



## A Study to Evaluate Esthetic Parameters Around Dental Implants and Natural Teeth in the Maxillary Anterior Region- An in Vivo Study

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### KEYWORDS :

#### INTRODUCTION

Esthetic demands in today's world of dentistry is soaring new heights, and is driven by the zest to look beautiful. The soft tissue esthetics around implants is the foci of attention, which, if failed to fulfil leads to unacceptable esthetic failure. During the advent of the Branemark system, the esthetic requirement was not one of the prime important factors considered in many years. Palacci was one among the first pioneer clinicians to discuss restorative options taking into consideration the esthetic problem in relation to the peri implant zone in the anterior region of the mouth<sup>1</sup>. Today's world of implantology highlights the appealing prosthetic restorative options as well as the esthetics that are identical to the contralateral natural healthy teeth and the gingival outline harmonious with the gingival silhouette of the adjacent teeth.

When dealing with implant-supported restorations, success, to a large extent, depends on the esthetic outcome. Thus, Smith and Zarb once extended the success criteria by emphasizing the fact that a successful implant must allow for adequate esthetic appearance<sup>2</sup>. The demand for good esthetic outcome from both the professional and the patient becomes an essential part and also a challenge in implant therapy.

#### AIMS AND OBJECTIVES

1. To evaluate and compare the esthetic parameters of single tooth implants and natural dentition.
2. To quantify clinical parameters useful as esthetic guidelines which may enable us to obtain a more predictable outcome.
3. To investigate which esthetic parameter shows greater variation in comparison of single tooth implant in the anterior maxillary region and the natural dentition.

#### METHODOLOGY

##### SOURCE OF THE DATA

The study was conducted on a group of 30 subjects ( age group 18-55 years) visiting outpatient department in A.B.Shetty Memorial Institute of Dental Sciences (Nitte University), Deralakatte, Mangalore. Informed consent (Annexure I) to participate in the study was obtained from each subject and the permission to use the obtained data for the study.

#### INCLUSION CRITERIA

1. Age group of 18 years to 55 years.
2. Single tooth implant supported prosthesis in the maxillary esthetic zone with both neighboring teeth and the contralateral natural tooth present.
3. Minimum of 3 months after implant placement.
4. All patients in good health with no systemic diseases.
5. Signed informed consent.

#### EXCLUSION CRITERIA

1. Less than 3 months after implant placement.
2. Smokers.
3. Untreated periodontal diseases and/or caries.
4. Need of restorative treatment of adjacent teeth.
5. Single tooth implant supported prosthesis in maxillary posterior region and mandibular region.

#### MATERIALS USED

##### PHOTOGRAPHY (Fig 1,2,3)

1. D-SLR camera NIKON D 3200
2. Tameron EF 100 mm f/1.1L Macro IS USM Lens
3. Ring flash

#### METHODOLOGY

Thirty patients from the department of Prosthodontics, A.B.Shetty Memorial Institute of Dental Sciences (A constituent college of Nitte University), Deralakatte, Mangalore were selected for the prospective study. All patients requiring replacement of missing tooth or single tooth extraction as a result of root fractures, caries or failed endodontic treatment were selected.

The study evaluated the single tooth implant supported prosthesis in 30 patients who underwent implant placement in anterior maxillary esthetic zone with contralateral natural tooth in the same jaw.

The following esthetic parameters were examined :

1. Interdental papilla volume
2. Gingival zenith
3. Tooth shape
4. Gingival pigmentation

Pre-treatment clinical examination was performed on the selected patients which included a thorough medical and dental history, current general and oral health status, inclusion and exclusion criteria. Patients were recalled to the institution 3 months after cementation of the single implant supported prosthesis in the anterior esthetic zone and an informed consent was taken from the patient to carry out the photographic analysis and to use the information obtained from the same for the study.

