implant soft tissue returns to its original position upon replacement of a contoured restoration. **Methods:** Ten subjects with a maxillary implant-supported provisional restoration for at least 8 weeks were enrolled. Three scans were taken on each subject with an intraoral scanner: one with the restoration, one 20 minutes after removal of the restoration, and one immediately after replacement of the restoration. The scans were aligned and differences in gingival height between the scans were measured at the mesial, distal, palatal, and facial aspects. A 1-way ANOVA was used to assess variance among the measured sites, and a 1-tailed t-test was performed to determine significance of peri-implant tissue change compared to no change (alpha=0.05). **Results**: Tissue changes 20 minutes after removal averaged 0.32 mm, consistent with previous studies. A 1-way ANOVA found no significant difference in

tissue height change among the four sites. A 1-tailed t-test found no significant difference in tissue height among all sites from the initial scan to the scan where the provisional was replaced ($p=<0.001$). Across the sites, only the distal aspect was not significant ($p=0.19$). The mean height change among all sites was 0.054 mm. **Conclusions:** There was a statistically significant difference between peri-implant tissues from initial presentation to replacement of the provisional restoration. However, the extent of the height change may not be a relevant factor in producing clinically acceptable restorations.

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| | |
|---|---|
| ANOVA | Analysis of Variance |
| µm | Micrometer |
| mm | Millimeter |
| STL | Standard Tessellation Language file |

# CHAPTER 1: Introduction

## RECORDING PERI-IMPLANT SOFT TISSUES

Accurate recording of the precise position of the peri-implant tissues is paramount for successful restoration of implant retained prosthetics. Studies show that peri-implantitis and peri-implant mucositis can be greatly influenced by the presence of residual cement within the implant dento-gingival complex.[1,2] Linkevicius et al. in 2013 studied the influence of abutment margin depth on the ability to properly detect and clean residual cement from the subgingival implant surface.[3] Their study found that the more subgingival the cementation margin is placed, the more residual cement persists, despite meticulous cement removal by the clinician. However, the ability to clean residual cement must also be balanced by the esthetic demands of the restoration, which may require that the cementation margin be equi-gingival or slightly subgingival in order to hide the crown-abutment junction from view. Therefore, the ideal position of the implant crown-abutment interface should be equi-gingival or less than 1 mm below the gingival margin. Due to the small margin of error to minimize esthetic and biologic complications, the demand for a precise recording of the peri-implant tissues at the time of final impression cannot be understated.

Shaping of peri-implant soft tissues is routinely used to develop the subgingival emergence profile for optimal esthetics and peri-implant health.[4,5] Soft tissue-shaping is typically accomplished using an implant-supported fixed provisional restoration.[6,7] This practice is common in the esthetic zone, which for most patients extends from maxillary first molar to first molar.[8] Clinicians who advocate for this approach recommend

developing the tissues between one to three months in order to create a stable gingival position prior to impression making and fabrication of a definitive abutment and restoration.[9-11] Establishing a stable gingival margin position is particularly critical when planning an implant-supported cement-retained restoration. As stated previously, the exact location of the crown-abutment margin must be precisely recorded, in order to produce a restoration that is both esthetically pleasing, as well as avoiding deleterious biological complications after delivery.

## SOFT TISSUE COLLAPSE

Final impression of implants requires the removal of the implant provisional in order to place either an analog or digital coping, allowing the clinician to accurately translate the implant position and timing to the master cast. Studies and clinical experience show that peri-implant soft tissues experience collapse upon removal of the provisional restoration.[12,13] Li et al. in 2019 demonstrated that the magnitude of the collapse in an apico-coronal dimension was near zero immediately upon removal. However, this increased to a maximum of 0.15 mm at the mid-facial and 0.27 mm at the mesial and distal papillae after 20 minutes.[12] These measurements were statistically significant relative to a baseline measurement taken prior to removal of the provisional restoration. The authors postulate that removal of the transmucosal element reduces pressure on the peri-implant soft tissue. The low osmotic pressure of the tissue then results in an inflow of interstitial fluid, causing a thickening and flattening of the tissue. In a clinical setting, various procedural steps might take place between the removal of the transmucosal element to making the final impression, resulting in gradual gingival collapse. These clinical steps could take up to 20 minutes and might include placing

multiple impression copings, confirming complete seating, and setting up for the final impression. The recording of collapsed tissue will then lead to a final crown-abutment margin that is more subgingival than required, potentially increasing biological complications.

