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Research Article

Reduction of Chair Time by Pre-Clinical Adjustment of Indirect Dental Restoration Interproximal Contacts

Steven R Curtis[1] and Steven J Sadowsky[2]*

[1]*Associate Professor, Department of Preventive and Restorative Dentistry, University of the Pacific Arthur A. Dugoni, School of Dentistry, San Francisco, California, USA*

[2]*Professor Emeritus, Department of Preventive and Restorative Dentistry, University of the Pacific Arthur A. Dugoni, School of Dentistry, San Francisco, California, USA*

***Corresponding Author:** Steven J Sadowsky, Professor Emeritus, Department of Preventive and Restorative Dentistry, University of the Pacific Arthur A. Dugoni, School of Dentistry, San Francisco, California, USA. scurtis@pacific.edu

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Abstract

Statement of Problem: Chair time expended in adjusting crown restorations can be reduced, but a systematic protocol has not been universally adopted.

Purpose: The purpose of this study is to test the hypothesis that pre-clinical interproximal contact adjustment of indirect restorations on a pristine mounting-stone cast will save chair time.

Material and Methods: Sixteen single-unit full crowns from dental students' cases at the University of the Pacific Arthur A. Dugoni School of Dentistry (UOPAASD) were used in this study. Each crown had mesial and distal contacts with adjacent teeth and intact impressions. New casts were made from mounting stone for all 16 crowns. For the first 8 experimental crowns, interproximal adjustments were optimized on the new mounting-stone cast using 11.7-micron shimstock and 21-micron articulating paper, while on the second 8, no adjustments were made. One researcher completed all adjustments. Students were given a form detailing the reporting requirements.

Results: A t-test showed that pre-clinical adjustment of interproximal contacts on new casts resulted in a decrease of chair time between 5.8 minutes and 35.6 minutes with statistical significance of $p = 0.007$.

Conclusion: Pre-clinical adjustment of interproximal contacts on fresh mounting-stone casts can decrease chair time in a dental school setting.

Clinical Implications: Dentists/technicians can reduce chair time by pre-clinical verification/adjustment of interproximal contacts. A new mounting stone cast can be made from the original impression that demonstrates fidelity to the patient's intraoral topography. When using a production laboratory, technicians can be taught to use pristine casts with this protocol to titrate interproximal contact adjustments to the clinician's preferences, or this can be performed by the clinician.

Keywords: *Chair Time; Crown Restorations; pristine Mounting-Stone Cast*

Introduction

Pre-clinical verification and adjustment of indirect restorations may minimize delivery appointment chair time, thereby improving both patient comfort and clinical efficiency. Although there are many time studies comparing digital systems to conventional systems [1-5], there is currently only one time study on pre-clinical adjustment of restorations. Boyarski., *et al*. [6] adjusted working casts to ideal occlusion before the restoration occlusion was adjusted with the patient, and then measured the amount of time it took to adjust occlusion chairside. This pre-clinical adjustment decreased chair time. In a study addressing interproximal contact accuracy, Davis [7] described using multiple casts for pre-clinical interproximal contact adjustment. His methodology was to lightly adjust the cast on adjacent tooth contact areas prior to restoration contact adjustment to ensure that interproximal contacts would not be open. However, this was not strictly a time study, but instead an over-correction which attempted to avoid the addition of interproximal contacts in the dental laboratory. Given the present literature, the authors are not aware of any specific time studies to evaluate the accuracy of interproximal crown contacts using analogue casts.

Purpose of the Study

The purpose of this study is to test whether pre-clinical adjustment of indirect restoration interproximal contacts on a cast generated from a duplicate pour will decrease chair time in a dental school setting. The null hypothesis is that there will be no significant difference in delivery time between restorations with pre-clinical adjustment and those without pre-clinical adjustment.

