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Assessment of Effective Oral Health Status among Diabetic population by Modified Special Tooth Brush with Beat Sound- An observational study

Vijay Anand. M, Keerthi Narayan. V, Kalaivani. S, Safa Thabassum. S.

Professor, Senior lecturer, CRRI, CRRI Thai Moogambigai dental college and hospital, Chennai, Tamilnadu, India- 600107.

ABSTRACT

Background of the study: Proper guided brushing technique improves the oral health status especially among diabetic individuals who are more susceptible for periodontal disease. **Aim and objective:** To find the outcome efficacy of modified design special tooth brush with beat sound by evaluating oral hygiene status among diabetic individuals. **Material and methods:** The present observational study included 25 study participants irrespective of age and gender divided and categorized as 13 non-diabetic (control) group and 12 belong to diabetic (study) group. All the study participants were educated to use modified special tooth brush with beat sound regularly for a period of 1 week and their oral hygiene status were evaluated by using Oral hygiene index simplified (OHI-S), periodontal index (PI) and Gingival index (GI) at regular intervals on 1st, 3rd, 5th and 7th day. **Results:** It was observed that all the study participants showed significant improvement in oral health status at the end of 7th day. It was also observed that diabetic individuals showed superior OHI-S ($P=0.002$), PI ($P=0.0001$) and GI ($P=0.0004$) scores with greater significance ($p<.05$) than non-diabetic individuals. **Conclusion:** From the above results it can be concluded that the modified special tooth brush with beat sound used in the present study can reduce the burden of periodontal disease status by improving oral health among diabetic individuals.

Keywords: modified Special Tooth Brush, Gingival Index, Plaque, Bleeding, Diabetes.

*Correspondence to Author:

Vijay Anand. M

Professor, Senior lecturer, CRRI, CRRI Thai Moogambigai dental college and hospital, Chennai, Tamilnadu, India- 600107.

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Introduction:

Oral health is often ignored by this age group due to poor oral health care practices, nutritional habits and exposure to illegitimate practices that adversely affecting the quality of life [1]. Dental plaque or calculus is the major etiological factor in the causation of gingivitis which subsequently left untreated leads to periodontitis [2]. Mechanical control using tooth brush for removing of the deposits is the gold standard in its prevention or progression of disease process however; it is insufficient in the interdental areas [3]. According to a study in 2010 conducted on the basis of consumer usage, almost half of the population of India did not use toothbrush to clean their teeth[4]. Therefore, Effective Oral hygiene practices such as proper brushing technique, appropriate use of brushes; use of adjunctive oral hygiene aids, interdental aids like interdental toothbrushes, toothpicks and floss along with tooth brushes is often recommended. These practices play a vital role in maintaining a good oral health thereby preventing gingival or periodontal diseases[5]. In addition to professional care, successful management of periodontal disease depends on the capacity of patient's oral self-care [6].

The presence of systemic conditions such as diabetes mellitus, hypertension, cardiovascular disease, respiratory disorders, endocrine disorders, etc. can individually or collectively attribute to tooth loss. According to the Diabetes Atlas (2006), published by the International Diabetes Federation, the number of people with diabetes in India currently around 40.9 million is expected to rise to 69.9 million by 2025 unless urgent preventive steps are taken [7]. Low levels of insulin to achieve adequate response and/or insulin resistance of target tissues, mainly skeletal muscles, adipose tissue, and to a lesser extent, liver, at the level of insulin receptors, signal transduction system, and/or effector enzymes or genes are responsible for these metabolic abnormalities [8]. Studies establishing the relationship among diabetes mellitus, periodontal health and subsequent tooth loss

have been broadly reported (Campus et al 2005 [9]; Khader et al 2008 [10]; Furukawa et al 2007 [11]; Taylor and Borgnakke 2008 [12]). Individuals with diabetes tend to have higher values for indices of plaque, dental calculus, and gingival inflammation, and deeper periodontal pockets. They are frequently in greater need of periodontal treatment and prophylactic procedures [13]. Various studies have shown abrupt periodontal destruction and more severe periodontitis in individuals with uncontrolled diabetes compared to individuals with well controlled blood glucose level. The patients with poorly controlled diabetes are at greater risk of developing periodontal disease. It starts with gingivitis and then with poor glycaemic control it progresses to advanced periodontal disease [14, 15]. The present study was aimed to evaluate the oral health status among diabetic individuals and to find the outcome efficacy of this method by modified design special tooth brush with beat sound.