Analog solutions to this problem involve either fabricating a custom impression coping that mimics the contours of the provisional restoration or by using the provisional restoration itself as an impression coping.[14-16] In a digital workflow utilizing an intraoral scanner for impression-making, similar solutions include using a custom scan body or scanning the tissue surface of the provisional restoration.[17,18] While these methods allow for accurate reproduction of the tissue surface of the provisional restoration, they may not accurately capture the position of the gingival crest. These methods assume that upon placement of the custom impression coping, the tissue immediately returns to its original position with the provisional restoration in place.

An analog custom impression coping fabricated using the implant provisional requires significant time to fabricate prior to seating. Then, the coping is placed, and the impression is made immediately. If the peri-implant soft tissue does not immediately return to its original position upon placing the custom coping, the dimensional changes that had been observed may be clinically significant, leading to capture of a more apical tissue position.

To reiterate, soft tissue behavior following placement of an impression coping is a vital component in marginal position planning and long-term implant success, particularly in areas of high esthetic demand. As discussed previously, changes in peri-implant soft tissue once a provisional restoration has been removed have been

investigated. To date, no study to the knowledge of this investigative group has assessed whether the peri-implant soft tissues return to their original position following placement of a custom impression coping or replacement of the provisional restoration itself.

The objective of this observational study is to determine the positional changes in peri-implant soft tissue, shaped for an ideal emergence profile around a single-tooth implant, following removal and replacement of a provisional restoration after 20 minutes.

# CHAPTER 2: Materials and methods

## STUDY DESIGN

This study was reviewed and approved by the Institutional Review Board at Walter Reed National Military Medical Center, Bethesda, MD (WRNMMC-2021-0335). A total of twelve patients were approved to be enrolled as subjects for the study, with ten patients sufficient for adequate statistical power. The inclusion criteria were adult patients who have received maxillary single-tooth implants in the esthetic zone (defined as the first molar to first molar). Sites must have been tooth-bound and have undergone a minimum of eight weeks of soft tissue sculpting utilizing a fixed implant-supported provisional restoration. Patients with active periodontal disease or systemic conditions or disorders that impaired periodontal health were excluded from the study. Written informed consent for the study and permission for release of health information was obtained from all participants. Determination of gingival phenotype of each subject was determined via clinical observation of the gingival morphology, as well as periodontal probing at the facial of the teeth adjacent to the enrolled implant site. Visibility of the periodontal probe through the gingiva determined whether the patient had thick or thin tissue, while observation of the gingival morphology determined whether the tissue was flat or scalloped in the thick gingival biotype patients. All patient identifiers were removed from the data set at the conclusion of the study. All clinicians authorized to consent patients were calibrated to provide uniformity in determining gingival phenotype and in scanning strategy.

An intraoral scanner (3Shape TRIOS 3, Copenhagen, Denmark) was used to capture three scans for each implant site. Prior to scanning, the scanner was calibrated in order to ensure scanning accuracy. The first scan (Scan 1) captured the position of the peri-implant soft tissues and adjacent teeth with the provisional restoration in place. Following this scan, the provisional restoration was removed, and the peri-implant tissues remained untouched for twenty minutes. After twenty minutes had elapsed, a second scan (Scan 2) was made of the peri-implant soft tissues and adjacent teeth. The provisional restoration was then replaced, and a third scan (Scan 3) was immediately made of the peri-implant soft tissues and adjacent teeth with the provisional restoration in place, emulating the placement of a custom impression coping prior to making the final impression. Utilizing the provisional restoration instead of a custom impression coping eliminated the potential effects of inaccurate custom impression coping fabrication.

