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치의학석사 학위논문

**Objective occlusal force and oral
health indicators
among Korean elders**

한국 노인들에서 구강건강 지표에 따른 객관적
저작력

2021년 2월

서울대학교 대학원
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이 현 진

Objective occlusal force and oral health indicators among Korean
elders

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2020년 12월

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-Abstract-

**Objective occlusal force and oral health indicators
among Korean elders**

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Objective: To investigate the distribution of objective occlusal force (OF) and its association with oral health indicators (OHI) such as denture status, number of natural teeth (NT), natural and rehabilitated teeth (NRT) among Korean elders after controlling for various confounders encompassing socio-demographic factors, behavioral factors and health factors including oral health.

Background: With the global increase in the ageing population, effective oral function including occlusal force is an important goal in geriatric oral health. Many studies have used OHIs such as denture status, NT and NRT as a surrogate of OF. Hence, there is a need to clarify the objective OF according to OHI.

Materials and Methods: This cross-sectional study recruited 551 elders from the Sungbook-Gu health education cohort. Occlusal force measured using Prescale II was an outcome variable. OHI assessed by dentists was

main explanatory variables. Analysis of covariance and multivariable linear regression models were applied to evaluate the association of OHI with OF. Sex and age group stratified analyses were also applied.

Results: OF (Newton[N]) was higher in dentate elders than denture wearers ($p < 0.05$). The adjusted mean occlusal force was 468.3 ± 17.1 N for dentate elders, 289.8 ± 28.7 N for partial denture wearers, 268.9 ± 47.7 N for complete denture wearers. NT showed the highest association with OF (partial $r = 0.348$, $p < 0.05$). OF was higher in males and elders aged less than 75 years.

Conclusion: OF was significantly associated with OHI and could be a robust indicator for evaluating overall oral health status among elders.

Key words: occlusal force, oral health indicator, natural and rehabilitated teeth, elder.

Student Number: 2013-22616

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1. Introduction

1-1. Background and Objectives

One of the global key goals of oral health 2020 by the FDI is to reduce the individuals experiencing dental functional disorders such as chewing, swallowing and speaking¹. According to the reports from the ‘Global burden of oral conditions in 1990-2010’, oral conditions were ranked in the top 100 causes of disability adjusted life years because of population growth and aging: severe tooth loss due to carious or periodontal conditions ranked 36th².

Since 2000, South Korea has become an aging society and is expected to become a super aged society in the future³. New challenges are arising for elders’ dental health including maintenance of their natural teeth and rehabilitation of missing teeth⁴. In 2016, amongst the edentulous Korean elderly, 87.8% were denture wearers and 12.2% were non-denture wearers³.

Statistics showed that Koreans aged over 65 wearing a mandibular complete denture experienced oral problems such as chewing and pronouncing: the prevalence of oral problems ranged up to 30-40%⁵. The Korean National Health Insurance has covered implants and dentures for

Koreans aged over 65. Although rehabilitation such as implants and dentures would have improved in their oral function, the proportion of Korean elders who had limitation in chewing ability was still at 45.8%⁶.

The occlusal force was related to functional decline in the geriatric population. Low masticatory ability due to tooth loss had a negative effect on nutritional status⁷. Rehabilitation of lost teeth could reduce the risk of cognitive impairment, because it would potentially increase the occlusal force⁸. However, many epidemiological studies used Oral Health Indicators (OHI) such as Denture status (DS), Natural teeth (NT) and Natural and rehabilitated teeth (NRT) as a surrogate: they have not measured the objective occlusal force^{9,10}.

1-2.Objectives

Thus far, the distribution of objective occlusal force(OF) and its relationship with oral health indicators is unclear. Hence, this study aims to investigate the amount of OF across OHI and evaluate the association between OF and OHIs among Korean elders after controlling for various confounders including age, sex, education, smoking, alcohol drinking and metabolic syndrome.

2. Materials and Methods

2.1 Ethical Considerations and study design.

This cross-sectional study was approved by the Institutional Review Board for Human Subjects at the Seoul National University School of Dentistry (approval number: S-020190017) and the Seoul National University Hospital Biomedical Research institute (IRB approval no., C-1803-117-932). All participants provided a written informed consent of their own accord. This study was the baseline (2018-2019) of the community health education cohort¹¹. Participants were recruited from the residents in Sungbook-Gu after advertisement for several weeks in advance of the survey. The survey was conducted at a community health center in Sungbook-Gu, Seoul, which was a combined Medical and Dental health promotion research. Systemic health status and oral health status were assessed by trained medical and dental health professionals who received calibration training beforehand.

2.2 Participants

Participants were recruited from 10 sub-districts in Sungbook-Gu, which were selected by cluster sampling methods. The inclusion criteria were six-

fold: 1) aged 65 and above who lived in Sungbook-Gu, 2) elders without critical diseases such as cancer and paralysis, 3) no problem with communication 4) willingness to follow the recommendation of the cohort procedures, 5) joined voluntarily with self-written informed consent, and 6) without any missing information for this study. A total of 743 elders in Sungbook-Gu were recruited for this cohort. Out of them, 551 elders met the inclusion criteria of this study.