Materials and methods:

The present observational study included 26 random study participants categorized as two groups among which 13 were non-diabetic (control) group and 12 belong to diabetic (study) group irrespective of age and gender. All the study participants were given modified design tooth brush which is designed in such a way to guide proper brushing technique by presence of beads in the shank portion capable of producing beat sound (Figure 1). The beads are placed in a regular interval for effective movement of the handle in the direction of vertical along with circular motions hence by producing noise only at the time of proper brushing technique. The instructions were given and study participants were educated to use modified special tooth brush regularly twice a day for a period of 1 week and not to use any other oral hygiene aids.

Oral hygiene status was evaluated by using Oral hygiene index simplified (OHI-S) given by John C Greene and Jack R Vermillion (1964), Periodontal index (PI) given by Russell A L (1956) and Gingival index (GI) given by Loe H

and Silness J (1963) at regular intervals on 1st, 3rd, 5th and 7th day. Indices scores were recorded. All the data collected was tabulated. Statistical analysis was performed by using SPSS software version 21.0 (SPSS V21.0 Illinois, Chicago).

Results:

All the score were validated and compared for evaluation by chi-square test and One-Way ANOVA. Among the non-diabetic individuals interrelation within the group OHI-S scores showed f-ratio value of 12.99911 (Table 1), PI scores showed f-ratio value of 13.73005 and GI scores showed f-ratio value of 17.58903 (Table 2) with p-value is < .00001. All the three indices showed significant at $p < .05$. Similarly Among the diabetic individuals interrelation within the group OHI-S scores showed f-ratio value of 63.6499 (Table 3), PI scores showed f-ratio value of 121.582 (Table 4) and GI scores showed

f-ratio value of 261.301 (Table 5) with p-value is < .00001. All the three indices showed significant at $p < .05$. Pearson's correlation coefficients analysis was used to evaluate the efficacy of present technique on oral health status among diabetic and non-diabetic individuals. A moderate positive correlation was found with OHI-S index which means there is a tendency for high diabetic variable scores go with high non-diabetic variable scores (and vice versa). The value of R is 0.5868. This is The P-Value is .002047. Similarly a moderate positive correlation was also observed with PI indices scores with R value of 0.6848 and P-Value of .000159 and with GI indices score with R value of 0.6504 and P-Value of .000432. All these results were significant at $p < .05$ among the three indices a greater correlation was observed with periodontal indices than other indices used in the present study (Table 6).

TABLE 1: INTERRELATION WITHIN THE GROUPS OF OHI-S SCORES AMONG NON-DIABETIC INDIVIDUALS

OHI- S SCORES AMONG NON DIABETIC INDIVIDUALS					
	DAY 1	DAY 3	DAY 5	DAY 7	Total
N	13	13	13	13	52
ΣX	32.6	26	17.2	11.8	87.6
Mean	2.5077	2	1.3231	0.9077	1.685
ΣX^2	84.28	57.42	31.28	18.42	191.4
Std.Dev.	0.4591	0.6721	0.8428	0.8015	0.927
Source	SS	Df	MS		
Between-treatments	19.6462	3	6.5487	F = 12.99911	
Within-treatments	24.1815	48	0.5038		
Total	43.8277	51			
The f-ratio value is 12.99911. The p-value is < .00001. The result is significant at $p < .05$.					

TABLE 2: INTERRELATION WITHIN THE GROUPS OF GI SCORES AMONG NON-DIABETIC INDIVIDUALS

GI SCORES AMONG NON DIABETIC INDIVIDUALS					
	DAY 1	DAY 3	DAY 5	DAY 7	Total
N	13	13	13	13	52
ΣX	18.8	14.7	10.4	6.9	50.8
Mean	1.4462	1.1308	0.8	0.5308	0.977
ΣX^2	28.3	17.65	10.52	4.93	61.4
Std.Dev.	0.3045	0.2926	0.4282	0.325	0.4804
Source	SS	df	MS		
Between-treatments	6.1646	3	2.0549	F = 17.58903	
Within-treatments	5.6077	48	0.1168		
Total	11.7723	51			
The f-ratio value is 17.58903. The p-value is < .00001. The result is significant at p < .05.					