Scans were saved as standard tessellation language (STL) files and the three STL files of each site were superimposed using 3D manipulation software (Materialise 3matics, Leuven, Belgium). This superimposition was accomplished by identifying stable landmarks on the adjacent teeth. The long axis of the provisional restoration being studied was aligned to the z axis, and all three scans were then exported to a 3D analysis software for measurement (Materialise Magics, Leuven, Belgium). For each scan, the gingival margin position was marked and compared at four locations: mid-facial, mid-palatal, and at the peaks of the mesial and distal papillae. These positions were marked in reference to a fixed point on an adjacent tooth. Once the measurement between the two scans was taken, the distance along the z axis was recorded to assess vertical tissue change.

The first comparison assessed the change in vertical position between Scan 1 and Scan 2, in order to support the presence of a soft tissue collapse as observed in previous studies. The second comparison assessed the change in vertical position between Scan 1 and Scan 3 to observe the extent to which the gingival tissues would return to their original position. A one-tailed t-test with a test value of 0.00 mm (alpha = 0.05) was performed to determine significance between the original and final position, and a one-way analysis of variance (ANOVA) was used to examine variability among the four aspects of the free gingival margin measured.

# CHAPTER 3: Results

Eleven subjects with a total of eleven maxillary implants were enrolled in the study. Due to a deviation in study protocol, one subject's data was removed. Thus, data were analyzed on the remaining ten subjects. Demographic data for the ten subjects are displayed in Table 1.

Analysis comparing Scan 1 and Scan 2 showed an average vertical tissue collapse of 0.32±0.17 mm across all recorded sites. There were no significant differences among the four recorded sites across all subjects.

Comparing Scan 1 and Scan 3, there was a significant difference in the marginal position after replacement of the provisional restoration ($0.054 \pm 0.026$ mm, $p<0.01$). One way ANOVA showed no significant differences among the four sites tested. Comparing the four sites individually, the facial ($p=0.019$) and mesial ($p=0.048$) aspects were significantly different from the initial scan, while for the distal ($p=0.089$) and palatal ($p=0.052$) aspects were not significant. Table 2 delineates the values found at all sites.

# CHAPTER 4: Discussion

The results of the study showed quantitative evidence of tissue rebound immediately upon replacement of an implant provisional restoration. The tissue collapse seen at 20 minutes of provisional restoration removal was consistent with previous studies.[12] However, the tissue rebound appeared to be incomplete, and the final peri-implant tissue position was significantly different from the initial tissue position.

Despite the statistical significance of the final position, a difference of 0.054 mm would cause limited impact to final restoration fabrication since this discrepancy could be compensated for without risk of prosthetic or biological complication. Furthermore, the scale of the discrepancy leads to otherwise negligible confounding variables to create significant differences in the study results. For example, the accuracy of the intraoral scanner may have played a role in the discrepancy. While the published trueness of the Trios 3 intraoral scanner is 6.9±0.9 μm, independent studies have rated the trueness of the Trios 3 from 9 μm up to 34 μm.[19] While this value may be inconsequential in routine clinical dentistry, the effect of intraoral scan trueness may have significantly contributed to the discrepancy between the scans in this study. Updated intraoral scanner systems in future studies may provide a more accurate and precise record of the final gingival position.

The advent of digital dentistry has ushered in a new variety of workflows and techniques to capture intraoral records. Particularly with peri-implant soft tissues, digital workflows have been documented that either limit provisional restoration removal time or eliminate the need to record collapsing tissues entirely. Monaco et al. in 2019 described two techniques for capturing peri-implant soft tissues: directly via scanning the

soft tissue upon removal of the implant provisional restoration, or indirectly by scanning the implant provisional itself and aligning that scan to a full arch scan made prior to provisional restoration removal.[20] While the indirect method circumvents the issue of tissue collapse, the direct method is still subject to the effect of immediate tissue collapse, which Li et al. found to be approximately 70 μm at the free gingival margin within 12 seconds of removal.[12] Additionally, both techniques require the possession of an intraoral scanner and experience with design software, both of which can render these workflows cost prohibitive. The analog method of a custom impression coping continues to be a cost-effective method of capturing the peri-implant soft tissues with comparative accuracy to current digital workflows.