#### PHOTOGRAPHIC ANALYSIS

High quality photographs were taken with D-SLR camera NIKON D 3200 and macro-lens along with a set magnification of 1:1. Photographs were taken 3 months post cementation. The set magnification of the macro-lens helped in taking photographs at a fixed focal length thus standardizing all the photographs taken at a fixed distance. Hence it was very critical to focus on the area of interest as any

tooth closer or further from this focal plane would appear blurred. A ring flash was attached to the macro-lens to eliminate the shadow formation in photographs of such close range. The patient was made to sit upright and the cheek retractor was kept in place for better visibility. The photographs were taken by adjusting the macrolens manually until the area of interest appeared clearly in the set distance and magnification. The photographs taken were then transferred to the computer where further evaluation of the esthetic parameters could be carried out. The software Adobe photoshop version 8 was used to analyse the various esthetic parameters of concern to the study.

The papillary fill was measured by joining the zeniths of the adjacent teeth and then drawing a line perpendicular to it till the contact point in the software. The line was divided into 4 equal parts. The papillary volume fill was measured using papilla index (4) (Jemt 1997)<sup>6</sup>. Scores ranging from 0 to 4 was given based on the soft tissue fill in the interdental area (Fig 4).

**Index score 0:** No papilla is present.

**Index score 1:** Less than half of the height of the papilla is present.

**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.

**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

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

The gingival zeniths were also evaluated of the teeth involved and graded as coinciding or non-coinciding with their contralateral tooth. The gingival zeniths of lateral incisors are found to be placed 1mm coronally when compared to that of the central incisors and canines in the maxillary esthetic zone (Fig 5).

The tooth shape was classified as three groups being square, tapered and ovoid. Ovoid or square teeth give rise to a shallower gingival scallop, while triangular teeth form a pronounced scallop. The latter is responsible to cause the so-called 'black triangles'; especially with a thin biotype which has a higher incidence for recession.

If present, the variation in gingival pigmentation between the teeth involved were determined as light or dark pigmentation.

**RESULTS**

Thirty patients were scheduled from July 2013 to February 2015 for evaluation and comparison of the esthetic parameters of single implant supported prostheses and the contralateral natural tooth in the maxillary anterior esthetic zone. Four parameters were measured three months post cementation. The data obtained on evaluation of various esthetic parameters were tabulated in Microsoft Excel Sheets and the statistical analysis was performed using IBM SPSS Statistics, Version 22 (Armonk NY: IBM Corp). Descriptive data were presented in the form of Mean, Median, Standard Deviation and Quartiles. Marginal homogeneity test was used to compare the interdental papilla volume in the mesial and distal aspects of the implant supported prosthesis and the contralateral natural teeth. McNemar test was used to compare the gingival pigmentation whereas the tooth shape of the implant supported prosthesis and contralateral natural teeth were compared using the fishers exact test. P value <0.05 was considered as statistically significant.

**Table no.1a: EVALUATION OF MESIAL INTER DENTAL PAPILLA BETWEEN IMPLANT SUPPORTED PROSTHESIS AND NATURAL TEETH ON THE CONTRA LATERAL SIDE ACCORDING TO THE JEMT INDEX.**

This table shows the interdental papilla volume in the mesial aspect of both single implant supported prosthesis and contralateral natural teeth. When the mesial inter dental papilla between implant supported prosthesis and natural teeth was compared with that of mesial interdental papilla between two natural teeth on the contra lateral side, maximum of symmetry was seen in 56.7% of cases when papillary fill

was complete with the score of 3, whereas papillary fill asymmetry was noticed in 13.3% of cases when papillary fill was less than half with a score of 2. Marginal Homogeneity Test was not statistically significant (p=0.18) between the two groups.