2.3 Assessment of occlusal force

Occlusal force was assessed by dentists using a commercial occlusal film kit (Dental Prescale II, GC Corporation, Tokyo, Japan). The maximal OF was evaluated in Newton (N). Occlusal force in N is expressed as occlusal contact area (mm²) multiplied by occlusal pressure MPa¹². We followed the working guideline of the kit as follows. The film was selected from medium or large size and the patient's neck was unrestrained but supported by the examiner's nonworking hand for upright positioning, whilst the patient was asked to bite with maximal intercuspation onto the film with maximum force for 3 seconds. For denture wearers, measurement was performed while dentures were in the mouth. During the evaluation of OF in the Prescale II software, dentists erased artefacts and occlusal interference for getting real

OF. This procedure was performed on the day of the survey. For reliability of OF testing, 10% of the films were planned to re-test. Finally, intra-examiner reliability was 0.967 (n=50) and inter-examiner reliability was 0.956 (n=20).

2.4 Assessment of dental health indicators

We selected denture status (DS), Natural teeth (NT), natural and rehabilitated teeth (NRT) as OHI. DS was classified into 3 groups: the dentate elders, removable partial denture (PD) wearers, and complete denture (CD) wearers. PD denotes having any removable PD without complete denture. CD denotes wearing at least one CD. During the oral examination, dentists counted NT and NRT using dental explorer and naked eye under the blue light in the mobile dental unit-chair. Wisdom teeth were excluded from the analysis. Pontic of fixed bridge and implants were considered as rehabilitated teeth. NRT and NT was categorized into 3 groups: Low group with (0-15 teeth), moderate group with (16-23 teeth), high group with (24-28 teeth). According to the short arch concept, the minimum NRT number was set at 24 teeth for high NT and NTR group¹³. For low NT and NRT group, the cut-off was set at 15 teeth according to the mean teeth number in the elders with mastication problem (unpublished data).

2.5 Potential confounders.

Socio-demographic factors such as age, sex, education, behavioral factors such as smoking and drinking and, medical and dental factors such as periodontitis and metabolic syndrome were potential confounders which were assessed by trained dentists and physicians. Age, sex, education level, smoking and drinking were obtained from the interview in the survey.

Metabolic syndrome defined by APT III guidelines was assessed through data measured from the medical examination and laboratory blood tests.

Assessment of MS was having three or more components based on the following five components: obesity (waist circumference ≥ 90 cm for men and ≥ 85 cm for women)¹⁴; hypertriglyceridemia (triglycerides > 150 mg/dl); low HDL cholesterol (< 40 mg/dl for men and < 50 mg/dl for women); high blood pressure (systolic: > 130 mmHg or diastolic: < 85 mmHg or on blood pressure medication); and high plasma glucose (> 110 g/dl)¹⁵.

Periodontitis was assessed using the clinical attachment loss (CAL) of individual tooth and tooth loss due to periodontitis according to the AAP-EFP periodontal classification guideline using Staging and Grading of

periodontitis¹⁶. CAL was calculated in consideration of both recession and pocket depth by the UNC probe measurement. The criteria for periodontitis was followed using the Staging and grading of periodontitis: Framework and proposal of a new classification and case definition. Periodontitis was classified into 2 groups: No (Stages 1-2) and Yes (Stages 3-4).

2.6 Statistical methods and analysis.

Distribution in characteristics of the participants according to denture status were expressed using frequencies and percentages for categorical variables and mean values with standard deviations for continuous variables. The differences were evaluated using chi-square test for categorical variables and analysis of variance (ANOVA) including Bonferroni's post hoc multiple comparison test for continuous variables. The outcome variable was OF and main explanatory variables were OHI such as DS, NS and NRT. Correlation analysis was applied for evaluation of relationships between OHI and OF. OF was highly correlated with denture status, NT and NRT (Figure 1): correlation coefficient of $r=-0.272$ for denture status, 0.382 for NT and 0.115 for NRT. We performed a separate independent analyses to show the association of each OHI on OF. Analysis of covariance (ANCOVA) was applied for evaluating the differences in

adjusted values after controlling for various confounders encompassing socio-demographic factors such as education, age, sex, behavioral factors such as alcohol intake and smoking status and health factors including metabolic disease. Multivariable linear regression analysis was applied to evaluate the impact of association (partial r) between OF and OHI after controlling for various confounders. Stratified analyses were also applied for sex (male versus female) and age group (less than 75 years versus 75 years or older).

3.Results

3-1. Characteristics of the participants according to denture status

Total 551 participants (165 males and 386 females) had a mean age of 75.8 with standard deviation(SD) of 5.2 years (Table 1). Dentate group compared to denture groups were younger and less smoking, and had more metabolic syndrome, higher NT and less NRT ($p<0.05$) (Table 1). Dentate group were more educated, less drinking, less periodontitis, which were not statistically significant ($p>0.05$).

According to Bonferroni's post hoc multiple comparisons test, the crude and adjusted OF were higher in dentate group than in denture group ($p<0.001$) (Table 2).

