

Effects of Toothbrushing Maneuver on Gingival Health Status

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Abstract:

Introduction: Toothbrush is regarded as a principal tool for controlling dental plaque. It is the most widely used device for keeping good oral hygiene. Meticulous oral hygiene performance through proper plaque removal can be achieved via using an appropriate toothbrush and toothbrushing method accomplished by interdental aids of cleaning, which primarily reduces periodontal diseases and dental caries.

Aim and objective: To determine the efficiency of toothbrushing maneuver on gingival health status among patients attended Periodontal Department Clinics at School of Dentistry/ University of Sulaimani during the academic year 2014-2015.

Materials and methods: Three hundred and forty two patients attended dental clinics of University of Sulaimani for purposes of dental scaling and polishing and other periodontal problems. Complete medical questionnaire was filled for every patient that included patient general information such as name age, sex and address. Patients were questioned about the type of the toothbrush that they use, duration, frequency and toothbrushing technique. Periodontal examination was performed on Ramfjord teeth, the six teeth of Ramfjord were examined for the presence and absence of dental plaque and bleeding upon probing. Michigan dental probe was used in this study.

Results: Among three hundred and forty two patients, 189 male and 153 female. The age group (20-40) comprised the higher percentage (70%) among all age groups. 324 patients brushed their teeth and only 18 did not. 57.7% of the total patients used soft, 32.1% used medium and 10.2% used hard type of toothbrushes. 44.7% of the patients brushed their teeth once a day, 44.7% twice a day, 4.6% three times a day, and 6% four times a day. 24.1% of the patients took one minute of duration for toothbrushing, 36.7% took 2 minutes, 20.9% took 3 minutes, and 18.3% more than three minutes. 22.5% of the patients used vertical technique of toothbrushing, 34.8% used horizontal scrubbing, 5.2% used roll technique, and 36.6% used combined vertical and horizontal scrubbing. The percentages of surface plaque accumulation groups were: (0-0.25, 3.2% - 0.25-0.50, 14.3% - 0.50-0.75, 25.7% and 0.75-1, 56.8%) and the percentages of bleeding surface groups (0-0.25, 20.3% - 0.25-0.50, 28.7% - 0.50-0.75, 24.7% and 0.75-1, 26.3%).

Conclusions: The study showed that most of the patients brush their teeth, and the majority are using soft type of toothbrushes and consume about two minutes of toothbrushing duration. Furthermore, most of the patients were using combined vertical and horizontal technique among other brushing techniques.

Key words: Dental Plaque, Gingivitis, Toothbrush

I. Introduction

Periodontal disease and dental caries are the most prevalent oral diseases. Both conditions impair normal function and appearance of the entire dentition at advanced stages. Oral hygiene performance will be impeded as the diseases develop and progress which further increasing treatment cost¹.

Oral hygiene performance through proper plaque removal can be achieved via using an appropriate toothbrush and toothbrushing method accomplished by interdental aids of cleaning. Thorough plaque control primarily reduces periodontal diseases and dental caries². Toothbrushing has a powerful effect on removing dental plaque that covers facial, lingual and occlusal surfaces of the teeth but not the interproximal areas, where dental caries and periodontal diseases are common³. Dental floss is regarded as an efficient tool in removing dental plaque and thoroughly cleaning the proximal surfaces of the teeth; moreover, interdental brushes have been designed to clean the spaces at interdental areas of reduced periodontal tissues and furcation regions⁴. Toothbrushing is the most common method of mechanical plaque removal. However, proper oral hygiene performance with toothbrushing alone seems to be insufficient for some people especially those with disability and lack of proper motivation and oral hygiene instruction. Therefore, chemical methods of plaque control such as antimicrobial mouth rinses is necessary to be used as either an adjunct to, or an alternative method to mechanical plaque removal⁵.

“Gingivitis is defined as inflammation of the gingiva in the absence of clinical attachment loss. It may be characterized by the presence of any of the following clinical signs: redness and edema of the gingival tissue, bleeding upon provocation, changes in contour and consistency, presence of calculus and/or plaque, and no radiographic evidence of crestal bone loss”⁶.