**Table no.1b: EVALUATION OF DISTAL INTER DENTAL PAPILLA BETWEEN IMPLANT SUPPORTED PROSTHESIS AND NATURAL TEETH ON THE CONTRA LATERAL SIDE ACCORDING TO THE JEMT INDEX.**

This table shows the interdental papilla volume in the distal aspect of both single implant supported prosthesis and contralateral natural teeth. When the distal interdental papilla between implant supported prosthesis and natural teeth was compared with that of distal interdental papilla between two natural teeth on the contra lateral side, maximum of symmetry was seen in 63.3% of cases when papillary fill was complete with the score of 3, whereas papillary fill asymmetry was noticed in 20% of cases when papillary fill was less than half with a score of 2. Marginal Homogeneity Test was not statistically significant (p=0.32) between the two groups.

**Table no.2: EVALUATION OF GINGIVAL PIGMENTATION BETWEEN THE IMPLANT SUPPORTED PROSTHESIS AND NATURAL TEETH ON THE CONTRALATERAL SIDE.**

This table compares the gingival pigmentation between the two groups. 6.7% of subjects showed asymmetry in their gingival pigmentation where the gingival pigmentation was increased in case of implant prosthesis compared to its contra lateral natural tooth. There was however no statistically significant difference (p=0.50) noted between the two groups.

**Table no.3: EVALUATION OF TOOTH SHAPE BETWEEN THE IMPLANT SUPPORTED PROSTHESIS AND NATURAL TEETH ON THE CONTRALATERAL SIDE.**

This table compares the tooth shape of the single implant supported prosthesis and the contralateral natural teeth involved. 23.3% of subjects showed asymmetry in their tooth shape in the 2 groups with a greater asymmetry seen in cases where the natural teeth had an ovoid shape, ie 20%. A statistically significant difference (p=0.001) was seen among the two groups.

**Table no.4: EVALUATION OF GINGIVAL ZENITH BETWEEN IMPLANT SUPPORTED PROSTHESIS AND CONTRA LATERAL NATURAL TOOTH.**

This table shows that only 20% of subjects showed a coinciding gingival zenith whereas 80% of subjects showed a non-coinciding gingival zenith.

**Table no.1a: EVALUATION OF MESIAL INTER DENTAL PAPILLA BETWEEN IMPLANT SUPPORTED PROSTHESIS AND NATURAL TEETH ON THE CONTRA LATERAL SIDE ACCORDING TO THE JEMT INDEX.**

Mesial Inter-dental papilla	Jemt Score	Natural teeth			Total	Marginal Homogeneity test	
		1	2	3		Std MH Statistic	p-value
Implant Supported Prosthesis	1	2 (6.7%)	0	0	2 (6.7%)	-1.34	0.18 (NS)
	2	0	6 (20%)	4 (13.3%)	10 (33.3%)		
	3	0	0	17 (56.7%)	17 (56.7%)		
	4	0	0	1 (3.3%)	1 (3.3%)		
	Total	2 (6.7%)	6 (20%)	22 (73.3%)	30 (100%)		

\*P<0.05 statistically significant

P>0.05 non significant, NS

**Table no.1b: EVALUATION OF DISTAL INTER DENTAL PAPILLA BETWEEN IMPLANT SUPPORTED PROSTHESIS AND NATURAL TEETH ON THE CONTRA LATERAL SIDE ACCORDING TO THE JEMT INDEX.**

Distal Inter-dental papilla	Jemt Score	Natural teeth		Total	Marginal Homogeneity test	
		1	3		Std MH Statistic	p-value
Implant Supported Prosthesis	1	2(6.7%)	0	2(6.7%)	-1.00	0.32(NS)
	2	0	6(20.0%)	6(20.0%)		
	3	0	19(63.3%)	19(63.3%)		
	4	0	3(10.0%)	3(10.0%)		
	Total	2(6.7%)	28(93.3%)	30(100.0%)		

\*P<0.05 statistically significant

P>0.05 non significant, NS

**Table no.2: EVALUATION OF GINGIVAL PIGMENTATION BETWEEN THE IMPLANT SUPPORTED PROSTHESIS AND NATURAL TEETH ON THE CONTRALATERAL SIDE.**