TABLE 3: INTERRELATION WITHIN THE GROUPS OF OHI-S SCORES AMONG DIABETIC INDIVIDUALS

OHI-S SCORES AMONG DIABETIC INDIVIDUALS					
	DAY 1	DAY 3	DAY 5	DAY 7	TOTAL
N	12	12	12	12	48
ΣX	41.5	34.4	22	8.6	106.5
Mean	3.4583	2.8667	1.8333	0.7167	2.219
ΣX^2	146.41	101.92	45.36	7	300.69
Std.Dev.	0.5125	0.5483	0.676	0.2758	1.1705
Source	SS	Df	MS		
Between-treatments	52.334	3	17.4447	F = 63.6499	
Within-treatments	12.0592	44	0.2741		
Total	64.3931	47			
The f-ratio value is 63.6499. The p-value is < .00001. The result is significant at p < .05.					

TABLE 4: INTERRELATION WITHIN THE GROUPS OF PI SCORES AMONG DIABETIC INDIVIDUALS

PI SCORES AMONG DIABETIC INDIVIDUALS					
	DAY 1	DAY 3	DAY 5	DAY 7	TOTAL
N	12	12	12	12	48
ΣX	46.3	35.1	25	9.9	116.3
Mean	3.8583	2.925	2.0833	0.825	2.423
ΣX^2	182.5298	103.79	53.92	8.53	348.7698
Std.Dev.	0.5946	0.3194	0.4086	0.1815	1.1938
Source	SS	df	MS		
Between-treatments	59.774	3	19.9247	F = 121.58221	
Within-treatments	7.2106	44	0.1639		
Total	66.9846	47			
The f-ratio value is 121.58221. The p-value is < .00001. The result is significant at p < .05.					

TABLE 5: INTERRELATION WITHIN THE GROUPS OF GI SCORES AMONG DIABETIC INDIVIDUALS

GI SCORES AMONG DIABETIC INDIVIDUALS					
	DAY 1	DAY 3	DAY 5	DAY 7	Total
N	12	12	12	12	48
ΣX	29.7	17.9	13	7.7	68.3
Mean	2.475	1.4917	1.0833	0.6417	1.423
ΣX^2	73.81	26.93	14.3	5.43	120.47
Std.Dev.	0.1658	0.1443	0.1403	0.2109	0.7039
Source	SS	Df	MS		
Between-treatments	22.0473	3	7.3491	F = 261.30124	
Within-treatments	1.2375	44	0.0281		
Total	23.2848	47			
The f-ratio value is 261.30124. The p-value is < .00001. The result is significant at p < .05.					

TABLE 6: SUMMARY OF DIABETIC AGAINST NON-DIABETIC OHI-S, PI, GI INDEX SCORE CORRELATION ANALYSIS

DIABETIC VS NONDIABTEIC		
OHI-S	PI	GI
X Values	X Values	X Values
$\Sigma = 87.6$	$\Sigma = 20.3$	$\Sigma = 50.8$
Mean = 1.685	Mean = 0.39	Mean = 0.977
$\Sigma(X - Mx)^2 = SSx = 43.828$	$\Sigma(X - Mx)^2 = SSx = 4.405$	$\Sigma(X - Mx)^2 = SSx = 11.772$
Y Values	Y Values	Y Values
$\Sigma = 106.9$	$\Sigma = 119.3$	$\Sigma = 71.3$
Mean = 2.056	Mean = 2.294	Mean = 1.371
$\Sigma(Y - My)^2 = SSy = 80.968$	$\Sigma(Y - My)^2 = SSy = 77.328$	$\Sigma(Y - My)^2 = SSy = 24.987$
X and Y Combined	X and Y Combined	X and Y Combined
N = 52	N = 52	N = 52
$\Sigma(X - Mx)(Y - My) = 34.955$	$\Sigma(X - Mx)(Y - My) = 12.639$	$\Sigma(X - Mx)(Y - My) = 11.155$
R Calculation	R Calculation	R Calculation
$r = \frac{\Sigma((X - My)(Y - Mx))}{\sqrt{((SSx)(SSy))}}$	$r = \frac{\Sigma((X - My)(Y - Mx))}{\sqrt{((SSx)(SSy))}}$	$r = \frac{\Sigma((X - My)(Y - Mx))}{\sqrt{((SSx)(SSy))}}$
$r = 34.955 / \sqrt{((43.828)(80.968))} = 0.5868$	$r = 12.639 / \sqrt{((4.405)(77.328))} = 0.6848$	$r = 11.155 / \sqrt{((11.772)(24.987))} = 0.6504$
Meta Numerics (cross-check)	Meta Numerics (cross-check)	Meta Numerics (cross-check)
r = 0.5868	r = 0.6848	r = 0.6504