Dental plaque is a complex microbial community in ground substances of bacterial and salivary glycoprotein, which is a true biofilm. After thorough cleaning of the teeth, saliva will coat the cleaned teeth surfaces by glycoprotein to form dental pellicle⁷. Bacteria rapidly occupy this pellicle; they grow and develop to produce dental plaque. Periodontium remains healthy if there is a dynamic equilibrium between dental plaque and gingiva; this balance usually results in unnoticed marginal gingival inflammation. Controlling this biofilm “dental plaque” is the most influential method for maintaining periodontal health. Sometimes, the treatment strategy is directed toward specific microorganisms to control the disease. Failure in removing dental plaque properly results in lack of balance between the microbiota and the host defense mechanisms because the microbial virulence eventually overwhelms the host immunity. Consequently, this leads to progression of the gingivitis to periodontitis and further accumulation of microorganisms with more difficulties in controlling these deposits⁸.

Bleeding has been demonstrated in clinical and histological studies to be a more sensitive sign of gingival inflammation than visual alterations. Therefore, assessment of bleeding upon probing (BOP) is an important step of the periodontal examination⁹. The relation between dental plaque and gingival bleeding is well documented clinically and microbiologically by Loe and his colleagues¹⁰. The aim of this study was to determine the effects of toothbrush on gingival health status.

II. Materials And Methods

Three hundred and forty two patients attended dental clinics of University of Sulaimani for the purposes of dental scaling and polishing and other periodontal problems. Complete medical questionnaire was filled for every patient included patient general information such as name age, sex and address. Furthermore, the following questions about toothbrushing method were asked:

1. Do you brush your teeth or not? If (yes, I do, then the following questions were asked)
2. What type of toothbrush do you use? Soft, medium, or hard.
3. How many times do you brush your teeth? One time, two times, three times or more.
4. How long does your toothbrushing take? One minute, two minutes, three minutes or more than three minutes.
5. What technique of toothbrushing do you practice? Horizontal, vertical, rotary, circular, combined horizontal and vertical.

Ethical approval was obtained from the University Research Ethics Committee, School of Dentistry – University of Sulaimani which is in accordance with Helsinki Declaration.

According to age patients were involved into four groups; (< 20, 20-40, 40-60 and >60) respectively. Before undertaking periodontal examination, patients asked about their medical and dental history to find out if there is any local or systemic cause that might impede oral hygiene performance.

Periodontal examination was performed on Ramfjord teeth, the six teeth of Ramfjord were examined for the presence and absence of dental plaque and bleeding upon probing¹¹. Michigan dental probe was used in this study. The facial, lingual, mesial and distal surfaces of every tooth were examined for dental plaque and bleeding. If any tooth missed, the adjacent tooth was examined instead. The means of dental plaque and gingival bleeding were calculated by dividing the sites that exhibit dental plaque or gingival bleeding by total number of sites. The mean of plaque and gingival bleeding were run into four groups (0-0.25, 0.25-0.50, 0.50-0.75, and 0.75-1).

III. Results

The highest numbers of patients was found within age group 2 (20-40), which implicated about 70% of the total number of patients, this followed by age group 1 (< 20), age group 3 (40-60) and 4 (>60) respectively As Table 1 demonstrates. The four age groups in this study significantly ($P < 0.05$) demonstrated the highest level of plaque score (0.75-1) as the table shows. However, the percentages of gingival bleeding were less in all age groups compared to the amount of dental plaque. Moreover, the study showed a significant relation between age and gingival bleeding scores ($P < 0.05$) which was less than common alpha level (0.05) as Fisher’s exact test demonstrated (Table 1).

Table 2 demonstrates distribution of plaque and gingival bleeding according to sex, among 342 patients attended dental clinics of the School of Dentistry of University of Sulaimani - 189 male and 153 female were

involved in this study. The majority of males and females were located in the highest mean plaque score (0.75-1). However, the mean gingival bleeding scores were almost equally distributed among both sexes – males and females. Statistically, Fisher's exact test showed no significant differences between dental plaque and sex ($P>0.05$) and gingival bleeding and sex ($P>0.05$) as shown in Table 2.