3-2. Crude and adjusted occlusal force according to dental health indicators

The crude mean of OF with SD was 471.8 ± 367.9 N for dentate, 284.6 ± 217.4 N for PD, 256.5 ± 35.2 N for CD (ANOVA, $p < 0.001$). The adjusted mean of OF with standard error (SE) was 468.3 ± 17.1 N for dentate, 289.8 ± 28.7 N for PD and 268.9 ± 47.7 N for CD (ANCOVA, $p < 0.001$). High NT and NRT showed significantly higher OF as compared to moderate and low NT and NRT groups ($p < 0.001$). High NT group showed highest adjusted OF of 548.8 ± 24.7 N, followed by 411.2 ± 22.6 N for moderate NT group and 262.4 ± 24.9 N for low NT group (ANCOVA, $p < 0.001$). Similarly, as to NRT group, adjusted OF was highest in the high NRT group at 436.7 ± 15.8 N, followed by moderate NRT group at 292.5 ± 35.2 N and lower NRT group at 284.6 ± 81.6 N (ANCOVA, $p < 0.001$).

3-3. Occlusal force according to sex and age group.

Males showed higher adjusted occlusal force than females (ANCOVA, $p < 0.001$): 421.4 ± 32.5 N for males and 402.5 ± 19.0 N for females (Figure 2). Younger elders aged less than 75 years also showed higher adjusted occlusal force than older elders aged 75 years or more (ANCOVA, $p < 0.001$): 434.0 ± 22.6 for youngers and for 390.2 ± 18.8 for older elders.

3-4. Occlusal force according to denture status with NRT high and moderate group.

NRT group separate analysis showed that dentate group showed higher OF than denture group in both high and moderate NRT groups ($p < 0.05$) (Fig 3). In high NRT group, higher OF in dentate group was positively related to higher NT and NT in posterior teeth area (Post): 23.6 for dentate, 13.6 for PD and 5.6 for CD in NT, and 12.6 for dentate, 5.7 for PD and 2.3 for CD in NT(post) (ANOVA, $p < 0.001$). In moderate NRT group, dentate group higher OF had higher NT and NT(Post): 17.7 for dentate and 12.4 denture in NT, and 7.7 for dentate, 5.7 for denture in NT(post) (T-test, $p < 0.001$). In both high and moderate NRT groups, NRT and NRT(Post) showed an adverse effect on OF. NRT and NRT(Post) were higher in denture group, but OF was lower in denture status compared to dentate group.

3-5 Comparison between association impact of oral health indicators on occlusal force.

In total participants, the association impact of NT with OF was highest (partial $r = 0.344$, $p < 0.001$), followed by denture status (partial $r = -0.231$, $p < 0.001$) and NRT (partial $r = 0.165$, $p < 0.001$) (Table 3). Sex and age group

stratified analyses showed the same trends as the participants' analysis. The impact of NT was increased in older elders (partial $r=0.368$, $p<0.001$), but decreased in females (partial $r=0.338$, $p<0.001$) and in younger elders (partial $r=0.319$, $p<0.001$).

The impact of denture status was increased in females (partial $r= -0.245$, $p<0.001$) and in younger elders (partial $r= -0.241$, $p<0.001$), but decreased in males (partial $r= -0.180$, $p<0.001$). The impact of NRT was increased in younger elders (partial $r=0.194$, $p=0.003$) and in males (partial $r=0.181$, $p<0.001$), but decreased in females (partial $r=0.144$, $p=0.004$) and in older elders (partial $r=0.137$, $p<0.010$).

4. Discussion

Our results showed that OF was 468N for dentate, 290N for PD, 269N for CD and it was associated with OHI. For elders, keeping NT, especially NT (Post), was the most critical factor for keeping OF. When tooth loss occurred, rehabilitation of the lost tooth could ameliorate the decrease in OF, which could not reach the original OF before tooth loss. Moreover, sex and age group were effect modifier of the association between OHI and OF. Our findings rectified the previous speculation that cognitive impairment risk could be reduced by increased occlusal force through rehabilitation of

lost tooth⁸. Thus, OF could be a robust indicator for oral health status. Also our results supported the previous studies that OF had high relationship with number of residual teeth¹⁷⁻¹⁸. Moreover, the key finding from this study supported the previous studies¹⁸⁻¹⁹ about the OF increases of rehabilitation in denture. Rehabilitative treatment with dental prosthesis such as denture is one of viable treatment option as it is known for its functional support and increase in occlusal force²⁰. To the best of our knowledge, this is the first evidence to show the distribution and critically related oral factors of objective occlusal force according to OHI such as denture status, NT and NRT among Korean elders.

The major strengths of this study were four-fold. Firstly, the number of participants were adequate to generalize the findings of this study to Korean elders. Secondly, our participants were from a community based health cohort, which could reduce the selection bias of the hospital based participants. Thirdly, the examinations were performed by trained physicians and dentists. They showed high reliability for consistent measurement. Finally, the association was controlled for various confounders such as important socio-demographic factors such as age, sex and education, behavioral factors such as alcohol drinking, smoking and health factors such as periodontitis and metabolic syndrome.

