Improving the Ability of PES/WES in Predicting Patient Satisfaction of Anterior Implant Restorations

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THESIS

Submitted as partial fulfillment of the requirements
for the degree of Master of Science in Oral Sciences
in the Graduate College of the
University of Illinois at Chicago, 2015

Chicago, Illinois

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This thesis is dedicated to any patients who desire esthetic anterior restorations, particularly the voluntary participants in my research project, without whom the completion of this study would not have been possible. As a dental health care provider and researcher, I vow to explore and provide the highest quality of care and research to increase patient satisfaction and quality of life.

ACKNOWLEDGEMENTS

First and foremost, I would like to thank Drs. Cortino Sukotjo and Judy Yuan who have provided me with much assistance and guidance in pursuing my Master of Science in Oral Sciences. I am greatly appreciative of their time, encouragement, and commitment throughout this process. I would also like to thank the additional members of my thesis committee and my colleagues for their added support.

I would like to thank Merry Wang, for beautifully altering the photographs, and Cindy Lau, for programming the survey and website. Without them this project would not be possible.

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LIST OF ABBREVIATIONS

COD	College of Dentistry
IRB	Institutional Review Board
PC	Personal computer
PES	Pink Esthetic Score
SPSS	Statistical Package for the Social Sciences
UIC	University of Illinois at Chicago
VAS	Visual Analog Scale
WES	White Esthetic Score

SUMMARY

Purpose: The purposes of this photographic survey study were (1) to standardize the PES/WES and to reduce subjectivity in scoring, (2) to determine how each esthetic factor influences patient satisfaction scores, (3) to develop a new modified PES/WES esthetic index to better predict patient satisfaction and acceptance, (4) to compare satisfaction scores, perceptibility and acceptability between dentist and patients.

Methods: A set of 29 photographs was digitally altered to score 0,1, and 2 (ideal) for each of the esthetic factors in the PES and WES. A survey containing these photographs of anterior implant supported restorations was given to patients and dentists at the University of Illinois at Chicago (UIC) on electronic tablet (Apple Inc., California) or delivered to the non-UIC participants in a web-based format. Participants were asked to report their satisfaction of the photographs on a 100mm visual analog scale, as well as perceptibility and acceptability. Data from the UIC group and non-UIC group were compared using the Independent t-test. For patients and dentists, ANOVA was used to compare the satisfaction scores for score 0, score 1 and ideal photos for each esthetic factor within the study population. Post hoc Tukey tests were used to analyze the differences within each factor. Independent t-tests were used to investigate the differences between patients and dentists in rating each esthetic variable. For perceptibility and acceptability ratings between the study

populations, chi-squared tests or Fisher's exact tests were used when appropriate. Statistical significance is defined as $p < 0.05$.

Results: A total of 204 participants took the electronic survey. Six participants (5 male and 1 female) were deemed colorblind because they were unable to identify all 4 Ishihara plates correctly and were not included in the initial analysis. Analysis was performed on participants from UIC, which consisted of 56 participants. Within the patient group, only 9 out of the 14 esthetic factors had a statistically significant difference ($p < 0.05$) in satisfaction scores between the score 0, 1 and ideal photos. Alveolar process, tooth surface texture, tooth form wide, soft tissue contour and soft tissue texture were esthetic factors that did not show statistically significant difference in satisfactions scores between the score 0, 1 and ideal photos. When comparing dentists' and patients' satisfaction scores, 8 photos were significantly different between the 2 groups. Patient scores were higher than dentist scores in the 8 photos that were significantly different in satisfaction scores. When comparing dentists' and patients' perceptibility, 12 photos were significantly different between the 2 groups. When comparing dentists' and patients' acceptability, 6 photos were significantly different between the 2 groups.

Conclusion: In order of importance, tooth color, mesial papilla, distal papilla, and soft tissue color were the 4 most important esthetic factors in determining patient satisfaction scores. Alveolar process, soft tissue contour, soft tissue

texture, tooth form wide, and tooth surface texture were the 5 factors that had minimal to no influence on patient satisfaction scores. These factors were dropped from a new UIC-SIU Index which is correlated with patient satisfaction scores and percentage of patient acceptance. Dentists had statistically significant lower satisfaction scores than patients in 6 factors. There were soft tissue contour, tooth form wide, tooth form narrow, tooth outline/volume, tooth color and tooth translucency low/ value high. In general, dentist satisfaction scores were 20 points lower than patient scores. If dentists are satisfied, then patients should be satisfied. Dentists had better perception than patients of all esthetic factors except mesial papilla, distal papilla, soft tissue color, and tooth translucency low/value high. For these 4 factors, dentists and patients had the same perceptibility. Dentists were less accepting than patients in all white esthetic factors except tooth translucency high/value low.

1. INTRODUCTION

1.1 Background

Advances in dental implant research, design and their clinical application have greatly changed dental care. Improved protocols in implant therapy over the last several decades have made implant supported restorations biologically and mechanically predictable.(1-3) The use of implants in the esthetic zone has increased and patients are becoming more esthetically demanding.(4, 5)

Patient satisfaction is an important factor in predicting the success of implant therapy in the anterior maxilla.(6, 7) Despite the importance of esthetic outcomes, few studies included in a systematic review evaluated the esthetics of implant supported single crowns.(8) In another systematic review, only 6 studies included esthetic criteria in determining implant success.(9) In addition, these studies had no standardized method to evaluate esthetics. Some studies asked their patients to rate their overall satisfaction of their implant-supported crowns, while others studies asked patients to rate only crown color and shape. Some studies had the practitioner, rather than the patient, evaluate the esthetics of the implant restoration. It is well known that the practitioner's perspective is different than that of the patient's.(10-12) Since less than 2% of publications on dental implants focus on patient-centered issues, outcomes such as esthetics and

patient satisfaction of implant supported restorations need more focus in future dental research.(5, 13)

There is a need for an objective and reproducible esthetic score for the restoration and the peri-implant soft tissues to drive dental implant research towards a more esthetic focus and to improve implant therapy for patients.(14) Furhauser and colleagues (14) developed the 7 criteria Pink Esthetic Score (PES) to objectively evaluate the peri-implant soft tissue (figure 1). The PES was shown to have a good intra-examiner agreement.(15) Belser and colleagues developed the White Esthetic Score (WES) to objectively evaluate implant supported restorations based on 5 criteria (figure 2). The authors combined a simplified 5 criteria PES with the WES to evaluate anterior implant supported restorations.(10) An arbitrary score of 6 was set to represent the minimum WES required for clinical acceptance(10) and a minimum PES was set at 8.(4) Correlations between PES and patient satisfaction determined on a visual analog scale have been reported.(16, 17) However, some studies have reported poor to moderate correlation between PES/WES with patient satisfaction determined on the same scale.(4) There seems to be emerging evidence supporting the reproducibility of the PES and correlation with patient satisfaction(15-18) but similar evidence for the WES is scarce.(5)

In order to compare esthetic results of different treatment modalities using the PES/WES for the future research, these indices *should* correlate with patient

satisfaction. If this correlation is weak, then a more complex treatment resulting in a higher objective PES/WES may be rendered to patients when they may be equally satisfied with a more conservative but lower scoring treatment. If the objective indices are not correlated to a patient's esthetic perception, then the practitioner may be overlooking treatments and materials that are able to satisfy a patient, and overusing others that cannot meet patient expectations.(5)

1.2 **Significance**

A critical factor in determining the success of implant-supported restorations in the anterior maxilla is the esthetics of the crown and surrounding soft tissues. New indices such as the Pink Esthetic Score (PES) and the White Esthetic Score (WES) provide practitioners and researchers a new method to objectively evaluate esthetics. However, patients often perceive esthetics differently than dental professionals. There is great value in improving the correlation between dentist-determined PES/WES and subjective patient satisfaction scores. If high PES/WES scores can accurately predict patient satisfaction or acceptance, then these indices provide a standardized method to compare the esthetic outcomes of different treatment modalities and biomaterials.(5)

The expected outcome from this study includes determining the relative importance of each esthetic factor within the PES/WES, and to improve these indices to better predict patient satisfaction by weighting important criteria more heavily. A new esthetic diagnostic tool may be developed to better correlate with patient perceptions. This may also identify more esthetically demanding patients. It is critical to carefully evaluate treatment options using mechanical, biological and esthetic factors to ensure patient satisfaction can be achieved. If the esthetic expectation of a patient is high in any specific PES/WES criterion, then the practitioner may be required to take additional steps. Implant therapy may not be

the treatment of choice altogether, if the patient's esthetic demand cannot be met. Therefore it is important that our esthetic diagnostic tools reflect patient satisfaction and acceptance.(5)

In this project, we examined the patient satisfaction scores using questionnaires with altered photographs of PES/WES. If high PES/WES scores can accurately predict patient satisfaction or acceptance, then these indices provide a standardized method to compare the esthetic outcomes of different treatment modalities and biomaterials.(5)

1.3 Specific Aims and Hypotheses

A critical factor in determining the success of implant-supported restorations in the anterior maxilla is the esthetics of the crown and surrounding soft tissues. New indices such as the Pink Esthetic Score (PES) and the White Esthetic Score (WES) provide practitioners and researchers a new method to objectively evaluate esthetics. However, patients often perceive esthetics differently than dental professionals. Therefore, the esthetic outcomes perceived by the dental professionals and the patients and their correlation need to be further investigated.(5)

Aim #1: Analyze and improve the current PES/WES. A review of literature was completed to identify currently available research on each esthetic factor. A set of 29 altered photographs was created based on available research. A group of 5 dental specialists reached an agreement to these photographs. More objective scoring criteria were developed. **Hypothesis #1: These reference photographs and more objective scoring instructions should make the PES/WES more reproducible, reliable and standardized.**

Aim #2: Determine how each esthetic factor influences patient satisfaction scores. A survey containing the 29 altered photographs of maxillary anterior teeth with different PES/WES scores determined by dental professionals was administered to participants to assess the esthetic outcomes. This study

evaluated the importance of each PES/WES criterion from the perspective of patients and dentists. **Hypothesis #2: Each esthetic factor within the PES/WES will have a different level of influence on satisfaction scores.**

Aim #3: Recommend a new validated esthetic index that correlates with patient satisfaction and acceptance. Based on how each esthetic factor influences patient satisfaction scores, important factors were emphasized in a new UIC-SIU Index and factors that had no effect on satisfaction were eliminated. **Hypothesis #3: A new objectively determined esthetic index could be developed that accurately predicts patient satisfaction and acceptance.**

Aim #4: Determine any differences in satisfaction, perceptibility and acceptability between dental professionals and patients. Altered photographs of maxillary anterior teeth were given to both dental professionals and patients to rate satisfaction based on the esthetics outcome. Perceptibility and acceptability were also assessed. This study investigated how responses differ between the two populations. **Hypothesis #4: There is a difference between satisfaction scores, perceptibility and acceptability between dentists and patients.**

If the relative importance of each PES/WES criterion can be determined, then it is possible to improve this index to better predict patient satisfaction by

weighting important criteria more heavily. A new esthetic diagnostic tool may be developed to better correlate with patient and clinician perception, as well as identify esthetically demanding patients. It is critical to carefully evaluate treatment options using mechanical, biological and esthetic factors to ensure patient satisfaction can be achieved. If the esthetic expectation of a patient is high in any specific PES/WES criterion, then the practitioner may be required to take additional steps to meet the patient demands.(5)

2. REVIEW OF LITERATURE

2.1 Success Criteria for Anterior Implants and Restorations

For the last three decades, implant dentistry has become more predictable and the quality of implant treatment has improved. (1-3) Traditionally, implant restorations are utilized mainly to restore masticatory function, which demanded fixtures to osseointegrate, be free of pain and infection, and survive. More currently, there is an increasing need for implants in the anterior zone to restore not only function, but also esthetics. (4) This requires implant restorations to mimic or even be superior to the patient's natural dentition. Since the development of osseointegrated dental implants, many concepts have been described to evaluate implants and restorations long-term. These concepts, however, may be incomplete because they do not include a comprehensive evaluation of esthetics and patient satisfaction. (19)

One of the first concepts to evaluate implant success was described by Schnitman and Schulman in 1979. Their criteria mainly focus on lack of mobility, absence of disease, and 5 years of function.

1. Mobility less than 1 mm in any direction (20)
2. Radiologically observed radiolucency graded but no success criterion defined (20)

3. Bone loss no greater than one third of the vertical height of the bone (20)
4. Gingival inflammation amenable to treatment, absence of symptoms and infection, absence of damage to adjacent teeth, absence of parasthesia and anesthesia or violation of the mandibular canal, maxillary sinus or floor of the nasal passage (20)
5. Functional service for 5 years in 75% of patients (20)

In 1982, Cranin *et al* described implant success criteria that are similar to the Schnitman and Schulman concept but their evaluation of radiographs is more specific. (21)

1. In place 60 months or more (21)
2. Lack of significant evidence of cervical saucerisation on radiographs (21)
3. Freedom from hemorrhage according to Muhleman′s index
4. Lack of mobility (21)
5. Absence of pain or percussive tenderness (21)
6. No pericervical granulomatosis or gingival hyperplasia (21)
7. No evidence of a widening peri-implant space on radiograph (21)

In 1986, Albrektsson *et al* defined arguably the most widely known implant success criteria. It is unique to previous concepts because it was the first to provide a suggested rate of bone loss around osseointegrated implants. The

success rate at the 5 year observation period was also 10% higher when compared to the Schnitman criteria.(22)

1. Individual unattached implant that is immobile when tested clinically (22)
2. Radiography that does not demonstrate evidence of peri-implant radiolucency (22)
3. Bone loss that is less than 0.2 mm annually after the implant's first year of service (22)
4. No persistent pain, discomfort or infection (22)
5. By these criteria, a success rate of 85% at the end of a 5 year observation period and 80% at the end of a 10 year period are minimum levels for success (22)

The implant success concepts described so far did not include any patient-centered outcomes or esthetics criteria. In 1984, McKinney *et al*. was the first to describe success criteria that included subjective factors. (23)

Subjective criteria

1. Adequate function
2. Absence of discomfort
3. Patient belief that esthetics and emotional and psychological attitudes are improved

Objective criteria

4. Good occlusal balance and vertical dimension
5. Bone loss no greater than one third of the vertical height of the implant, absence of symptoms, and functionally stable after 5 years
6. Gingival inflammation vulnerable to treatment
7. Mobility of less than 1 mm buccolingually, mesiodistally, and vertically
8. Absence of symptoms and infection associated with the dental implant
9. Absence of damage to adjacent tooth or teeth and their supporting structures
10. Absence of parasthesia or violation of mandibular canal, maxillary sinus, or floor of nasal passage
11. Healthy collagenous tissue without polymorphonuclear infiltration

Success criterion

12. Provides functional service for 5 years in 75% of implant patients

The McKinney success criteria concept was a step in the right direction because it attempted to incorporate patient determined factors. However, it lacked a detailed, evidence-based set of criteria to determine esthetic success.

Over the past few decades, researchers and clinicians have come up with a set of criteria to evaluate implant survival and success. Despite their efforts, there is no uniformly accepted concept that encompasses every aspect that affects implant success. Many studies that investigate implant success/survival each have their own definitions of success or survival. As a result, systematic reviews have a difficult time pooling data from previous studies. Nevertheless, the success/survival of dental implants is relatively well-documented and peer reviewed with reported survival rates of more than 95% after 5 years of function. (8, 24) These systematic reviews also noted the lack of uniformity in assessing implant esthetics. They reported that only a small fraction of the included studies evaluated esthetics as an implant success criteria. (8, 9) Moreover, those few studies were not uniform in their evaluation of esthetics. (8, 9) Different esthetic criteria were used and the evaluation of esthetics was done by both dental professionals and patients despite the suggestion that there is a difference in the perception between the 2 groups. (8-12, 25) It may be difficult to draw any definitive conclusions but the reported rate of unacceptable or semi-optimal dental implant restorations is 8.7%. (8) This may suggest that poor esthetics contribute more to implant failures than more traditional factors such as pain, infection and bone loss.

Patient satisfaction is an important factor in predicting the success of implant therapy in the anterior maxilla because a functionally acceptable prosthesis is a failure if it is not esthetically accepted by the patient. (6, 7) Patient

satisfaction is important and less than 2% of the current literature on dental implants focus on patient-centered outcomes. (13, 26)

2.2 Evaluation of Esthetics

Dental implant restorations in the anterior maxilla, or the esthetic zone, need to be in harmony with the rest of the dentition, lips and face of the patient. (27) Currently there are many objective and subjective esthetic parameters that have been used in clinical and experimental studies. (28) In 2004, a review article concluded that the literature on dental implants and restorations is largely inconclusive because there is no uniform way to evaluate esthetics in a well-defined manner. (29) It was suggested that in order for research in the area of dental implant esthetics to improve, there was a need for a widely used, objective and reproducible esthetic index. (29) Since then, a vast number of researchers and clinicians have described parameters that influences implant esthetics. (28) Implant restorations are unique because both restoration and surrounding soft tissue influence the esthetic outcome. (30) A systematic review reported that 149 studies described parameters and methods to evaluate implant esthetics at the professional level. (28) Thirty two randomized controlled trials included in the systematic review used current esthetic indices to compare different treatment modalities such as implant type, timing of implant placement, loading, and restoration, abutment type, restoration type, and type of soft tissue or hard tissue grafting. (28) Whether these treatment modalities have an influence on the final esthetic outcome is of vital importance. There are also a variety of methods to evaluate esthetics. Photography, spectrophotometry, optical scanners and computer software have all been reported as reliable tools to measure esthetic parameters. (28, 31-33) Current esthetic indices can be categorized into three

major groups. The first group encompasses the indices that evaluate soft tissue esthetics. The second group of indices evaluates strictly the implant superstructure. The last group includes more comprehensive esthetic indices that evaluate both the soft tissue and the restorations.

2.3 Current Soft Tissue Esthetic Indices

The **Papilla Index** (Figure 1) proposed by Jemt in 1997 evaluates the papilla fill with scores ranging from 0-4. (34) It is one of the earliest soft tissue esthetic indices described. The Papilla Index is heavily referenced, despite the fact that it only evaluates 1 parameter.

Index score 0: no papilla is present, and there is no indication of a curvature of the soft tissue contour adjacent to the single-implant restoration (34)

Index score 1: less than half of the height of the papilla is present. A convex curvature of the soft tissue contour adjacent to the single implant crown and the adjacent tooth is observed (34)

Index score 2: at least half of the height of the papilla is present, but not all the way up to the contact point between the teeth. The papilla is not completely in harmony with the adjacent papillae between the permanent teeth. Acceptable soft tissue contour is in harmony with adjacent teeth (34)

Index score 3: the papilla fills up the entire proximal space and is in good harmony with the adjacent papillae. There is optimal soft tissue contour. (34)

Index score 4: the papillae are hyperplasic and cover too much of the single implant restoration and/or the adjacent tooth. The soft tissue contour is more or less irregular. (34)

Figure 1: The Papilla Index

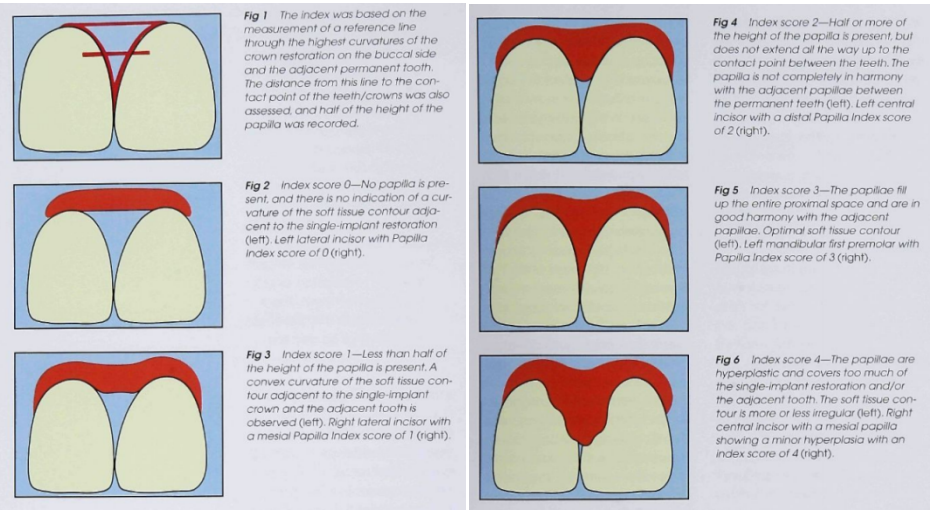


Fig 1 The index was based on the measurement of a reference line through the highest curvatures of the crown restoration on the buccal side and the adjacent permanent tooth. The distance from this line to the contact point of the teeth/crowns was also assessed, and half of the height of the papilla was recorded.

Fig 2 Index score 0—No papilla is present, and there is no indication of a curvature of the soft tissue contour adjacent to the single-implant restoration (left). Left lateral incisor with Papilla Index score of 0 (right).

Fig 3 Index score 1—Less than half of the height of the papilla is present. A convex curvature of the soft tissue contour adjacent to the single-implant crown and the adjacent tooth is observed (left). Right lateral incisor with a mesial Papilla Index score of 1 (right).

Fig 4 Index score 2—Half or more of the height of the papilla is present, but does not extend all the way up to the contact point between the teeth. The papilla is not completely in harmony with the adjacent papillae between the permanent teeth (left). Left central incisor with a distal Papilla Index score of 2 (right).

Fig 5 Index score 3—The papillae fill up the entire proximal space and are in good harmony with the adjacent papillae. Optimal soft tissue contour (left). Left mandibular first premolar with Papilla Index score of 3 (right).

Fig 6 Index score 4—The papillae are hyperplastic and covers too much of the single-implant restoration and/or the adjacent tooth. The soft tissue contour is more or less irregular (left). Right central incisor with a mesial papilla showing a minor hyperplasia with an index score of 4 (right).

The **Modified Jemt Papilla Index** described by Schropp & Isidor in 2008 also assess papilla fill. It is the same as Jemt's original Papilla Index, but the authors recognize that in cases with previous generalized recession, complete papilla fill cannot be achieved. Therefore they suggested that in cases of generalized recession, the distal papilla of the adjacent tooth should be the reference. (35)

Score 0: no papilla or a negative papilla (35)

Score 1: less than half of the height of the proximal area occupied by soft tissue (35)

Score 2: at least half of the height of the proximal area occupied by soft tissue (35)

Score 3: inter-proximal area completely occupied by soft tissue (35)

The **Papilla Height Classification System** (Figure 2) described by Nordland & Tarnow in 1998 evaluates papilla level. (36) It is different from the Papilla Index because it uses the facial and interproximal CEJ as reference lines.

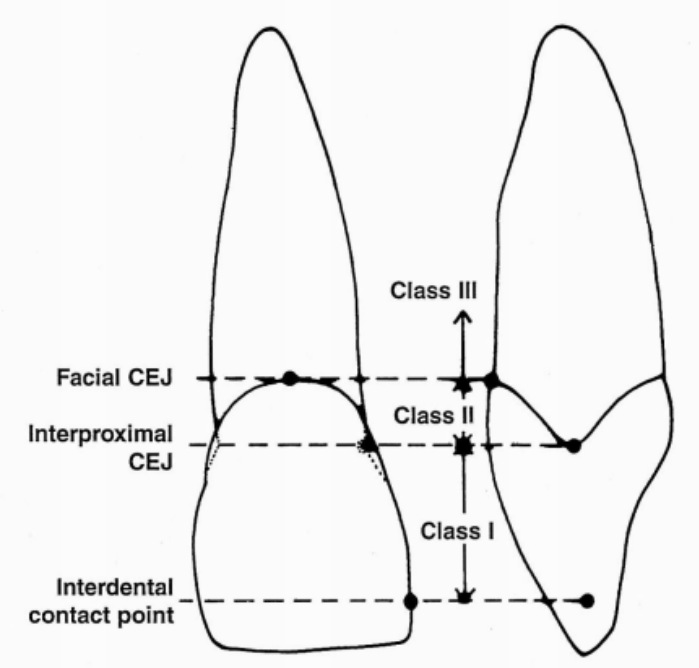
Normal: the inter-dental papilla fills embrasure space to the apical extent of the inter-dental contact point/area (36)

Class I: the tip of the inter-dental papilla lies between the inter-dental contact point and the most coronal extent of the inter-proximal CEJ (space present, but inter-proximal CEJ is not visible) (36)

Class II: the tip of the inter-dental papilla lies at or apical to the inter-proximal CEJ, but coronal to the apical extent of the facial CEJ (inter-proximal CEJ visible) (36)

Class III: the tip of the inter-dental papilla lies level with or apical to the facial CEJ (36)

Figure 2: Papilla Height Classification System



The **Subjective Aesthetic Score** described by Evans & Chen in 2008 evaluates the level of the facial gingival margin. (37) This index only includes 1 parameter, similar to the Papilla Index.