The findings also present a strong argument for utilizing a custom impression coping to offer tissue support during impression making, particularly for cement-retained restorations. During digital design, manufacturers of custom abutments for cement-retained restorations will design the margin position subgingival by default, as far as 1 mm sub-gingivally.[21] Without proper tissue support during impression making, tissue collapse will result in recording the final gingival position an average of 0.32 mm gingival to the original tissue position. If the default values of custom abutment fabrication do not compensate for this tissue collapse, the final abutment will be far more subgingival than required, putting the final restoration at risk for residual cement and peri-implant disease. Utilization of a custom impression coping to support the peri-implant soft tissue maintains the current soft tissue level, resulting in accurate soft tissue recording and design of a custom abutment as equi-gingival as possible to allow for proper excess cement removal.

This study has several limitations which may be worth further investigation. Only one posterior tooth in the esthetic zone was included, which may present with different tissue collapse patterns compared to anterior teeth. Similarly, most of the subjects possessed a thick scalloped gingival phenotype, while only one thin scalloped phenotype subject and one thick flat phenotype subject were enrolled. It has been documented that thin gingiva tends to result in more recession with tissue manipulation compared to thick gingiva.[22] Tissue phenotype was recorded through the study not for statistical analysis, but in hopes of a future study that evaluates the relationship of gingival phenotype in the magnitude of soft tissue collapse and rebound. Finally, the rebounded tissue was only recorded immediately after replacement of the implant provisional restoration. Further studies scanning subjects at various times after provisional restoration replacement would aid in establishing a temporal relationship of soft tissue rebound, which may guide clinical practice in timing of final impression making after seating of a custom impression coping.

# CHAPTER 5: Conclusions

Within the limitations of this study, it can be concluded that there is evidence of peri-implant soft tissue rebound upon replacement of an implant-retained provisional restoration. There is a significant difference between the initial and final peri-implant soft tissue position. However, in a clinical setting, the difference between the two tissue positions is negligible. Therefore, use of a custom impression coping to record the soft tissue position can produce clinically acceptable tissue positions, despite the tissue collapse that occurs during its fabrication.

**Table 1. Demographic Data for Subjects Enrolled (n=10)**

| | |
|---|---|
| **Mean Age (SD)** | 43.5 years (12.9) |
| **Gender** | |
| Male | 9 |
| Female | 1 |
| **Gingival Phenotype** | |
| Thick Flat | 1 |
| Thick Scalloped | 8 |
| Thin Scalloped | 1 |

**Table 2. Average Positional Changes Between Scans**

| | Average Change Scan 1 to Scan 2 (SD) in mm | Average Change Scan 1 to Scan 3 (SD) in mm | p-value Scan 1 to Scan 3 |
|---|---|---|---|
| Total | 0.32 (0.17) | 0.054 (0.026) | 0.00016 |
| Facial | 0.26 (0.19) | 0.049 (0.039) | 0.019 |
| Palatal | 0.31 (0.12) | 0.059 (0.0518) | 0.052 |
| Mesial | 0.31 (0.12) | 0.050 (0.0476) | 0.048 |
| Distal | 0.40 (0.20) | 0.056 (0.0894) | 0.089 |

