

Effects of Tightening and Retightening Protocol on Position Changes of Screwed-Retained Single Implant Crowns

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Introduction

Screw loosening is a most common complication in Implant dentistry causing by “loss of preload”.¹ Preload is defined as axial force in the neck of the screw that is generated while tightening the abutment screws. Once adequate preload is achieved, screw generates the clamping force that secures the abutment to the implant.¹⁻³

Clinically, tightening and retightening protocol is recommended for delivery of a screw retained implant crown in order to reach maximum cramping effect^{2,3} and reduce chances of screw loosening^{3,4}. Several studies suggested retightening protocol 10 to 15 minutes after tightening the abutment screws to compensate the loss of preload.¹⁻³ However, there is limited research on the position change of single implant crowns following tightening and retightening protocol. With new digital technology like intraoral scanner and 3D matching software, clinicians now can capture three-dimensional contours directly and compare them between the different time points.^{5,6}

The purpose of this study was to evaluate position change of a single screw retained implant crown after tightening and retightening protocol. **The null hypothesis** was that no significant difference would be found in screw retained single implant crown's position before and after tightening and retightening protocol. The threshold was defined as the thickness of one layer of articulating paper (0.03 mm).

Materials and Methods

A pilot study was performed to determine the sample size with 80% power. IRB determination was submitted and approved (IRB #5230365). A total of 11 screw retained single implant crowns and corresponding master casts were obtained from LLUSD Pre-Doctoral clinic. Each implant crown was connected to corresponding implant analog from Straumann or Nobel Biocare.

Each abutment screw and crown was tightened to the implant analog with corresponding screwdriver and scanned using intraoral scanner (Trios 4, 3Shape, Copenhagen, Denmark)(Fig 1) at 4 different timeframe: 1) After hand-tightening protocol⁷ (Control) 2) After tightening protocol following manufacture's recommended torque value (35 Ncm) 3)Ten minutes after the first tightening protocol 4) After retightening protocol to 35 Ncm (10 minutes after the first tightening protocol).

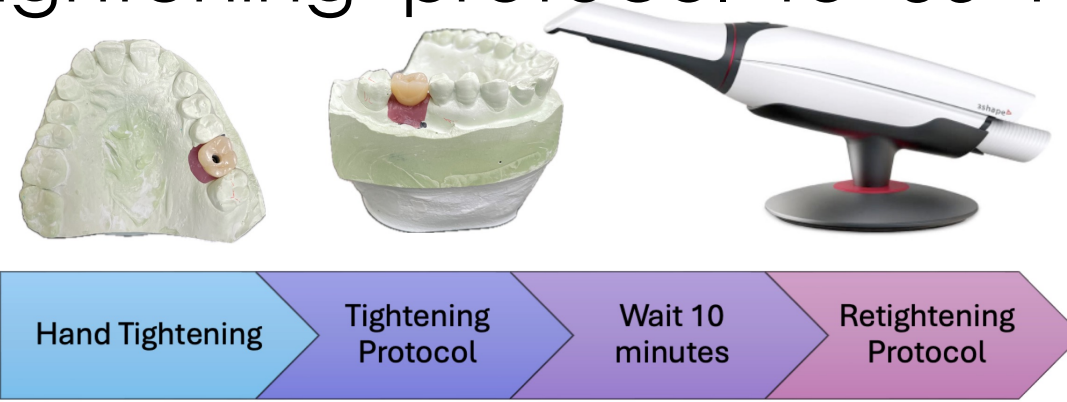


Figure 1. Screw retained implant crown with cast was scanned using intraoral scanner (Trios 4, 3Shape, Denmark) at 4 different timeframe.

Materials and Methods

Short span scans cover 1-2 adjacent teeth were obtained to reduce the amount of distortion³ and exported to create the STL files. All STL files were superimposed and analyzed using a 3D matching software (Geomagic Control X, Artec 3D, California, United States) (Fig 2) to determine the 3D position deviation. Two region of interests (ROIs) were defined as occlusal and gingival zones.

Statistical analysis: One-sample Wilcoxon Sign Rank test, two-way analysis of variance(ANOVA) and pairwise comparisons were performed at an alpha level of 0.05.