Up until now, an objective measurement for occlusal force and its effect on masticatory function was lacking for geriatric dentistry. Most of the studies involved a subjective assessment of the participant's masticatory performance and efficiency^{9,13} Although some studies used the Prescale system,²¹⁻²³ they did not take confounders into consideration. Prescale system is indeed an objective method for producing occlusal force with high reliability, but it has a subjective part involved in erasing the artefacts in the film. Our results were obtained from the objective measurement of occlusal force and adjusted for various variables, which guaranteed the internal validity of our evidence. Since the occlusal force measurement has clinical diagnostic value, it could measure the functional recovery objectively, when there is a vertical dimensional loss for prosthodontic, orthodontic or orthognathic surgery²⁴. Moreover, OF could be used as a practical tool to evaluate overall oral function in epidemiological studies and in clinics.

Our data showed similar trends on the OF across denture status as previous results for Japanese elders^{25,26}.

Sex (gender) and age group were effect modifier of the association between OHI and OF. Our results supported gender difference in OF from some Japanese studies^{17,25} : OF was higher in males than in females. Our results showed that OF was 436 N for males and 396 N for females, which

was comparable to Japanese evidence: 408 N for males and 244 N for females in 65-75 years Japanese elders²⁵, 502 N for males and 372 N for females in 60-87 years Japanese elders¹⁷. Gender difference in OF could be due to the females' tendency to have weaker muscles of mastication compared to males. Our results showed age difference in OF that younger elders had higher OF than older elders. A Japanese study showed that age, rather than number of remaining teeth, accounts for the lower occlusal force,¹⁷. Some study showed that there was no or little difference in terms of occlusal force and age group²⁶.

Maximum occlusal force increased until age 20, stabilized up to 40-50 years, then reduced due to the aging process, but there was no differences over 80 years for elders with 20 or more teeth²¹.

Our study had some limitations. Firstly, OF was measured with dentures in the mouth, therefore NT was a component of NRT. The OF of real NT can be measured without dentures in the mouth, which can be indicated in further studies. Secondly, OF could be affected by dynamic oral soft tissues, physical muscle, grip strength and frailty of the elders²⁷, which could increase under-adjustment bias in the results. Occlusal force for elders was associated with walking speed¹⁷ and functional ability¹⁹. Further studies

including these factors could reduce this type of bias. Despite the limitations, our data and analyses were sufficient to fulfil the aims of this study.

5. Conclusion

Overall, objective occlusal force was associated with oral health indicators such as denture status, natural teeth, natural and rehabilitated teeth. Objective occlusal force could be an appropriate indicator for assessing oral health status.

Table 1. Characteristics of Participants According to Dental status (N=551)

	Total (n=551)	Dentate (n=371)	Partial Denture (n=131)	Complete Denture (n=49)	p-value
Sex					0.187
Male	165	102(61.8%)	45(27.3%)	18(10.9%)	
Female	386	269(69.7%)	86(22.3%)	31(8.0%)	
Age, year ^a	75.8±5.2	75.4±5.1	76.4±5.1	77.3±6.2	0.016
NT ^a	18.4±7.3	21.9±5.3 ^a	13.4±5.2 ^b	5.7±3.1 ^c	<0.001
NRT ^a	25.4±3.8	25.4±4.5 ^a	26.4±2.7 ^b	27.1±1.9 ^b	<0.001
Education level					0.135
High school or more	132(24%)	98(74.2%)	26(19.7%)	8(6.1%)	
Junior school or less	419(76%)	273(65.2%)	105(25.1%)	41(9.8%)	
Smoking [*]					0.008
No	391(71%)	278(71.1%)	85(21.7%)	28(7.2%)	
Yes	160(29%)	93(58.1%)	46(28.7%)	21(13.1%)	
Alcohol drinking [†]					0.140
No	188(34%)	122(64.9%)	43(2.9%)	23(12.2%)	
Yes	363(66%)	249(68.6%)	88(24.2%)	26(7.2%)	
Periodontitis					0.139
No	398(72%)	277(69.6%)	86(21.6%)	35(8.8%)	
Yes	153(28%)	94(61.4%)	45(29.4%)	14(9.2%)	
Metabolic Syndrome [‡]					0.004
No	235(43%)	144(61.3%)	60(25.5%)	31(13.2%)	
Yes	316(57%)	227(71.8%)	71(22.5%)	18(5.7%)	

Values: n,raw(%) for categorical variables and mean± standard deviation for continuous variables^a

p-value: obtained from chi-square test for categorical variables and ANOVA including Bonferroni post hoc multiple comparison test for continuous variables.

Bold denotes statistically significant.

*Smoking: No = never smoked, Yes = past and current smoker.

†Alcohol drinking: No = never drink, Yes = past and current drinker.

‡Metabolic syndrome by following the ATP III guideline.

^aNT: number of natural teeth. ^aNRT: number of natural and rehabilitated teeth.

Table 2. Occlusal force according to dental health indicators (N=551)

Variable	N	Occlusal Force (Newton: N)	
		Crude, mean \pm SD	Adjusted, mean \pm SE
Denture status			
Dentate	371	471.8 \pm 367.9 ^a	468.3 \pm 17.1 ^a
Partial denture	131	284.6 \pm 217.4 ^b	289.8 \pm 28.7 ^b
Complete denture	49	256.5 \pm 35.2 ^b	268.9 \pm 47.7 ^b
	p-value	<0.001	<0.001
NT			
Low (0-15 teeth)	174	264.9 \pm 220.9 ^a	262.4 \pm 24.9 ^a
Moderate (16-23 teeth)	201	408.5 \pm 344.1 ^b	411.2 \pm 22.6 ^b
High (24-28 teeth)	176	549.4 \pm 374.8 ^c	548.8 \pm 24.7 ^c
	p-value	<0.001	<0.001
NRT			
Low (0-15 teeth)	17	265.4 \pm 347.8 ^a	284.6 \pm 81.6 ^a
Moderate (16-23 teeth)	91	299.6 \pm 277.8 ^b	292.5 \pm 35.2 ^b
High (24-28 teeth)	443	435.9 \pm 346.8 ^c	436.7 \pm 15.8 ^c
	p-value	<0.001	<0.001

SD: standard deviation, SE: standard error.