Furthermore, this study also investigated the relation between types of toothbrushes and gingival health status. Based on the questionnaire form, it was recorded that 187 subjects were using soft toothbrush, whereas 104 subjects found to use medium type of toothbrush and only 33 subjects were using hard toothbrush. However, the majority of subjects with the 3 different types of toothbrush found to be located in the highest plaque score group – group 4 (0.75-1), this was followed by group 3 (0.50-0.75), group 2 (0.25-0.50) then followed by group 1 (0-0.25) respectively as shown in Table 3. Statistically no significant differences were reported between the 3 types of toothbrush and both mean plaque scores ($P>0.05$) and gingival inflammation ($P>0.05$) as Fisher's exact test showed (Table 3).

Moreover, the study also investigated the relation between the frequency of toothbrushing and the gingival health status, Table 4 demonstrating the relation between number of toothbrushing per day and mean plaque scores and gingival inflammation. The table shows that the majority of the subjects brushing their teeth once (44.7%) or twice (44.7%) per day and less frequently three times (4.6%) and four times (6.0%) per day. Similar to the previous section the majority of subjects was found to be located in group 4 mean plaque score followed by group 3, group 2 and group 1 respectively. Statistically no significant differences were reported between the frequency of toothbrushing and mean plaque scores ($P>0.05$), and between frequency of toothbrushing and gingival bleeding ($P>0.05$).

Amount and distribution of dental plaque and gingival bleeding were also demonstrated according to duration of toothbrushing, Table 5 shows that 78 subjects are performing toothbrushing for only one minute, 199 subjects taking two minutes for toothbrushing, 68 subjects brushing in 3 minutes and 59 subjects taking more than 3 minutes for toothbrushing. With the 4 duration groups, Group 4 (0.75-1) constituted the major group of plaque accumulation followed by groups (0.50-0.75), (0.25-0.50) and (0.0-0.25) respectively. Statistically, a significant relation ($P<0.05$) between duration of toothbrushing and amount of dental plaque was recorded. Furthermore, Fisher's exact test revealed a significant difference between duration of toothbrushing and mean gingival bleeding scores ($P<0.05$).

Finally the study investigated the effect of different toothbrushing techniques on the amount of plaque accumulation and gingival inflammation and this is shown in Table 6. Among the study sample, 73 subjects were found to use horizontal brushing technique, whereas 113 subjects found to use vertical brushing technique and a total of 118 subjects were using a combination of horizontal and vertical brushing technique. Only 17 subjects found to use rotary technique and 3 subjects using circular technique. Similarly group 4 which is the highest mean plaque score constituted the higher number of subjects with all groups of brushing technique. Statistically a highly significant effect of toothbrushing technique and mean plaque score was recorded ($P<0.05$). However, the relation between brushing technique and gingival inflammation was non-significant statistically ($P>0.05$).

IV. Discussion

Toothbrush is regarded as one of the influential and commonly applied mechanical plaque removal tools. People brush their teeth for purpose of having fresh felling with more confidence and having good smile with good breathe in addition to reducing dental and periodontal diseases¹². In this study we employed Ramfjord teeth to represent the entire dentition to calculate the amount of plaque deposition and gingival bleeding. This method is commonly used in epidemiologic studies; it doesn't record the variables on each individual tooth in the oral cavity. Therefore, it might lack accuracy in obtaining an exact data from all participants.

In the current study, the age group (20 to 40) constituted about 70% of the study population. This indicates that the majority of the study sample including an adult population. All age groups showed significantly a higher frequency of plaque deposition (0.75-1) when results of this study statistically analyzed. Although there is a slight increase in the individual gingival bleeding for the surface bleeding groups however, the total of the four surfaces was 25% but plaque surface deposition groups recorded more than 56% at the heavy plaque deposition group (0.75-1) which constituted more than half of plaque surfaces compared to the other plaque surface groups.

Male showed about 10% higher (0.75-1) plaque depositions than females (33.6% vs. 23.2%), whereas (0-0.25, 0.25-0.50 and 0.50-0.75 surface plaque depositions showed almost similar amounts and distribution. This indicates that female has a better plaque control than male. Thus, male demonstrated slightly higher percentages of gingival bleeding than female in all gingival bleeding surface groups. However, no significant relations between sex and dental plaque and between sex and gingival bleeding were detected. Results of this study found to be consistent with (Nazir S.) and (Zhang J. et al)^{13,14}.