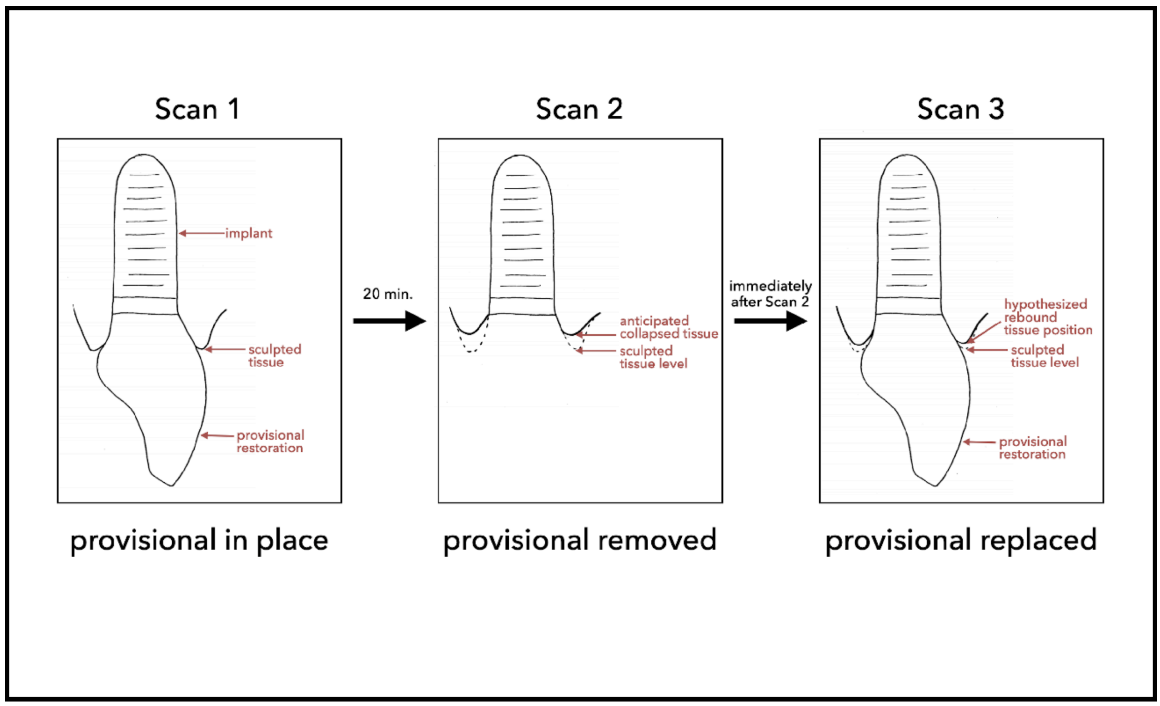


**Figure 1. Schematic of three scans taken during study.**

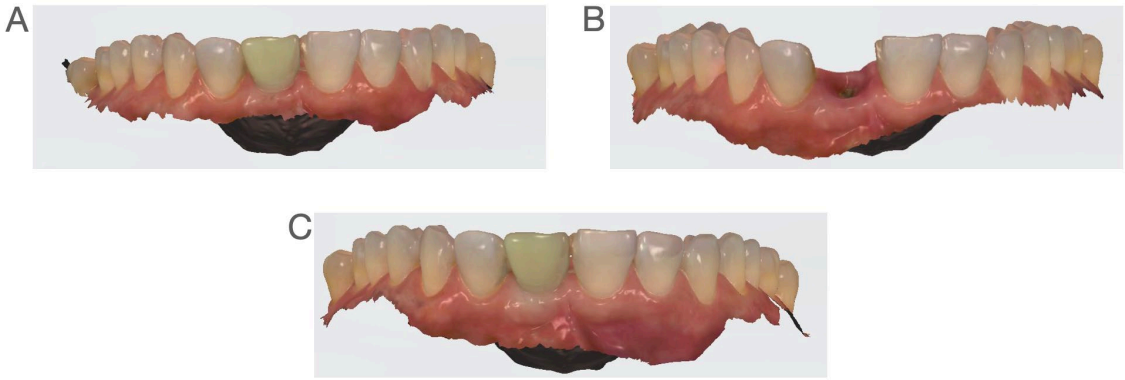


**Figure 2. Representative Scan Series.** A) Scan 1 taken with provisional in place. B) Scan 2 taken 20 minutes after provisional removal. C) Scan 3 taken immediately upon replacement of implant provisional.