NT: number of natural teeth, NRT: number of natural and rehabilitated teeth.

P-value obtained from ANOVA for crude value and ANCOVA for adjusted value controlling for age, sex, education, smoking, alcohol, periodontitis, metabolic syndrome.

Superscript ^{abc} denotes same subgroup by Bonferroni's post hoc multiple comparisons test.

Table 3. Comparison between association impact of oral health indicators on occlusal force (n=551)

Participants Variable (range)	β	SE	Partial r	p-value	R²
<u>Model 1</u>					
Dentate	186.2	30.5	0.249	<0.001	0.081
PD	-180.6	33.7	-0.219	<0.001	
CD	-202.1	51.2	-0.162	<0.001	
Sex	-16.9	40.5	-0.017	0.677	
Age	-4.08	2.8	-0.061	0.139	
Periodontitis	-60.9	31.7	-0.079	0.055	
Education	40.4	34.2	0.048	0.238	
Smoking	39.0	41.2	0.039	0.344	
Alcohol	24.5	30.8	0.033	0.428	
Metabolic Syndrome	25.6	28.7	0.037	0.372	
<u>Model 2</u>					
NRT (0-28)	15.08	3.8	0.165	<0.001	0.049
Sex	-27.3	41.2	-0.028	0.508	
Age	-5.6	2.8	-0.084	0.044	
Periodontitis	-62.1	32.1	-0.080	0.054	
Education	48.8	34.6	0.059	0.160	
Smoking	27.3	41.7	0.027	0.514	
Alcohol	29.6	31.3	0.039	0.343	
Metabolic Syndrome	51.5	28.9	0.074	0.075	
<u>Model 3</u>					
NT (0-28)	16.8	1.9	0.344	<0.001	0.142
Sex	-39.8	39.1	-0.040	0.310	
Age	-3.3	2.7	-0.048	0.220	
Periodontitis	-49.4	30.6	-0.064	0.107	
Education	10.9	33.3	0.013	0.743	
Smoking	65.3	39.9	0.065	0.102	
Alcohol	11.9	29.8	0.016	0.691	
Metabolic Syndrome	34.0	27.5	0.049	0.216	

NT: number of natural teeth; NRT: number of natural and rehabilitated teeth.

β : regression coefficient; SE: standard error for **β** .

Partial r obtained from linear regression model for occlusal force adjusted for age, sex, smoking, alcohol, education, periodontitis and metabolic syndrome.

Dental Status: 0 Dentate; 1 Partial denture; 2 Complete denture.

Model 1: for DS Model 2: for NRT Model 3: for NT

Table 4. Sex and age stratified association impact of oral health indicators on occlusal force.

Stratum Variable (range)	β	SE	Partial r	p-value	R²
Male (n=165)	-97.9	41.4	-0.18	0.019	0.051
Denture status (0-2)					
NT (0-28)	17.7	3.7	0.350	<0.001	0.145
NRT (0-28)	16.5	6.2	0.201	0.009	0.059
Female (n=386)					
Denture status (0-2)	-135.3	27.1	-0.245	<0.001	0.079
NT (0-28)	16.3	2.3	0.338	<0.001	0.134
NRT (0-28)	14.1	4.9	0.144	0.004	0.039
Age <75 (n=226)					
Denture status (0-2)	-162.2	43.1	-0.241	<0.001	0.083
NT (0-28)	16.8	3.3	0.319	<0.001	0.128
NRT (0-28)	20.0	6.7	0.194	0.005	0.062
Age >75 (n=325)					
Denture status (0-2)	-112.5	25.2	-0.238	<0.001	0.077
NT (0-28)	16.8	2.3	0.368	<0.001	0.157
NRT (0-28)	11.6	4.6	0.137	0.010	0.038

NT: number of natural teeth; NTR: number of natural and rehabilitated teeth; β : regression coefficient; SE: standard error for β .

Partial r :obtained from linear regression model for occlusal force adjustedfor age, sex, smoking, alcohol, education, periodontitis and metabolic syndrome.

Dental Status: 0 Dentate; 1 Partial denture; 2 Complete denture.