Our study also investigated use of different types of toothbrush and their relation to patient's plaque control efficacy and frequency of gingival bleeding, it was shown that about 58% of the patients used soft

toothbrushes followed by 32% of medium toothbrushes and only 10% used hard toothbrushes. Patients prefer soft toothbrushes probably because most of the dental professionals recommend soft bristles toothbrushes¹⁵. Although percentages of (0.75-1) plaque surface groups in all types of toothbrush groups were higher, then followed by the groups (0.50-0.75, 0.25-0.50 and 0-.25) respectively, however all groups of gingival bleeding surfaces had nearly similar bleeding surfaces percentages. This indicates that all types of toothbrushes has similar efficacy in removing dental plaques or reducing gingival inflammation¹⁶. Statistically, no significant relations between types of toothbrushes and amount of plaque depositions and gingival inflammation were reported.

The majority of patients used combined vertical and horizontal toothbrushing technique (36.6%) followed by vertical (34.8%), horizontal (22.5%) and less frequently other toothbrushing techniques, a similar results was recorded by (Padilla et al) who studied this relation on 105 patients with gingival recession in southern Chile¹⁷. Although modified Bass technique of toothbrushing is the most recommended technique by dental professionals, it has been estimated that over 90% of people employ this technique as their “personal tooth-brushing method” which is generally a “scrub” method using vigorous horizontal, vertical, and/or circular movements¹⁸. Number of tooth surfaces with dental plaque deposition showed that group (0.75-1) showed a high percentage of patients in group (0.75-1) which presents tooth surface with a highest amount of plaque deposition, followed by groups (0.50-0.75, 0.25-0.50 and 0-.25) respectively and the relation between these groups was statistically significant. Gingival bleeding surface groups approximately showed similar number of gingival bleeding surfaces with all kinds of toothbrushing techniques, statistically a non-significant relation between toothbrushing techniques and gingival bleeding was recorded. Published studies showed that modified Bass technique of toothbrushing results in an excellent plaque controlling techniques among other techniques^{19,20}, however, this technique was not employed by any patient in the current study.

Another factor that affects oral health relating to toothbrushing is the frequency of toothbrushing, brushing frequency up to two times a day is substantial and no more than twice a day provides additional oral health benefits^{21,22}. The current study revealed high percentages (44.7%) of patients are brushing their teeth once a day and a similar percentage of patients brushing their teeth twice a day equally which constitutes about 89.4% collectively and less frequently more than two times employed by our patients in this study. Two times toothbrushing frequency showed slight decrease in surfaces plaque deposition compared to brushing once a day. This is agreeing with (Barzan A.) study that conducted in Duhok city in Iraq²³. The current study showed no significant relation between these variables and dental plaque deposition. Number of gingival bleeding surfaces showed approximately similar percentages among the four gingival bleeding groups. This indicates that the frequency of brushing did not have a visible impact on gingival bleeding in the current study.

Published Reports have determined that toothbrushing duration is an affective variable in plaque removal efficacy²⁴. However, a crucial determination of the ideal brushing time has been problematic²⁵. It is acknowledged that increased brushing time results in more plaque removal, type of tooth brushing method used can modify study comparisons²⁵. However, three minutes brushing time was recommended as ideal by some authors for manual brushing²⁵. A noticeable increase and/or decrease of dental plaque surface percentages in all plaque surfaces group have been recorded in relation to toothbrushing duration. This is attributed to overestimation or underestimation of the actual duration of toothbrushing by the patients²⁶. Furthermore, one-minute duration of toothbrushing showed an increase in the gingival bleeding surfaces percentage than two minutes in all gingival bleeding surfaces groups. Infrequent decrease and/or increase in gingival bleeding surfaces recorded in three and more than three minute's toothbrushing duration in all gingival bleeding surfaces groups. This irrational data can be explained by inaccurate estimation of toothbrushing duration.

Our data revealed that the majority of our patients are not achieving a proper plaque removal and not applying the right plaque controlling technique irrelevant to number of times of brushing per day and/or type of tooth brush and techniques performed. Therefore, further efforts are required toward motivation and oral hygiene performance by using appropriate toothbrush type and brushing technique plus interdental aids in order to achieve maximum plaque controlling and preserving the gingival and periodontal health.