Gingival Pigmentation Increased		Natural Teeth		Total P-value	McNemar test
		De-creased			
Implant Supported Prosthesis	In-creased	8(26.7%)	2(6.7%)	10(33.3%)	0.50(NS)
	De-creased	0	20(66.7%)	20(66.7%)	
Total		8(26.7%)	22(73.3%)	30(100.0%)	

\*P<0.05 statistically significant

P>0.05 non significant, NS

**Table no.3: EVALUATION OF TOOTH SHAPE BETWEEN THE IMPLANT SUPPORTED PROSTHESIS AND NATURAL TEETH ON THE CONTRALATERAL SIDE.**

Tooth Shape Ovoid	Natural Teeth			Total value	Fisher's exact test	
	Square	Triangular			P-value	
Implant Supported Prosthesis	Square	6 (20%)	19 (63.3%)	1 (3.3%)	26 (86.7%)	14.91 <0.001*
	Triangular	0	0	4 (13.3%)	4 (13.3%)	
	Ovoid	0	0	0	0	
Total	6 (20%)	19 (63.3%)	5 (16.7%)	30 (100%)		

\*P<0.05 statistically significant

P>0.05 non significant, NS

**Table no.4: EVALUATION OF GINGIVAL ZENITH BETWEEN IMPLANT SUPPORTED PROSTHESIS AND CONTRA LATERAL NATURAL TOOTH.**

Gingival Zenith			Frequency	Percent
	Coinciding		6	20.0%
	Non- Coinciding		24	80.0%

**DISCUSSION**

The maxillary anterior region, better known as the esthetic zone, due to its high visibility and influence on the individual's appearance is one of the most challenging areas for the clinician. Replacement of a single tooth in this region is one of the most important and difficult tasks to achieve. The tooth can be replaced with a conventional fixed dental prosthesis, which restores the function but, esthetics and the longevity of the adjacent tooth will be hampered. Implant supported single-tooth prosthesis can be a viable treatment option to restore a single missing tooth with an optimal esthetic outcome. In situations where a non-restorable tooth undergoes extraction, a minimum of 3 months after the extraction is recommended for the bone to form before placement of implant<sup>6</sup>.

The present study was conducted to compare and evaluate the esthetic parameters of single tooth implant supported prosthesis and the contralateral natural teeth. It helped us to quantify certain clinical parameters as esthetic guidelines which will help us to achieve a more predictable outcome in future. It also helped us to investigate which esthetic parameter showed greater variation in comparison of the single tooth implant supported prosthesis in the anterior maxillary region and the contralateral natural teeth.

Although the problem with inadequate papilla (black hole disease) has been identified, and attempts have been made to correct the problem with various surgical techniques, the regeneration of the papilla adjacent to the dental implant is still difficult to form and often not predictable<sup>7</sup>. The key to esthetic papilla may include the quality and quantity of the bone level on the adjacent tooth and the status of the papilla before implant placement. In other words, if the papilla at the implant site does not fill the space because of bone loss on the adjacent tooth and at the implant site, there will probably be a loss of papilla after final restoration. As the distance from the contact point to the implant increases, there will be a significant chance of loss of papilla. A study was conducted with the use of Guided Bone Regeneration in the anterior zone in which it was found that 64.3% papillae had a score of 2 while the remaining 35.7% had a score of 3 according to the Jemt (1997) papillary index. No class 0, class 1, or class 4 inter-proximal papillae at 1-year follow up were noted. Thus use of Guided Bone Regeneration was able to maintain the papillae height and appearance<sup>5</sup>.

In the present study, there was no statistically significant difference between the Jemt scores of the implant supported prosthesis and natural teeth involved in both the mesial and distal aspects of interdental papilla. However, an asymmetry was noticed involving a score 2 in the interdental papilla volume in 13.3% of subjects in the mesial aspect and in 20% of subjects in the distal aspect of interdental papilla volume. The limitation of the current study was that the analysis was done on a vertical level and did not take into consideration the bucco-lingual volume of the papilla. Therefore, the present study analyzed the papilla as a unit and focused on the vertical dimensions related to the implant and adjacent teeth.