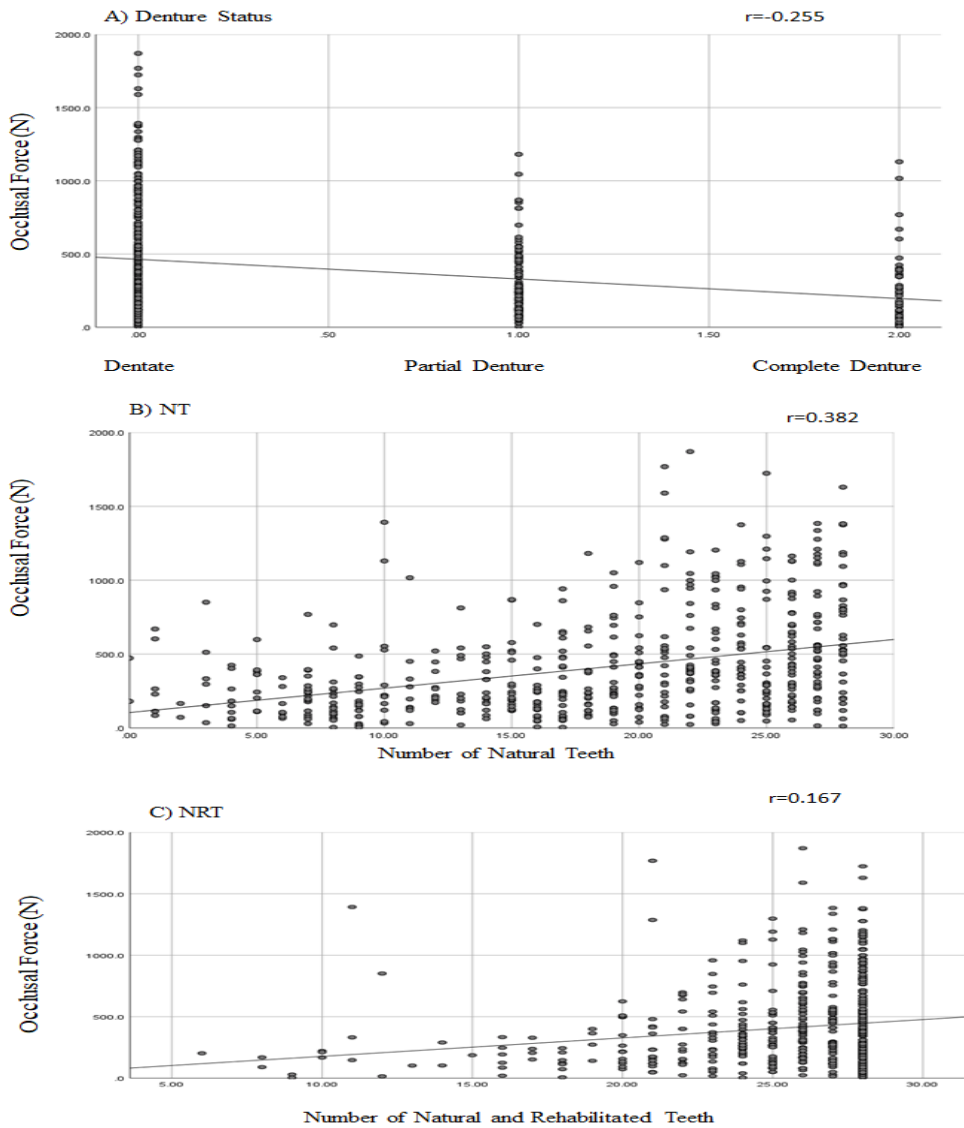


Figure 1. Total occlusal force according to dental status, natural teeth, natural and rehabilitated teeth. Values were obtained from scatterplots to show the association between occlusal force and A) denture status, B) number of natural teeth, C) number of Natural and rehabilitated. The correlation coefficient (r) was obtained from correlation analysis.