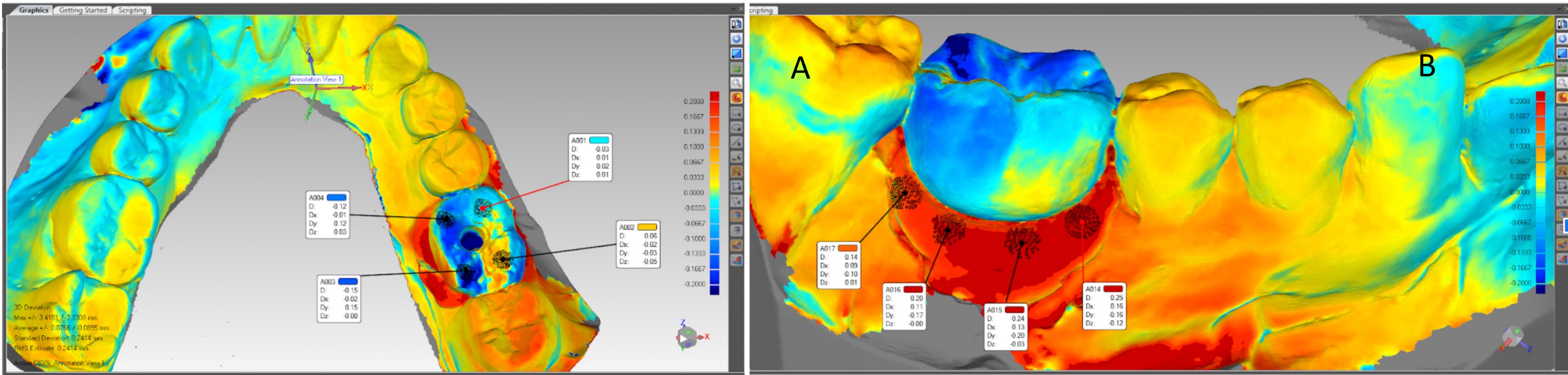


Figure 2. Superimposition and analysis of position change by 3D matching Software. (A)Occlusal deviation, (B) Gingival deviation

Results

At occlusal region, no significant differences in position changes were found among all groups ($P>.05$)(Table 1,2,3).

At gingival region, significant differences in soft tissue changes were found after tightening protocol ($P=.025$)(Table 1,4), and after retightening protocol ($P=.014$)(Table 1,4). Moreover, after retightening protocol, soft tissue changes were found at gingival region as compared to at 10 minutes ($P=.034$)(Table 2,4).

		P	
Occlusal Hand Tightening VS Tightening Protocol	Student's t	0.175	
	Wilcoxon W	0.122	
Occlusal Hand Tightening VS Wait 10 minutes	Student's t	0.336	
	Wilcoxon W	0.182	
Occlusal Hand Tightening vs Retightening Protocol	Student's t	0.660	
	Wilcoxon W	0.623	
Gingival Hand Tightening vs Tightening Protocol	Student's t	0.046	
	Wilcoxon W	0.025	
Gingival Hand Tightening vs Wait 10 minutes	Student's t	0.173	
	Wilcoxon W	0.139	
Gingival Hand Tightening vs Retightening Protocol	Student's t	0.020	
	Wilcoxon W	0.014	

Pairwise Comparisons : Occlusal region deviation			
		Statistic	p
Hand Tight VS Tightening	- Hand Tight VS Wait 10 minutes	1.119	0.278
Hand Tight VS Tightening	- Hand Tight VS Retightening	1.492	0.153
Hand Tight VS Wait 10 minutes	- Hand Tight VS Retightening	0.373	0.713

Pairwise Comparisons : Gingival region deviation			
		Statistic	p
Hand Tight VS Tightening	- Hand Tight VS Wait 10 minutes	0.766	0.454
Hand Tight VS Tightening	- Hand Tight VS Retightening	1.532	0.143
Hand Tight VS Wait 10 minutes	- Hand Tight VS Retightening	2.298	0.034

Table 1. Comparison of mean position deviations at the occlusal and gingival region between hand tightening(Control) with other test groups

Table 2. Pairwise comparisons of mean position deviation between groups at occlusal and gingival regions