The current study shows that only 20% of subjects showed a coinciding gingival zenith whereas 80% of subjects showed a non-coinciding gingival zenith between the single tooth implant supported prosthesis and contralateral natural teeth. A more apically placed free gingival margin is seen with convex tooth morphology whereas a concave shape leads to a coronal position of the free gingival margin. In most cases, poor dentistry conceals these zeniths, which are readily regained by replacing the offending prosthesis. A flat or slightly concave design of an artificial prosthesis will encourage a more coronal location of the zenith, while the opposite is true for a convex surface topography, resulting in a more apical position of the zenith<sup>7</sup>.

In the present study only 6.7% of subjects showed asymmetry in their gingival pigmentation where the gingival pigmentation was increased for implant prosthesis.

23.3% of subjects showed asymmetry in their tooth shape in the 2 groups with a greater asymmetry seen in cases where the natural teeth had an ovoid shape, ie 20%. A statistically significant difference (p=0.001) was seen among the two groups in the present study. Circular (oval) or square teeth produce a flat gingival scallop as seen in this study, while triangular teeth form a pronounced scallop. Studies have shown that square shaped teeth can produce better interproximal papilla due to a smaller interproximal distance from the crest of the bone to the free gingival margin<sup>7</sup>.

Within the limitations of the study and the data collected, we can see that there is a higher incidence of asymmetry in the interdental papilla with respect to score 2 in the Jemt index. There was also a correlation seen in between more variation in the gingival architecture and the shape of the tooth involved, ovoid shaped teeth showed a flat scallop.

Of the various esthetic parameters that were assessed in this study, maximum asymmetry was found among the gingival zeniths and tooth shape between the implant supported prosthesis and contra

lateral natural teeth in the maxillary anterior esthetic zone. Prudent assessment of the gingival zenith and gingival contour prior to implant placement provides the clinician with a foresight into planning soft tissue and hard tissue augmentation procedures for the purpose of achieving superior esthetic outcome. Of equal importance is the evaluation of the tooth shape by the clinician in order to improve the white esthetics and also determine the gingival architecture.

## CONCLUSION

Within the limitations of this study, the following conclusions were obtained:

- There was no statistically significant difference between the Jemt scores of the implant supported prosthesis and natural teeth involved in both the mesial and distal aspects of interdental papilla. However, an asymmetry was noticed involving a Jemt score 2 in the interdental papilla volume in 13.3% of subjects in the mesial aspect and in 20% of subjects in the distal aspect of interdental papilla volume.
- In the current study only 20% of subjects showed a coinciding gingival zenith whereas 80% of subjects showed a non-coinciding gingival zenith between the single tooth implant supported prosthesis and contralateral natural teeth
- There was no statistically significant difference noted between gingival pigmentation between the Implant Supported Prosthesis and Natural Teeth on the contralateral side.
- A statistically significant difference was seen in tooth shape among the two groups in the present study. 23.3% of subjects showed asymmetry in their tooth shape in the 2 groups with a greater asymmetry seen in cases where the natural teeth had an ovoid shape, ie 20%.

## SUMMARY

A study was conducted to compare and evaluate the esthetic parameters of single tooth implant supported prosthesis and the contralateral natural teeth. Thirty patients were selected from the outpatient department of Department of Prosthodontics, A.B. Shetty Memorial Institute of Dental Sciences, Deralakatte, Mangalore.

Four parameters were measured three months post cementation of implant supported prosthesis. The data obtained on evaluation of various esthetic parameters were tabulated and analysed. It helped us to quantify certain clinical parameters as esthetic guidelines which will help us to achieve a more predictable outcome in future. This study widens the possibilities for further research that can be conducted to evaluate the esthetic parameters of implant supported prosthesis in the anterior esthetic zone.

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