Score I: vertical buccal change 0.5 mm or less and labial tissue fullness in harmony with the adjacent teeth (37)

Score II: vertical buccal change between 0.5 mm and 1 mm and the labial tissue fullness in harmony (37)

Score III: vertical buccal change between 1 mm and 1.5 mm and the labial tissue appears deficient in contour (37)

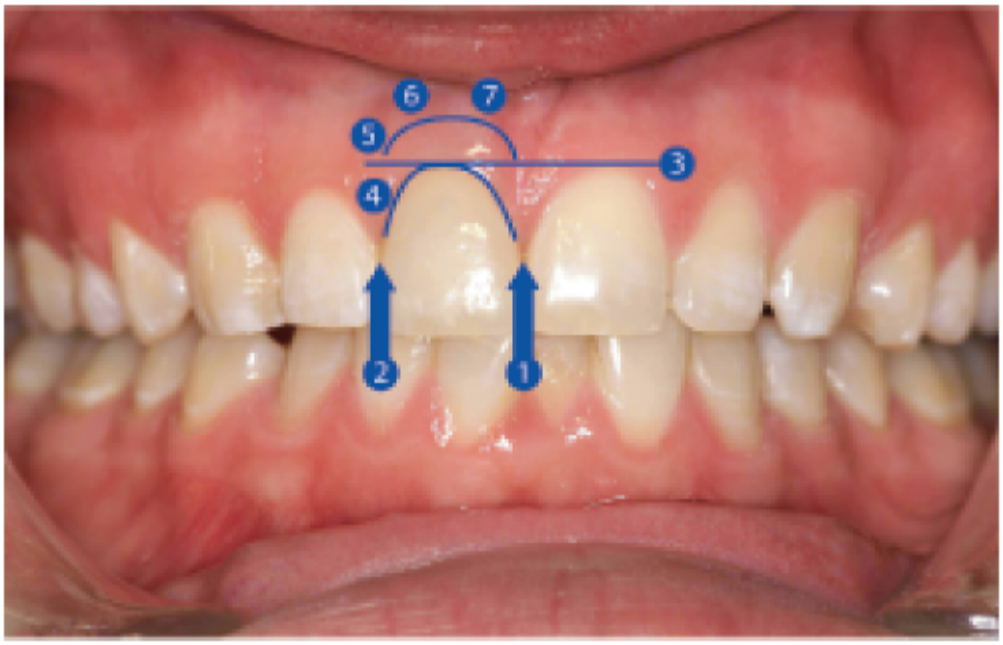
Score IV: vertical buccal change greater than 1.5 mm and deficiency in labial tissue contour (37)

The **Pink Esthetic Score** (Figure 3 and 4) described by Furhauser et al. in 2005 evaluates 7 soft tissue criteria. (14) It is one of the first soft tissue indices that evaluate parameters other than the papilla. Each criterion can be given a score of 0, 1 or 2 when compared to the corresponding reference tooth.(14) Mesial and distal papilla are scored based on complete, incomplete or absent of fill. (14) A maximum score of 14 can be achieved by adding the scores of the 7 parameters up. This makes the assumption that all 7 parameters have the same effect on the final esthetic outcome. The PES was shown to have a good intra-examiner agreement. (15)

Figure 3: Scoring criteria for the Pink Esthetic Score

Variables		0	1	2
Mesial papilla	Shape vs. reference tooth	Absent	Incomplete	Complete
Distal papilla	Shape vs. reference tooth	Absent	Incomplete	Complete
Level of soft-tissue margin	Level vs. reference tooth	Major discrepancy >2 mm	Minor discrepancy 1–2 mm	No discrepancy <1 mm
Soft-tissue contour	Natural, matching reference tooth	Unnatural	Fairly natural	Natural
Alveolar process	Alveolar process deficiency	Obvious	Slight	None
Soft-tissue color	Color vs. reference tooth	Obvious difference	Moderate difference	No difference
Soft-tissue texture	Texture vs. reference tooth	Obvious difference	Moderate difference	No difference

Figure 4: The 7 factors in the Pink Esthetic Score

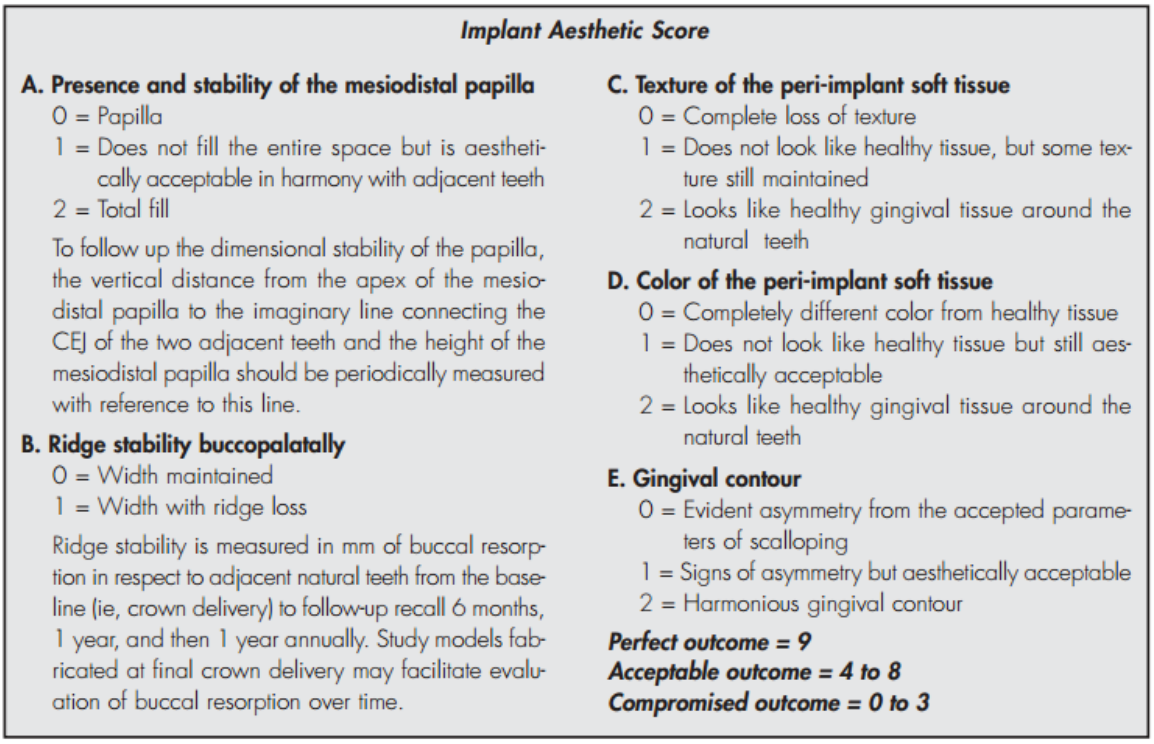


(1) Mesial papilla (2) Distal papilla (3) Level of soft tissue margin (4) Soft tissue contour (5) Alveolar process (6) Soft tissue color (7) Soft tissue texture

The **Implant Aesthetic Score** (Figure 5) developed by Testori et al. in 2005 includes 5 soft tissue parameters. (38) With the exception of the ridge stability parameter, which can only be given a score of 0 or 1, the 4 other parameters can be given a score of 0, 1, or 2. (38) Therefore, a maximum score of 9 can be achieved. (38) This scoring design makes the assumption that ridge

stability is less important than the other 4 factors because it can only be given a maximum score of 1 rather than 2.

Figure 5: Implant Aesthetic Score



Implant Aesthetic Score

A. Presence and stability of the mesiodistal papilla

0 = Papilla
1 = Does not fill the entire space but is aesthetically acceptable in harmony with adjacent teeth
2 = Total fill

To follow up the dimensional stability of the papilla, the vertical distance from the apex of the mesiodistal papilla to the imaginary line connecting the CEJ of the two adjacent teeth and the height of the mesiodistal papilla should be periodically measured with reference to this line.

B. Ridge stability buccopalatally

0 = Width maintained
1 = Width with ridge loss

Ridge stability is measured in mm of buccal resorption in respect to adjacent natural teeth from the baseline (ie, crown delivery) to follow-up recall 6 months, 1 year, and then 1 year annually. Study models fabricated at final crown delivery may facilitate evaluation of buccal resorption over time.

C. Texture of the peri-implant soft tissue

0 = Complete loss of texture
1 = Does not look like healthy tissue, but some texture still maintained
2 = Looks like healthy gingival tissue around the natural teeth

D. Color of the peri-implant soft tissue

0 = Completely different color from healthy tissue
1 = Does not look like healthy tissue but still aesthetically acceptable
2 = Looks like healthy gingival tissue around the natural teeth

E. Gingival contour

0 = Evident asymmetry from the accepted parameters of scalloping
1 = Signs of asymmetry but aesthetically acceptable
2 = Harmonious gingival contour

Perfect outcome = 9
Acceptable outcome = 4 to 8
Compromised outcome = 0 to 3

2.4 Current Restoration Esthetic Indices

In 2000, De Bruyn et al modified the 1977 **Guidelines for the assessment of clinical quality and professional performance proposed by the Californian Dental Association (CDA)** to evaluate dental implant restorations. (39, 40) The original CDA index was designed to evaluate natural tooth-borne crowns that rated 3 variables of the prosthetic component: surface and color of crown, anatomic form, and marginal integrity. Each of the criteria can be given a score from 0-3.

Score 3: Perfect. No mismatch in color/shade/translucency between crown and adjacent teeth. Perfect lip filling and facial height. Natural appearance when the patient is smiling (37)

Score 2: Acceptable. Mismatch in color/shade/translucency. Discoloration of acrylic teeth. Lip fill and facial height in harmony (37)

Score 1: To be corrected for prevention. Aesthetically disturbing mismatch in color/shade/translucency. Heavy discoloration and or damage of acrylic teeth. Unharmonious lip fill and facial height (37)

Score 0: To be redone. Gross esthetical disharmony unsatisfactory lip fill/facial height/color/shade/translucency (37)

Since the CDA is designed to evaluate natural-tooth borne crowns, it does not consider the surrounding soft tissue that frames an implant restoration. This index was found to correlate poorly with other indices and a patient's self-reported outcome. (41)

2.5 Current Combined Soft Tissue and Restoration Esthetic Indices

The **Implant Crown Aesthetic Index** (ICAI) developed by Meijer et al. in 2005 incorporates 9 soft tissue and restoration parameters. After a review of the literature at the time, the authors believed that these 9 parameters influence dental implant esthetics.(30, 42-44) The dental professional can rate each of the parameters from 0-5 using a penalty system. A perfect restoration is given a 0 penalty whereas an unacceptable restoration is given a 5 penalty. This index included 9 esthetic criteria.

1. Mesiodistal dimension of the crown: position must be in harmony with the adjacent and contra- lateral tooth; grossly undercontoured, slightly undercontoured, no deviation, slightly overcontoured, grossly overcontoured (42)

2. Position of the incisal edge of the crown: position must be in harmony with the adjacent and contra-lateral tooth; grossly undercontoured, slightly undercontoured, no deviation, slightly overcontoured, grossly overcontoured (42)

3. Labial convexity of the crown: position must be in harmony with the adjacent and contra-lateral tooth; grossly undercontoured, slightly

undercontoured, no deviation, slightly overcontoured, grossly overcontoured (42)

4. Color and translucency of the crown: position must be in harmony with the adjacent and contra-lateral tooth; gross mismatch, slight mismatch, no mismatch (42)

5. Surface of the crown: position must be in harmony with the adjacent and contra-lateral tooth; gross mismatch, slight mismatch, no mismatch (42)

6. Position of the labial margin of the periimplant mucosa: at same level of contra-lateral tooth and in harmony with adjacent; deviation of 1.5mm or more, deviation less than 1.5mm, no deviation (42)

7. Position of the mucosa in the approximal embrasures: deviation of 1.5mm or more, deviation less than 1.5mm, no deviation (42)

8. Contour of the labial surface of the mucosa: position must be in harmony with the adjacent and contra-lateral tooth; grossly under-contoured, slightly under-contoured, no deviation, slightly over-contoured, grossly over-contoured (42)

9. Color and surface of the labial mucosa: position must be in harmony with the adjacent and contra-lateral tooth; gross mismatch, slight mismatch, no mismatch (42)

A study found that there was a high to moderate correlation between the ICAI and PES but these indices did not correlate with the CDA since it only evaluates the prosthetic component. It was suggested that the soft tissue around the implant restoration is the major concern and that the ICAI and the PES measures similar factors. (41, 45, 46) There was low or no correlation between objective indices such as the ICAI, PES and CDA and patients' perception of esthetics. It was suggested that these indices are too detailed and do not reflect a patients subjective views on appearance. (41)

Belser and colleagues developed the **combined White Esthetic Score (WES) and Pink Esthetic Score (PES)** (Figures 6 and 7) to objectively evaluate implant-supported restorations based on 5 criteria (Figure 2). The authors combined a simplified 5 criteria PES with the WES to evaluate anterior implant supported restorations. (10) An arbitrary score of 6 was set to represent the minimum WES required for clinical acceptance (10) and a minimum PES was set at 8. (4) Positive correlations between PES and patient satisfaction determined on a visual analog scale have been reported. (16, 17) However, some studies have reported poor to moderate correlation between PES/WES with patient satisfaction determined on the same scale. (4) There seems to be emerging

evidence supporting the reproducibility of the PES and correlation with patient satisfaction(15-18) but similar evidence for the WES is scarce. The PES has been shown to have moderate to substantial intra-examiner agreement and fair to moderate inter-examiner agreement. However, there are differences in scoring between specialty clinicians. (4, 15) The WES has been shown to have fair to substantial intra-examiner and inter-examiner agreement.(4) Due to its ease of use and its relatively good reproducibility, the combined PES/WES is perhaps the most widely used esthetic index to evaluate anterior implant restorations. Further research to improve this index is necessary so that it can be more reproducible and importantly, better predict patient satisfaction.

Figure 6: Combined Pink Esthetic Score and White Esthetic Score

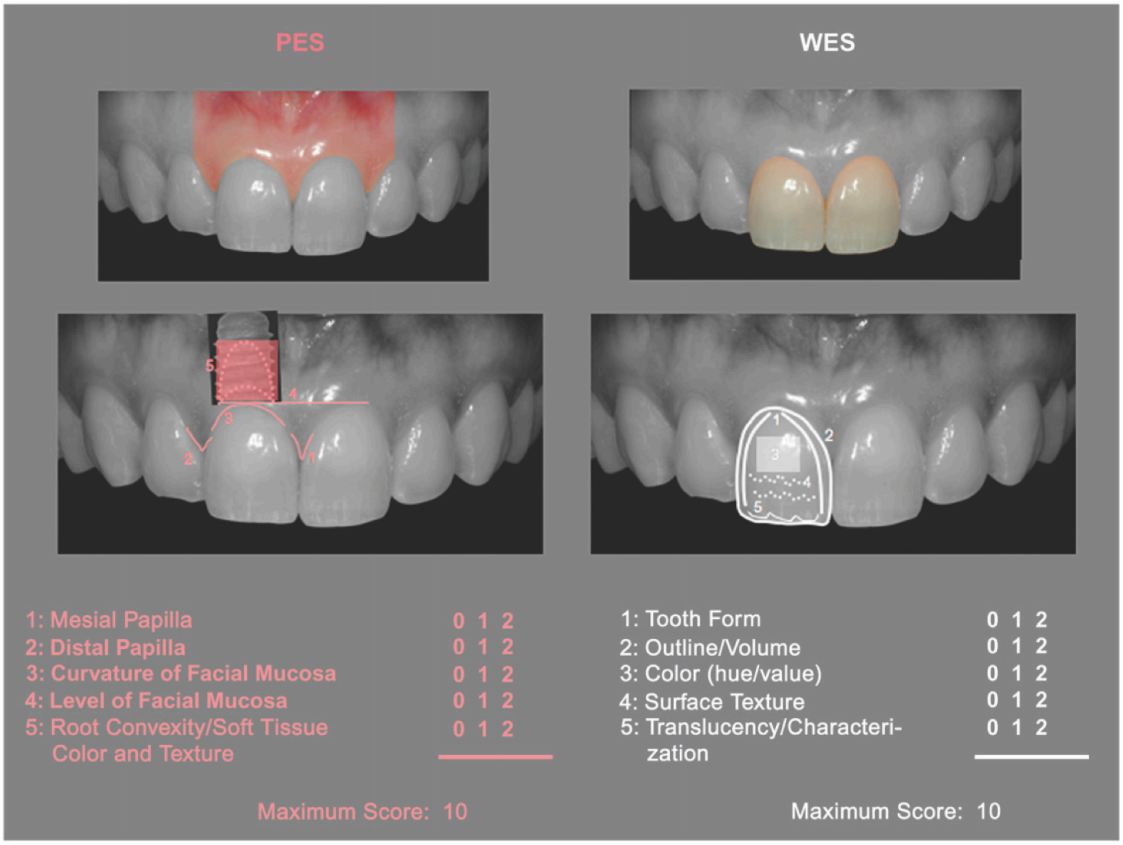


Figure 7: Scoring criteria for esthetic factor in PES/WES

PES			
Parameter	Absent	Incomplete	Complete
Mesial papilla	0	1	2
Distal papilla	0	1	2
	Major Discrepancy	Minor Discrepancy	No Discrepancy
Curvature of facial mucosa	0	1	2
Level of facial mucosa	0	1	2
Root convexity/soft tissue color and texture	0	1	2
Maximum total PES score			10
WES			
Parameter	Major Discrepancy	Minor Discrepancy	No Discrepancy
Tooth form	0	1	2
Tooth volume/outline	0	1	2
Color (hue/value)	0	1	2
Surface texture	0	1	2
Translucency	0	1	2
Maximum total WES score			10

2.6 Components of the Pink Esthetic Score

In a study that evaluated patient's "satisfaction of appearance" for implant-supported crowns, it was concluded that patients were significantly more satisfied when the smile line was average or low than if the smile line was high ($P<0.01$). This suggests that the soft tissue that frames the restoration is of significant importance. (30)

Numerous studies have examined the mesial and distal papillae adjacent to an anterior implant restoration. It is suggested that that the interproximal bone of the natural teeth beside the implant site supports the papillae. (47, 48) The mesial and distal papillae height changes at 12 months after immediate implant placement were determined to be –0.55 ± 0.53 mm and –0.39 ± 0.40 mm respectively. The bone loss were –0.26 ± 0.40 mm mesially and –0.22 ± 0.28 mm distally. (49) A study that used photographic examination of single-tooth implant restorations found that over a period of 1 to 9 years, 75% of patients had complete papilla fill. For 83.9% of the implants, there was regeneration of the papillae and the rate was at 0.65 mm mesially and 0.62 mm distally. (50)

The literature has described 2 tissue biotypes: thin scalloped or thick flat. (51) The thick flat biotype is more dense and fibrotic and the underlying osseous structure is flat. There is usually a wider band of attached gingival tissue that reacts to trauma by forming periodontal pockets. The distance between the

gingival margin and the interproximal soft tissue is usually less. On the other hand, the thin scalloped biotype is friable and delicate and the osseous structure is often fenestrated. A thinner band of attached gingiva is associated which reacts to trauma by recession. A 1-year prospective study looking at anterior maxillary single tooth implants determined that the mean coronal bone level change at 6 and 12 months were 0.45mm and 0.75 respectively. (52) The theory that the soft tissue generally follows the underlying bone is confirmed in another study evaluating implant restorations in the esthetic zone. The soft tissue shrinkage at the mid facial aspect of the implant crowns was on average 0.6mm at 1 year. (53) Another prospective study investigating 63 implants over 1 year determined that the 80% of all sites had around 1mm of recession on the buccal aspect. The majority of the recession was found to happen in the first 3 months. (54) A study that analyzed 106 implants in 39 patients found that there was 1mm of soft tissue recession at the buccal aspect in 61% of the 106 implants but in 19% of the sites, there was 1mm or more of soft tissue gain. The study concluded that there could be significant soft tissue changes after restorations have been delivered. (55)

The contour of the soft tissue margin has also been addressed in the literature. One report focused on the parameters that would preserve or create the optimum soft tissue esthetics around an implant restoration. The study concluded that tapered implants allow immediate implant placement, which help preserve the osseous structure and surrounding soft tissues. The use of a

custom healing abutment or an immediate provisional can help shape or preserve the gingival architecture and papillae. (56) A group looking at gingival zeniths on natural teeth measured 240 anterior sites. They found that in a 100% of central incisors, the gingival zenith is located distal to the vertical bisecting line. The average distance between the location of the zenith and this vertical midline is 1mm for a central incisor. Sixty five percent of the lateral incisors had zeniths located distal to the tooth midline with an average distance of 0.4mm. In 35% of the lateral incisors, the zenith was located concurrent with the tooth midline. In 97.5% of canines that the researchers evaluated, the gingival zenith was located at the tooth midline. (57)

Many studies have reported on the horizontal bone loss after tooth extraction. This is an area of interest because advanced buccal resorption can prevent implant placement. Buccal bone may be preserved by socket preservation or rebuilt by guided bone regeneration using different membranes and bone substitutes. However, the alveolar process, or the horizontal bone and soft tissue thickness at the implant site, may also be a factor in determining esthetics. A recent systematic review that included 20 studies looked at the dimensional changes of the alveolar process in humans after tooth extraction. It concluded that in 6 months, the horizontal dimensional reduction in hard tissue is 3.79 ± 0.23 mm and the vertical dimension reduction is 1.24 ± 0.11 mm. 32% of the horizontal bone loss occurred in 3 months and up to 63% occurred in 6 months. The combined hard and soft tissue horizontal dimensional change at 12

months was 0.1-6.1mm. (58) Another study analyzed CBCT scans of 21 patients who had immediate implant placement. The results revealed that the horizontal facial bone thickness changes were -1.23 to 0.08mm at 7 different points along the implant site. The area with the most horizontal dimension change was at the level of implant platform. (59) A clinical study compared different socket preservation techniques and spontaneous healing reported that there were no statistically differences in horizontal contour changes after 6 months. Preservation of the socket with demineralized bovine bone material alone or combined with a collagen matrix or autogenous soft tissue punch graft resulted in dimension changes of 1.2mm ± 0.7 mm to -1.7mm ± 0.7 mm. This was not statistically different than spontaneous healing which resulted in dimensional change of -1.8 ± 0.8 mm. (60) A prospective study over 5 years focused on guided bone regeneration at the same time of implant placement. The survival rate of the implants with concurrent bone augmentation was 93% compared to 97% survival rate of the control group. The authors concluded that bone resorption was more pronounced in guided bone regeneration sites (61)

A 10-year retrospective clinical study recommended that flapless surgery was a predictable procedure in the properly selected patient because it resulted in similar implant survival rates and decreased bone resorption. (62)

In recent years, there has been more focus on the abutment material because it may influence the peri-implant gingival shade, however a systematic reviews reported that the current available literature on soft tissue color is of poor quality. (63)The color of soft tissue has been objectively determined by

colorimetric or spectrophotometric analysis similar to the evaluation of tooth shades. (63, 64) Instruments use the Commission Internationale de L'éclairage (CIELAB) color scale where the “L” value denotes black/white, the “a” value denotes red/green and the “b” value denotes yellow/blue. When comparing 2 different colors, ΔE is calculated using the equation:

$$\Delta E = [\ (\Delta L)^2 + (\Delta a)^2 + (\Delta b)^2\ ]^{1/2}.$$ (65, 66)

There is belief that all-ceramic restorations may have esthetic advantages on the surrounding soft tissue. (67, 68) The peri-implant soft tissue shade is reported to be more natural when the abutment material is all-ceramic rather than metal. (69, 70) The use of pink colored abutment and implant head has also been described. (71) Despite the use of zirconia, gold-hue, pink-colored or titanium abutments, the soft tissue color around an implant restoration was found to be significantly different than the tissue around a natural tooth. (72) Another study confirmed this finding and found that the soft tissue around titanium abutments had a ΔE = 11 ± 0.4 when compared to the contralateral natural tooth. ΔE was found to be 8.9 ± 0.4 for gold-hue abutments and 8.5 ± 0.4 for zirconia abutments. Interestingly, they found no correlation between soft tissue color change and soft tissue thickness. (70) Dental professionals concluded that a perfect match of soft tissue color is any site with a ΔE less than 6.63. Good matching was determined to be a ΔE of 8.54 and poor matching was found to be anything greater than 15.54. The study found that the threshold for acceptability was ΔE = 8.74. (73)

There are currently no studies on the soft tissue texture around dental implants. No studies have described the amount of scarring that occurs after implant surgeries. One study concluded that implants with a band of keratinized mucosa less than 2 mm is associated with higher Gingival Index Score, Plaque Index score, radiographic bone loss and bleeding on probing. (74) The literature is currently still unclear as to whether a wider band of keratinized tissue around an implant creates a more stable esthetic situation. (75) However, it is suggested that keratinized mucosa around an implant restoration allows for easier manipulation and shaping with the implant restoration. (76)

2.7 **Components of the White Esthetic score**

The implant restoration replaces the clinical crown and is ultimately what a patient desires. It seems likely that esthetic factors in the White Esthetic Score should influence patient satisfaction scores. A study reported that 76% of the variance of “overall satisfaction with appearance” of anterior implant restorations could be explained by 4 esthetic factors: surrounding soft tissue appearance, form of the crown, contact point position and color of the incisal half of the crown. (30) A study comparing implant restorations in the esthetic zone to a natural contralateral tooth concluded that implant crowns were generally longer, smaller in the facial-lingual dimension, had thicker facial mucosa and smaller distal papilla, had a higher incidence of bleeding on probing and mucositis. The study also found that patients were generally, satisfied with an average satisfaction rating of 95% despite the differences between an implant restoration and the contralateral natural tooth. (77) Unlike the previous mentioned study, these authors concluded that the difference between implant restoration and natural teeth is of minor importance for the patient’s esthetic outcome and satisfaction. Another study concurs with this suggestion after it found that there was little agreement between the factors within the PES/WES and overall patient satisfaction. Since the PES/WES studies are based on the contralateral tooth, a high score could be given to a restoration that resembled closely to an unaesthetic natural tooth. (78)

The literature has described different crown forms associated with different tissue biotypes. A more square-shaped dentition with more bulbous

convexities in the cervical region is associated with the thick flap tissue biotype. On the other hand, a more triangular crown form with less bulbous convexities is associated with the thin scalloped biotype. (51) After a tooth is extracted and an implant is placed, there is often some loss in papilla height. To eliminate “black triangles,” clinicians often widen the restoration in the interproximal areas by creating a crown form that is more square. There is currently no research that supports this clinical decision as it is unclear which results in higher patient satisfaction. There is also no evidence that suggest patients can perceive or care about the difference in crown form.