Results

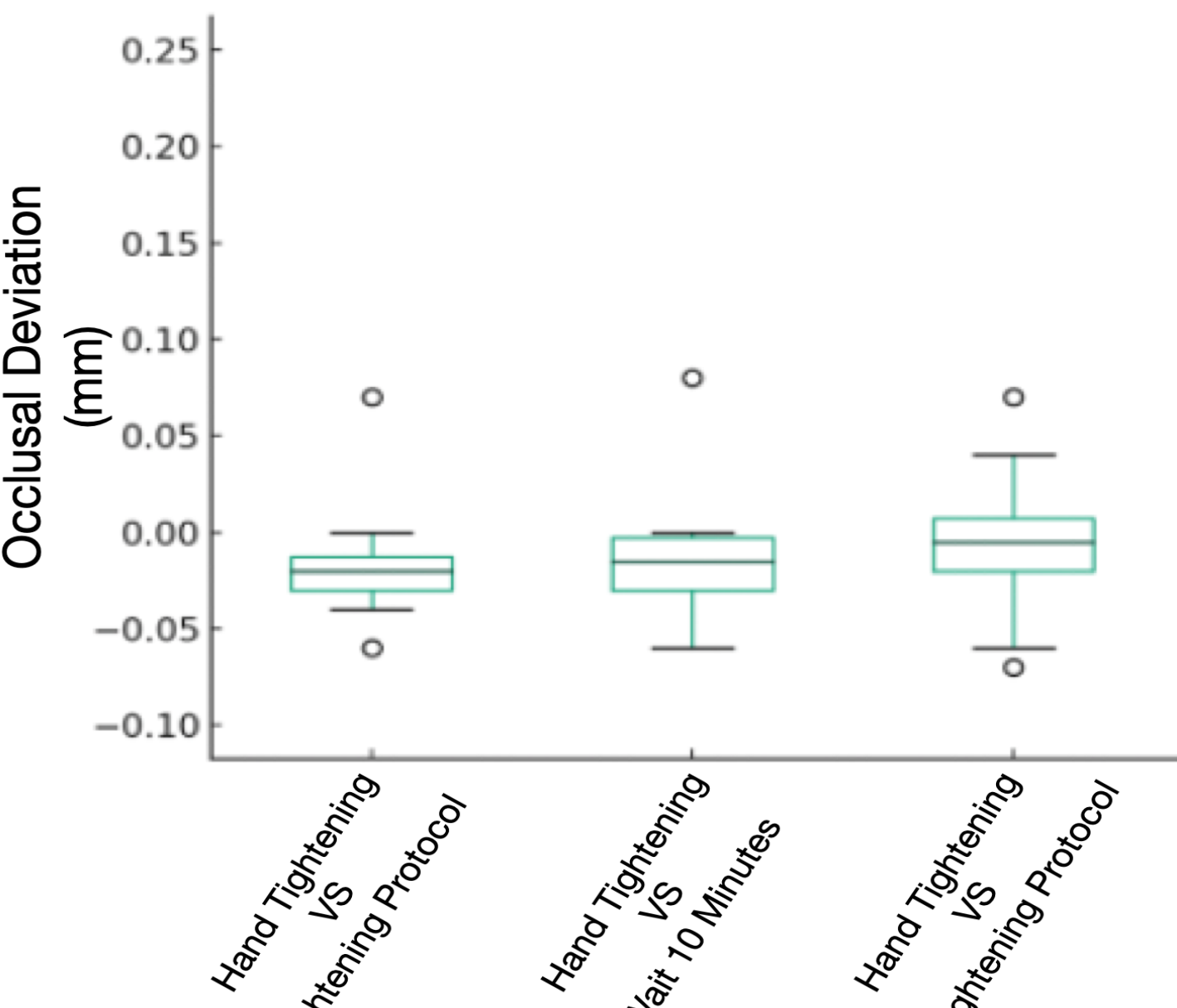


Table 3. Boxplot of mean position deviation at occlusal regions between hand tightening(Control) and other test groups.