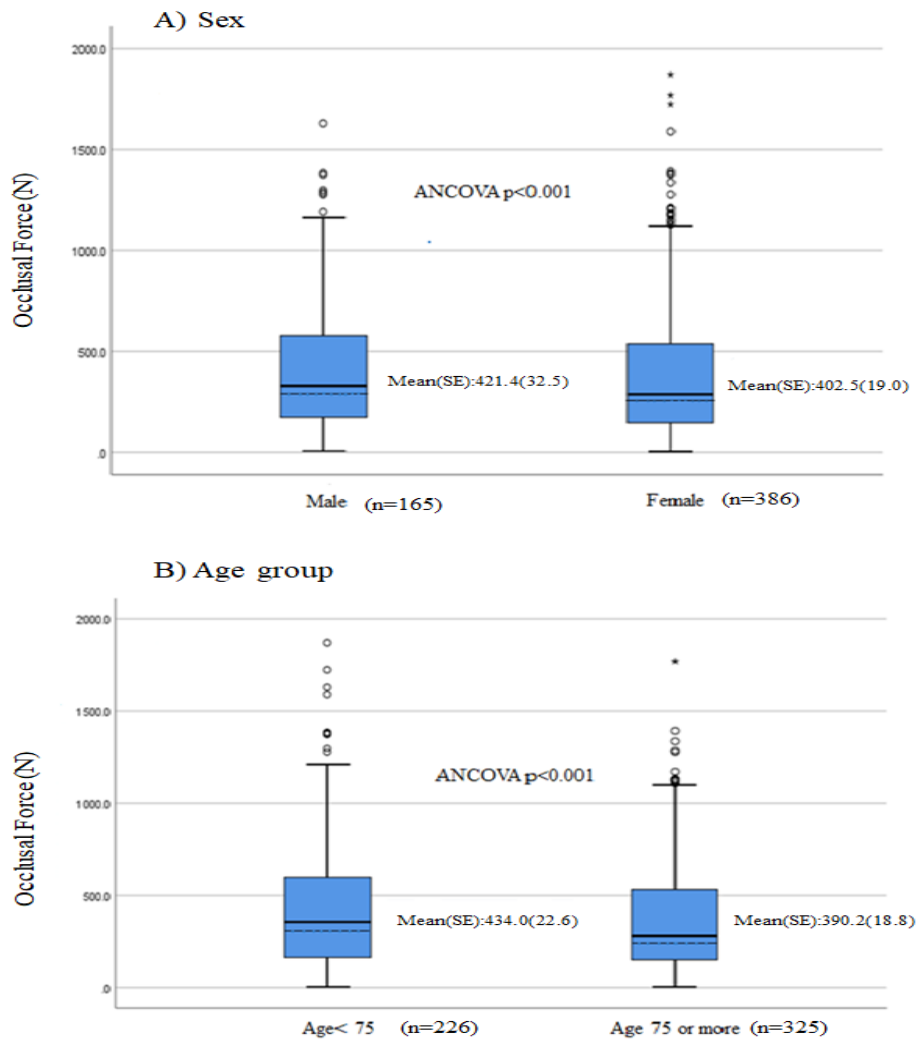


Figure2. Occlusal force according to sex and age group. Box and whisker plot for stratified data for A) sex (male female) and B) age group (less than 75 years vs 75 years or more). Values denotes median, interquartile range values. For median it is shown as dotted line. Mean values and standard error were derived separately with ANOVA (indicated by bold horizontal line) in the box plot.

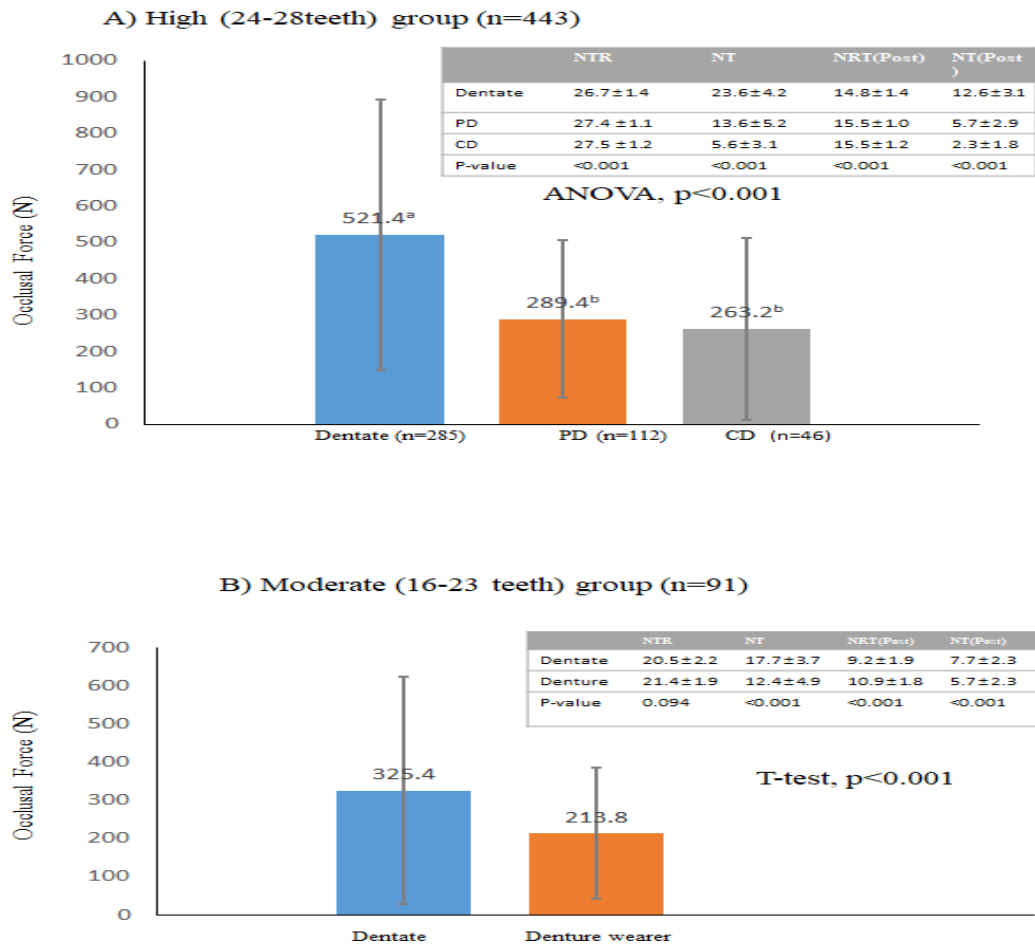


Figure 3. Occlusal force according to denture status with NRT high and moderate group.

Two separate graphs to compared occlusal force with denture status in A) high NRT group (24-28 teeth) and B) moderate NRT group (16-23teeth). Bar denotes mean value and whisker denotes standard deviation.