Material and Methods

An IRB (#2024-55) was filed at the University of the Pacific Arthur A. Dugoni School of Dentistry (UOPAADSD) campus. Twenty students at UOPAADSD were interviewed for participation. During this interview, criteria for interproximal contact evaluation and a document with study guidelines were reviewed. Fourteen of these students were selected, predicated on their ability to comply with the methodology. Sixteen indirect restorations were selected for use, based on a power analysis (Figure 1). The criteria for restorations included 2 interproximal contacts, an intact impression with complete margin capture, smooth well-defined margins, and no loss of the provisional restoration. The first 16 indirect restorations submitted by students were judged acceptable by the investigator. The first 8 had interproximal contacts were adjusted pre-clinically (experimental) while the second 8 had no adjustment (control).

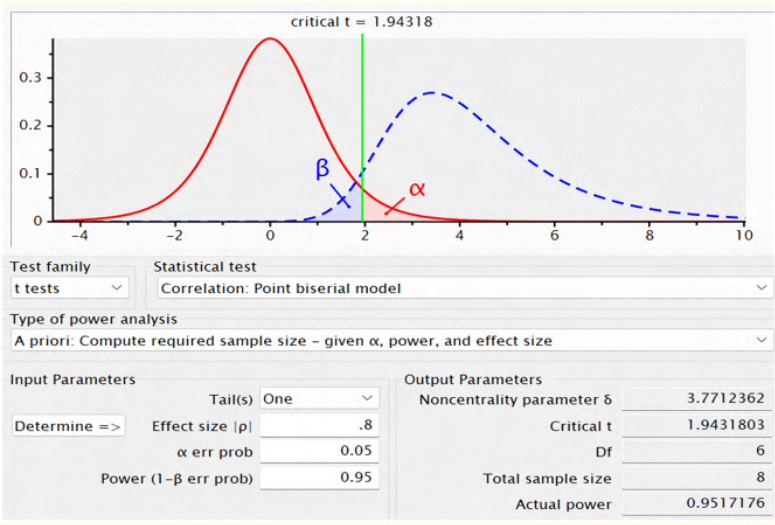

Figure 1: *Power analysis.*

The school laboratory sends an untouched die with each restoration for clinicians' inspection. All 16 crown restorations were inspected on these dies by the investigator and all showed an adequate fit. However, under magnification every restoration showed sub-clinical seating and fit deviation as compared to the master die. These deviations were corrected on the 8 experimental restorations using occlude spray (Occlude spray; Pascal) and a fine diamond, (856-012 Fine; Brassler). Seating and fit were not adjusted on the second 8 control restorations. Neither seating time nor occlusal adjustment time was recorded in this study.

All 16 impressions had a fresh mounting-stone cast (Blue ISO type 3; Whip Mix Corp.) made from them [8]. Because the laboratory makes 3 casts for fabrication, the mounting-stone cast was the fourth cast made from the poly vinylsiloxane impression material (Imprint 4; 3M) [9]. This cast was allowed to set for at least 30 minutes. Tissue areas that might interfere with restoration seating were trimmed with a sharp knife. If contact areas had any impression irregularities or artifact, these were lightly removed. A recent study suggests that it is not necessary to provide extra relief to avoid open contacts and this was not done [10]. Interproximal contacts on the 8 experimental restorations were adjusted with blue porcelain polishing wheels (Dialite Porcelain Polishers; Brassler) to the following standard: 11.7-micron (Shimstock Occlusal Foil; Almore International Inc.) (SOF) passed through the mounting-stone cast contacts, and 21-micron articulating paper (AccuFilm; Parkell) (AF) held or dragged between contacts [11].

After preparation of experimental and controlled pre-clinical cases, the restorations were returned to the students with the reporting form. The following instructions were given to students, which were shared with the faculty:

All procedures are to be completed with loupes:

1. Remove the provisional crown.
2. Clean preparation thoroughly with Pumice and a rubber cup, and an explorer.
3. Inspect intaglio of restoration for debris.
4. Place restoration in with finger pressure and verify seating at the margin with an explorer.
5. If crown seats, verify SOF passes through interproximal contact and AF does not.
6. If crown does not seat, adjust interproximal surface with porcelain polishing wheels and follow evaluation in #5.
7. Record the time necessary to determine the problem in seating and time to adjust interproximal contacts.
8. Record if the restoration met the SOF/AF standard.