Crown color is an esthetic factor that has the most research on both dentists’ and patients’ perception. Many researchers have tried to determine the ΔE required for acceptability and perceptibility. One in vivo study concluded that a ΔE of 3.7 is the average color difference between natural teeth considered a good match in the oral environment. A ΔE of 6.8 was the average value when comparing natural teeth that were considered a mismatch in color. (79) An in-vitro studies looking at dental porcelain determined that when 2 samples had a ΔE of 1, 50% of the observers could perceive a color difference where as 100% of the observers could see a color difference if the ΔE is 2. (80) Another study suggested that acceptable metal-ceramic crowns should have a ΔE of less than 1.7 as determined by prosthodontists. (81) More recent clinical studies on patients found that the thresholds for perceptibility is ΔE = 2.6 and acceptability is a ΔE = 5.5. (82, 83) These thresholds are the ΔE values required to have 50% of the population perceive a color difference and have 50% of the population accept

the color difference. The study predicted that, 95% of observers can perceive a color difference when ΔE = 4.9 and 95% of observers will not accept a ΔE = 7.0. (82) Studies have also reported that color and translucency is highly subjective. Surface texture, different lighting, and an observer's previous eye experience are some factors that influence color perception. (79)

While there are some studies on crown color, there is very little research on dentist's perceptions of crown form, crown volume/outline, surface translucency and surface texture. There is even less literature about the patients perception of these esthetic factors. One study found that crown form and crown color explained some of the variance in overall satisfaction with appearance but these factors were not found to be statistically significant in influencing appearance satisfaction. (30) There is some evidence that age, gender and crown shade were factors that had the most influence with satisfaction scores (84, 85) while another study found that none of the mentioned factors had a significant effect on patient satisfaction scores. (30) However, the authors discovered that crown form, contact-point position, topography of surrounding soft tissues influenced a clinician's satisfaction score. Dental professionals appear to be more aware of these factors when determining satisfaction while patients have less concern for them. (30)

2.8 **Limitations of the PES/WES**

Conventional criteria for implant success and survival is not sufficient to evaluate anterior implant restorations. The evaluation of an anterior implant restoration should include both the surrounding soft tissue and the prosthesis itself. (10, 42) Currently there are 2 comprehensive esthetic indices, the ICAI and the PES/WES, which incorporate both of these areas. (10, 42) Of the 2, the PES/WES by Belser et al. is more widely used and warranted further research and refinement. An arbitrary score of 6 was set to represent the minimum WES required for clinical acceptance (10) and a minimum PES was set at 8.(4, 5) However, it is uncertain how these minimum thresholds are related to patient satisfaction and acceptance. The current PES/WES and other indices as used by clinicians and researchers do not accurately predict patient satisfaction.(4) Correlations between PES and patient satisfaction determined on a visual analog scale have been reported.(16, 17) However, some studies have reported poor to moderate correlation between PES/WES and patient satisfaction.(4) Neither the California Dental Association recommended esthetic index, the PES, nor the ICAI have been found to accurately capture both the objective and subjective perception of esthetic outcomes. (41) Patient satisfaction scores were usually higher than professional ratings, which suggest that these 2 groups have different perceptions about which esthetic factor contribute to overall esthetic satisfaction. (41) This is a problem because patient satisfaction of esthetics is an increasingly important criterion in implant dentistry. Ultimately, the patient is the

person getting the restoration and not the dentist. Therefore, both patient and the dentist should be satisfied with the esthetic outcome. A second issue with the current PES/WES is that the scoring is highly subjective. A score 0 is an “obvious difference” while a score 1 is a “moderate difference.” However, every dentist will have a different interpretation of what an obvious or moderate difference is.

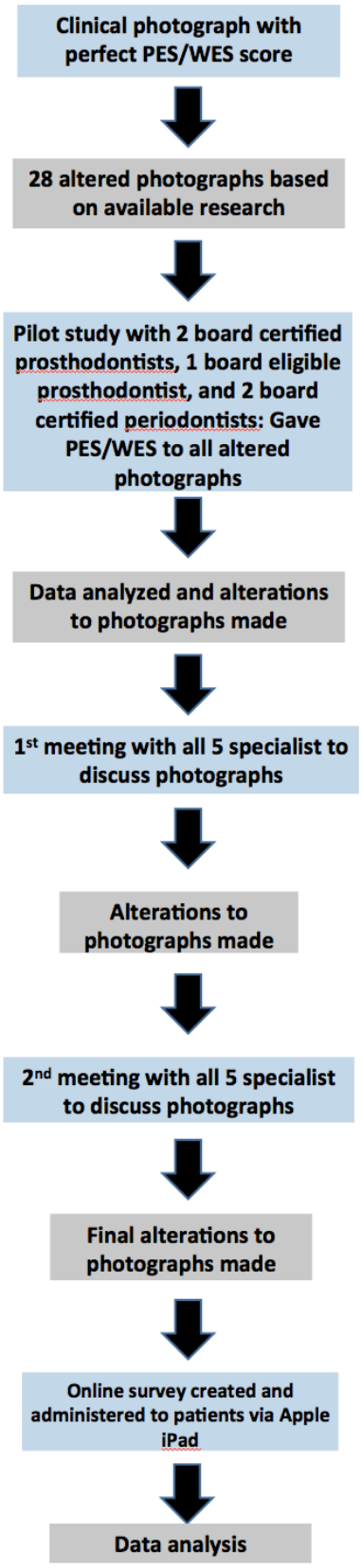
A useful and powerful esthetic index can greatly improve patient care as perceived by patients and dentists. Currently, there is an abundant amount of research in the area of implant dentistry. Unfortunately, systematic reviews often are unable to amalgamate data and provide definitive conclusions that can aid clinicians. This is largely because many dental studies use different criteria to evaluate outcomes, especially esthetic outcomes. (8, 9) There is an urgent need for a standardized index to evaluate esthetic outcomes so that we can compile data and make meaningful conclusions in implant dentistry. This index should correlate well with patient satisfaction and can predict patient acceptance.

3. METHODOLOGY

3.1 Study Design

A survey containing 29 digitally altered photographs of anterior implant supported restorations were given to patients on iPads or delivered in a web-based format (Figure 8). The photographs are digitally altered to varying scores for each of the criteria in the PES and WES. Patients were asked to report their satisfaction of the photographs on a 100mm visual analog scale, as well as perceptibility and acceptability. Data from the iPad group and the web-based group were compared. The relationship between objective scores (PES/WES) for each of the esthetic factors and the subjective scores (patient satisfaction) were also determined. The effect of each esthetic factor on satisfaction scores was determined from the data. Statistical significance is defined as $p < 0.05$. The experimental protocol was approved by the University of Illinois at Chicago Institutional Review Board office (IRB #2012-0396).

Figure 8: Research design flow chart



3.2 Materials and Methods

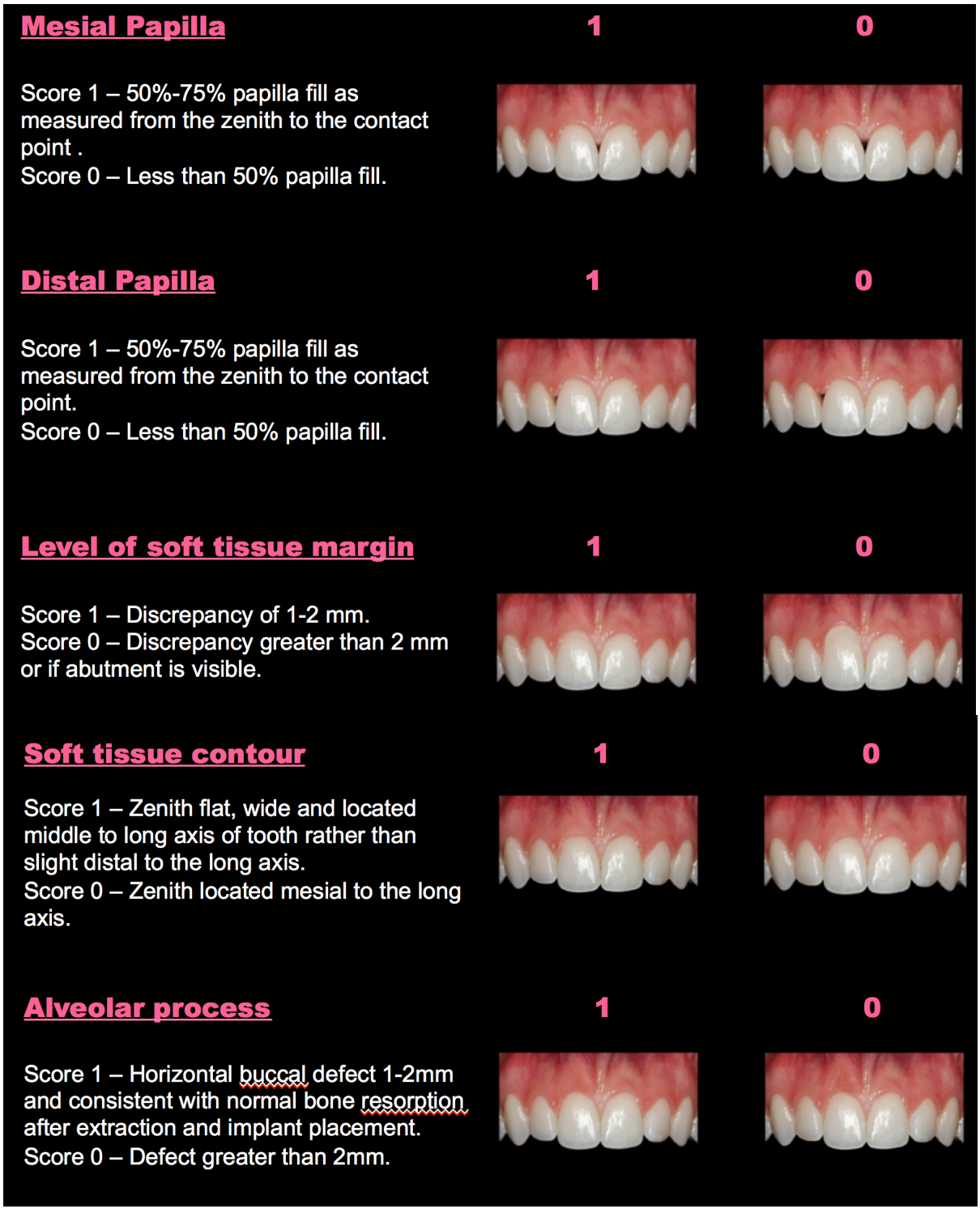
Photograph preparation

A total of 29 photographs of the maxillary anterior 6 teeth were used in this survey study (Figure 9). One photograph in the series had an ideal PES/WES. The subsequent 28 photographs were digitally altered versions of the initial ideal scoring photograph similar to the previous studies of altered dental esthetics. (25, 86) An independent biomedical illustrator performed the alteration under the guidance of the authors. Twenty-eight of these photographs had one PES/WES criteria digitally altered to represent scores 1 and 0 for that particular criterion (Figures 4 and 5). The degree of alteration for some criteria was based upon previous research on noticeable thresholds. (25) Criteria that had no previous research on noticeable thresholds were altered enough to be clinically relevant as determined by a group of 5 prosthodontists and periodontists. The intended scores for each photograph were verified in a pilot study. More objective scoring criteria were developed (Figure 9). There are 7 esthetic factors in the original PES and these factors were unchanged in the current study. However, some changes were made to the original 5 esthetic factors in the WES. Tooth form was expanded to 2 criteria: when the tooth appears too wide or too narrow. The original tooth color factor involved hue and value. In the modified version, tooth color involved hue and chroma. The original translucency factor has also been expanded to 2 new factors: when the restoration appears too translucent, or too low in value, or when the restoration appears too opaque or too high in value.

Since, translucency and value influence each other and one cannot be altered without changing the other.(5)

All photographs were altered using a software program (Adobe Photoshop 5.0.2; Adobe Systems Inc, San Jose, CA) by an independent biomedical illustrator. The researchers had frequent meetings with the illustrator to ensure the photographic alterations met the intent and purpose of the study. Sample photographs were also used to communicate with the illustrator. All 29 photographs were then presented to patients in a randomized order so they are not grouped by criteria. The photographs were in a 1:1 size ratio to simulate how patients view anterior implant supported restorations in real life. For this study, the lips and face were not included in the photographs.(5)

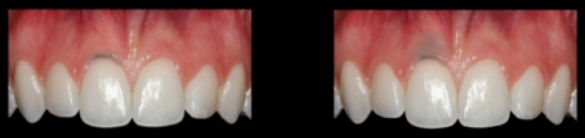
Figure 9: Standardized set of 29 altered photographs



Soft tissue color

1 0

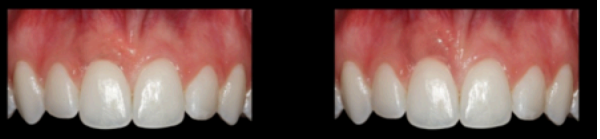
Score 1 – Grey discoloration limited to the gingival margin area.
Score 0 – Discoloration extending apically to the mucosa.



Soft tissue texture

1 0

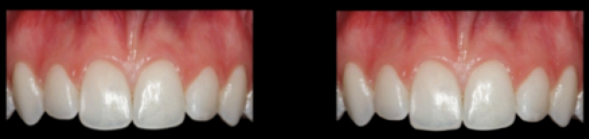
Score 1 – Slight scaring or hyperplastic tissue consistent with normal flap elevation.
Score 0 – White or red fibrotic tissue consistent with extensive periodontal procedures.



Tooth Form - Wide

1 0

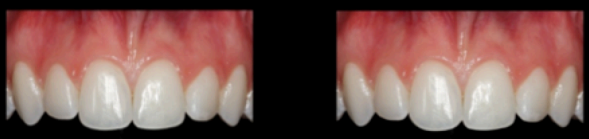
Score 1 – Line angles are located too far to the periphery.
Score 0 – Line angles are incorrect and incisal edge is too straight.



Tooth Form – Narrow

1 0

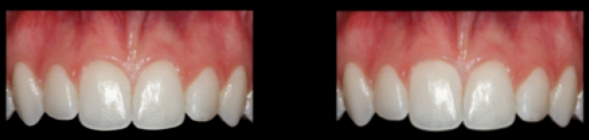
Score 1 – Line angles are located too proximally.
Score 0 – Line angles are incorrect and incisal edge is too rounded.



Tooth outline/volume

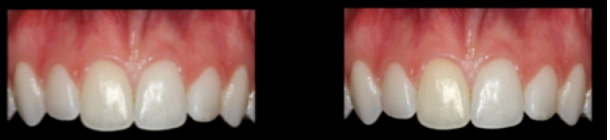
1 0

Score 1 – Tooth volume required to eliminate black triangles if there was only a 50-75% papilla fill.
Score 0 – Volume required to eliminate black triangles if there was less than 50% papilla fill.



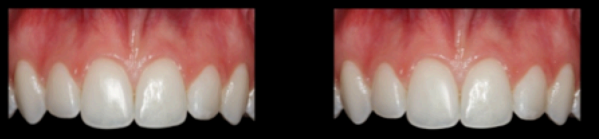
Tooth color (hue and chroma) 1 0

Score 1 – A discrepancy in the b value (CIELAB color system) by 4.9-7.0.
Score 0 – A discrepancy in the b value greater than 7.0.



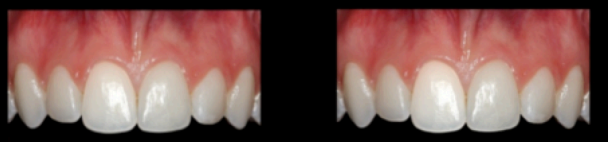
Tooth surface texture 1 0

Score 1 – Slight discrepancy in texture, gloss, stains and characterization.
Score 0 – Major discrepancy in texture, gloss, stains and characterization.



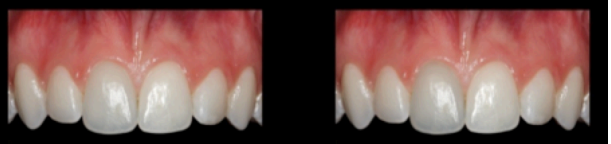
Tooth translucency low/value high 1 0

Score 1 – A discrepancy in the l value (CIELAB color system) by 4.9-7.0 in the positive direction.
Score 0 – A discrepancy in the l value greater than 7.0 in the positive direction.



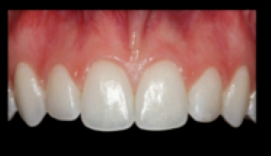
Tooth translucency high/value low 1 0

Score 1 – A discrepancy in the l value (CIELAB color system) by 4.9-7.0 in the negative direction.
Score 0 – A discrepancy in the l value greater than 7.0 in the negative direction.



Ideal 2

This photograph shows an implant restoration at #8 that would score 2 in every factor in the PES and WES.



Pilot study

The pilot study determined whether the altered photographs actually depicted the intended criteria scores. If the desired scores were not obtained, the degree of alteration was increased or decreased accordingly.(5)

The altered photographs were shown to 2 board certified prosthodontists, 2 board certified periodontists and 1 board eligible prosthodontist at University of Illinois at Chicago, College of Dentistry. Each specialist was asked independently to give a PES and WES for each of the 29 photographs. The results were analyzed and if 4 or 5 specialists agreed, no further modifications were made to the photographs. For example, if 4 or more specialists gave a score of 1 for the photograph that represented a score of 1 for tooth color, then no additional changes were made to that photograph. A meeting with all 5 specialists and the researchers for this study was arranged to discuss the photos that had agreement from only 3 or less specialists. Once all 5 specialists agreed upon the necessary modifications needed to represent the intended scores, the photos were further modified. A second meeting was arranged to confirm all 5 specialists had a consensus that all photos were clear representations of each of the esthetic factors.

Study population

Inclusion criteria for this study were that subjects must be 18 years or older to provide informed consent, and understand English. Exclusion criteria were those with known colorblindness, unwilling to participate on the colorblind test or did not pass the colorblind test. Colorblind individuals were identified in this study by a simple Ishihara test at the beginning of the survey. A total of 4 Ishihara plates were used and survey participants were deemed not colorblind only if they were able to see all 4 numbers in the plates. Demographic data regarding year of birth, gender, education level, income level, ethnicity and occupation were obtained from all participants (Figure 6). Income level categories were based on the current federally marked poverty level of $11,170 for a family of 1.(5)

There were 2 methods of distribution for the survey and hence 2 study populations. One group of participants took the survey on an electronic tablet available to dentists and patients receiving dental care at the UIC COD in the Advanced Prosthodontics Clinic and the Implant and Innovations Center. Both clinics had uniform fluorescent lighting and patients were completing the surveys in the dental chair. The second group of participants had access to the survey online using their own computer and in uncontrolled environments. This second group of participants were not limited to dental patients but included the general public. This second group of participants had 2 subgroups because some participants used an Apple device while others used a personal computer. A link to the survey was sent out via email through a social network (Facebook Inc,

Menlo Park, California, U.S.) and word of mouth. The web-site link was made available to the general public for a 6 months period. All participants were asked whether they were using an Apple device (Mac) or a personal computer (PC). The survey did not include a mobile version because the size of the images would not be life-size.

Survey

The survey could be accessed world wide via iPad or a home computer at the web address "uicestheticsmile.com" (Figures 10-14). An independent programmer was hired to build the web-based survey through the direction of the researchers. The website was hosted by an independent company (Netfirms Inc., Toronto, Canada) and the data were automatically stored online where it could be easily retrieved for analysis. Data were stored only when participants had completed the entire survey.

The initial page of the survey offers a description of the study, followed by a consent form. Once consent was given, the participant was shown a series of 4 Ishihara plates and was asked to select the number they can see. A page of instructions explained to participants how to complete the survey. Participants could view each photograph for a maximum of 30 seconds after which the photo would disappear. A timer that displayed the remaining time was located on the top of the screen. A pause button could be pressed to pause at any time but the screen turned to a solid 18% grey. When the survey is resumed, the timer

continued to countdown. The participants were also instructed not to zoom in to any of the photos since all the photographs were life-size with the height of the central incisor measuring 10.5mm. Life-size were used instead of enlarged images because the goal was to simulate a real life scenario. Lastly, participants were instructed to move the mark along the VAS scale to represent their satisfaction scores. The VAS scale was also used in previous studies on dental esthetics. (16, 17, 25) After the instructions page, the survey officially began. For each of the photographs, study participants were asked to answer 3 questions. The first questions asked “how satisfied would you be with the esthetic outcome of the front teeth and gums if this was your mouth?” Participants indicated their satisfaction level on a VAS from 0 (very unsatisfied) to 100 (very satisfied).(4, 10) The second question asked the participant “do you see a difference between the treated area and the rest of the teeth?” This question tested perceptibility and the possible responses were either yes or no. The third question inquired of the participants “would you accept these results if these were your teeth?” This question tested acceptability and the possible response was either yes or no. The questions were aimed to not direct the focus of the participant to any particular tooth and was intended to have the participant consider the esthetics of the entire photograph as a unit. Participants were instructed not to compare photographs and they were unable to go back to change their answers. The order of the photographs was randomized for each participant and questions regarding demographics were also interspersed throughout the survey to decrease participant fatigue. To reduce eye fatigue, there was a period of 1

second where the screen was a solid 18% reflectance grey in between every question.