FIGURE 1: Photograph showing the modified tooth brush with presence of beads in the shank portion capable of producing beat sound

Discussion:

Periodontitis is the most common multifactorial oral disease often associated with systemic conditions such as Hypertension, Diabetes Mellitus, Cardiovascular diseases, smoking. Over the years numerous epidemiological studies were carried out to confirm that diabetes is a substantial risk element for periodontitis, and the risk of periodontitis is greater if glycaemic levels are poor or less controlled [16]. Accumulation of dental plaque and calculus is usually caused by improper toothbrushing techniques, failure to carry out interdental cleaning and irregular dental visits. This accumulation probably results in gingival inflammation. Faulty tooth brushing techniques, improper use of oral hygiene aids involving excessive pressure may not efficiently or effectively remove plaque but also considerably increase gingival recession and loss of tooth substance by mechanical abrasion [17].

In the present study it was observed among the diabetic individuals interrelation within the group on OHI-S scores, PI scores and GI scores

showed significant at $p < .05$. The present study is similar to the study by Toda et al [18], Lee et al [19] who also observed patients with diabetes are likely to have more severe periodontitis in terms of average plaque index (PI), average gingival index (GI), and clinical attachment loss (CAL), but exhibit the same extent of periodontal disease. This could be attributed to the fact that duration of the disease process play a role in the increasing magnitude of periodontal disease, 1 week follow up was made in the present study in contrast to their studies this may explain the apparent contradiction to the study by Emrich et al [20].

The results of the present investigation revealed that the diabetic patients exhibited significantly higher levels of gingivitis, periodontitis and bone loss than the non-diabetic patients. The above findings are in agreement with the studies by Collin et al [21], Taylor et al [22] and Sznajder et al [23]. However, the reduction of gingival or OHI-S Index may not have been greater due the age group of selected patients and for the low quality of brushing technique that they presented previously. Hence a higher significance was

present with the periodontal status of an individual especially on diabetic group.

In a study by Rohit et al on severity of scores of periodontal index, gingival index, oral hygiene index simplified and bone loss score showed no significant difference in their severity [24] where as in the present study a moderate positive correlation was found with OHI-S index, PI indices scores and with GI indices score that explained by the fact that Bass technique was followed producing beat sound emphasizes the sulcular placement of the bristles, removing the plaque not only from the gingival margin but also with the cleaning efficiency can reach a depth of 0.5 mm subgingivally [25].

Ueno et al in a community based study observed the outcome of periodontal disease seemed to be influenced by the diabetic state to some degree, but a clear association between diabetes and oral health status was not found in the study [26]. In contrast, our study showed a moderate positive correlation which means there is a tendency for high diabetic indices variable scores go with high non diabetic indices variable scores (and vice versa). Differences in types of subjects (i.e., race, gender, and age) and degree of diabetes or using more rigorous and systematic study by evaluating CPITN index, Plaque Index on a large population, will be necessary to confirm the current observations which might have produced these conflicting results.

In the present study among the three indices recorded a greater correlation was observed with periodontal indices than other indices used in the present study. Studies by Bridges [27] and Javed et al [28] shows similar findings and reported that severity of gingival bleeding and periodontal disease was more in individuals with poorly controlled type 2 diabetes than non-diabetic individuals. There is emerging suggestion to support the presence of a two-way association between diabetes and periodontitis, with diabetes increasing the risk for periodontitis, and periodontal inflammation negatively affecting glycaemic control [29].

Conclusion:

Within the limits of this study and based on clinical implication of the obtained results when comparing diabetic and non-diabetic individuals, it can be concluded that modified special tooth brush with beat sound technique show effectiveness on the plaque control by improving the overall oral health indices score in patients especially in individuals with good diabetic control. Further studies may be important to confirm these findings by long term follow up of patients to demonstrate the effectiveness of this method on the periodontal tissues health and also in improving the overall health status of an individual.

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