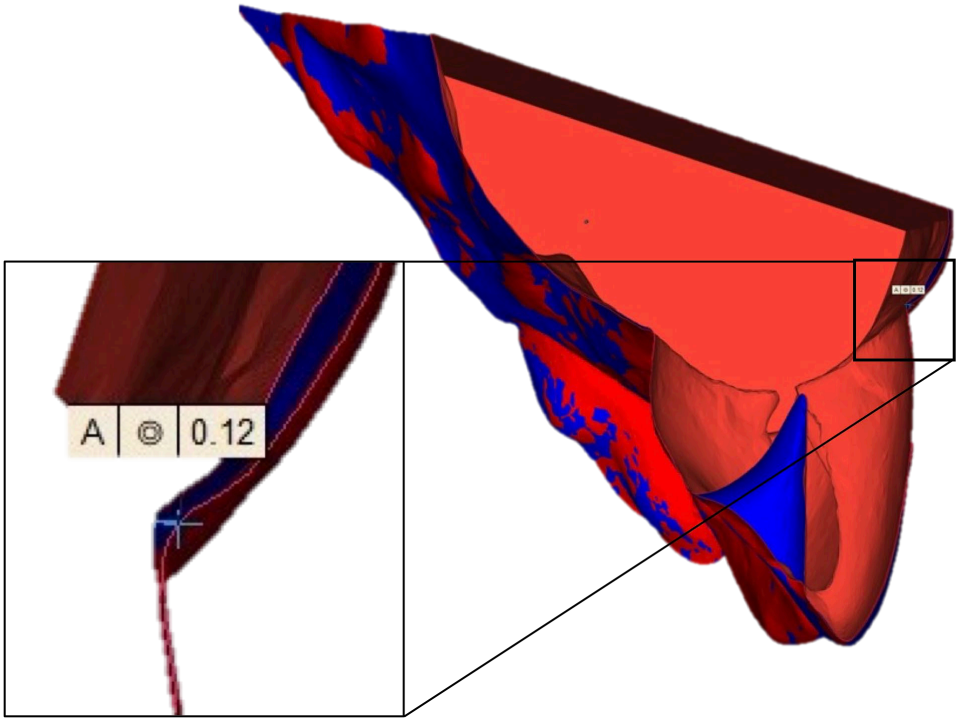


**Figure 3. Aligned scans (Scans 1 and 3) measured at facial aspect**. Measurement is zoomed in (left) to show measurement between the gingival margins of both scans. Note that the value shown is the absolute distance – for this study, the vertical vector of the measurement was calculated in the software and recorded.

# REFERENCES


1. Dalago HR, Schuldt Filho G, Rodrigues MA, Renvert S, Bianchini MA. Risk indicators for Peri-implantitis. A cross-sectional study with 916 implants. *Clin Oral Implants Res*. Feb 2017;28(2):144-150. doi:10.1111/clr.12772

2. Wilson TG, Jr. The positive relationship between excess cement and peri-implant disease: a prospective clinical endoscopic study. *J Periodontol*. Sep 2009;80(9):1388-92. doi:10.1902/jop.2009.090115

3. Linkevicius T, Vindasiute E, Puisys A, Linkeviciene L, Maslova N, Puriene A. The influence of the cementation margin position on the amount of undetected cement. A prospective clinical study. *Clin Oral Implants Res*. Jan 2013;24(1):71-6. doi:10.1111/j.1600-0501.2012.02453.x

4. Beretta M, Poli PP, Pieriboni S, et al. Peri-Implant Soft Tissue Conditioning by Means of Customized Healing Abutment: A Randomized Controlled Clinical Trial. *Materials (Basel)*. Sep 19 2019;12(18)doi:10.3390/ma12183041

5. Fürhauser R, Mailath-Pokorny G, Haas R, Busenlechner D, Watzek G, Pommer B. Immediate Restoration of Immediate Implants in the Esthetic Zone of the Maxilla Via the Copy-Abutment Technique: 5-Year Follow-Up of Pink Esthetic Scores. *Clin Implant Dent Relat Res*. Feb 2017;19(1):28-37. doi:10.1111/cid.12423

6. Potashnick SR. Soft tissue modeling for the esthetic single-tooth implant restoration. *J Esthet Dent*. 1998;10(3):121-31. doi:10.1111/j.1708-8240.1998.tb00348.x

7. Morton D, Chen ST, Martin WC, Levine RA, Buser D. Consensus statements and recommended clinical procedures regarding optimizing esthetic outcomes in implant dentistry. *Int J Oral Maxillofac Implants*. 2014;29 Suppl:216-20. doi:10.11607/jomi.2013.g3