Figure 10: Screen 1 of survey showing description of study

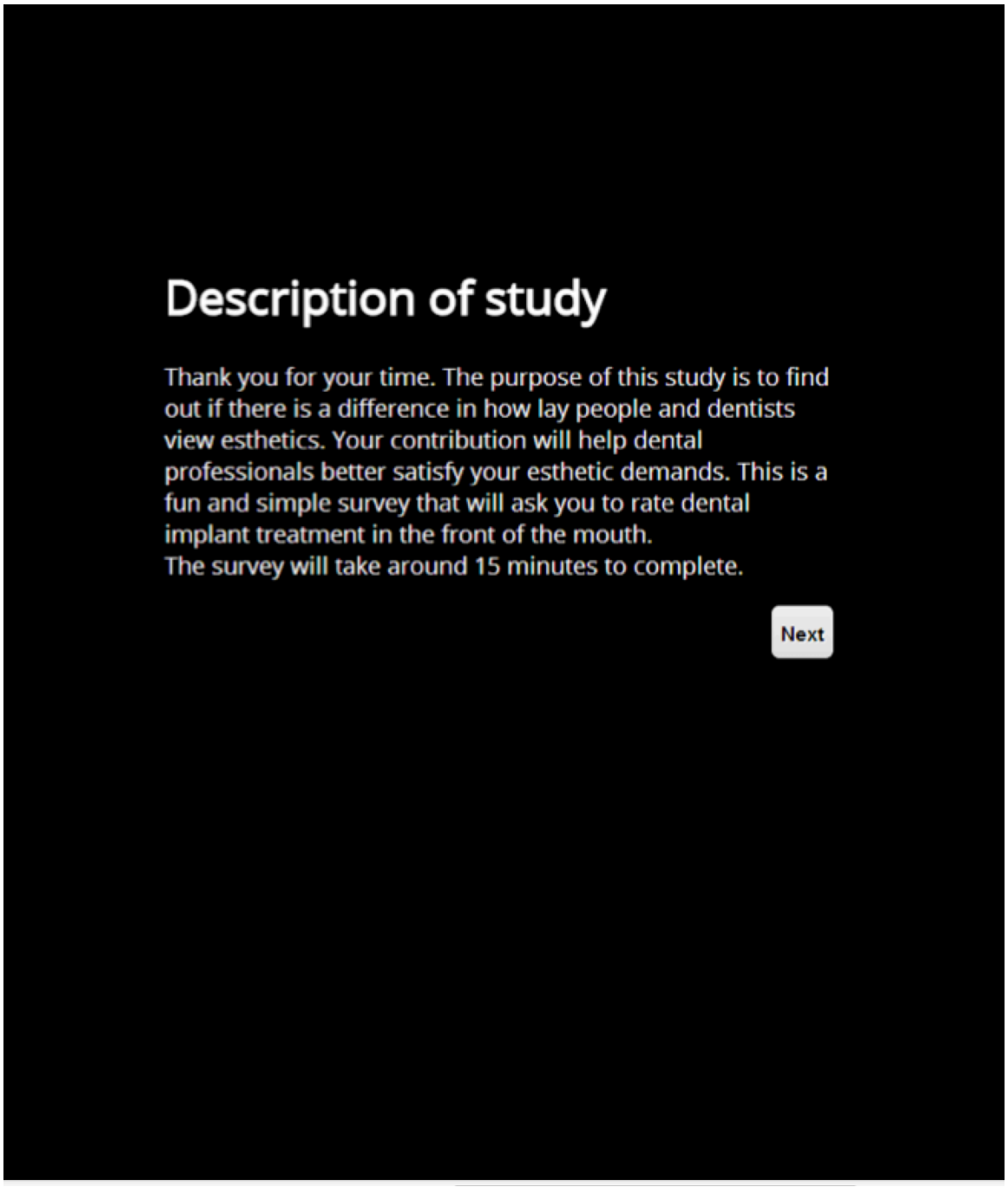


Figure 11: Screen 2 of survey showing consent form

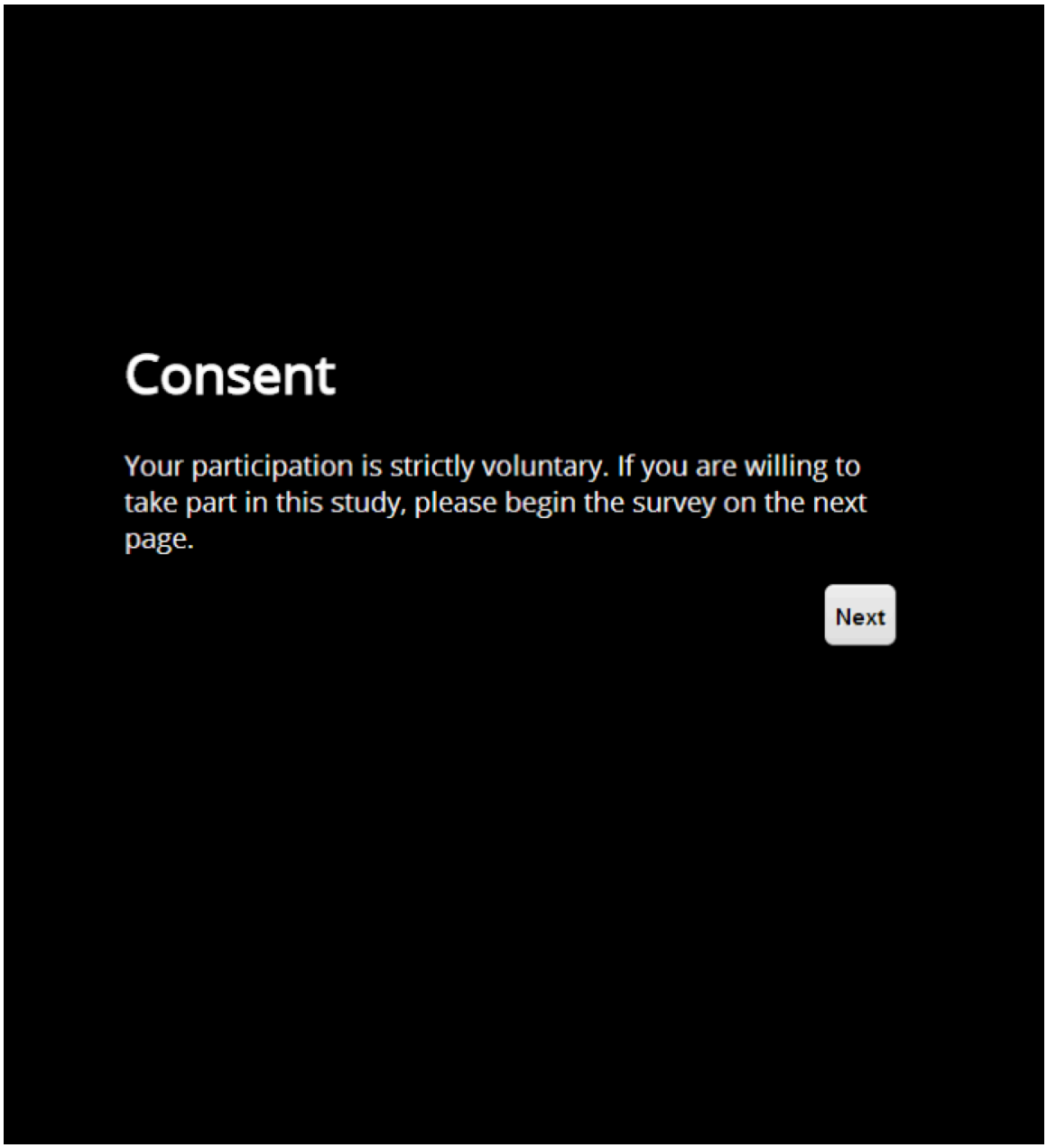


Figure 12: Screen 3 of survey showing Ishihara plates

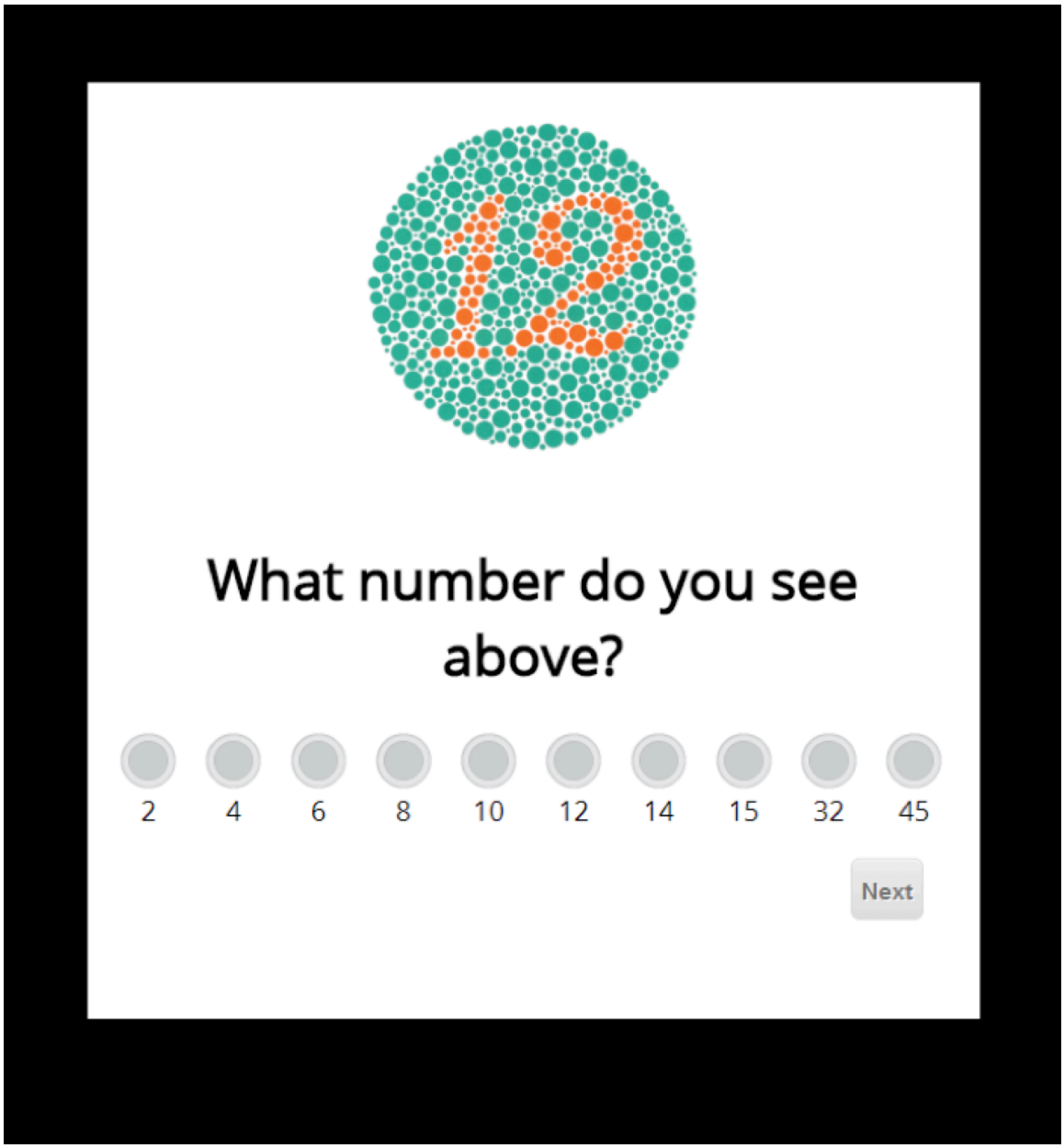


Figure 13: Screen of survey showing an altered photograph question page

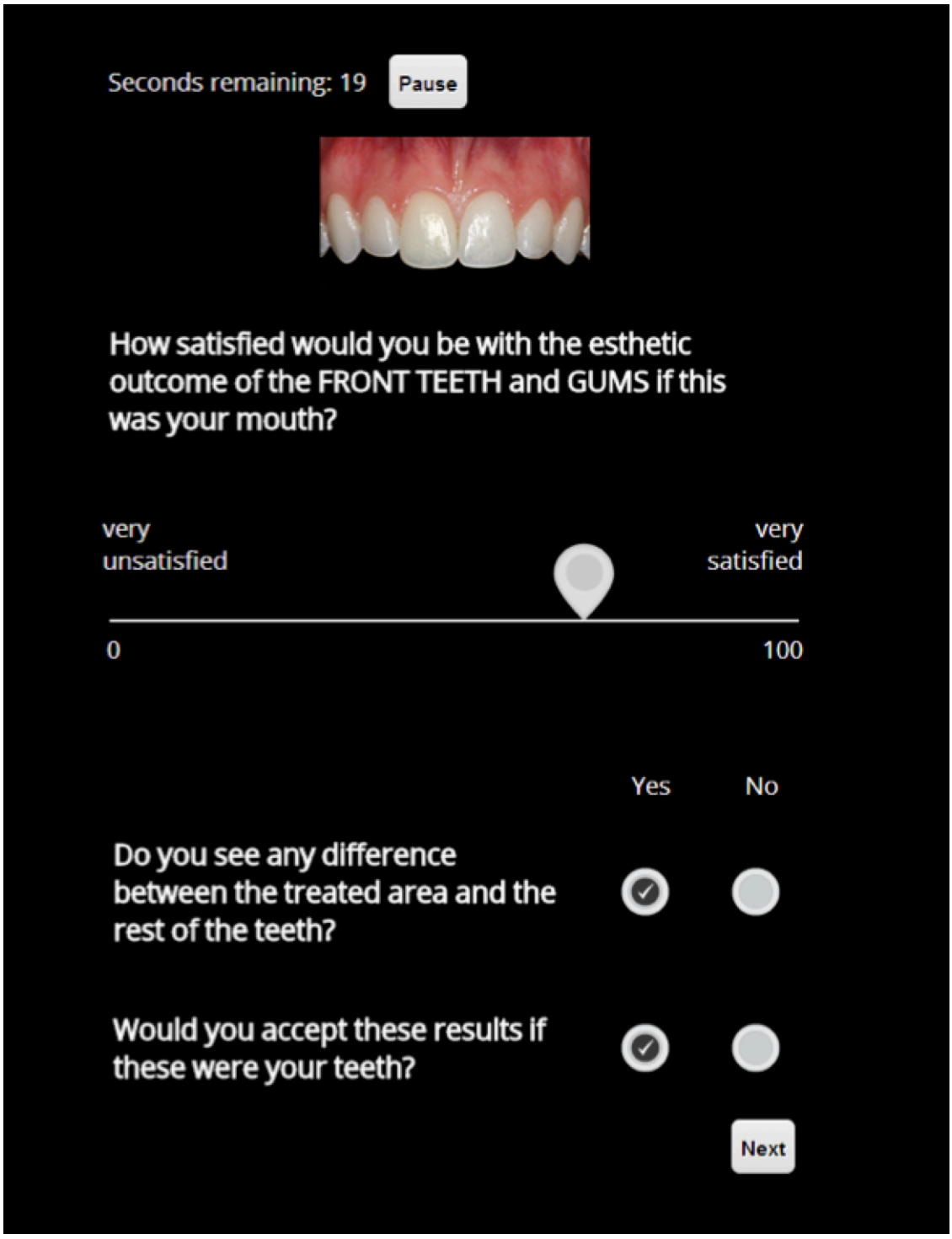
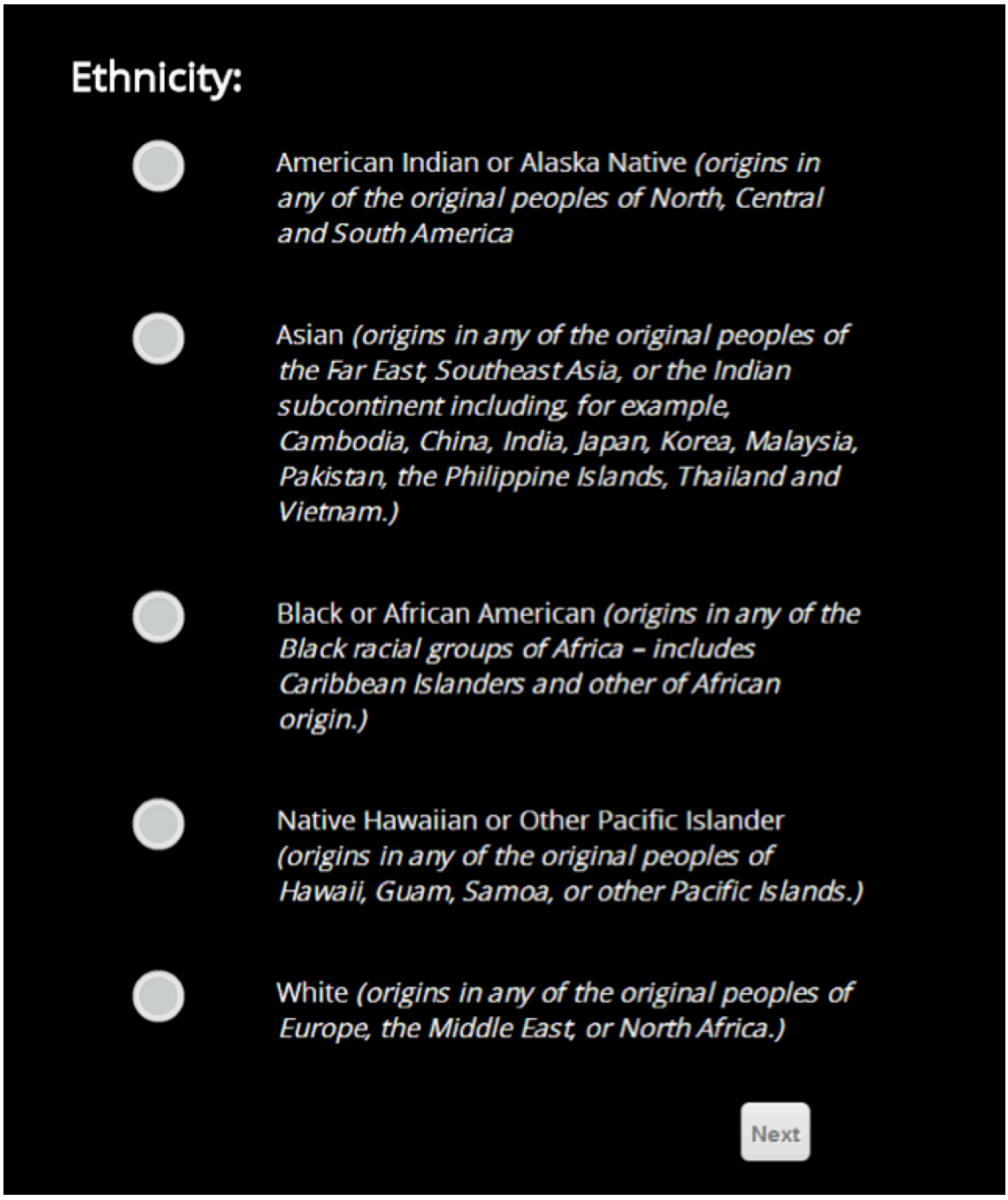


Figure 14: Screen of survey showing a demographic question



3.3 Statistical Analysis

Data were extracted and exported to a spreadsheet for data cleaning (Microsoft Excel, Redmond, Washington, USA). Descriptive analyses were performed for the demographic data using statistical software (SPSS v.20, Armonk, NY, USA).

1. An independent t-test was utilized to compare the mean satisfaction scores between UIC and non-UIC users. A similar analysis compared mean satisfaction scores between participants who took the survey on an Apple iPad or personal computer.

2. ANOVA was used to compare the mean satisfaction scores given for each of the 3 photos (score 0, score 1 and ideal photo) for each variable within the UIC patient population. Post hoc Tukey tests were used to analyze the differences within each variable.

3. Independent t-tests were used to investigate the difference in mean satisfaction scores between UIC patients and UIC dentists in rating each esthetic factor. For perceptibility and acceptability ratings between dentists and patients, chi-squared tests or Fisher's exact tests were used when appropriate. Statistical significance is defined as $p < 0.05$.

4. RESULTS

A total of 204 participants took the electronic survey. Six participants (5 male and 1 female) were deemed colorblind because they were unable to identify all 4 Ishihara plates correctly and were not included in the initial analysis. Out of the 198 participants remaining, 153 took the survey on an Apple iPad and 45 used a personal computer. Fifty six participants were from UIC and all used an Apple iPad. An initial analysis was performed on the group of participants who were not at UIC. A comparison of mean satisfaction scores between the participants who used a PC to view the survey and those who used an Apple device revealed that there was a significant difference ($p < 0.0001$) (Table I). This suggested that the type of electronic display might be a confounding factor in determining patient satisfaction. Since the 2 subgroups of PC and Apple users had different demographics, it is uncertain whether this difference in means satisfaction scores was truly due to the monitor type or other demographic factors such as gender or age. Further analysis of this non-UIC population will be performed in the future but is not included in this current study. A similar comparison of mean satisfaction scores between participants who were at UIC and those who were not at UIC also revealed a significant difference ($p < 0.0001$) (Table II). This suggested that these 2 populations are not homogenous and data from these 2 groups should be analyzed separately. Further analysis was performed on only participants from UIC, which consisted of 56 participants. Although this sample size is much less than the initial group of 204, it is a larger sample size than previous similar studies, which usually consisted of 30 samples.

The 56 participants all took the survey in a controlled environment, had the same set of instructions, and all used an Apple iPad device. The demographic data for age, gender, education, ethnicity, income, occupation and prior history of implant treatment are shown in Tables III-IX, respectively.

Within the 56 UIC participants, there was a statistically significant difference in satisfaction scores between the 29 photographs ($p < 0.0001$) (Table X). This meant the 29 photos prompted different satisfaction scores. Out of the 56 participants, 33 of them were patients and 23 were dental professionals. Further analysis was performed separately for the dentist and patient groups.

Within the patient group, only 9 out of the 14 esthetic factors had a statistically significant difference ($p < 0.05$) in satisfaction scores between the score 0, 1 and ideal photos (Table XI). Alveolar process, tooth surface texture, tooth form wide, soft tissue contour and soft tissue texture were the 5 esthetic factors that did not show statistically significant difference in satisfactions scores between the score 0, 1 and ideal photos (Appendix A). This suggested that these 5 factors had no effect on patient satisfaction scores. Appendix B shows in red, the 9 esthetic factors that had significant differences ($p < 0.05$) in satisfaction scores when comparing the score 0, score 1 and ideal photos for each esthetic factors. In the patient group, tooth color was the only factor where satisfaction scores for 0, 1 and ideal were all significantly different to each other ($p < 0.05$) (Appendix B). Tooth translucency/value low, tooth translucency/value high, mesial papilla, distal papilla, tooth form narrow, tooth outline volume, soft tissue

margin and soft tissue color were the 8 esthetic factors that had significant difference ($p < 0.05$) in satisfaction scores between a photo and the 2 other scoring photos (Appendix B). In the 9 esthetic factors that had an effect on patient satisfaction, satisfaction scores decreased as the esthetic factors became more deficient.

Within the dentist group, analysis was performed to investigate if there were any significant differences in satisfaction scores between the 3 photos for each esthetic factor. For dentists, all 14 esthetic factors with the exception of alveolar process had a statistically significant difference ($p < 0.05$) (Table XI). This suggested that any deficiencies in the alveolar process factor did have an effect on dentist satisfaction.

The mean satisfaction scores of the 29 photos for dentists and patients are shown in Appendix C. When comparing dentists' and patients' satisfaction scores, 8 photos were significantly different ($p < 0.05$) between the 2 groups (Appendix D). The mean satisfaction scores that are statistically different between dentists and patients are shown in red (Appendix E). They were tooth color 1, tooth translucency/value high 0, tooth form narrow 0, tooth form wide 0, tooth outline form 0 and 1, soft tissue contour 0 and soft tissue texture 1 ($p < 0.05$). Patient satisfaction scores were higher than dentist scores in all 8 photos.

When comparing dentists' and patients' perceptibility, 12 photos were significantly different ($p < 0.05$) between the 2 groups (Appendix F). They were

tooth color 1, tooth translucency/value low 1, alveolar process 1, tooth surface texture 1, tooth form narrow 0, tooth form wide 0, tooth outline volume 1, soft tissue contour 0 and 1, soft tissue margin 1, and soft tissue texture 0 and 1 ($p < 0.05$).

When comparing dentists' and patients' acceptability, 6 photos were significantly different between the 2 groups (Appendix G). They were tooth color 1, tooth translucency/value high 0, tooth surface texture 0, tooth form narrow 0, tooth form wide 0, and tooth outline volume 0 ($p < 0.05$).

Table I: Different in satisfaction scores between PC users and Apple users

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Satisfaction	Equal variances assumed	8.934	.003	-7.969	5740	.000	-8.0144	1.0057	-9.9861	-6.0428
	Equal variances not assumed			-8.133	2196.823	0.000	-8.0144	.9854	-9.9469	-6.0820

Table II: Difference in satisfaction scores between UIC participants and non-UIC participants

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Satisfaction	Equal variances assumed	.022	.882	10.493	5740	.000	9.2143	.8781	7.4929	10.9357
	Equal variances not assumed			10.487	4165.685	.000	9.2143	.8786	7.4918	10.9369

Table III: Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	18-29	19	33.9	33.9	33.9
	30-50	17	30.4	30.4	64.3
	50+	20	35.7	35.7	100.0
	Total	56	100.0	100.0	

Table IV: Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	21	37.5	37.5	37.5
	Female	35	62.5	62.5	100.0
	Total	56	100.0	100.0	

Table V: Education

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than high school	1	1.8	1.8	1.8
	High school	18	32.1	32.1	33.9
	Bachelor's degree	13	23.2	23.2	57.1
	Master's degree	7	12.5	12.5	69.6
	Doctorate	17	30.4	30.4	100.0
	Total	56	100.0	100.0	

Table VI: Ethnicity

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	American Indian or Alaska Native	3	5.4	5.4	5.4
	Asian	11	19.6	19.6	25.0
	Black or African American	8	14.3	14.3	39.3
	White	34	60.7	60.7	100.0
	Total	56	100.0	100.0	

Table VII: Income

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	<$5,499	10	17.9	17.9	17.9
	$5,500-$10,999	2	3.6	3.6	21.4
	$11,000-$21,999	6	10.7	10.7	32.1
	$22,000-$44,999	14	25.0	25.0	57.1
	$45,000-$89,999	12	21.4	21.4	78.6
	>$90,000	12	21.4	21.4	100.0
	Total	56	100.0	100.0	

Table VIII: Occupation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Dental professionals	23	41.1	41.1	41.1
	Other	33	58.9	58.9	100.0
	Total	56	100.0	100.0	

Table IX: Prior Implant Treatment

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	13	23.2	23.2	23.2
	No	43	76.8	76.8	100.0
	Total	56	100.0	100.0	

Table X: Difference in satisfaction scores between all 29 photographs, (N = 56, dentists and patients)

Satisfaction

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	584763.967	28	20884.427	30.199	0.000
Within Groups	1103037.018	1595	691.559		
Total	1687800.985	1623			

5. DISCUSSION

5.1 Discussion

Based on the results from this study, the authors recommended some changes to the PES/WES in order to better predict patient satisfaction. A new UIC-SIU Index (USI) eliminated esthetic factors that had no effect on patient satisfaction and emphasized factors that heavily influenced patient satisfaction. While the PES/WES may be useful for determining clinician satisfaction and research documentation, the USI is designed to predict patient satisfaction and acceptance of anterior implant restorations.

The scoring of the USI is slightly different than the PES/WES. Tooth color was the only factor that had significantly different satisfaction scores between all 3 scoring photographs. This suggested that patients were most perceptive of this esthetic factor because any degree of deficiency elicited a statistically significant drop in patient satisfaction scores. Tooth color had had a dose-dependent effect on patient satisfaction scores. It can be concluded that this esthetic factor is the most important to patients and is heavily weight in the USI. Any restoration that has tooth color match similar to or better than the ideal photo should be given a score 4. Any tooth color match that is similar to or worse than the score 0 photo should be given a score of 0. Any color match that is better than the score 0 photo but worse than the ideal photo should be scored a 2 (Figure 7).

The 3 factors that had satisfaction scores decrease significantly with the score 0 and 1 photos were mesial papilla, distal papilla, and soft tissue color. This indicated that patient' were not able to tolerate any deficiencies in these factors because any photo other than the ideal resulted in a drop in satisfaction scores. This decrease in satisfaction was not statistically different between the score 0 and score 1 photo. This suggested that the degree of the deficiency is not a concern for patients. The observed effect on patient satisfaction scores appeared to be an all-or-nothing response. Since patients were unable to tolerate even slight changes in these esthetic factors, a score of 0 should be given to any restorations that are worse than the ideal photo. A score of 2 should be given if the restoration looks similar to or better than the ideal photo (Figure 7).

The 5 factors that had satisfaction scores decrease significantly with the score 0 photo only were soft tissue margin, tooth outline volume, tooth translucency high/value low, tooth narrow and tooth translucency low/value high. This suggested that patients were able to tolerate minor deficiencies in these esthetic factors, as represented in score 1 photos, but major deficiencies shown in score 0 photos resulted in statistically significant decrease in satisfaction. For soft tissue margin and tooth translucency high/value low, the mean patient satisfaction scores for the score 0 photo were < 60% of the satisfaction score given to the ideal photo. Therefore a score of 0 should be given if the restoration has soft tissue margin or too low value that appears worse than the score 1 photo for each of these factors. A score of 2 should be given if the esthetic

factors are similar or better than the score 1 photos. For tooth outline volume, tooth narrow and tooth translucency low/value high, the mean patient satisfaction scores for the score 0 photo were 60-80% of the satisfaction score given to the ideal photo. Therefore a score of 1 should be given if the restoration appears worse than the score 1 photo for each of these factors. A score of 2 should be given if the esthetic factors are similar or better than the score 1 photos (Figure 7).

The 5 factors that were found to have no effect on patient satisfaction were alveolar process, soft tissue texture, soft tissue contour, tooth texture, and tooth form wide. These factors were not included in the USI.

Therefore, the maximum USI score a restoration can achieve is 20. The highest satisfaction score of 77 was given to the ideal photo. In the new scoring system of the USI, score 0 was given when satisfaction scores were < 60% of 77, the satisfaction score of the ideal photo. Score 1 was given when satisfaction scores were 60-80% of 77. Score 2 or 4 was given when satisfaction scores were 80-100% of 77. The mean patient satisfaction scores given for the 9 esthetic factors and how they are related to each other are summarized in Table XVIII. The patient satisfaction scores expressed as a percentage of 77 are shown in Table XIX. The USI is summarized in Table XX. The USI is also expressed in patient acceptance rates in Table XXI.

Since many clinicians and researchers use the PES/WES to score implant restorations, it needed to be standardized and have clear and objective criteria.

Every researcher and clinician should follow this standardized method of evaluating anterior implant esthetics. This is difficult because many of the esthetic factors are poorly studied and there is no reference to follow.

The first aim of this study was to modify the PES/WES so that scoring is standardized and more objective. A literature review was completed on esthetic factors within the PES and WES to determine the degree of change that is clinically relevant. For esthetic factors that had no available research, a group of 5 specialists reached an agreement to determine what represents a score 0, 1, or ideal situation. The modification of the PES/WES led to the development of the UIC-SIU Index (USI), which was the third aim of this study. To the author's knowledge, this is the first esthetic index that is being refined and validated through the use of available literature and the agreement of a group of dental specialists. Photographs have been used in previous studies to evaluate PES. (87) A set of 29 altered, life-size photographs were created in this study to represent the score 0, 1 and 2 (or ideal) scenario for each of the esthetic factors. More objective descriptions for each of the clinical situations were provided to reduce subjectivity. Objective descriptions for some esthetic factors such as alveolar process or tooth surface texture were not possible because there were currently no method to measure these factors. However, the created photographs provide future users of this esthetic index a visual reference when they score a restoration. For example, a restoration with outline volume that is more deficient/worse than the score 1 tooth volume reference photograph should be scored 0. A tooth outline volume that is better looking than the score 1

reference photograph should be scored 2. Providing a visual reference allow users of the esthetic index to compare between 2 scenarios. This method is more objective and may help standardize the way dentist score the esthetic factors in the USI.

A useful esthetic index should accurately predict or correlate with patient satisfaction. The PES/WES had poor to moderate correlation with patient satisfaction. The second aim of this study was to improve this correlation by determining how each esthetic factor influences patient satisfaction scores. Table XVIII below shows a summary of the 9 out of 14 esthetic factors that had statistically significant difference in satisfaction scores among patients between score 0, 1 and ideal photographs. Mesial papilla, distal papilla and soft tissue color were factors that had satisfaction scores that were similar between the score 0 and score 1 photos. However, both score 0 and score 1 photos had satisfaction scores that were significantly different than the ideal photo. This suggests that these factors have an all-or-nothing effect on satisfaction scores. Any slight deviation from a score 2 photo, regardless of severity, caused a significant drop in patient satisfaction. Any loss of papilla, resulting in black triangles of any size, caused a drop in patient satisfaction. Likewise, a change in soft tissue color, most commonly grey show through of the implant, abutment or crown margin caused a drop in patient satisfaction no matter the severity. Soft tissue margin, tooth outline volume, and tooth high translucency/value lower were 3 factors that had satisfaction scores similar between the score 1 and score 2 photos but statistically different than the score 0 photo. This indicated that

patients can tolerate slight changes to these factors. A gingival margin level discrepancy of 1mm did not significantly affect patient satisfaction but gingival margin discrepancies more than 2mm or if the abutment is showing decreased satisfaction. Likewise, patients tolerated any slight altering of the tooth outline volume to close a small black triangle. However, clinician cannot alter crown outline volume to close black triangles resulting from a greater than 50% papilla loss without reducing patient satisfaction. Tooth value is decreased when there is increased translucency. This study suggested that patients can tolerate increases of tooth value of around $\Delta E = 4.9$ but not anything more than 7.0. This confirmed the result of a previous study that found 95% of the population can perceive a difference if $\Delta E = 4.9$ and 95% of the population would not accept a $\Delta E = 7.0$. (82)

Tooth form narrow, and tooth low translucency/value high, were 2 factors that had satisfaction scores that were statistically different between score 0 and score 2 photos. Score 1 photo satisfaction scores were not significantly different than either score 0 or score 2 photos. This suggested that patient satisfaction scores were very insensitive to these factors. When tooth form was severely narrow when compared to the contralateral tooth, or when tooth value was as high as $\Delta E = 7.0$, patient satisfaction was decreased significantly. However, based on the mean satisfaction scores for the score 0 photos for these 2 factors, this reduction in satisfaction scores may not large.