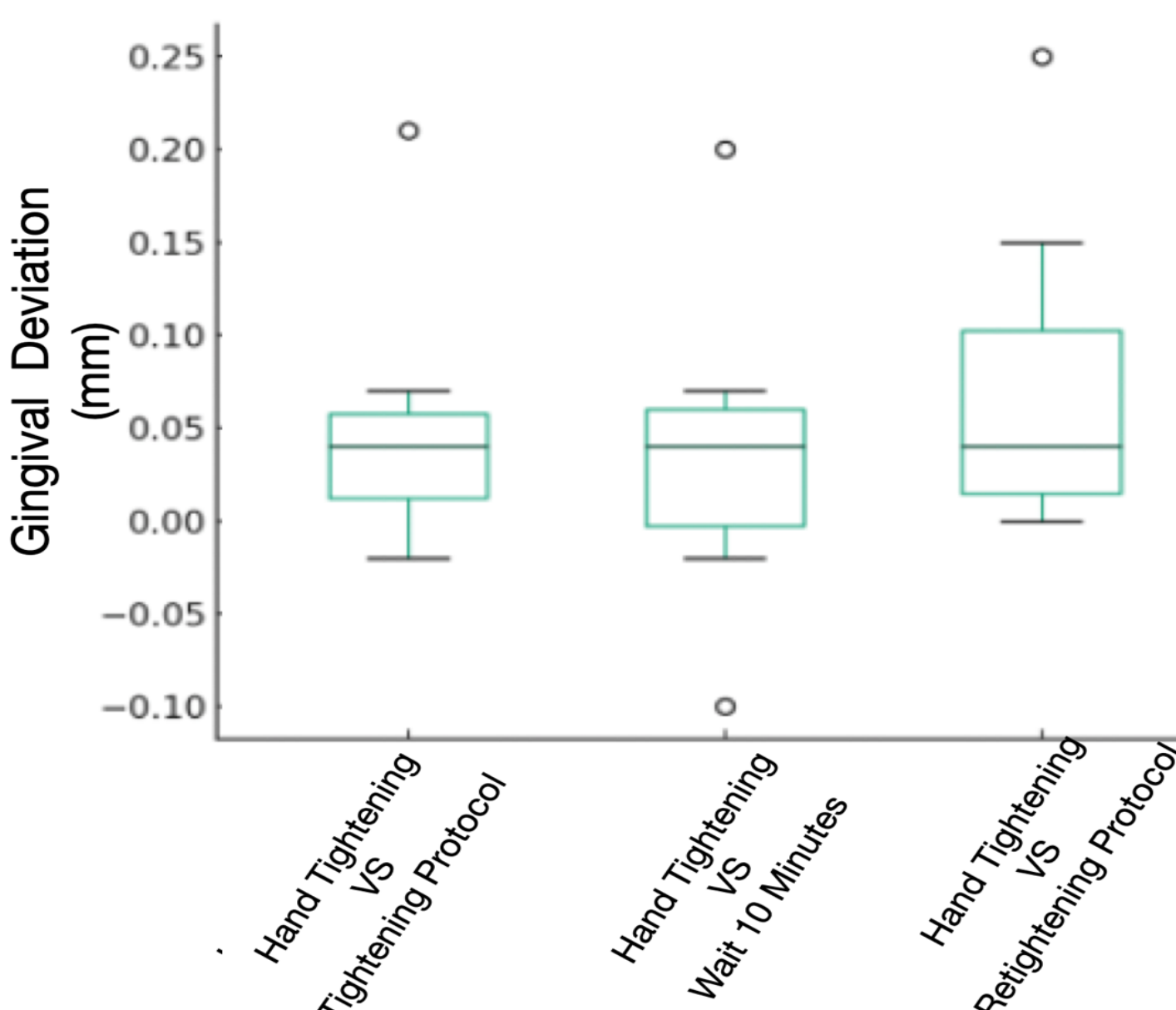


Table 4. Boxplot of mean soft tissue deviation at gingival regions between hand tightening(Control) and other test groups.

Discussion

The null hypothesis was accepted as no significant differences were found for the position changes at occlusal region of screw-retained implant crowns among all groups. However, mean occlusal deviation following tightening and retightening protocol was higher than the thickness of the shimstock. Clinician should carefully plan when assessing occlusion for implant crowns. Additionally, future studies should be conducted with larger sample sizes to investigate this further.

Conclusions

Within the limitations of this study, the protocol for tightening and retightening might not impact the occlusal position of the screw-retained single implant crown; however, it could influence soft tissue changes in the cervical region.

References

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