8. Van der Geld P, Oosterveld P, Kuijpers-Jagtman AM. Age-related changes of the dental aesthetic zone at rest and during spontaneous smiling and speech. *Eur J Orthod*. Aug 2008;30(4):366-73. doi:10.1093/ejo/cjn009

9. Son MK, Jang HS. Gingival recontouring by provisional implant restoration for optimal emergence profile: report of two cases. *J Periodontal Implant Sci*. Dec 2011;41(6):302-8. doi:10.5051/jpis.2011.41.6.302

10. Grizas E, Kourtis S, Andrikopoulou E, Romanos GE. A detailed decision tree to create, preserve, transfer, and support the emergence profile in anterior maxillary implants using custom abutments. *Quintessence Int*. 2018;49(5):349-364. doi:10.3290/j.qi.a39820

11. Papadopoulos I, Pozidi G, Goussias H, Kourtis S. Transferring the emergence profile from the provisional to the final restoration. *J Esthet Restor Dent*. May-Jun 2014;26(3):154-61. doi:10.1111/jerd.12068

12. Li J, Chen Z, Wang M, Wang HL, Yu H. Dynamic changes of peri-implant soft tissue after interim restoration removal during a digital intraoral scan. *J Prosthet Dent*. Sep 2019;122(3):288-294. doi:10.1016/j.prosdent.2018.07.020

13. Duran JC, Aguirre F, Pino R, Velásquez D. Dimensional Variations in the Soft Tissue Profile After Removal of Implant-Supported Fixed Interim Restorations: A Pilot Clinical Study. *Implant Dent*. Feb 2018;27(1):28-32. doi:10.1097/id.0000000000000720

14. Alshiddi IF, Dent DC. Accurate registration of peri-implant soft tissues to create an optimal emergence profile. *Contemp Clin Dent*. 2015:S122-5. vol. Suppl 1.

15. Noh K, Kwon KR, Kim HS, Kim DS, Pae A. Accurate transfer of soft tissue morphology with interim prosthesis to definitive cast. *J Prosthet Dent*. Feb 2014;111(2):159-62. doi:10.1016/j.prosdent.2013.09.018

16. Man Y, Qu Y, Dam HG, Gong P. An alternative technique for the accurate transfer of periimplant soft tissue contour. *J Prosthet Dent*. Feb 2013;109(2):135-7. doi:10.1016/s0022-3913(13)60031-1

17. Joda T, Wittneben JG, Brägger U. Digital implant impressions with the "Individualized Scanbody Technique" for emergence profile support. *Clin Oral Implants Res*. Mar 2014;25(3):395-397. doi:10.1111/clr.12099

18. Monaco C, Evangelisti E, Scotti R, Mignani G, Zucchelli G. A fully digital approach to replicate peri-implant soft tissue contours and emergence profile in the esthetic zone. *Clin Oral Implants Res*. Dec 2016;27(12):1511-1514. doi:10.1111/clr.12599

19. Winkler J, Gkantidis N. Trueness and precision of intraoral scanners in the maxillary dental arch: an in vivo analysis. *Sci Rep*. Jan 24 2020;10(1):1172. doi:10.1038/s41598-020-58075-7

20. Monaco C, Scheda L, Baldissara P, Zucchelli G. Implant Digital Impression in the Esthetic Area. *J Prosthodont*. Jun 2019;28(5):536-540. doi:10.1111/jopr.12991

21. Sirona D. Clinician-to-laboratory prescription form. Accessed June 8, 2023. https://www.dentsplysirona.com/content/dam/dentsply/web/Implants/Franchise%20Content/1224859-ATLANTIS-Abutments-Clinic-to-laboratory-prescription-form-1501-yrxkwyf-en-1504.pdf

22. Kim DM, Bassir SH, Nguyen TT. Effect of gingival phenotype on the maintenance of periodontal health: An American Academy of Periodontology best evidence review. *J Periodontol*. Mar 2020;91(3):311-338. doi:10.1002/jper.19-0337