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Project Title: **A Novel Approach to Assessing Orthodontic Bracket Placement Teaching Techniques: A Pilot Study**

Project Dates: January 2013 through January 2014

Project Checklist:

__x__ Statement of support from the department chair or school dean
__x__ Simple budget: A detailed budget is not necessary.
__x__ IRB (Institutional Review Board) approval to be obtained

ABSTRACT: One of the most essential clinical concepts learned by a future orthodontist is the effective placement of orthodontic brackets. This skill is present at the core of any orthodontic residency clinical curriculum; yet research documenting the most effective methods of teaching this indispensable skill is lacking. The purpose of this pilot study is to assess the impact of different pedagogical modalities on the development of bracket placement abilities in orthodontic graduate students. Outcomes from this study will be used to identify an ideal method of bracket placement instruction for orthodontic graduate students and improve the orthodontic department's clinical curriculum.

PURPOSE:

Orthodontic postgraduate programs are advanced dental education programs that aim to train dentists to become orthodontists over a 2-3 year period. During this additional training, graduate students learn a multitude of didactic and clinical knowledge that will allow them to safely and effectively manage the orthodontic needs of the general public. One of the most crucial skills a graduate student will learn during their program is how to appropriately place orthodontic brackets on teeth. This important skill is taught in one of two primary ways, via direct or indirect bracket placement. Direct bracket placement was first described approximately 50 years ago (Newman, 1965) and has since undergone several modifications (Lee, 1974; Newman 1974; Zachrisson, 1978); in general however, it involves the orthodontist placing each individual bracket by hand on a patient's teeth. During indirect bracket placement, orthodontic brackets are first placed on a dental cast and later transferred to the patient's mouth via a transfer tray (Thomas 1979). When it comes to the overall accuracy of bracket placement with these two techniques, the orthodontic literature seems to indicate that there is no difference or only a very slight advantage in using the indirect method (Aguirre, 1982; Hickman, 1993; Koo, 1999; Hodge, 2004; Shpack, 2007).

Accurate bracket placement is important because when errors in bracket placement occur positional discrepancies can arise (Suaréz, 2009), such as deviations in tooth rotation, tipping, in/out, extrusion/intrusion, and torque (McLaughlin, 1995). These problems can result in a number of adverse treatment sequelae like increased treatment time and suboptimal orthodontic treatment results. Therefore, to reduce the potential for these problems orthodontist must quickly increase their ability to identify the proper position for orthodontic brackets.

Most postgraduate programs typically provide their students with foundational information via lectures or limited pre-clinical laboratory activities and then have them continue to improve this skill on actual patients. By trial and error, with only subjective feedback from

their faculty members, orthodontic graduate students gradually gain more experience and an increased ability to adequately place brackets. Unfortunately, the rate of improvement for each student is extremely variable. And within the dental and orthodontic literature, there are no studies that have investigated the best method for optimally training orthodontic students in this fundamental clinical skill.

The specific aims of this pilot study are to:

1. Identify the most effective method of teaching orthodontic bracket placement to orthodontic graduate students.
2. Evaluate a novel digital method of assessing proper bracket placement and providing objective feedback during student training.

INTENDED OUTCOMES OF PROJECT:

While the orthodontic literature discusses the precision of various methods of orthodontic bracket placement, there are no documented studies that investigate the most effective method of teaching this clinical skill to orthodontic graduate students. The major outcome of this pilot study will be the identification of an optimal method for training students. A second outcome will be the evaluation of the proposed digital model superimposition process as an accurate method of providing objective feedback to orthodontic students during their clinical training. If this pilot study is successful, another potential outcome will be the completion of a larger scale study, among multiple orthodontic postgraduate programs, in order to gather sufficient data that would allow the investigators to make curriculum recommendations to the orthodontic education community.

ASSESSMENT METHOD:

A prospective, longitudinal, cohort study design (Figure 1) will be used for this study. Following IRB approval, orthodontic graduate students with less than one year of bracket placement experience will be recruited for this pilot study. Students will be randomly assigned to one of two groups. One group will undergo further bracket placement training on hand-held

stone models (Group 1), while the other group will participate in bracket placement training using stone models mounted in mannequin simulation units (Group 2). Both groups will have a baseline bracket placement session, where they will be given 1 hour to place 10 ceramic brackets (second premolar to second premolar) on an upper stone model in mannequin simulation units. After the baseline session, each group will meet for additional bracket placement training over a three week period. The groups will meet once each week, for 1 hour, and practice bracket placement using the designated teaching modality (hand-held models or models in simulation unit). After the three training sessions, both groups will participate in a final bracket placement assessment on the mannequin simulation units, using replicas of the models used during the baseline session. The stone models with ceramic brackets for both the initial and final assessment sessions will be scanned using an Ortho Insight 3D scanner (Figure 2). The scanned images will then be imported into the 3dMD Vultus superimposition software. Since the same stone model will be used for both the initial and final assessment, they will be superimposed using the teeth and anatomical structures of the roof of the mouth as reference points. The software will then quantify the linear and angular bracket placement discrepancies between the initial and final models in all planes of space (anteroposterior, transverse, and vertical). The magnitude of the discrepancies will be quantified using a surface tomography feature within the software program (Figure 3). Each study participant will have a unique identification code and the observed bracket placement discrepancies will be recorded under that code and delivered to the biostatistician for statistical analysis.