V. Conclusion

The study showed that most of the patients are brushing their teeth. The majority of the patients are using soft type of toothbrushes and least frequently using hard one. High percentage of patients is brushing their teeth for about one to two minutes. Combined vertical and horizontal toothbrushing technique was very common among other toothbrushing techniques. One to two times of toothbrushing frequency dominated the frequency groups of toothbrushing. Three to four surfaces of plaque surface groups comprised more than half of the other groups, but the gingival surface bleeding groups was equally distributed.

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VI. Tables

Table 1: Mean plaque and gingival bleeding according to age

Age groups	Mean scores and percentages of dental plaque (P) and gingival bleeding (B) groups					
		0-0.25	0.25-0.50	0.50-0.75	0.75-1.0	Total
< 20	P	3 (0.8%)	12 (3.5%)	11 (3.2%)	34 (10.0%)	60 (17.5%)
	B	13 (3.8%)	13 (3.8%)	12 (3.5%)	22 (6.4%)	
20-40	P	4 (1.3%)	32 (9.4%)	64 (18.7)	139 (40.4%)	239 (69.8%)
	B	40 (11.7%)	70 (20.4%)	68 (19.8%)	61 (17.9%)	
40-60	P	3 (0.8%)	5 (1.4%)	12 (3.5%)	19 (5.7%)	39 (11.4%)
	B	17 (4.9%)	10 (2.9%)	5 (1.4%)	7 (2.2%)	
>60	P	1 (0.3%)	0 (0.0%)	1 (0.3%)	0 (0.0%)	4 (1.3%)
	B	1 (0.3%)	2 (0.66%)	1 (0.3%)	2 (0.7%)	
Total	P	11 (3.2%)	49 (14.3%)	88 (25.7%)	194 (56.8%)	342
	B	71 (20.72%)	95(27.76%)	86 (25.02%)	90 (26.5%)	
Fisher	P	15.145				0.047

Exact	B	22.108	P-Value	0.009
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Table 2: Mean plaque score and gingival bleeding according to sex

Sex groups	Mean scores and percentages of dental plaque (P) and gingival bleeding (B) groups					
		0-0.25	0.25-0.50	0.50-0.75	0.75-1.0	Total
Male	P	5 (1.4%)	24 (7.1%)	45 (13.2%)	115 (33.6%)	189 (55.3%)
	B	41 (11.9%)	53 (15.5%)	49 (14.3%)	46 (13.6%)	
Female	P	6 (1.8%)	25 (7.2%)	43 (12.5%)	79 (23.2%)	153 (44.7%)
	B	30 (8.82%)	42(12.26%)	37 (10.72%)	44 (12.9%)	
Total	P	11 (3.2%)	49 (14.3%)	88 (25.7%)	194 (56.8%)	342
	B	71 (20.72%)	95(27.76%)	86 (25.02%)	90 (26.5%)	
Fisher Exact	P	3.082			P-Value	0.379
	B	0.917				0.821

Table 3: Mean plaque and gingival bleeding according to types of tooth brushes

Types of toothbrushes	Mean scores and percentages of dental plaque (P) and gingival bleeding (B) groups					
		0-0.25	0.25-0.50	0.50-0.75	0.75-1.0	Total
Soft	P	7 (2.0%)	28 (8.6%)	49 (15.1%)	103 (32.0%)	187 (57.7%)
	B	35 (10.8%)	45(13.8%)	54 (16.6%)	53 (16.5%)	
Medium	P	4 (1.2%)	17 (4.8%)	27 (7.9%)	56 (18.2%)	104 (32.1%)
	B	21 (6.5%)	36 (11.1%)	23 (7.1%)	24 (7.4%)	
Hard	P	0 (0.0%)	3 (0.9%)	9 (2.7%)	21 (6.6%)	33 (10.2%)
	B	10 (3.0%)	12 (3.8%)	3 (1.0 %)	8 (2.4%)	
Total	P	11 (3.2%)	49 (14.3%)	88 (25.7%)	194 (56.8%)	324
	B	66 (20.3%)	93 (28.7%)	80 (24.7%)	85 (26.3%)	
Fisher Exact	P	6.428			P-Value	0.696
	B	13.67				0.134

Table 4: Mean plaque and gingival bleeding according to frequency of tooth brushing