Interestingly, tooth color was the only factor that had satisfaction scores different between all 3 photographs. This suggested that patients were very

aware of tooth color and any slight changes in this factor will affect patient satisfaction. Tooth color may have a dose-dependent effect on patient satisfaction. The importance of tooth color had been suggested by many previous studies. (79-82)

There was no statistically significant difference in satisfaction scores among all 3 scoring photographs for alveolar process, soft tissue contour, tissue texture, tooth surface texture, and tooth form wide. This meant that these 5 factors had no effect on patient satisfaction scores as long as the implant restoration is not worse than the situations presenting in the score 0 photographs. Although it is always encouraged for dentist to strive for esthetic perfection in these esthetic factors as it improves dentist satisfaction scores, majority of patients cannot perceive changes in these factors.

The fourth aim of this study was to determine if dentist and patients view dental esthetics differently. When dentists and patients were compared, there were 8 photographs that had statistically significant ($p < 0.05$) different satisfaction scores between the 2 groups (Table XXII). In all 8 photos, patient satisfaction scores were higher than dentist scores. Based on the trend of mean satisfaction scores, patient satisfaction scores were around 20 points higher than dentist scores. This suggested that dentists were overly critical of soft tissue contour, tooth form, tooth outline volume, slight color changes, and severe value changes. It could also indicate that patients were not sensitive to these factors.

Comparing dentist and patient perceptibility, 12 photos had statistically

significant difference ($p < 0.05$) between the 2 groups (Table XXIII). In all 12 photos, there were a higher percentage of dentists that perceived a difference. This made sense since dentists are trained to be critical in evaluating esthetic factors such as gingival contours and tooth forms. Perhaps more interesting was that patients could perceive papillae, soft tissue color, and high tooth value the same as dentists. The reason why these esthetic factors were among those found to have an effect on satisfaction may be because patients were more perceptive of them.

Comparing dentist and patient acceptability, 6 photos had statistically significant differences ($p < 0.05$) between the 2 groups (Table XXIV). In all 6 photos, there were a higher percentage of patients that accepted the result. Five of the 6 photos were score 0 photos and this suggested that patients were generally more forgiving of score 0 situations in tooth form, volume, texture and value. All 6 photos were in white esthetic factors. This indicated that dentists were less accepting of prosthetic issues. On the other hand, dentist and patients accepted pink esthetic factors equally. This may be because prosthetic issues are generally easier to correct while soft tissues are more unpredictable.

Results from this study provided useful information about perceptibility and acceptability thresholds. Currently, the dental profession does not have adequate literature on what patients can and cannot perceive. Likewise, it is unknown what satisfaction score is required to have a patient accept the clinical result. A previous study suggested that patients would not accept anything below 50% satisfaction. This was determined by comparing verbal descriptors

and VAS score recordings. (88) Belser et al. recommended an arbitrary 60% of the maximum PES/WES score as the clinical acceptability threshold. (10) However, it is uncertain how this correlates with patient satisfaction and acceptance. Table XXIII and XXIV can be used to determine perceptibility and acceptability thresholds. For example, if the goal was to provide a restoration that 80% of patients would accept, Table XXIV can be used to identify which esthetic factors are most critical in achieving that goal. In order for at least 80% of patients to accept an anterior implant restoration, there can only be major deficiencies in alveolar process and tooth surface texture or minor deficiencies in soft tissue texture, tooth form wide and tooth form narrow. However, alveolar process, tooth surface texture, soft tissue texture and tooth form wide were all eliminated in the USI. Of the factors mentioned above, tooth form narrow was the only esthetic factor within the USI. To achieve a greater than 80% patient acceptance rate, there can only have minor deficiencies in tooth form narrow, which corresponds to the score 1 reference photograph. This minor deficiency in tooth form is given a score of 2 in the USI. Therefore it can be concluded that in order to achieve 80% patient acceptance, a restoration must have a USI score of 20/20. In fact, according to Table XX a restoration scoring 20 in the USI will predict a patient acceptance rate of above 61%. It is interesting to note that the patient acceptance for the ideal photo was only 90%, compared to 96% of dentists. The 10% of patients that did not accept the ideal photo could be due to error in answering the survey, or there were indeed patients that were extremely difficult to satisfy. To account for this, a USI of 20 will in fact predict a patient

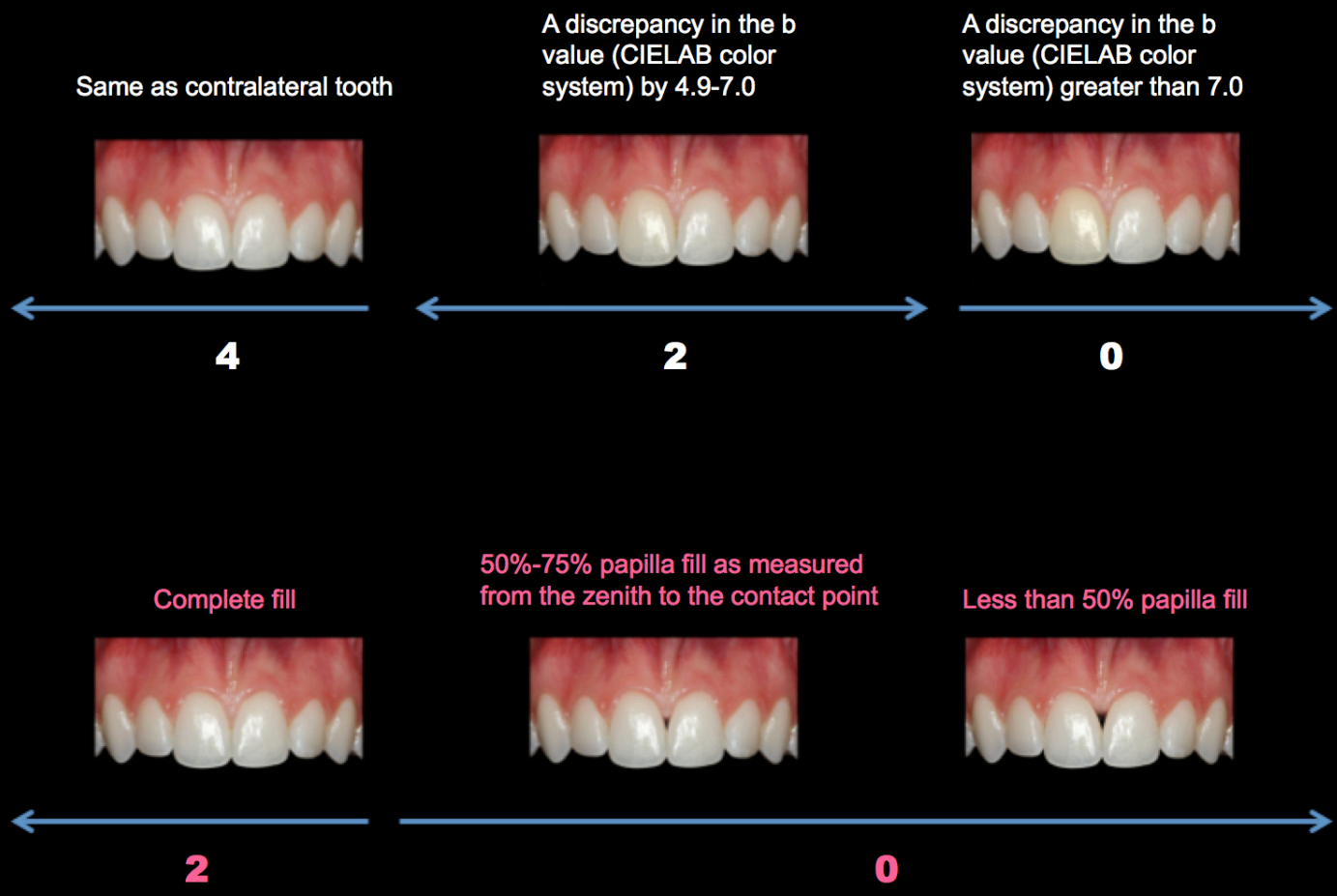
acceptance rate of 67.8% (61/90) or roughly two-thirds of patients.

For the ideal scoring photograph, the mean satisfaction score for patients was 77 compared to 81 for dentists. Therefore patient satisfaction scores should be calculated out of 77. Table XVIII indicated that a USI of 20 would predict a patient satisfaction score of 63 or greater. When adjusted to be out of 77, a USI of 20 will predict patient satisfaction of around 82% (Table XIX)

Previous studies reported that the range of patient satisfaction scores was 70%-100%. They concluded that the differences between an implant crown and the surrounding natural teeth were of minor importance to the patient's overall satisfaction of esthetics. They also suggested that esthetic factors that dental professionals believe contribute to overall satisfaction might not be important for the patient. (30) This study both supported and refuted these suggestions. Patient satisfaction scores for this study ranged from 21-77 while acceptability ranged from 6-90%. This indicated that patients were able to perceive and did care about the differences between an implant crown and the surrounding natural teeth. However, if certain esthetic factors that were found to drop satisfaction scores significantly were controlled, like papillae, soft tissue and crown color, then patient satisfaction can easily be achieved. This study supported the claim that dental professionals and patients placed different levels of importance to each esthetic factor. This was in agreement with several other studies. (30, 41, 77) In general, dentists overestimated the importance of prosthetic factors in predicting overall patient satisfaction. To achieve a high level of patient satisfaction and acceptance, clinicians must achieve ideal

papillae, soft tissue color and tooth color, which were esthetic factors of vital importance. Any slight deficiencies in these factors dropped patient acceptance and satisfaction greatly (Figure XXI).

Figure 15: UIC-SIU Index (USI)



Distal Papilla

Complete fill

50%-75% papilla fill as measured from the zenith to the contact point

Less than 50% papilla fill

2 ← → 0

Soft tissue color

Same as contralateral tooth

Grey discoloration limited to the gingival margin area

Discoloration extending apically to the mucosa

2 ← → 0

Level of soft tissue margin

Same as contralateral tooth

Discrepancy of 1-2 mm

Discrepancy greater than 2 mm or if abutment is visible

2

0

Tooth translucency high/value low

Translucency and value same as contralateral tooth

A discrepancy in the I value by 4.9-7.0 in the negative direction

A discrepancy in the I value (CIELAB color system) greater than 7.0 in the negative direction

2

0

Tooth translucency low/value high

Translucency and value same as contralateral tooth

A discrepancy in the l value (CIELAB color system) by 4.9-7.0 in the positive direction

A discrepancy in the l value (CIELAB color system) greater than 7.0 in the positive direction

2 1

Tooth outline/ volume

Same as contralateral tooth

Tooth volume required to eliminate black triangles if there was only a 50-75% papilla fill

Volume required to eliminate black triangles if there was less than 50% papilla fill

2 1

Tooth Form - Narrow

Same as contralateral tooth

Line angles are located too proximally

Line angles are too proximal and incisal edge is too rounded

2

1

Table XI: Summary of esthetic factors that had statistically significant difference in satisfaction scores among patients between the score 0, 1 and ideal photographs

		Patient mean satisfaction scores			
Esthetic factors in order of importance	**Esthetic factor**	**Score 2 (ideal) photo**	**Score 1 photo**	**Score 0 photo**	**Comments**
1	Tooth color	77	57	24	All 3 photos significantly different from each other
2	Mesial papilla	77	36	27	Score 0 and 1 has no difference with each other but is different than score 2
3	Distal papilla	77	37	32	
4	Soft tissue color	77	23	21	
5	Soft tissue margin	77	63	21	Score 1 and 2 has no difference with each other but is different than score 0
6	Tooth translucency high/value low	77	63	41	
7	Tooth translucency low/value high	77	67	52	Score 1 different than score 0 but score 1 has no difference with score 0 or 2
8	Tooth outline volume	77	70	47	Score 1 and 2 has no difference with each other but is different than score 0
9	Tooth form narrow	77	72	60	Score 1 different than score 0 but score 1 has no difference with score 0 or 2

Table XII: Summary of satisfaction scores as expressed as a percentage of 77 (satisfaction score of the ideal photo)

		Patient mean satisfaction scores as a percentage of 77			
Esthetic factors in order of importance	**Esthetic factor**	**Score 2 (ideal) photo**	**Score 1 photo**	**Score 0 photo**	**Comments**
1	Tooth color	100%	74%	31%	All 3 photos significantly different from each other
2	Mesial papilla	100%	47%	35%	Score 0 and 1 has no difference with each other but is different than score 2
3	Distal papilla	100%	48%	42%	
4	Soft tissue color	100%	30%	27%	
5	Soft tissue margin	100%	82%	27	Score 1 and 2 has no difference with each other but is different than score 0
6	Tooth translucency high/value low	100%	82%	53%	
7	Tooth translucency low/value high	100%	87%	68%	Score 1 different than score 0 but score 1 has no difference with score 0 or 2
8	Tooth outline volume	100%	91%	61%	Score 1 and 2 has no difference with each other but is different than score 0
9	Tooth form narrow	100%	94%	78%	Score 1 different than score 0 but score 1 has no difference with score 0 or 2

Table XIII: UIC-SIU Index (USI) in table format

		UIC-SIU Index			
Esthetic factors in order of importance	**Esthetic factor**	**Score 2 (ideal) photo**	**Score 1 photo**	**Score 0 photo**	**Comments**
1	**Tooth color**	4	2	0	A score of 0,2 or 4 is given according to the amount of color mismatch as represented by the 3 reference photographs
2	**Mesial papilla**	2	0		If the esthetic factor appears more deficient than the ideal photo, a score 0 is given
3	**Distal papilla**	2	0		
4	**Soft tissue color**	2	0		
5	**Soft tissue margin**	2		0	If the esthetic factor appears more deficient than the score 1 photo, a score 0 is given
6	**Tooth translucency high/value low**	2		0	
7	**Tooth translucency low/value high**	2		1	If the esthetic factor appears more deficient than the score 1 photo, a score 1 is given
8	**Tooth outline volume**	2		1	
9	**Tooth form narrow**	2		1	

Highest possible score = 20

Scores of 2 and 4 are based on having patient satisfaction scores of 80-100% of the satisfaction score of 77 for the Ideal control photo.

Scores of 1 are based on having patient satisfaction scores of 60-80% of the satisfaction score of 77 for the Ideal control photo.

Scores of 0 are based on having patient satisfaction scores of <60% of the satisfaction score of 77 for the Ideal control photo.

Table XIV: Correlation between the UIC-SIU Index and percentage of patient who will accept the outcome

		Percentage (%) of Patient Acceptance			
Esthetic factors in order of importance	Esthetic factor	Score 2 (ideal) photo	Score 1 photo	Score 0 photo	Comments
1	Tooth color	90	52	15	Ideal color match will result in 90% patient acceptance. Slight color mismatch will result in 52% patient acceptance. Severe color mismatch will result in 15% patient acceptance.
2	Mesial papilla	90	15-27		If the esthetic factor appears more deficient than the ideal photo, the percentage of patients who will accept the result ranges from 6-27%
3	Distal papilla	90	15-27		
4	Soft tissue color	90	6-9		
5	Soft tissue margin	64-90		6	If the esthetic factor appears more deficient than the score 1 photo, the percentage of patients who will accept the result ranges from 6-30%
6	Tooth translucency high/value low	61-90		30	
7	Tooth translucency low/value high	70-90		49	If the esthetic factor appears more deficient than the score 1 photo, the percentage of patients who will accept the result ranges from 49-61%
8	Tooth outline volume	79-90		49	
9	Tooth form narrow	82-90		61	

Table XV: Summary of photographs that had statistically significant difference in satisfaction scores between dentists and patients

			Mean satisfaction scores	
	Esthetic factor	Score	Dentists	Patients
	Mesial Papilla	0	27	27
		1	41	36
	Distal Papilla	0	26	32
		1	38	37
	Soft tissue margin	0	17	21
		1	51	63
	Soft tissue contour	0	54	71
		1	61	74
	Alveolar process	0	76	77
		1	81	75
	Soft tissue colour	0	25	21
		1	28	23
	Soft tissue texture	0	61	72
		1	71	79
	Tooth form - wide	0	54	70
		1	70	73
	Tooth form - narrow	0	44	60
		1	77	73
	Tooth outline/volume	0	27	47
		1	53	70
	Tooth color	0	25	24
		1	38	57
	Tooth surface texture	0	61	72
		1	71	79
	Tooth translucency low/value high	0	35	52
		1	61	67
	Tooth translucency high/value low	0	33	41
		1	47	63
	Ideal	2	81	77

Table XVI: Summary of photographs that had statistically significant difference in perceptibility between dentists and patients

			Percent (%) that perceived a difference (perceptibility)	
	Esthetic factor	Score	Dentists	Patients
	Mesial Papilla	0	87	88
		1	91	79
	Distal Papilla	0	96	94
		1	91	88
	Soft tissue margin	0	100	94
		1	87	55
	Soft tissue contour	0	83	36
		1	78	39
	Alveolar process	0	52	36
		1	57	24
	Soft tissue colour	0	100	97
		1	65	24
	Soft tissue texture	0	83	46
		1	83	39
	Tooth form - wide	0	83	49
		1	70	39
	Tooth form - narrow	0	96	67
		1	61	33
	Tooth outline/volume	0	96	76
		1	83	42
	Tooth color	0	96	91
		1	100	64
	Tooth surface texture	0	74	46
		1	65	24
	Tooth translucency low/value high	0	96	82
		1	83	61
	Tooth translucency high/value low	0	96	76
		1	91	61
	Ideal	2	18	14

Table XVII: Summary of photographs that had statistically significant difference in acceptability between dentists and patients

			Percent (%) that accepted the result (acceptability)	
	Esthetic factor	Score	Dentists	Patients
	Mesial Papilla	0	13	15
		1	26	27
	Distal Papilla	0	4	15
		1	22	27
	Soft tissue margin	0	0	6
		1	52	64
	Soft tissue contour	0	52	76
		1	70	76
	Alveolar process	0	91	85
		1	100	88
	Soft tissue colour	0	4	6
		1	9	9
	Soft tissue texture	0	70	73
		1	70	85
	Tooth form - wide	0	39	70
		1	78	82
	Tooth form - narrow	0	17	61
		1	96	82
	Tooth outline/volume	0	9	49
		1	57	79
	Tooth color	0	9	15
		1	17	52
	Tooth surface texture	0	48	82
		1	87	88
	Tooth translucency low/value high	0	9	49
		1	44	70
	Tooth translucency high/value low	0	9	30
		1	30	61
	Ideal	2	96	90

5.2 Limitations of the Study

This study had several limitations, one of which was the sample size of N = 56 (23 dentist, 33 patients). A total of 204 participants took the survey but in order to increase the homogeneity of the study, strict inclusion criteria were used. Colorblind individuals, non-UIC participants and non-Apple users were not included in this study. The small sample size, combined with multiple statistical analyses, increased the chance of Type 1 error. Similarly, a small sample size also increased the chance of Type 2 error, which means significant results could not be detected. Future studies should have a larger sample size to evaluate the correlation between the PES/WES and patient satisfaction.

Another limitation of this study was the inability to test for any interactions between several esthetic factors. Since each altered photograph had only 1 factor changed, the study was unable to determine if deficiencies in 2 or more esthetic factor could result in an additive or exponential drop in satisfaction scores. Previous studies have found that patients could interpret a lack of papillae as a deficiency of crown form. (30, 46, 77, 89) This suggested another limitation of this study. It is difficult to be certain whether the effect on satisfaction score was truly caused by each esthetic factor or whether it is was perceived differently as another factor. Future research could include photographs with several altered esthetic factors. This could test for interactions between the factors. Moreover, this would allow for a multivariate linear regression analysis,

which could determine a predictive model. The quantitative effect of each esthetic factor on patient satisfaction scores could be determined. This would further refine the PES/WES. The current study only had 1 esthetic factor altered for each photograph. This method allowed the authors to determine which factors had an effect on satisfaction scores but only assumptions could be made on the effect size by observing trends.

The current study only included photos of the anterior teeth. The lips and the face were not included. A previous study concluded that the face and skin tone affects the perception of tooth color. (82) Future studies could verify this finding and moreover, determine whether the presence of the lips or face has any effect on the perception and acceptance of different esthetic factors.

Lastly, this study utilized altered photographs to represent real life clinical scenarios. Although a biomedical illustrator was utilized to digitally alter the photographs, and they were peer reviewed by a group of specialists, it is difficult to show certain esthetic factors in a 3 dimensional manner with the use of a photograph. Future studies should investigate whether photographs accurately represent real life clinical situations and whether patient satisfaction scores are affected.

5.3 **Future Research**

Clinicians and research should use a standardized esthetic index in order to have uniform research documentation. Since dentist and patients perceive and accept implant esthetics differently, an esthetic index should either predict dentist satisfaction, patient satisfaction, or both. The PES/WES evaluates esthetic criteria that appear affect dentist satisfaction. This study developed more objective scoring criteria as well as reference photographs to increase inter- and intra-examiner agreement. Future studies are required to verify that the usage of this new scoring method does result in a more reproducible and reliable index.

The USI was designed to predict patient satisfaction scores or acceptance rates. Since a new scoring method was also recommended based on the results of this study, further research could determine whether USI correlates to patient satisfaction better and perhaps creates improved correlation between dentists and patients. The possible scores for each factor in USI still ranged from 0 to 2 (with the exception of tooth color which ranged from 0-4) similar to the original PES/WES since the relative weight of each factor could only be concluded based on trends. Further research is required to identify the relative effect size each esthetic factor have on patient satisfaction. It is also uncertain at this time the percentage of the maximum score required to achieve overall patient satisfaction. Further research study could include photographs of actual anterior implants restorations delivered to patients. A group of dentists would be asked to score

the restorations using the USI. A survey containing these photographs would then be administered to a different group of dentists and patients. Satisfaction scores, perceptibility, acceptability would be tested similar to this study. This would allow the authors to examine the inter- and intra-examiner agreement of the USI. The interaction between different esthetic factors can be determined. Through a linear regression analysis, a predictive model can be created to determine the relative effect size each esthetic factor has on patient satisfaction. Lastly, this will test whether the USI correlates with patient satisfaction.

From the total of 204 participants, demographic information was collected and colorblind individuals were also identified. Around 6-10% of males have some form of color deficiency and future research could evaluate how this condition influences the perception of implant esthetics. Previous studies have reported that males generally value function while females value esthetics. (30, 85, 90) Subsequent analysis of the data in a future study would reveal gender differences in patient satisfaction of anterior implant esthetics. The influence of age, education level, income level, ethnicity and prior experience with implants on patient satisfaction could also be studied in future research. Comparing participants who took the survey using an Apple device and those who used a personal computer could also reveal whether type of monitor had an effect on how esthetics is perceived.

Dentists and patients were found to have differences in satisfaction scores, perceptibility and acceptability. Dentists had significantly lower satisfaction scores when compared to patients for 8 of the 29 photos. In general, patient satisfaction scores were around 20 points higher for these photographs. Dentists were also found to perceive esthetic factors better than patients in 12 of the 29 photographs. Most of these photos are score 1 photographs which suggest dentist are better at perceiving minor deficiencies. Dentists were found to be significantly less accepting than patients in 6 of the 29 photographs. All of these photographs were prosthetic factors. This suggests that dentists are more forgiving of soft tissue imperfections but less forgiving of prosthetic issues. A study suggested that the perception of altered dental esthetics is different between general dentists and orthodontists. (25) It would be interesting to investigate whether certain dental specialties are more critical of certain esthetic factors.

The results of this study concluded that around 10% of patients were not accepting of an esthetic result that was determined by dentists to be ideal. This suggested that a small subset of the patient population have unrealistic expectations regarding their dental implant treatments. Utilizing the standardized reference photographs, an esthetic tool can be developed to screen for such patients.

Further research is warranted to continue to improve the PES/WES and USI. A reproducible and reliable esthetic index that accurately predicts patient satisfaction and dentist satisfaction would be of immeasurable worth. The dental profession would be able to use the esthetic index to compare different treatment modalities or materials. Meaningful recommendations could be made on which strategy is best at achieving patient satisfaction and dentist can better predict the outcome of treatment.

6. CONCLUSION

The results of this study allowed the authors to accept hypotheses 2-4 but further research is required to determine if hypothesis 1 can be accepted.

The first aim of the study was to analyze and improve the current PES/WES. A set of 29 standardized photographs that illustrated the verifying scores for each of the 14 esthetic factors in the PES/WES was created. Each photograph was altered based on available research and reflected common clinical scenarios. A group of 5 dental specialists reached an agreement that these photographs represented the verifying scores for each of the esthetic factors. More objective scoring criteria were also developed and agreed upon by the group of specialists. The reference photographs, combined with more objective scoring criteria should be used in future implant research. Future studies are needed to determine if inter and intra-examiner agreement of this esthetic index is improved. Therefore the authors cannot accept hypothesis 1 at this time.

The second aim of the study was to determine how each esthetic factor influences patient satisfaction scores. A survey containing the 29 altered photographs was administered to patients and dentists, which collected data on satisfaction scores, perceptibility and acceptability. The authors concluded that certain esthetic factors have more of an influence on patient satisfactions scores.

By modifying the PES/WES, a new esthetic index was developed. Therefore the second and third hypotheses were accepted. By comparing the satisfaction scores, perceptibility and acceptability between dentists and patients, the authors found differences between the 2 groups. The fourth hypothesis was also accepted.

The results of this study allowed the authors to make the following conclusions:

1. The current PES/WES is not reflective of patient satisfaction and acceptance. It should be modified and scientifically validated.