Students did not know if their restorations were in the experimental or control cohort and all 16 forms were returned. Data were analyzed by a t-test.

Results

At the placement appointment, none of the control restoration interproximal contacts met the SOF/AF standard. Seven out of 8 required adjustments of between 1 minute and 55 minutes. The control restoration that did not require adjustment did not meet the SOF/AF standard because the AF freely through the mesial interproximal contact. However, the faculty decided it did not require contact addition. Seven of 8 experimental restorations required no adjustments and met the SOF/AF standard, while 1 required 15 seconds of adjustment (Table 1). The t-test showed that pre-clinical adjustment of interproximal contacts on new casts resulted in a decrease of chair time between 5.8 minutes and 35.6 minutes with statistical significance of $p = 0.007$ (Table 2).

Experimental Time	15 sec.	0 sec.	0 sec.	0 sec.	0 sec.	0 sec.	0 sec.	0 sec.
Experimental Quality	N	O	O	O	O	O	O	O
Control Time	0 sec.	1 min.	15 min.	15 min.	20 min.	30 min.	30 min.	30 min.
Control Quality	N	N	N	N	N	N	N	N

Table 1: *Time required for interproximal contact adjustment and quality of contact.*

Quality: O is optimal, N is non-optimal.

One-sided p	F Two-sided p		Sig. Mean Difference		t Std. Error Difference			df
Adjustment Time (Equal Variances Assumed)	11.495	0.004	3.282	14	0.003	0.005	20.71875	6.3126
Adjustment Time (Equal Variances Not Assumed)			3.282	7.000	0.007	0.013	20.71875	6.3126

Table 2a: *Independent samples test.*

Note: The F statistic (Levene's test for equality of variance) is 0.004. Equal variances cannot be assumed

Variable	Statistic	Standardizers	Point Estimate	Lower (CI)	Upper (CI)
Adjustment Time	Cohen's d	12.62524	1.641	0.470	2.770
Adjustment Time	Hedges Correction	13.35598	1.551	0.444	2.619
Adjustment Time	Glass's delta	0.08839	234.406	115.167	354.533

Table 2b: *Independent sample effect sizes.*

Discussion

These results document the effectiveness of a pre-clinical adjustment of the interproximal contacts for placement of indirect restorations, in the dental school setting. Therefore, the null hypothesis was rejected. Both dental students' abilities and the means dental faculty use to evaluate interproximal contacts vary greatly. Because of this, there was high variation in control restoration adjustment times. However, the experimental group of interproximal adjustment times were zero with one exception, where adjustment time was 15 seconds. Despite the heterogeneity of both faculty decision making and student ability, pre-clinical adjustment of interproximal contacts reduced chairside adjustment time to nearly zero. Furthermore, the adjustment protocol has an added benefit of establishing a quantifiable standard for restoration interproximal contact evaluation.

The UOPAADSD uses a large production laboratory. A "production laboratory" can be defined as a dental laboratory with many employees divided up into different sections such as cast work, scanning design, milling, adjustment and finishing. In these laboratories technicians do not know most of their dental practitioners. Because some practitioners (faculty) prefer tighter contacts, and it is less time consuming to reduce tight contacts than add material to a weak contact, their default is to make slightly tight contacts using the technique described by Davis [7]. Smaller "boutique" laboratories where technicians know their dental practitioners can adjust interproximal contacts to individual providers and reduce clinical adjustment times. When using a production laboratory, technicians can be taught to use fresh casts with this protocol to titrate interproximal contact adjustments to the clinician's preferences, or this can be performed by the clinician. This is relevant in most dental university settings and dental service organizations.

Limitation of the Study

The limitation of this study is the pre-clinical adjustment on the fresh cast was performed by one investigator. Multiple investigators may have generated different data. However, if the SOF/AF criteria are followed carefully, it should reduce the variability of inter-operator error.

Conclusion

Pre-clinical adjustment of restoration interproximal contacts on a pristine mounting-stone cast can reduce chairside adjustment time of interproximal contacts in a dental school setting.

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