Frequency of toothbrushing	Mean scores and percentages of dental plaque (P) and gingival bleeding (B) groups					
		0-0.25	0.25-0.50	0.50-0.75	0.75-1.0	Total
1	P	4 (1.2%)	15 (4.6%)	37 (10.9%)	89 (28.0%)	145 (44.7%)
	B	25 (7.7%)	48(14.8%)	35 (10.8%)	37 (11.4%)	
2	P	6 (1.7%)	27 (7.9%)	35 (10.8%)	77 (24.3%)	145 (44.7%)
	B	34 (10.5%)	37 (11.4%)	36 (11.1%)	38(11.7%)	
3	P	0 (0.0%)	2 (0.6%)	8 (2.5%)	5 (1.5%)	15 (4.6%)
	B	5 (1.6%)	4 (1.2%)	3 (0.9%)	3 (0.9%)	
4	P	1 (0.3%)	4 (1.2%)	5 (1.5%)	9 (3.0%)	19 (6.0%)
	B	2 (0.9%)	4 (1.2%)	6 (1.9%)	7 (2.0%)	
Total	P	11 (3.2%)	49 (14.3%)	88 (25.7%)	194 (56.8)	324
	B	66 (20.3%)	93 (28.7%)	80 (24.7%)	85 (26.3%)	
Fisher Exact		16.034			P-Value	0.19
		9.853				0.629

Table 5: Mean plaque and gingival bleeding according to time duration of tooth brushing

Duration of toothbrushing	Mean scores and percentages percentages of dental plaque and gingival bleeding groups					
		0-0.25	0.25-0.50	0.50-0.75	0.75-1.0	Total
1	P	2 (0.6%)	8 (2.4%)	22 (6.8%)	46 (14.3%)	78 (24.1%)
	G	13 (4.0%)	22 (6.7%)	14 (4.3%)	29 (9.1%)	
2	P	1 (0.3%)	19 (5.4%)	34 (9.9%)	65 (21.1%)	119 (36.7%)
	G	18 (5.5%)	34 (10.5%)	31 (9.5%)	36(11.2%)	
3	P	3 (0.9%)	14 (4.3%)	22 (6.8%)	29 (8.9%)	68 (20.9%)
	G	19 (5.8%)	29 (8.9%)	13 (4.0%)	7 (2.2%)	
4	P	5 (1.4%)	7 (2.2%)	7 (2.2%)	40 (12.5%)	59 (18.3%)
	G	16 (5.0%)	8 (2.6%)	22 (6.9%)	13 (3.8%)	
Total	P	11 (3.2%)	49 (14.3%)	88 (25.7%)	194 (56.8%)	324
	G	66 (20.3%)	93 (28.7%)	80 (24.7%)	85 (26.3%)	
Fisher Exact	P	24.268			P-Value	0.019
	G	35.077				0.000

Table 6: Mean plaque and gingival bleeding according to techniques of tooth brushing

Techniques of toothbrushing	Mean score and percentages of dental plaque (P) and gingival bleeding (P) groups					
		0-0.25	0.25-0.50	0.50-0.75	0.75-1.0	Total
1	P	2 (0.6%)	7 (2.2%)	25 (7.7%)	39 (12.0%)	73 (22.5%)
	G	11 (3.3%)	24 (7.4%)	19 (5.8%)	19 (6.0%)	
2	P	5 (1.4%)	17 (5.2%)	32 (9.8%)	59 (18.2%)	113 (34.8%)
	G	29 (8.9%)	38(11.7%)	23 (7.1%)	23 (7.1%)	
3	P	0 (0.0%)	4 (1.2%)	3 (0.9%)	10 (3.1%)	17 (5.2%)
	G	6 (1.8%)	2 (0.6%)	6 (1.8%)	3 (1.0%)	
4	P	2 (0.6%)	0 (0.0%)	0 (0.0%)	1 (0.3%)	3 (0.9%)
	G	1 (0.3%)	1 (0.3%)	0 (0.0%)	1 (0.3%)	
5	P	2 (0.6%)	20 (5.7%)	25 (7.3%)	71 (23.2%)	118 (36.6%)
	G	19 (6.0%)	28 (8.7%)	32 (10.0%)	39 (11.9%)	
Total	P	11 (3.2%)	49 (14.3%)	88 (25.7%)	194 (56.8%)	324
	G	66 (20.3%)	93 (28.7%)	80 (24.7%)	85 (26.3%)	
Fisher Exact	P	51.821			P-Value	0.000
	G	19.528				0.191