2. In order of importance, tooth color, mesial papilla, distal papilla, and soft tissue color were the 4 most important esthetic factors in determining patient satisfaction scores.

3. Alveolar process, soft tissue contour, soft tissue texture, tooth form wide, and tooth surface texture were the 5 factors that had minimal to no influence on patient satisfaction scores. These factors were dropped from the UIC-SIU Index.

4. A new UIC-SIU Index was developed and is correlated with patient satisfaction scores and percentage of patient acceptance.

5. A restoration with a maximum score in every esthetic criteria resulted in a patient satisfaction score of 77 and patient acceptance of 90%.

6. A restoration with a maximum score in every esthetic criteria resulted in a dentist satisfaction score of 81 and dentist acceptance of 96%.

7. Dentists had statistically significant lower satisfaction scores than patients in 6 factors. There were soft tissue contour, tooth form wide, tooth form narrow, tooth outline/volume, tooth color and tooth translucency low/ value high. In general, dentist satisfaction scores were 20 points lower than patient scores. If dentists are satisfied, then patients should be satisfied.

8. Dentists had better perception than patients of all esthetic factors except mesial papilla, distal papilla, soft tissue color, and tooth translucency low/value high. For these 4 factors, dentists and patients had the same perceptibility.

9. Dentists were less accepting than patients in all white esthetic factors except tooth translucency high/value low.

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Appendix A: Differences in satisfaction scores within each esthetic factor

Occupation			Sum of Squares	df	Mean Square	F	Sig.
Dental Professionals	ToothColour	Between Groups	40111.507	2	20055.754	46.395	.000
		Within Groups	28530.783	66	432.285		
		Total	68642.290	68			
	ToothReduction	Between Groups	28578.899	2	14289.449	23.632	.000
		Within Groups	39907.652	66	604.661		
		Total	68486.551	68			
	ToothTrans	Between Groups	24791.072	2	12395.536	26.283	.000
		Within Groups	31126.696	66	471.617		
		Total	55917.768	68			
	AlveolarProcess	Between Groups	502.290	2	251.145	1.258	.291
		Within Groups	13173.913	66	199.605		
		Total	13676.203	68			
	DistalPap	Between Groups	38830.377	2	19415.188	42.726	.000
		Within Groups	29990.870	66	454.407		
		Total	68821.246	68			
	MesialPap	Between Groups	37273.072	2	18636.536	39.071	.000
		Within Groups	31481.565	66	476.993		
		Total	68754.638	68			
	ToothSurfaceTexture	Between Groups	4631.043	2	2315.522	6.549	.003
		Within Groups	23336.783	66	353.588		
		Total	27967.826	68			
	ToothForm_Narrow	Between Groups	19698.638	2	9849.319	30.368	.000
		Within Groups	21406.174	66	324.336		

		Total	41104.812	68			
	ToothForm_Wide	Between Groups	9028.029	2	4514.014	10.086	.000
		Within Groups	29539.304	66	447.565		
		Total	38567.333	68			
	ToothOutlineVolume	Between Groups	33739.159	2	16869.580	32.017	.000
		Within Groups	34775.391	66	526.900		
		Total	68514.551	68			
	SoftTissueContour	Between Groups	8405.420	2	4202.710	8.349	.001
		Within Groups	33223.739	66	503.390		
		Total	41629.159	68			
	SoftTissueMargin	Between Groups	49094.696	2	24547.348	67.822	.000
		Within Groups	23887.739	66	361.935		
		Total	72982.435	68			
	SoftTissueTexture	Between Groups	5554.290	2	2777.145	8.953	.000
		Within Groups	20472.261	66	310.186		
		Total	26026.551	68			
	SoftTissueColour	Between Groups	46704.116	2	23352.058	44.703	.000
		Within Groups	34476.870	66	522.377		
		Total	81180.986	68			
Patients	ToothColour	Between Groups	46131.172	2	23065.586	30.698	.000
		Within Groups	72130.848	96	751.363		
		Total	118262.020	98			
	ToothReduction	Between Groups	21560.424	2	10780.212	11.473	.000
		Within Groups	90200.485	96	939.588		
		Total	111760.909	98			
	ToothTrans	Between Groups	10310.788	2	5155.394	6.777	.002
		Within Groups	73029.394	96	760.723		

		Total	83340.182	98			
	AlveolarProcess	Between Groups	102.970	2	51.485	.083	.921
		Within Groups	59801.576	96	622.933		
		Total	59904.545	98			
	DistalPap	Between Groups	40033.838	2	20016.919	23.326	.000
		Within Groups	82380.606	96	858.131		
		Total	122414.444	98			
	MesialPap0	Between Groups	45634.970	2	22817.485	26.786	.000
		Within Groups	81777.758	96	851.852		
		Total	127412.727	98			
	ToothSurfaceTexture	Between Groups	702.970	2	351.485	.538	.586
		Within Groups	62695.939	96	653.083		
		Total	63398.909	98			
	ToothForm_Narrow	Between Groups	5174.081	2	2587.040	3.310	.041
		Within Groups	75042.606	96	781.694		
		Total	80216.687	98			
	ToothForm_Wide	Between Groups	859.535	2	429.768	.609	.546
		Within Groups	67752.970	96	705.760		
		Total	68612.505	98			
	ToothOutlineVolume	Between Groups	16233.354	2	8116.677	10.514	.000
		Within Groups	74110.667	96	771.986		
		Total	90344.020	98			
	SoftTissueContour	Between Groups	529.152	2	264.576	.354	.703
		Within Groups	71765.394	96	747.556		
		Total	72294.545	98			
	SoftTissueMargin	Between Groups	56661.657	2	28330.828	38.686	.000

		Within Groups	70302.970	96	732.323		
		Total	126964.626	98			
	SoftTissueTexture	Between Groups	1605.717	2	802.859	1.099	.337
		Within Groups	70143.939	96	730.666		
		Total	71749.657	98			
	SoftTissueColour	Between Groups	66251.091	2	33125.545	46.007	.000
		Within Groups	69121.636	96	720.017		
		Total	135372.727	98			

Appendix B: Differences in satisfaction scores between score 0, 1 and 2 photos for each esthetic factor

Occupation				Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Dental Professionals	ToothColour_0_s_0_11_1	score 0	score 1	-12.435	6.131	.113	-27.14	2.27
			ideal	-56.217*	6.131	.000	-70.92	-41.52
		score 1	score 0	12.435	6.131	.113	-2.27	27.14
			ideal	-43.783*	6.131	.000	-58.48	-29.08
		ideal	score 0	56.217*	6.131	.000	41.52	70.92
			score 1	43.783*	6.131	.000	29.08	58.48
	ToothReduction_0_s_0_11_1	score 0	score 1	-14.000	7.251	.138	-31.39	3.39
			ideal	-48.435*	7.251	.000	-65.82	-31.05
		score 1	score 0	14.000	7.251	.138	-3.39	31.39
			ideal	-34.435*	7.251	.000	-51.82	-17.05
		ideal	score 0	48.435*	7.251	.000	31.05	65.82
			score 1	34.435*	7.251	.000	17.05	51.82
	ToothTrans0_s_0_11_1	score 0	score 1	-25.565*	6.404	.000	-40.92	-10.21
			ideal	-46.348*	6.404	.000	-61.70	-30.99
		score 1	score 0	25.565*	6.404	.000	10.21	40.92
			ideal	-20.783*	6.404	.005	-36.14	-5.43
		ideal	score 0	46.348*	6.404	.000	30.99	61.70
			score 1	20.783*	6.404	.005	5.43	36.14
	AlveolarProcess0_s_0_11_1	score 0	score 1	-5.565	4.166	.381	-15.55	4.42
			ideal	-5.870	4.166	.342	-15.86	4.12
		score 1	score 0	5.565	4.166	.381	-4.42	15.55

			ideal	-.304	4.166	.997	-10.29	9.68
		ideal	score 0	5.870	4.166	.342	-4.12	15.86
			score 1	.304	4.166	.997	-9.68	10.29
	DistalPap0_s_0_11_1	score 0	score 1	-11.130	6.286	.187	-26.20	3.94
			ideal	-54.957*	6.286	.000	-70.03	-39.88
		score 1	score 0	11.130	6.286	.187	-3.94	26.20
			ideal	-43.826*	6.286	.000	-58.90	-28.75
		ideal	score 0	54.957*	6.286	.000	39.88	70.03
			score 1	43.826*	6.286	.000	28.75	58.90
	MesialPap0_s_0_11_1	score 0	score 1	-14.130	6.440	.080	-29.57	1.31
			ideal	-54.826*	6.440	.000	-70.27	-39.38
		score 1	score 0	14.130	6.440	.080	-1.31	29.57
			ideal	-40.696*	6.440	.000	-56.14	-25.25
		ideal	score 0	54.826*	6.440	.000	39.38	70.27
			score 1	40.696*	6.440	.000	25.25	56.14
	ToothSurfaceTexture_0_s_0_11_1	score 0	score 1	-9.174	5.545	.230	-22.47	4.12
			ideal	-20.043*	5.545	.002	-33.34	-6.75
		score 1	score 0	9.174	5.545	.230	-4.12	22.47
			ideal	-10.870	5.545	.130	-24.16	2.43
		ideal	score 0	20.043*	5.545	.002	6.75	33.34
			score 1	10.870	5.545	.130	-2.43	24.16
	ToothForm_Narrow0_s_0_11_1	score 0	score 1	-33.522*	5.311	.000	-46.26	-20.79
			ideal	-37.783*	5.311	.000	-50.52	-25.05
		score 1	score 0	33.522*	5.311	.000	20.79	46.26
			ideal	-4.261	5.311	.703	-16.99	8.47
		ideal	score 0	37.783*	5.311	.000	25.05	50.52
			score 1	4.261	5.311	.703	-8.47	16.99

	ToothForm_Wide0_s_0_11_1	score 0	score 1	-16.435*	6.238	.028	-31.39	-1.48
			ideal	-27.870*	6.238	.000	-42.83	-12.91
		score 1	score 0	16.435*	6.238	.028	1.48	31.39
			ideal	-11.435	6.238	.167	-26.39	3.52
		ideal	score 0	27.870*	6.238	.000	12.91	42.83
			score 1	11.435	6.238	.167	-3.52	26.39
	ToothOutlineVolume_0_s_0_11_1	score 0	score 1	-25.391*	6.769	.001	-41.62	-9.16
			ideal	-54.130*	6.769	.000	-70.36	-37.90
		score 1	score 0	25.391*	6.769	.001	9.16	41.62
			ideal	-28.739*	6.769	.000	-44.97	-12.51
		ideal	score 0	54.130*	6.769	.000	37.90	70.36
			score 1	28.739*	6.769	.000	12.51	44.97
	SoftTissueContour0_s_0_11_1	score 0	score 1	-12.304	6.616	.159	-28.17	3.56
			ideal	-27.000*	6.616	.000	-42.86	-11.14
		score 1	score 0	12.304	6.616	.159	-3.56	28.17
			ideal	-14.696	6.616	.075	-30.56	1.17
		ideal	score 0	27.000*	6.616	.000	11.14	42.86
			score 1	14.696	6.616	.075	-1.17	30.56
	SoftTissueMargin0_s_0_11_1	score 0	score 1	-34.478*	5.610	.000	-47.93	-21.03
			ideal	-65.304*	5.610	.000	-78.76	-51.85
		score 1	score 0	34.478*	5.610	.000	21.03	47.93
			ideal	-30.826*	5.610	.000	-44.28	-17.37
		ideal	score 0	65.304*	5.610	.000	51.85	78.76
			score 1	30.826*	5.610	.000	17.37	44.28
	SoftTissueTexture_0_s_0_11_1	score 0	score 1	2.870	5.194	.846	-9.58	15.32
			ideal	-17.435*	5.194	.004	-29.89	-4.98
		score 1	score 0	-2.870	5.194	.846	-15.32	9.58

			ideal	-20.304*	5.194	.001	-32.76	-7.85
		ideal	score 0	17.435*	5.194	.004	4.98	29.89
			score 1	20.304*	5.194	.001	7.85	32.76
	SoftTissueColour0_s_0_11_1	score 0	score 1	-2.957	6.740	.900	-19.12	13.20
			ideal	-56.609*	6.740	.000	-72.77	-40.45
		score 1	score 0	2.957	6.740	.900	-13.20	19.12
			ideal	-53.652*	6.740	.000	-69.81	-37.49
		ideal	score 0	56.609*	6.740	.000	40.45	72.77
			score 1	53.652*	6.740	.000	37.49	69.81
Patients	ToothColour_0_s_0_11_1	score 0	score 1	-32.364*	6.748	.000	-48.43	-16.30
			ideal	-52.394*	6.748	.000	-68.46	-36.33
		score 1	score 0	32.364*	6.748	.000	16.30	48.43
			ideal	-20.030*	6.748	.010	-36.09	-3.97
		ideal	score 0	52.394*	6.748	.000	36.33	68.46
			score 1	20.030*	6.748	.010	3.97	36.09
	ToothReduction_0_s_0_11_1	score 0	score 1	-22.303*	7.546	.011	-40.27	-4.34
			ideal	-35.788*	7.546	.000	-53.75	-17.82
		score 1	score 0	22.303*	7.546	.011	4.34	40.27
			ideal	-13.485	7.546	.179	-31.45	4.48
		ideal	score 0	35.788*	7.546	.000	17.82	53.75
			score 1	13.485	7.546	.179	-4.48	31.45
	ToothTrans0_s_0_11_1	score 0	score 1	-14.788	6.790	.080	-30.95	1.38
			ideal	-24.848*	6.790	.001	-41.01	-8.68
		score 1	score 0	14.788	6.790	.080	-1.38	30.95
			ideal	-10.061	6.790	.304	-26.22	6.10
		ideal	score 0	24.848*	6.790	.001	8.68	41.01
			score 1	10.061	6.790	.304	-6.10	26.22

	AlveolarProcess0_s_0_11_1	score 0	score 1	2.333	6.144	.924	-12.29	16.96
			ideal	.394	6.144	.998	-14.23	15.02
		score 1	score 0	-2.333	6.144	.924	-16.96	12.29
			ideal	-1.939	6.144	.947	-16.57	12.69
		ideal	score 0	-.394	6.144	.998	-15.02	14.23
			score 1	1.939	6.144	.947	-12.69	16.57
	DistalPap0_s_0_11_1	score 0	score 1	-5.152	7.212	.756	-22.32	12.02
			ideal	-45.000*	7.212	.000	-62.17	-27.83
		score 1	score 0	5.152	7.212	.756	-12.02	22.32
			ideal	-39.848*	7.212	.000	-57.02	-22.68
		ideal	score 0	45.000*	7.212	.000	27.83	62.17
			score 1	39.848*	7.212	.000	22.68	57.02
	MesialPap0_s_0_11_1	score 0	score 1	-9.061	7.185	.421	-26.17	8.04
			ideal	-49.394*	7.185	.000	-66.50	-32.29
		score 1	score 0	9.061	7.185	.421	-8.04	26.17
			ideal	-40.333*	7.185	.000	-57.44	-23.23
		ideal	score 0	49.394*	7.185	.000	32.29	66.50
			score 1	40.333*	7.185	.000	23.23	57.44
	ToothSurfaceTexture_0_s_0_11_1	score 0	score 1	-6.394	6.291	.568	-21.37	8.58
			ideal	-4.333	6.291	.771	-19.31	10.64
		score 1	score 0	6.394	6.291	.568	-8.58	21.37
			ideal	2.061	6.291	.943	-12.92	17.04
		ideal	score 0	4.333	6.291	.771	-10.64	19.31
			score 1	-2.061	6.291	.943	-17.04	12.92
	ToothForm_Narrow0_s_0_11_1	score 0	score 1	-12.939	6.883	.150	-29.33	3.45
			ideal	-16.939*	6.883	.041	-33.33	-.55
		score 1	score 0	12.939	6.883	.150	-3.45	29.33

			ideal	-4.000	6.883	.831	-20.39	12.39
		ideal	score 0	16.939*	6.883	.041	.55	33.33
			score 1	4.000	6.883	.831	-12.39	20.39
	ToothForm_Wide0_s_0_11_1	score 0	score 1	-2.970	6.540	.893	-18.54	12.60
			ideal	-7.182	6.540	.518	-22.75	8.39
		score 1	score 0	2.970	6.540	.893	-12.60	18.54
			ideal	-4.212	6.540	.796	-19.78	11.36
		ideal	score 0	7.182	6.540	.518	-8.39	22.75
			score 1	4.212	6.540	.796	-11.36	19.78
	ToothOutlineVolume_0_s_0_11_1	score 0	score 1	-23.000*	6.840	.003	-39.28	-6.72
			ideal	-29.970*	6.840	.000	-46.25	-13.69
		score 1	score 0	23.000*	6.840	.003	6.72	39.28
			ideal	-6.970	6.840	.567	-23.25	9.31
		ideal	score 0	29.970*	6.840	.000	13.69	46.25
			score 1	6.970	6.840	.567	-9.31	23.25
	SoftTissueContour0_s_0_11_1	score 0	score 1	-1.303	6.731	.980	-17.33	14.72
			ideal	-5.424	6.731	.700	-21.45	10.60
		score 1	score 0	1.303	6.731	.980	-14.72	17.33
			ideal	-4.121	6.731	.814	-20.15	11.90
		ideal	score 0	5.424	6.731	.700	-10.60	21.45
			score 1	4.121	6.731	.814	-11.90	20.15
	SoftTissueMargin0_s_0_11_1	score 0	score 1	-42.667*	6.662	.000	-58.53	-26.81
			ideal	-56.121*	6.662	.000	-71.98	-40.26
		score 1	score 0	42.667*	6.662	.000	26.81	58.53
			ideal	-13.455	6.662	.113	-29.31	2.41
		ideal	score 0	56.121*	6.662	.000	40.26	71.98
			score 1	13.455	6.662	.113	-2.41	29.31

	SoftTissueTexture_0_s_0_11_1	score 0	score 1	-7.091	6.655	.538	-22.93	8.75
			ideal	-9.485	6.655	.332	-25.33	6.36
		score 1	score 0	7.091	6.655	.538	-8.75	22.93
			ideal	-2.394	6.655	.931	-18.24	13.45
		ideal	score 0	9.485	6.655	.332	-6.36	25.33
			score 1	2.394	6.655	.931	-13.45	18.24
	SoftTissueColour0_s_0_11_1	score 0	score 1	-1.364	6.606	.977	-17.09	14.36
			ideal	-55.545*	6.606	.000	-71.27	-39.82
		score 1	score 0	1.364	6.606	.977	-14.36	17.09
			ideal	-54.182*	6.606	.000	-69.91	-38.46
		ideal	score 0	55.545*	6.606	.000	39.82	71.27
			score 1	54.182*	6.606	.000	38.46	69.91

Appendix C: Mean satisfaction scores for each photo between dentists and patients

Occupation		N	Mean	Std. Deviation	Std. Error Mean
ToothColour_0_s	Dental professionals	23	25.22	24.854	5.182
	Patients	33	24.33	23.772	4.138
ToothColour_1_s	Dental professionals	23	37.65	22.900	4.775
	Patients	33	56.70	30.631	5.332
ToothReduction_0_s	Dental professionals	23	33.00	28.368	5.915
	Patients	33	40.94	32.327	5.627
ToothReduction_1_s	Dental professionals	23	47.00	29.233	6.095
	Patients	33	63.24	31.984	5.568
ToothTrans0_s	Dental professionals	23	35.09	22.950	4.785
	Patients	33	51.88	27.937	4.863
ToothTrans1_s	Dental professionals	23	60.65	27.082	5.647
	Patients	33	66.67	27.404	4.770
AlveolarProcess0_s	Dental professionals	23	75.57	17.365	3.621
	Patients	33	77.12	22.634	3.940
AlveolarProcess1_s	Dental professionals	23	81.13	11.940	2.490
	Patients	33	74.79	24.613	4.285
DistalPap0_s	Dental professionals	23	26.48	23.909	4.985
	Patients	33	31.73	32.092	5.586
DistalPap1_s	Dental professionals	23	37.61	25.237	5.262
	Patients	33	36.88	28.174	4.905
MesialPap0_s	Dental professionals	23	26.61	26.610	5.548
	Patients	33	27.33	27.827	4.844
MesialPap1_s	Dental professionals	23	40.74	23.837	4.970
	Patients	33	36.39	32.101	5.588

ToothSurfaceTexture_0_s	Dental professionals	23	61.39	25.370	5.290
	Patients	33	72.39	26.102	4.544
ToothSurfaceTexture_1_s	Dental professionals	23	70.57	16.200	3.378
	Patients	33	78.79	22.962	3.997
ToothForm_Narrow0_s	Dental professionals	23	43.65	25.375	5.291
	Patients	33	59.79	30.301	5.275
ToothForm_Narrow1_s	Dental professionals	23	77.17	13.207	2.754
	Patients	33	72.73	26.004	4.527
ToothForm_Wide0_s	Dental professionals	23	53.57	29.072	6.062
	Patients	33	69.55	27.620	4.808
ToothForm_Wide1_s	Dental professionals	23	70.00	18.515	3.861
	Patients	33	72.52	24.570	4.277
ToothOutlineVolume_0_s	Dental professionals	23	27.30	25.261	5.267
	Patients	33	46.76	30.361	5.285
ToothOutlineVolume_1_s	Dental professionals	23	52.70	28.069	5.853
	Patients	33	69.76	25.366	4.416
SoftTissueContour0_s	Dental professionals	23	54.43	27.990	5.836
	Patients	33	71.30	27.041	4.707
SoftTissueMargin0_s	Dental professionals	23	16.13	18.840	3.928
	Patients	33	20.61	24.537	4.271
SoftTissueMargin1_s	Dental professionals	23	50.61	24.003	5.005
	Patients	33	63.27	29.055	5.058
SoftTissueTexture_0_s	Dental professionals	23	64.00	20.143	4.200
	Patients	33	67.24	30.526	5.314
SoftTissueTexture_1_s	Dental professionals	23	61.13	19.238	4.011
	Patients	33	74.33	22.572	3.929
SoftTisseContour1_s	Dental professionals	23	66.74	23.917	4.987

	Patients	33	72.61	27.582	4.801
SoftTissueColour0_s	Dental professionals	23	24.83	26.174	5.458
	Patients	33	21.18	25.689	4.472
SoftTissueColour1_s	Dental professionals	23	27.78	26.970	5.624
	Patients	33	22.55	27.376	4.766
Ideal_s	Dental professionals	23	81.43	12.438	2.594
	Patients	33	76.73	27.399	4.770

Appendix D: Differences in satisfaction scores for each photo between dentists and patients

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
ToothColour_0_s	Equal variances assumed	.038	.846	.134	54	.894	.884	6.578	-12.305	14.073
	Equal variances not assumed			.133	46.111	.895	.884	6.632	-12.464	14.232
ToothColour_1_s	Equal variances assumed	4.612	.036	-2.527	54	.014	-19.045	7.536	-34.153	-3.937
	Equal variances not assumed			-2.661	53.685	.010	-19.045	7.158	-33.397	-4.692
ToothReduction_0_s	Equal variances assumed	1.210	.276	-.950	54	.346	-7.939	8.360	-24.699	8.820
	Equal variances not assumed			-.972	51.079	.335	-7.939	8.164	-24.329	8.451
ToothReduction_1_s	Equal variances assumed	.263	.610	-1.936	54	.058	-16.242	8.391	-33.066	.581
	Equal variances not assumed			-1.967	50.066	.055	-16.242	8.256	-32.824	.339
ToothTrans0_s	Equal variances assumed	3.454	.069	-2.376	54	.021	-16.792	7.068	-30.962	-2.621
	Equal variances not assumed			-2.461	52.448	.017	-16.792	6.823	-30.480	-3.103
ToothTrans1_s	Equal variances assumed	.021	.886	-.812	54	.420	-6.014	7.408	-20.867	8.838

	Equal variances not assumed			-.814	47.851	.420	-6.014	7.392	-20.879	8.850
AlveolarProcess0_s	Equal variances assumed	.569	.454	-.277	54	.783	-1.556	5.609	-12.802	9.690
	Equal variances not assumed			-.291	53.437	.772	-1.556	5.351	-12.287	9.175
AlveolarProcess1_s	Equal variances assumed	8.929	.004	1.143	54	.258	6.343	5.547	-4.779	17.464
	Equal variances not assumed			1.280	49.114	.207	6.343	4.955	-3.615	16.300
DistalPap0_s	Equal variances assumed	4.547	.038	-.665	54	.509	-5.249	7.887	-21.062	10.564
	Equal variances not assumed			-.701	53.713	.486	-5.249	7.487	-20.262	9.764
DistalPap1_s	Equal variances assumed	.277	.601	.099	54	.921	.730	7.338	-13.983	15.442
	Equal variances not assumed			.101	50.582	.920	.730	7.193	-13.714	15.174
MesialPap0_s	Equal variances assumed	.086	.770	-.098	54	.923	-.725	7.426	-15.612	14.163
	Equal variances not assumed			-.098	48.820	.922	-.725	7.366	-15.528	14.078
ToothSurfaceTexture_0_s	Equal variances assumed	.000	.989	-1.570	54	.122	-11.003	7.010	-25.056	3.051
	Equal variances not assumed			-1.578	48.346	.121	-11.003	6.973	-25.021	3.016
ToothSurfaceTexture_1_s	Equal variances assumed	2.056	.157	-1.478	54	.145	-8.223	5.562	-19.375	2.929
	Equal variances not assumed			-1.571	53.981	.122	-8.223	5.233	-18.715	2.270

ToothForm_Narrow0_s	Equal variances assumed	.841	.363	-2.092	54	.041	-16.136	7.714	-31.600	-.671
	Equal variances not assumed			-2.160	52.089	.035	-16.136	7.471	-31.127	-1.144
ToothForm_Narrow1_s	Equal variances assumed	8.418	.005	.754	54	.454	4.447	5.900	-7.382	16.275
	Equal variances not assumed			.839	50.090	.405	4.447	5.299	-6.195	15.089
ToothForm_Wide0_s	Equal variances assumed	.883	.352	-2.085	54	.042	-15.980	7.665	-31.349	-.612
	Equal variances not assumed			-2.065	45.899	.045	-15.980	7.737	-31.555	-.405
ToothForm_Wide1_s	Equal variances assumed	2.054	.158	-.415	54	.680	-2.515	6.058	-14.661	9.630
	Equal variances not assumed			-.437	53.616	.664	-2.515	5.762	-14.069	9.039
ToothOutlineVolume_0_s	Equal variances assumed	3.871	.054	-2.522	54	.015	-19.453	7.713	-34.916	-3.990
	Equal variances not assumed			-2.607	52.213	.012	-19.453	7.462	-34.425	-4.481
ToothOutlineVolume_1_s	Equal variances assumed	1.082	.303	-2.370	54	.021	-17.062	7.198	-31.494	-2.630
	Equal variances not assumed			-2.327	44.304	.025	-17.062	7.332	-31.835	-2.289
SoftTissueContour0_s	Equal variances assumed	.228	.635	-2.264	54	.028	-16.868	7.451	-31.807	-1.930
	Equal variances not assumed			-2.250	46.426	.029	-16.868	7.498	-31.957	-1.779
SoftTissueMargin0_s	Equal variances assumed	.661	.420	-.736	54	.465	-4.476	6.082	-16.670	7.718