Figure 1

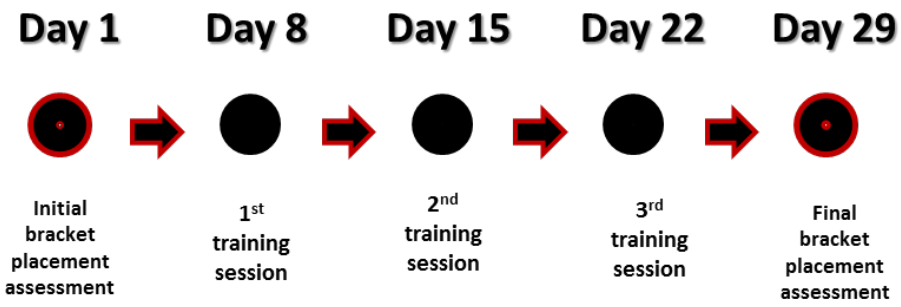
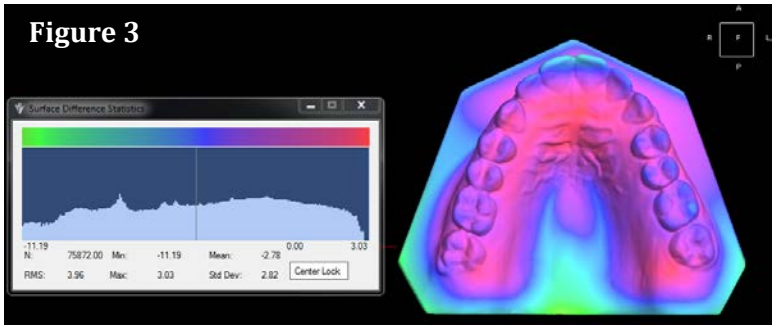


Figure 2

Figure 3



DATA ANALYSIS:

Due to the anticipated small sample size and potential variability in bracket placement experience, nonparametric statistical analysis will be utilized for this study. Descriptive statistics will be reported for the entire test sample. The Wilcoxon signed-rank test will be used to assess differences in bracket placement within subjects. The Mann-Whitney U Test will be used to evaluate the differences in bracket placement from the two assessment points between the two groups. A significance level of $p < .05$ will be established for this study.

METHODS OF EVALUATION AND DISSEMINATION:

The listed investigators are active members of various orthodontic constituencies, which will increase the potential audience for this work. They also have experience with the dissemination of institutional-based research in journals and during presentations throughout the world. The results from this study have the potentially to positively influence the manner in which orthodontic bracket placement is taught in orthodontic postgraduate programs, both nationally and internationally. Findings from this study will be disseminated in referred education/orthodontic journals and at local, regional, national, and international meetings focused on orthodontics and orthodontic education.

DETAILS ON INTENDED USE OF FINDINGS FOR PROGRAM IMPROVEMENT:

The identified project directors play an integral role in the didactic and clinical curriculum at the Indiana University School Dentistry Orthodontic Postgraduate Program. Study

findings will be shared with the department's curriculum assessment committee and administration for the purpose of encouraging and guiding the ongoing curriculum revision process. It will also allow the department to assess and document its process of evidence-based curriculum reform, in a critical area of clinical orthodontic education, for its upcoming Commission on Dental Accreditation (CODA) Site-Visit. Long-term, the investigators hope to identify a pedagogical strategy that optimizes the clinical training of orthodontic professionals and allows programs to graduate individuals who are highly competent and efficient in orthodontic bracket placement.

PROPOSED BUDGET:

Grant funding will be used to support the construction and execution of the proposed study. The statistical analysis and dissemination of study findings will also be supported through funds provided through the grant as indicated below.

Budget Item	**Proposed Cost**	**Total ($2500)**	**Rationale**
Supplies Orthodontic Brackets Magnets Stone	 $1200 $50 $50	$1300	3M Unitek APC Ceramic/metal brackets for placement testing, stone to fabricate dental models, magnets to help retain stone models in mannequin simulation units.
Student Worker	$10/hour for 30 hours	$300	Scanning the stone models and superimposing the images
Biostatistician	$400	$400	Support in study statistical analysis
Dissemination of findings (meetings)	$500	$500	Support for poster development, publication, and travel