	Equal variances not assumed			-.771	53.428	.444	-4.476	5.803	-16.113	7.162
SoftTissueMargin1_s	Equal variances assumed	1.364	.248	-1.720	54	.091	-12.664	7.364	-27.428	2.100
	Equal variances not assumed			-1.780	52.346	.081	-12.664	7.116	-26.940	1.612
SoftTissueTexture_0_s	Equal variances assumed	6.138	.016	-.446	54	.658	-3.242	7.276	-17.829	11.345
	Equal variances not assumed			-.479	53.883	.634	-3.242	6.773	-16.823	10.338
SoftTissueTexture_1_s	Equal variances assumed	.319	.575	-2.284	54	.026	-13.203	5.779	-24.790	-1.616
	Equal variances not assumed			-2.351	51.729	.023	-13.203	5.615	-24.472	-1.934
SoftTisseContour1_s	Equal variances assumed	.767	.385	-.826	54	.412	-5.867	7.103	-20.108	8.374
	Equal variances not assumed			-.847	51.353	.401	-5.867	6.923	-19.762	8.029
SoftTissueColour0_s	Equal variances assumed	.007	.935	.518	54	.606	3.644	7.032	-10.453	17.742
	Equal variances not assumed			.517	46.918	.608	3.644	7.056	-10.551	17.839
SoftTissueColour1_s	Equal variances assumed	.073	.789	.709	54	.482	5.237	7.391	-9.581	20.056
	Equal variances not assumed			.710	47.945	.481	5.237	7.371	-9.584	20.058
MesialPap1_s	Equal variances assumed	4.858	.032	.551	54	.584	4.345	7.883	-11.458	20.149
	Equal variances not assumed			.581	53.738	.564	4.345	7.479	-10.650	19.341

Ideal_s	Equal variances assumed	8.593	.005	.769	54	.445	4.708	6.122	-7.565	16.980
	Equal variances not assumed			.867	47.661	.390	4.708	5.429	-6.210	15.625

Appendix E: Mean satisfaction scores for each photo between dentists and patients (statistically significant difference in red)

Occupation		N	Mean	Std. Deviation	Std. Error Mean
ToothColour_0_s	Dental professionals	23	25.22	24.854	5.182
	Patients	33	24.33	23.772	4.138
ToothColour_1_s	Dental professionals	23	37.65	22.900	4.775
	Patients	33	56.70	30.631	5.332
ToothReduction_0_s	Dental professionals	23	33.00	28.368	5.915
	Patients	33	40.94	32.327	5.627
ToothReduction_1_s	Dental professionals	23	47.00	29.233	6.095
	Patients	33	63.24	31.984	5.568
ToothTrans0_s	Dental professionals	23	35.09	22.950	4.785
	Patients	33	51.88	27.937	4.863
ToothTrans1_s	Dental professionals	23	60.65	27.082	5.647
	Patients	33	66.67	27.404	4.770
AlveolarProcess0_s	Dental professionals	23	75.57	17.365	3.621
	Patients	33	77.12	22.634	3.940
AlveolarProcess1_s	Dental professionals	23	81.13	11.940	2.490
	Patients	33	74.79	24.613	4.285
DistalPap0_s	Dental professionals	23	26.48	23.909	4.985
	Patients	33	31.73	32.092	5.586
DistalPap1_s	Dental professionals	23	37.61	25.237	5.262

	Patients	33	36.88	28.174	4.905
MesialPap0_s	Dental professionals	23	26.61	26.610	5.548
	Patients	33	27.33	27.827	4.844
ToothSurfaceTexture_0_s	Dental professionals	23	61.39	25.370	5.290
	Patients	33	72.39	26.102	4.544
ToothSurfaceTexture_1_s	Dental professionals	23	70.57	16.200	3.378
	Patients	33	78.79	22.962	3.997
ToothForm_Narrow0_s	Dental professionals	23	43.65	25.375	5.291
	Patients	33	59.79	30.301	5.275
ToothForm_Narrow1_s	Dental professionals	23	77.17	13.207	2.754
	Patients	33	72.73	26.004	4.527
ToothForm_Wide0_s	Dental professionals	23	53.57	29.072	6.062
	Patients	33	69.55	27.620	4.808
ToothForm_Wide1_s	Dental professionals	23	70.00	18.515	3.861
	Patients	33	72.52	24.570	4.277
ToothOutlineVolume_0_s	Dental professionals	23	27.30	25.261	5.267
	Patients	33	46.76	30.361	5.285
ToothOutlineVolume_1_s	Dental professionals	23	52.70	28.069	5.853
	Patients	33	69.76	25.366	4.416
SoftTissueContour0_s	Dental professionals	23	54.43	27.990	5.836
	Patients	33	71.30	27.041	4.707
SoftTissueMargin0_s	Dental professionals	23	16.13	18.840	3.928
	Patients	33	20.61	24.537	4.271

SoftTissueMargin1_s	Dental professionals	23	50.61	24.003	5.005
	Patients	33	63.27	29.055	5.058
SoftTissueTexture_0_s	Dental professionals	23	64.00	20.143	4.200
	Patients	33	67.24	30.526	5.314
SoftTissueTexture_1_s	Dental professionals	23	61.13	19.238	4.011
	Patients	33	74.33	22.572	3.929
SoftTisseContour1_s	Dental professionals	23	66.74	23.917	4.987
	Patients	33	72.61	27.582	4.801
SoftTissueColour0_s	Dental professionals	23	24.83	26.174	5.458
	Patients	33	21.18	25.689	4.472
SoftTissueColour1_s	Dental professionals	23	27.78	26.970	5.624
	Patients	33	22.55	27.376	4.766
MesialPap1_s	Dental professionals	23	40.74	23.837	4.970
	Patients	33	36.39	32.101	5.588
Ideal_s	Dental professionals	23	81.43	12.438	2.594
	Patients	33	76.73	27.399	4.770

Appendix F: Differences in perceptibility for each photo between dentists and patients (no = could not perceive any difference, yes = could perceive any different)

			Occupation		
			Dental professionals	Patients	Total
ToothColour_0_d	no	Count	1	3	4
		% within ToothColour_0_d	25.0%	75.0%	100.0%
		% within occupation	4.3%	9.1%	7.1%
		% of Total	1.8%	5.4%	7.1%
	yes	Count	22	30	52
		% within ToothColour_0_d	42.3%	57.7%	100.0%
		% within occupation	95.7%	90.9%	92.9%
		% of Total	39.3%	53.6%	92.9%
Total		Count	23	33	56
		% within ToothColour_0_d	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.460[a]	1	.498		
Continuity Correction[b]	.023	1	.880		
Likelihood Ratio	.487	1	.485		
Fisher's Exact Test				.636	.453
N of Valid Cases	56				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 1.64.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
ToothColour_1_d	no	Count	0	12	12
		% within ToothColour_1_d	0.0%	100.0%	100.0%
		% within occupation	0.0%	36.4%	21.4%
		% of Total	0.0%	21.4%	21.4%
	yes	Count	23	21	44
		% within ToothColour_1_d	52.3%	47.7%	100.0%
		% within occupation	100.0%	63.6%	78.6%
		% of Total	41.1%	37.5%	78.6%
Total		Count	23	33	56
		% within ToothColour_1_d	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	10.645[a]	1	.001		
Continuity Correction[b]	8.594	1	.003		
Likelihood Ratio	14.931	1	.000		
Fisher's Exact Test				.001	.001
N of Valid Cases	56				

a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 4.93.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
ToothReduction_0_d	no	Count	1	8	9
		% within ToothReduction_0_d	11.1%	88.9%	100.0%
		% within occupation	4.3%	24.2%	16.1%
		% of Total	1.8%	14.3%	16.1%
	yes	Count	22	25	47
		% within ToothReduction_0_d	46.8%	53.2%	100.0%
		% within occupation	95.7%	75.8%	83.9%
		% of Total	39.3%	44.6%	83.9%
Total		Count	23	33	56
		% within ToothReduction_0_d	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	3.977[a]	1	.046		
Continuity Correction[b]	2.639	1	.104		
Likelihood Ratio	4.594	1	.032		
Fisher's Exact Test				.067	.047
N of Valid Cases	56				

a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 3.70.

b. Computed only for a 2x2 table

			Occupation		Total
			Dental professionals	Patients	
ToothReduction_1_d	no	Count	2	13	15
		% within ToothReduction_1_d	13.3%	86.7%	100.0%
		% within occupation	8.7%	39.4%	26.8%
		% of Total	3.6%	23.2%	26.8%
	yes	Count	21	20	41
		% within ToothReduction_1_d	51.2%	48.8%	100.0%
		% within occupation	91.3%	60.6%	73.2%
		% of Total	37.5%	35.7%	73.2%
Total		Count	23	33	56
		% within ToothReduction_1_d	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	6.513[a]	1	.011		
Continuity Correction[b]	5.042	1	.025		
Likelihood Ratio	7.243	1	.007		
Fisher's Exact Test				.014	.010
N of Valid Cases	56				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 6.16.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
ToothTrans0_d	no	Count	1	6	7
		% within ToothTrans0_d	14.3%	85.7%	100.0%
		% within occupation	4.3%	18.2%	12.5%
		% of Total	1.8%	10.7%	12.5%
	yes	Count	22	27	49
		% within ToothTrans0_d	44.9%	55.1%	100.0%
		% within occupation	95.7%	81.8%	87.5%
		% of Total	39.3%	48.2%	87.5%
Total		Count	23	33	56
		% within ToothTrans0_d	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2.372[a]	1	.124		
Continuity Correction[b]	1.275	1	.259		
Likelihood Ratio	2.678	1	.102		
Fisher's Exact Test				.220	.128
N of Valid Cases	56				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 2.88.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
ToothTrans1_d	no	Count	4	13	17
		% within ToothTrans1_d	23.5%	76.5%	100.0%
		% within occupation	17.4%	39.4%	30.4%
		% of Total	7.1%	23.2%	30.4%
	yes	Count	19	20	39
		% within ToothTrans1_d	48.7%	51.3%	100.0%
		% within occupation	82.6%	60.6%	69.6%
		% of Total	33.9%	35.7%	69.6%
Total		Count	23	33	56
		% within ToothTrans1_d	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	3.104[a]	1	.078		
Continuity Correction[b]	2.150	1	.143		
Likelihood Ratio	3.247	1	.072		
Fisher's Exact Test				.139	.070
N of Valid Cases	56				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 6.98.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
AlveolarProcess0_d	no	Count	11	21	32
		% within AlveolarProcess0_d	34.4%	65.6%	100.0%
		% within occupation	47.8%	63.6%	57.1%
		% of Total	19.6%	37.5%	57.1%
	yes	Count	12	12	24
		% within AlveolarProcess0_d	50.0%	50.0%	100.0%
		% within occupation	52.2%	36.4%	42.9%
		% of Total	21.4%	21.4%	42.9%
Total		Count	23	33	56
		% within AlveolarProcess0_d	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.383[a]	1	.240		
Continuity Correction[b]	.813	1	.367		
Likelihood Ratio	1.383	1	.240		
Fisher's Exact Test				.281	.184
N of Valid Cases	56				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 9.86.

b. Computed only for a 2x2 table

			Occupation		Total
			Dental professionals	Patients	
AlveolarProcess1_d	no	Count	10	25	35
		% within AlveolarProcess1_d	28.6%	71.4%	100.0%
		% within occupation	43.5%	75.8%	62.5%
		% of Total	17.9%	44.6%	62.5%
	yes	Count	13	8	21
		% within AlveolarProcess1_d	61.9%	38.1%	100.0%
		% within occupation	56.5%	24.2%	37.5%
		% of Total	23.2%	14.3%	37.5%
Total		Count	23	33	56
		% within AlveolarProcess1_d	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	6.025[a]	1	.014		
Continuity Correction[b]	4.727	1	.030		
Likelihood Ratio	6.048	1	.014		
Fisher's Exact Test				.024	.015
N of Valid Cases	56				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 8.63.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
DistalPap0_d	no	Count	1	2	3
		% within DistalPap0_d	33.3%	66.7%	100.0%
		% within occupation	4.3%	6.1%	5.4%
		% of Total	1.8%	3.6%	5.4%
	yes	Count	22	31	53
		% within DistalPap0_d	41.5%	58.5%	100.0%
		% within occupation	95.7%	93.9%	94.6%
		% of Total	39.3%	55.4%	94.6%
Total		Count	23	33	56
		% within DistalPap0_d	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.078[a]	1	.779		
Continuity Correction[b]	0.000	1	1.000		
Likelihood Ratio	.080	1	.777		
Fisher's Exact Test				1.000	.635
N of Valid Cases	56				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 1.23.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
DistalPap1_d	no	Count	2	4	6
		% within DistalPap1_d	33.3%	66.7%	100.0%
		% within occupation	8.7%	12.1%	10.7%
		% of Total	3.6%	7.1%	10.7%
	yes	Count	21	29	50
		% within DistalPap1_d	42.0%	58.0%	100.0%
		% within occupation	91.3%	87.9%	89.3%
		% of Total	37.5%	51.8%	89.3%
Total		Count	23	33	56
		% within DistalPap1_d	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.166[a]	1	.683		
Continuity Correction[b]	0.000	1	1.000		
Likelihood Ratio	.170	1	.680		
Fisher's Exact Test				1.000	.521
N of Valid Cases	56				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 2.46.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
MesialPap0_d	no	Count	3	4	7
		% within MesialPap0_d	42.9%	57.1%	100.0%
		% within occupation	13.0%	12.1%	12.5%
		% of Total	5.4%	7.1%	12.5%
	yes	Count	20	29	49
		% within MesialPap0_d	40.8%	59.2%	100.0%
		% within occupation	87.0%	87.9%	87.5%
		% of Total	35.7%	51.8%	87.5%
Total		Count	23	33	56
		% within MesialPap0_d	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.011[a]	1	.918		
Continuity Correction[b]	0.000	1	1.000		
Likelihood Ratio	.011	1	.918		
Fisher's Exact Test				1.000	.613
N of Valid Cases	56				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 2.88.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
MesialPap1_d	no	Count	2	7	9
		% within MesialPap1_d	22.2%	77.8%	100.0%
		% within occupation	8.7%	21.2%	16.1%
		% of Total	3.6%	12.5%	16.1%
	yes	Count	21	26	47
		% within MesialPap1_d	44.7%	55.3%	100.0%
		% within occupation	91.3%	78.8%	83.9%
		% of Total	37.5%	46.4%	83.9%
Total		Count	23	33	56
		% within MesialPap1_d	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.574[a]	1	.210		
Continuity Correction[b]	.783	1	.376		
Likelihood Ratio	1.680	1	.195		
Fisher's Exact Test				.282	.190
N of Valid Cases	56				

a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 3.70.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
ToothSurfaceTexture_0_d	no	Count	6	18	24
		% within ToothSurfaceTexture_0_d	25.0%	75.0%	100.0%
		% within occupation	26.1%	54.5%	42.9%
		% of Total	10.7%	32.1%	42.9%
	yes	Count	17	15	32
		% within ToothSurfaceTexture_0_d	53.1%	46.9%	100.0%
		% within occupation	73.9%	45.5%	57.1%
		% of Total	30.4%	26.8%	57.1%
Total		Count	23	33	56
		% within ToothSurfaceTexture_0_d	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	4.482[a]	1	.034		
Continuity Correction[b]	3.395	1	.065		
Likelihood Ratio	4.609	1	.032		
Fisher's Exact Test				.054	.032
N of Valid Cases	56				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 9.86.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
ToothSurfaceTexture_1_d	no	Count	8	25	33
		% within ToothSurfaceTexture_1_d	24.2%	75.8%	100.0%
		% within occupation	34.8%	75.8%	58.9%
		% of Total	14.3%	44.6%	58.9%
	yes	Count	15	8	23
		% within ToothSurfaceTexture_1_d	65.2%	34.8%	100.0%
		% within occupation	65.2%	24.2%	41.1%
		% of Total	26.8%	14.3%	41.1%
Total		Count	23	33	56
		% within ToothSurfaceTexture_1_d	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	9.402[a]	1	.002		
Continuity Correction[b]	7.785	1	.005		
Likelihood Ratio	9.562	1	.002		
Fisher's Exact Test				.003	.003
N of Valid Cases	56				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 9.45.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
ToothForm_Narrow0_d	no	Count	1	11	12
		% within ToothForm_Narrow0_d	8.3%	91.7%	100.0%
		% within occupation	4.3%	33.3%	21.4%
		% of Total	1.8%	19.6%	21.4%
	yes	Count	22	22	44
		% within ToothForm_Narrow0_d	50.0%	50.0%	100.0%
		% within occupation	95.7%	66.7%	78.6%
		% of Total	39.3%	39.3%	78.6%
Total		Count	23	33	56
		% within ToothForm_Narrow0_d	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	6.763[a]	1	.009		
Continuity Correction[b]	5.151	1	.023		
Likelihood Ratio	7.956	1	.005		
Fisher's Exact Test				.010	.009
N of Valid Cases	56				

a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 4.93.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
ToothForm_Narrow1_d	no	Count	9	22	31
		% within ToothForm_Narrow1_d	29.0%	71.0%	100.0%
		% within occupation	39.1%	66.7%	55.4%
		% of Total	16.1%	39.3%	55.4%
	yes	Count	14	11	25
		% within ToothForm_Narrow1_d	56.0%	44.0%	100.0%
		% within occupation	60.9%	33.3%	44.6%
		% of Total	25.0%	19.6%	44.6%
Total		Count	23	33	56
		% within ToothForm_Narrow1_d	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	4.159[a]	1	.041		
Continuity Correction[b]	3.119	1	.077		
Likelihood Ratio	4.189	1	.041		
Fisher's Exact Test				.057	.038
N of Valid Cases	56				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 10.27.

b. Computed only for a 2x2 table

			Occupation		Total
			Dental professionals	Patients	
ToothForm_Wide0_d	no	Count	4	17	21
		% within ToothForm_Wide0_d	19.0%	81.0%	100.0%
		% within occupation	17.4%	51.5%	37.5%
		% of Total	7.1%	30.4%	37.5%
	yes	Count	19	16	35
		% within ToothForm_Wide0_d	54.3%	45.7%	100.0%
		% within occupation	82.6%	48.5%	62.5%
		% of Total	33.9%	28.6%	62.5%
Total		Count	23	33	56
		% within ToothForm_Wide0_d	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	6.734[a]	1	.009		
Continuity Correction[b]	5.357	1	.021		
Likelihood Ratio	7.124	1	.008		
Fisher's Exact Test				.012	.009
N of Valid Cases	56				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 8.63.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
ToothForm_Wide1_d	no	Count	7	20	27
		% within ToothForm_Wide1_d	25.9%	74.1%	100.0%
		% within occupation	30.4%	60.6%	48.2%
		% of Total	12.5%	35.7%	48.2%
	yes	Count	16	13	29
		% within ToothForm_Wide1_d	55.2%	44.8%	100.0%
		% within occupation	69.6%	39.4%	51.8%
		% of Total	28.6%	23.2%	51.8%
Total		Count	23	33	56
		% within ToothForm_Wide1_d	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	4.941[a]	1	.026		
Continuity Correction[b]	3.807	1	.051		
Likelihood Ratio	5.042	1	.025		
Fisher's Exact Test				.033	.025
N of Valid Cases	56				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 11.09.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
ToothOutlineVolume_0_d	no	Count	1	8	9
		% within ToothOutlineVolume_0_d	11.1%	88.9%	100.0%
		% within occupation	4.3%	24.2%	16.1%
		% of Total	1.8%	14.3%	16.1%
	yes	Count	22	25	47
		% within ToothOutlineVolume_0_d	46.8%	53.2%	100.0%
		% within occupation	95.7%	75.8%	83.9%
		% of Total	39.3%	44.6%	83.9%
Total		Count	23	33	56
		% within ToothOutlineVolume_0_d	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	3.977[a]	1	.046		
Continuity Correction[b]	2.639	1	.104		
Likelihood Ratio	4.594	1	.032		
Fisher's Exact Test				.067	.047
N of Valid Cases	56				

a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 3.70.

b. Computed only for a 2x2 table

			Occupation		Total
			Dental professionals	Patients	
ToothOutlineVolume_1_d	no	Count	4	19	23
		% within ToothOutlineVolume_1_d	17.4%	82.6%	100.0%
		% within occupation	17.4%	57.6%	41.1%
		% of Total	7.1%	33.9%	41.1%
	yes	Count	19	14	33
		% within ToothOutlineVolume_1_d	57.6%	42.4%	100.0%
		% within occupation	82.6%	42.4%	58.9%
		% of Total	33.9%	25.0%	58.9%
Total		Count	23	33	56
		% within ToothOutlineVolume_1_d	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	9.043[a]	1	.003		
Continuity Correction[b]	7.459	1	.006		
Likelihood Ratio	9.596	1	.002		
Fisher's Exact Test				.005	.003
N of Valid Cases	56				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 9.45.

b. Computed only for a 2x2 table

			Occupation		Total
			Dental professionals	Patients	
SoftTissueContour0_d	no	Count	4	21	25
		% within SoftTissueContour0_d	16.0%	84.0%	100.0%
		% within occupation	17.4%	63.6%	44.6%
		% of Total	7.1%	37.5%	44.6%
	yes	Count	19	12	31
		% within SoftTissueContour0_d	61.3%	38.7%	100.0%
		% within occupation	82.6%	36.4%	55.4%
		% of Total	33.9%	21.4%	55.4%
Total		Count	23	33	56
		% within SoftTissueContour0_d	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	11.729[a]	1	.001		
Continuity Correction[b]	9.932	1	.002		
Likelihood Ratio	12.473	1	.000		
Fisher's Exact Test				.001	.001
N of Valid Cases	56				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 10.27.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
SoftTisseContour1_d	no	Count	5	20	25
		% within SoftTisseContour1_d	20.0%	80.0%	100.0%
		% within occupation	21.7%	60.6%	44.6%
		% of Total	8.9%	35.7%	44.6%
	yes	Count	18	13	31
		% within SoftTisseContour1_d	58.1%	41.9%	100.0%
		% within occupation	78.3%	39.4%	55.4%
		% of Total	32.1%	23.2%	55.4%
Total		Count	23	33	56
		% within SoftTisseContour1_d	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	8.285[a]	1	.004		
Continuity Correction[b]	6.787	1	.009		
Likelihood Ratio	8.652	1	.003		
Fisher's Exact Test				.006	.004
N of Valid Cases	56				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 10.27.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
SoftTissueMargin0_d	no	Count	0	2	2
		% within SoftTissueMargin0_d	0.0%	100.0%	100.0%
		% within occupation	0.0%	6.1%	3.6%
		% of Total	0.0%	3.6%	3.6%
	yes	Count	23	31	54
		% within SoftTissueMargin0_d	42.6%	57.4%	100.0%
		% within occupation	100.0%	93.9%	96.4%
		% of Total	41.1%	55.4%	96.4%
Total		Count	23	33	56
		% within SoftTissueMargin0_d	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.446[a]	1	.229		
Continuity Correction[b]	.221	1	.638		
Likelihood Ratio	2.167	1	.141		
Fisher's Exact Test				.507	.343
N of Valid Cases	56				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is .82.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Pstients	Total
SoftTissueMargin1_d	no	Count	3	15	18
		% within SoftTissueMargin1_d	16.7%	83.3%	100.0%
		% within occupation	13.0%	45.5%	32.1%
		% of Total	5.4%	26.8%	32.1%
	yes	Count	20	18	38
		% within SoftTissueMargin1_d	52.6%	47.4%	100.0%
		% within occupation	87.0%	54.5%	67.9%
		% of Total	35.7%	32.1%	67.9%
Total		Count	23	33	56
		% within SoftTissueMargin1_d	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	6.528[a]	1	.011		
Continuity Correction[b]	5.126	1	.024		
Likelihood Ratio	7.043	1	.008		
Fisher's Exact Test				.019	.010
N of Valid Cases	56				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 7.39.

b. Computed only for a 2x2 table

			Occupation		Total
			Dental professionals	Patients	
SoftTissueTexture_0_d	no	Count	4	18	22
		% within SoftTissueTexture_0_d	18.2%	81.8%	100.0%
		% within occupation	17.4%	54.5%	39.3%
		% of Total	7.1%	32.1%	39.3%
	yes	Count	19	15	34
		% within SoftTissueTexture_0_d	55.9%	44.1%	100.0%
		% within occupation	82.6%	45.5%	60.7%
		% of Total	33.9%	26.8%	60.7%
Total		Count	23	33	56
		% within SoftTissueTexture_0_d	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	7.844[a]	1	.005		
Continuity Correction[b]	6.364	1	.012		
Likelihood Ratio	8.313	1	.004		
Fisher's Exact Test				.006	.005
N of Valid Cases	56				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 9.04.

b. Computed only for a 2x2 table

			Occupation		Total
			Dental professionals	Patients	
SoftTissueTexture_1_d	no	Count	4	20	24
		% within SoftTissueTexture_1_d	16.7%	83.3%	100.0%
		% within occupation	17.4%	60.6%	42.9%
		% of Total	7.1%	35.7%	42.9%
	yes	Count	19	13	32
		% within SoftTissueTexture_1_d	59.4%	40.6%	100.0%
		% within occupation	82.6%	39.4%	57.1%
		% of Total	33.9%	23.2%	57.1%
Total		Count	23	33	56
		% within SoftTissueTexture_1_d	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	10.336[a]	1	.001		
Continuity Correction[b]	8.646	1	.003		
Likelihood Ratio	10.980	1	.001		
Fisher's Exact Test				.002	.001
N of Valid Cases	56				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 9.86.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
SoftTissueColour0_d	no	Count	0	1	1
		% within SoftTissueColour0_d	0.0%	100.0%	100.0%
		% within occupation	0.0%	3.0%	1.8%
		% of Total	0.0%	1.8%	1.8%
	yes	Count	23	32	55
		% within SoftTissueColour0_d	41.8%	58.2%	100.0%
		% within occupation	100.0%	97.0%	98.2%
		% of Total	41.1%	57.1%	98.2%
Total		Count	23	33	56
		% within SoftTissueColour0_d	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.710[a]	1	.400		
Continuity Correction[b]	0.000	1	1.000		
Likelihood Ratio	1.070	1	.301		
Fisher's Exact Test				1.000	.589
N of Valid Cases	56				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is .41.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
SoftTissueColour1_d	yes	Count	23	33	56
		% within SoftTissueColour1_d	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%
Total		Count	23	33	56
		% within SoftTissueColour1_d	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value
Pearson Chi-Square	.[a]
N of Valid Cases	56

a. No statistics are computed because SoftTissueColour1_d is a constant.

			Occupation		
			Dental professionals	Patients	Total
Ideal_d	no	Count	13	25	38
		% within Ideal_d	34.2%	65.8%	100.0%
		% within occupation	56.5%	75.8%	67.9%
		% of Total	23.2%	44.6%	67.9%
	yes	Count	10	8	18
		% within Ideal_d	55.6%	44.4%	100.0%
		% within occupation	43.5%	24.2%	32.1%
		% of Total	17.9%	14.3%	32.1%
Total		Count	23	33	56
		% within Ideal_d	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2.299[a]	1	.129		
Continuity Correction[b]	1.502	1	.220		
Likelihood Ratio	2.282	1	.131		
Fisher's Exact Test				.155	.111
N of Valid Cases	56				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 7.39.

b. Computed only for a 2x2 table

Appendix G: Differences in acceptability for each photo between dentists and patients (no = did not accept the outcome, yes = did accept the outcome)

			Occupation		
			Dental professionals	Patients	Total
ToothColour_0_a	no	Count	21	28	49
		% within ToothColour_0_a	42.9%	57.1%	100.0%
		% within occupation	91.3%	84.8%	87.5%
		% of Total	37.5%	50.0%	87.5%
	yes	Count	2	5	7
		% within ToothColour_0_a	28.6%	71.4%	100.0%
		% within occupation	8.7%	15.2%	12.5%
		% of Total	3.6%	8.9%	12.5%
Total		Count	23	33	56
		% within ToothColour_0_a	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.516[a]	1	.472		
Continuity Correction[b]	.095	1	.758		
Likelihood Ratio	.536	1	.464		
Fisher's Exact Test				.688	.387
N of Valid Cases	56				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 2.88.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
ToothColour_1_a	no	Count	19	16	35
		% within ToothColour_1_a	54.3%	45.7%	100.0%
		% within occupation	82.6%	48.5%	62.5%
		% of Total	33.9%	28.6%	62.5%
	yes	Count	4	17	21
		% within ToothColour_1_a	19.0%	81.0%	100.0%
		% within occupation	17.4%	51.5%	37.5%
		% of Total	7.1%	30.4%	37.5%
Total		Count	23	33	56
		% within ToothColour_1_a	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	6.734[a]	1	.009		
Continuity Correction[b]	5.357	1	.021		
Likelihood Ratio	7.124	1	.008		
Fisher's Exact Test				.012	.009
N of Valid Cases	56				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 8.63.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
ToothReduction_0_a	no	Count	21	23	44
		% within ToothReduction_0_a	47.7%	52.3%	100.0%
		% within occupation	91.3%	69.7%	78.6%
		% of Total	37.5%	41.1%	78.6%
	yes	Count	2	10	12
		% within ToothReduction_0_a	16.7%	83.3%	100.0%
		% within occupation	8.7%	30.3%	21.4%
		% of Total	3.6%	17.9%	21.4%
Total		Count	23	33	56
		% within ToothReduction_0_a	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	3.758[a]	1	.053		
Continuity Correction[b]	2.585	1	.108		
Likelihood Ratio	4.118	1	.042		
Fisher's Exact Test				.096	.051
N of Valid Cases	56				

a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 4.93.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
ToothReduction_1_a	no	Count	16	13	29
		% within ToothReduction_1_a	55.2%	44.8%	100.0%
		% within occupation	69.6%	39.4%	51.8%
		% of Total	28.6%	23.2%	51.8%
	yes	Count	7	20	27
		% within ToothReduction_1_a	25.9%	74.1%	100.0%
		% within occupation	30.4%	60.6%	48.2%
		% of Total	12.5%	35.7%	48.2%
Total		Count	23	33	56
		% within ToothReduction_1_a	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	4.941[a]	1	.026		
Continuity Correction[b]	3.807	1	.051		
Likelihood Ratio	5.042	1	.025		
Fisher's Exact Test				.033	.025
N of Valid Cases	56				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 11.09.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
ToothTrans0_a	no	Count	21	17	38
		% within ToothTrans0_a	55.3%	44.7%	100.0%
		% within occupation	91.3%	51.5%	67.9%
		% of Total	37.5%	30.4%	67.9%
	yes	Count	2	16	18
		% within ToothTrans0_a	11.1%	88.9%	100.0%
		% within occupation	8.7%	48.5%	32.1%
		% of Total	3.6%	28.6%	32.1%
Total		Count	23	33	56
		% within ToothTrans0_a	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	9.838[a]	1	.002		
Continuity Correction[b]	8.098	1	.004		
Likelihood Ratio	11.022	1	.001		
Fisher's Exact Test				.003	.002
N of Valid Cases	56				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 7.39.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
ToothTrans1_a	no	Count	13	10	23
		% within ToothTrans1_a	56.5%	43.5%	100.0%
		% within occupation	56.5%	30.3%	41.1%
		% of Total	23.2%	17.9%	41.1%
	yes	Count	10	23	33
		% within ToothTrans1_a	30.3%	69.7%	100.0%
		% within occupation	43.5%	69.7%	58.9%
		% of Total	17.9%	41.1%	58.9%
Total		Count	23	33	56
		% within ToothTrans1_a	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	3.850[a]	1	.050		
Continuity Correction[b]	2.842	1	.092		
Likelihood Ratio	3.860	1	.049		
Fisher's Exact Test				.060	.046
N of Valid Cases	56				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 9.45.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
AlveolarProcess0_a	no	Count	2	5	7
		% within AlveolarProcess0_a	28.6%	71.4%	100.0%
		% within occupation	8.7%	15.2%	12.5%
		% of Total	3.6%	8.9%	12.5%
	yes	Count	21	28	49
		% within AlveolarProcess0_a	42.9%	57.1%	100.0%
		% within occupation	91.3%	84.8%	87.5%
		% of Total	37.5%	50.0%	87.5%
Total		Count	23	33	56
		% within AlveolarProcess0_a	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.516[a]	1	.472		
Continuity Correction[b]	.095	1	.758		
Likelihood Ratio	.536	1	.464		
Fisher's Exact Test				.688	.387
N of Valid Cases	56				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 2.88.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
AlveolarProcess1_a	no	Count	0	4	4
		% within AlveolarProcess1_a	0.0%	100.0%	100.0%
		% within occupation	0.0%	12.1%	7.1%
		% of Total	0.0%	7.1%	7.1%
	yes	Count	23	29	52
		% within AlveolarProcess1_a	44.2%	55.8%	100.0%
		% within occupation	100.0%	87.9%	92.9%
		% of Total	41.1%	51.8%	92.9%
Total		Count	23	33	56
		% within AlveolarProcess1_a	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	3.002[a]	1	.083		
Continuity Correction[b]	1.453	1	.228		
Likelihood Ratio	4.444	1	.035		
Fisher's Exact Test				.136	.111
N of Valid Cases	56				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 1.64.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
DistalPap0_a	no	Count	22	28	50
		% within DistalPap0_a	44.0%	56.0%	100.0%
		% within occupation	95.7%	84.8%	89.3%
		% of Total	39.3%	50.0%	89.3%
	yes	Count	1	5	6
		% within DistalPap0_a	16.7%	83.3%	100.0%
		% within occupation	4.3%	15.2%	10.7%
		% of Total	1.8%	8.9%	10.7%
Total		Count	23	33	56
		% within DistalPap0_a	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.654[a]	1	.198		
Continuity Correction[b]	.717	1	.397		
Likelihood Ratio	1.837	1	.175		
Fisher's Exact Test				.384	.202
N of Valid Cases	56				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 2.46.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
DistalPap1_a	no	Count	18	24	42
		% within DistalPap1_a	42.9%	57.1%	100.0%
		% within occupation	78.3%	72.7%	75.0%
		% of Total	32.1%	42.9%	75.0%
	yes	Count	5	9	14
		% within DistalPap1_a	35.7%	64.3%	100.0%
		% within occupation	21.7%	27.3%	25.0%
		% of Total	8.9%	16.1%	25.0%
Total		Count	23	33	56
		% within DistalPap1_a	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.221[a]	1	.638		
Continuity Correction[b]	.025	1	.875		
Likelihood Ratio	.224	1	.636		
Fisher's Exact Test				.759	.442
N of Valid Cases	56				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 5.75.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
MesialPap0_a	no	Count	20	28	48
		% within MesialPap0_a	41.7%	58.3%	100.0%
		% within occupation	87.0%	84.8%	85.7%
		% of Total	35.7%	50.0%	85.7%
	yes	Count	3	5	8
		% within MesialPap0_a	37.5%	62.5%	100.0%
		% within occupation	13.0%	15.2%	14.3%
		% of Total	5.4%	8.9%	14.3%
Total		Count	23	33	56
		% within MesialPap0_a	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.049[a]	1	.824		
Continuity Correction[b]	0.000	1	1.000		
Likelihood Ratio	.050	1	.824		
Fisher's Exact Test				1.000	.572
N of Valid Cases	56				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 3.29.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
MesialPap1_a	no	Count	17	24	41
		% within MesialPap1_a	41.5%	58.5%	100.0%
		% within occupation	73.9%	72.7%	73.2%
		% of Total	30.4%	42.9%	73.2%
	yes	Count	6	9	15
		% within MesialPap1_a	40.0%	60.0%	100.0%
		% within occupation	26.1%	27.3%	26.8%
		% of Total	10.7%	16.1%	26.8%
Total		Count	23	33	56
		% within MesialPap1_a	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.010[a]	1	.921		
Continuity Correction[b]	0.000	1	1.000		
Likelihood Ratio	.010	1	.921		
Fisher's Exact Test				1.000	.585
N of Valid Cases	56				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 6.16.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
ToothSurfaceTexture_0_a	no	Count	12	6	18
		% within ToothSurfaceTexture_0_a	66.7%	33.3%	100.0%
		% within occupation	52.2%	18.2%	32.1%
		% of Total	21.4%	10.7%	32.1%
	yes	Count	11	27	38
		% within ToothSurfaceTexture_0_a	28.9%	71.1%	100.0%
		% within occupation	47.8%	81.8%	67.9%
		% of Total	19.6%	48.2%	67.9%
Total		Count	23	33	56
		% within ToothSurfaceTexture_0_a	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	7.180[a]	1	.007		
Continuity Correction[b]	5.706	1	.017		
Likelihood Ratio	7.195	1	.007		
Fisher's Exact Test				.010	.009
N of Valid Cases	56				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 7.39.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
ToothSurfaceTexture_1_a	no	Count	3	4	7
		% within ToothSurfaceTexture_1_a	42.9%	57.1%	100.0%
		% within occupation	13.0%	12.1%	12.5%
		% of Total	5.4%	7.1%	12.5%
	yes	Count	20	29	49
		% within ToothSurfaceTexture_1_a	40.8%	59.2%	100.0%
		% within occupation	87.0%	87.9%	87.5%
		% of Total	35.7%	51.8%	87.5%
Total		Count	23	33	56
		% within ToothSurfaceTexture_1_a	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.011[a]	1	.918		
Continuity Correction[b]	0.000	1	1.000		
Likelihood Ratio	.011	1	.918		
Fisher's Exact Test				1.000	.613
N of Valid Cases	56				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 2.88.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
ToothForm_Narrow0_a	no	Count	19	13	32
		% within ToothForm_Narrow0_a	59.4%	40.6%	100.0%
		% within occupation	82.6%	39.4%	57.1%
		% of Total	33.9%	23.2%	57.1%
	yes	Count	4	20	24
		% within ToothForm_Narrow0_a	16.7%	83.3%	100.0%
		% within occupation	17.4%	60.6%	42.9%
		% of Total	7.1%	35.7%	42.9%
Total		Count	23	33	56
		% within ToothForm_Narrow0_a	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	10.336[a]	1	.001		
Continuity Correction[b]	8.646	1	.003		
Likelihood Ratio	10.980	1	.001		
Fisher's Exact Test				.002	.001
N of Valid Cases	56				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 9.86.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
ToothForm_Narrow1_a	no	Count	1	6	7
		% within ToothForm_Narrow1_a	14.3%	85.7%	100.0%
		% within occupation	4.3%	18.2%	12.5%
		% of Total	1.8%	10.7%	12.5%
	yes	Count	22	27	49
		% within ToothForm_Narrow1_a	44.9%	55.1%	100.0%
		% within occupation	95.7%	81.8%	87.5%
		% of Total	39.3%	48.2%	87.5%
Total		Count	23	33	56
		% within ToothForm_Narrow1_a	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2.372[a]	1	.124		
Continuity Correction[b]	1.275	1	.259		
Likelihood Ratio	2.678	1	.102		
Fisher's Exact Test				.220	.128
N of Valid Cases	56				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 2.88.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
ToothForm_Wide0_a	no	Count	14	10	24
		% within ToothForm_Wide0_a	58.3%	41.7%	100.0%
		% within occupation	60.9%	30.3%	42.9%
		% of Total	25.0%	17.9%	42.9%
	yes	Count	9	23	32
		% within ToothForm_Wide0_a	28.1%	71.9%	100.0%
		% within occupation	39.1%	69.7%	57.1%
		% of Total	16.1%	41.1%	57.1%
Total		Count	23	33	56
		% within ToothForm_Wide0_a	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	5.171[a]	1	.023		
Continuity Correction[b]	3.998	1	.046		
Likelihood Ratio	5.212	1	.022		
Fisher's Exact Test				.030	.023
N of Valid Cases	56				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 9.86.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
ToothForm_Wide1_a	no	Count	5	6	11
		% within ToothForm_Wide1_a	45.5%	54.5%	100.0%
		% within occupation	21.7%	18.2%	19.6%
		% of Total	8.9%	10.7%	19.6%
	yes	Count	18	27	45
		% within ToothForm_Wide1_a	40.0%	60.0%	100.0%
		% within occupation	78.3%	81.8%	80.4%
		% of Total	32.1%	48.2%	80.4%
Total		Count	23	33	56
		% within ToothForm_Wide1_a	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.109[a]	1	.742		
Continuity Correction[b]	0.000	1	1.000		
Likelihood Ratio	.108	1	.743		
Fisher's Exact Test				.746	.500
N of Valid Cases	56				

a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 4.52.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
ToothOutlineVolume_0_a	no	Count	21	17	38
		% within ToothOutlineVolume_0_a	55.3%	44.7%	100.0%
		% within occupation	91.3%	51.5%	67.9%
		% of Total	37.5%	30.4%	67.9%
	yes	Count	2	16	18
		% within ToothOutlineVolume_0_a	11.1%	88.9%	100.0%
		% within occupation	8.7%	48.5%	32.1%
		% of Total	3.6%	28.6%	32.1%
Total		Count	23	33	56
		% within ToothOutlineVolume_0_a	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	9.838[a]	1	.002		
Continuity Correction[b]	8.098	1	.004		
Likelihood Ratio	11.022	1	.001		
Fisher's Exact Test				.003	.002
N of Valid Cases	56				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 7.39.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
ToothOutlineVolume_1_a	no	Count	10	7	17
		% within ToothOutlineVolume_1_a	58.8%	41.2%	100.0%
		% within occupation	43.5%	21.2%	30.4%
		% of Total	17.9%	12.5%	30.4%
	yes	Count	13	26	39
		% within ToothOutlineVolume_1_a	33.3%	66.7%	100.0%
		% within occupation	56.5%	78.8%	69.6%
		% of Total	23.2%	46.4%	69.6%
Total		Count	23	33	56
		% within ToothOutlineVolume_1_a	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	3.178[a]	1	.075		
Continuity Correction[b]	2.212	1	.137		
Likelihood Ratio	3.154	1	.076		
Fisher's Exact Test				.087	.069
N of Valid Cases	56				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 6.98.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
SoftTissueContour0_a	no	Count	11	8	19
		% within SoftTissueContour0_a	57.9%	42.1%	100.0%
		% within occupation	47.8%	24.2%	33.9%
		% of Total	19.6%	14.3%	33.9%
	yes	Count	12	25	37
		% within SoftTissueContour0_a	32.4%	67.6%	100.0%
		% within occupation	52.2%	75.8%	66.1%
		% of Total	21.4%	44.6%	66.1%
Total		Count	23	33	56
		% within SoftTissueContour0_a	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	3.363[a]	1	.067		
Continuity Correction[b]	2.393	1	.122		
Likelihood Ratio	3.347	1	.067		
Fisher's Exact Test				.089	.061
N of Valid Cases	56				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 7.80.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
SoftTisseContour1_a	no	Count	7	8	15
		% within SoftTisseContour1_a	46.7%	53.3%	100.0%
		% within occupation	30.4%	24.2%	26.8%
		% of Total	12.5%	14.3%	26.8%
	yes	Count	16	25	41
		% within SoftTisseContour1_a	39.0%	61.0%	100.0%
		% within occupation	69.6%	75.8%	73.2%
		% of Total	28.6%	44.6%	73.2%
Total		Count	23	33	56
		% within SoftTisseContour1_a	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.265[a]	1	.607		
Continuity Correction[b]	.043	1	.835		
Likelihood Ratio	.263	1	.608		
Fisher's Exact Test				.760	.415
N of Valid Cases	56				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 6.16.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
SoftTissueMargin0_a	no	Count	23	31	54
		% within SoftTissueMargin0_a	42.6%	57.4%	100.0%
		% within occupation	100.0%	93.9%	96.4%
		% of Total	41.1%	55.4%	96.4%
	yes	Count	0	2	2
		% within SoftTissueMargin0_a	0.0%	100.0%	100.0%
		% within occupation	0.0%	6.1%	3.6%
		% of Total	0.0%	3.6%	3.6%
Total		Count	23	33	56
		% within SoftTissueMargin0_a	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.446[a]	1	.229		
Continuity Correction[b]	.221	1	.638		
Likelihood Ratio	2.167	1	.141		
Fisher's Exact Test				.507	.343
N of Valid Cases	56				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is .82.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
SoftTissueMargin1_a	no	Count	11	12	23
		% within SoftTissueMargin1_a	47.8%	52.2%	100.0%
		% within occupation	47.8%	36.4%	41.1%
		% of Total	19.6%	21.4%	41.1%
	yes	Count	12	21	33
		% within SoftTissueMargin1_a	36.4%	63.6%	100.0%
		% within occupation	52.2%	63.6%	58.9%
		% of Total	21.4%	37.5%	58.9%
Total		Count	23	33	56
		% within SoftTissueMargin1_a	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.736[a]	1	.391		
Continuity Correction[b]	.338	1	.561		
Likelihood Ratio	.734	1	.392		
Fisher's Exact Test				.421	.280
N of Valid Cases	56				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 9.45.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
SoftTissueTexture_0_a	no	Count	7	9	16
		% within SoftTissueTexture_0_a	43.8%	56.3%	100.0%
		% within occupation	30.4%	27.3%	28.6%
		% of Total	12.5%	16.1%	28.6%
	yes	Count	16	24	40
		% within SoftTissueTexture_0_a	40.0%	60.0%	100.0%
		% within occupation	69.6%	72.7%	71.4%
		% of Total	28.6%	42.9%	71.4%
Total		Count	23	33	56
		% within SoftTissueTexture_0_a	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.066[a]	1	.797		
Continuity Correction[b]	0.000	1	1.000		
Likelihood Ratio	.066	1	.797		
Fisher's Exact Test				1.000	.514
N of Valid Cases	56				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 6.57.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
SoftTissueTexture_1_a	no	Count	7	5	12
		% within SoftTissueTexture_1_a	58.3%	41.7%	100.0%
		% within occupation	30.4%	15.2%	21.4%
		% of Total	12.5%	8.9%	21.4%
	yes	Count	16	28	44
		% within SoftTissueTexture_1_a	36.4%	63.6%	100.0%
		% within occupation	69.6%	84.8%	78.6%
		% of Total	28.6%	50.0%	78.6%
Total		Count	23	33	56
		% within SoftTissueTexture_1_a	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.880[a]	1	.170		
Continuity Correction[b]	1.082	1	0.29822253		
Likelihood Ratio	1.854	1	.173		
Fisher's Exact Test				.200	.149
N of Valid Cases	56				

a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 4.93.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
SoftTissueColour0_a	no	Count	22	31	53
		% within SoftTissueColour0_a	41.5%	58.5%	100.0%
		% within occupation	95.7%	93.9%	94.6%
		% of Total	39.3%	55.4%	94.6%
	yes	Count	1	2	3
		% within SoftTissueColour0_a	33.3%	66.7%	100.0%
		% within occupation	4.3%	6.1%	5.4%
		% of Total	1.8%	3.6%	5.4%
Total		Count	23	33	56
		% within SoftTissueColour0_a	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.078[a]	1	.779		
Continuity Correction[b]	0.000	1	1.000		
Likelihood Ratio	.080	1	.777		
Fisher's Exact Test				1.000	.635
N of Valid Cases	56				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 1.23.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
SoftTissueColour1_a	no	Count	21	30	51
		% within SoftTissueColour1_a	41.2%	58.8%	100.0%
		% within occupation	91.3%	90.9%	91.1%
		% of Total	37.5%	53.6%	91.1%
	yes	Count	2	3	5
		% within SoftTissueColour1_a	40.0%	60.0%	100.0%
		% within occupation	8.7%	9.1%	8.9%
		% of Total	3.6%	5.4%	8.9%
Total		Count	23	33	56
		% within SoftTissueColour1_a	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.003[a]	1	.959		
Continuity Correction[b]	0.000	1	1.000		
Likelihood Ratio	.003	1	.959		
Fisher's Exact Test				1.000	.670
N of Valid Cases	56				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 2.05.

b. Computed only for a 2x2 table

			Occupation		
			Dental professionals	Patients	Total
Ideal_a_01	No	Count	1	4	5
		% within Ideal_a_01	20.0%	80.0%	100.0%
		% within occupation	4.3%	12.1%	8.9%
		% of Total	1.8%	7.1%	8.9%
	Yes	Count	22	29	51
		% within Ideal_a_01	43.1%	56.9%	100.0%
		% within occupation	95.7%	87.9%	91.1%
		% of Total	39.3%	51.8%	91.1%
Total		Count	23	33	56
		% within Ideal_a_01	41.1%	58.9%	100.0%
		% within occupation	100.0%	100.0%	100.0%
		% of Total	41.1%	58.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.007[a]	1	.316		
Continuity Correction[b]	.278	1	.598		
Likelihood Ratio	1.096	1	.295		
Fisher's Exact Test				.639	.309
N of Valid Cases	56				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 2.05.

b. Computed only for a 2x2 table

APPENDIX H: VITA

Goth Siu

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GS

Education

University of Illinois at Chicago
Specialty Certificate in Prosthodontics — 2011-2014

University of Illinois at Chicago
Masters in Oral Sciences (M.Sc.) — 2011-2014

University of Pennsylvania
Doctor of Dental Medicine (DMD) — 2007-2011

Graduating GPA: 3.99

Class rank: 3/138

McMaster University
Bachelor of Health Sciences (BhSc) — 2003-2007

Graduating GPA: 3.91

Awards

UIC College of Dentistry Graduate Student Award for Clinical and Behavioral Science Research, 3rd Place
2014

American Academy of Esthetic Dentistry, Research Grant
2013

Northeastern Gnathological Society, Granger Pruden Memorial Award
2013

American Academy of Implant Dentistry, Student Research Grant
2012

Omicron Kappa Upsilon National Honor Society

2011

Academy of Osseointegration Award for Outstanding Dental Student in Implant Dentistry
2011

E. Howell Smith Award in Prosthetic Dentistry
2011

Matthew Cryer Honor Society
2009

University of Pennsylvania, Dean's Scholarship
2007-2011

McMaster University Dean's Honour List
2003-2007

McMaster University Senate Scholarship
2005, 2006

McMaster President's Award
2003

Fundacao Oriente Scholarship
2004-2007

Research

Improving the Pink and White Esthetic Scores (PES/WES) in Predicting Patient Satisfaction of Anterior Implant Restorations.
In progress

Development of the UIC-modified Pink Esthetic Score (PES) and White Esthetic Score (WES) to Improve Inter and Intra-examiner Agreement
In progress

Prosthodontic Rehabilitation of a Patient with Extensive Maxillectomy utilizing the Quad Zygomatic Implants Concept and CAD-CAM Technology; a Case Report.
In progress

The Culture of the Health Sciences Undergraduate Program
2007

The Effectiveness of the Learnlink Education Tool
2006

Externships

Princess Marina Hospital, Botswana
2010

Prince Philip Dental Hospital, Hong Kong
2011

Teaching Experience

Graduate Teaching Assistant for Complete Denture Prosthodontics, Year 2 lecture/laboratory course
University of Illinois at Chicago 2013

Graduate Teaching Assistant for Removable Prosthodontics, Year 2 lecture/laboratory course
University of Illinois at Chicago 2012

Graduate Teaching Assistant for Implant Comprehensive Care, Year 2 lecture/laboratory course
University of Illinois at Chicago 2011, 2012

Teaching Assistant for Anatomy and Dissection
University of Pennsylvania 2009, 2010

Teaching Assistant for General Restorative Dentistry
University of Pennsylvania 2008

Presentations

UIC Clinic and Research Day
Poster Presentation, Scheduled March 2014

American Academy of Fixed Prosthodontics
Poster Presentation, Scheduled for Feb 2014

American Academy of Implant Dentistry
Poster Presentation, 2013

Predoctoral Prosthodontic/Implant Club
Lecture, 2013

Examinations

National Dental Examining Board of Canada
2011

National Board Dental Examination Part II
2011

National Board Dental Examination Part I
2010

Professional Meetings

American College of Prosthodontist
Annual meeting 2013, 2012, 2011

Northeastern Gnathological Society
Annual meeting 2013

Greater New York Academy of Prosthodontics
Annual meeting 2013, 2012, 2011, 2009

Nobel Biocare Global Symposium – New York
2013

ITI Congress North America – Chicago
2013

American Academy of Fixed Prosthodontics
Annual meeting 2012, 2011

American Prosthodontic Society
Annual meeting 2012, 2011

Nobel Biocare Symposium –Toronto
2012

References

Available upon request