Superscript ^{abc}denotes same subgroup by Bonferroni's post hoc multiple comparisons test. Side table for high NRT group: ANOVA was done to compare mean and standard error of NT, NRT, NT posterior and NRT posterior across denture status. Side table for medium NRT group: T-test to derive mean and standard deviation of NRT, NT, NRT posterior, NT posterior between dentate and denture group.

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-국문 초록-

한국 노인들에서 구강건강 지표에 따른 객관적 저작력

1. 목 적: 고령 인구의 세계적 증가로, 교합력을 포함한 효과적 구강 기능은 노인 구강건강의 중요한 목표이다. 그러나 많은 연구에서 객관적 교합력을 측정하지 않았고, 혼란변수들을 또한 보정하지 않았다. 본 연구의 목적은 한국 노인들에서 구강건강지표인 치아상태, 자연치와 재활치수에 따른 객관적 교합력의 분포 및 연관성을 사회인구적 요인, 행동 요인 및 구강과 전신건강요인을 보정한 후 평가함이다.

2. 방 법: 성북구 교육 코호트 총 551명의 노인들이 이 단면조사 연구를 위해 모집되었다. 결과변수인 교합력(N)은 프리스케일 필름을 사용하여 측정되었다. 설명변수인 구강건강지표는 훈련된 치의사들에 의해 조사되었다. 설명변수의 결과변수에 대한 연관성 및 영향력 평가를 위해 공분산분석과 다변수 회기분석이 적용되었다. 나아가 성별 및 연령 집단별 층화분석이 수행되었다.

3. 결 과: 객관적 교합력은 자연치보유 노인들에서 틀니장착 노인에서보다 높았다 ($p < 0.001$). 보정된 평균 교합력(N)은 자연치보유 노인에서 $468.3 \pm 17.1N$ 이었고 부분틀니장착 노인에서 $289.8 \pm 28.7N$ 이었으며 전부틀니장착 노인들에서는 $268.9 \pm 47.7N$ 이었다. 자연치아 수, 특히 구치부 자연치아수가 교합력에 가장 영향력이 컸다 (partial $r = 0.348$). 교합력은 남성과 75세미만 노인에서 여성과 75세이상 노인에서보다 더 높았다.

결론적으로, 객관적 교합력은 구강건강지표와 유의한 연관성이 있었다. 객관적 교합력은 구강건강 상태를 평가할 수 있는 적절한 도구 및 구강건강 지표가 될 수 있다.

주요어 : 교합력, 구강건강지표, 자연치, 재활치, 노인
학 번 : 2013-22616

-Appendix-

Appendix 1. Raw data by SPSS statistics.

1-1. Raw data by SPSS statistics for Table

1-1-1 Sex : Male, Female (By Chi squared test)

Chi squared analysis

		1=M 2=F		Total	
		male	female		
0=Dentate 1=PD 2=CD	.00	Count	102	269	371
		% within 1=patril 2=CD	27.5%	72.5%	100.0%
		% within 1=M 2=F	61.8%	69.7%	67.3%
	1.00	Count	45	86	131
		% within 1=patril 2=CD	34.4%	65.6%	100.0%
		% within 1=M 2=F	27.3%	22.3%	23.8%
	2.00	Count	18	31	49
		% within 1=patril 2=CD	36.7%	63.3%	100.0%
		% within 1=M 2=F	10.9%	8.0%	8.9%
Total	Count	165	386	551	
	% within 1=patril 2=CD	29.9%	70.1%	100.0%	
	% within 1=M 2=F	100.0%	100.0%	100.0%	

Chi Squred p-value

	Value	df	Asymptotic Significance (2- sided)
Pearson chi squared	3.352 ^a	2	.187
Likelihood Ratio	3.298	2	.192
Linear by Linear Association	3.168	1	.075
N of Valid Cases.	551		

1-1-2. Age, NT28, NRT 28 Mean,

Statistics

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
Age year	.00	371	75.3929	5.08247	.26387	74.8740	75.9118	64.99	91.40
	1.00	131	76.4043	5.14560	.44957	75.5149	77.2937	65.55	87.48
	2.00	49	77.3550	6.24228	.89175	75.5621	79.1480	62.79	92.62
	Total	551	75.8079	5.23934	.22320	75.3694	76.2463	62.79	92.62
NT_28	.00	371	21.8760	5.30025	.27518	21.3349	22.4171	1.00	28.00
	1.00	131	13.4275	5.17840	.45244	12.5324	14.3226	3.00	23.00
	2.00	49	5.6939	3.07004	.43858	4.8121	6.5757	.00	12.00
	Total	551	18.4283	7.38117	.31445	17.8106	19.0460	.00	28.00
NRT_28	.00	371	24.8302	4.17272	.21664	24.4042	25.2562	6.00	28.00
	1.00	131	26.4122	2.72275	.23789	25.9416	26.8828	12.00	28.00
	2.00	49	27.1224	1.87786	.26827	26.5831	27.6618	19.00	28.00
	Total	551	25.4102	3.80796	.16222	25.0915	25.7288	6.00	28.00

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Age year	Between Groups	227.783	2	113.892	4.197	.016
	Within Groups	14870.074	548	27.135		
	Total	15097.858	550			
NT_28	Between Groups	15632.153	2	7816.076	298.840	.000
	Within Groups	14332.766	548	26.155		
	Total	29964.918	550			
NRT_28	Between Groups	399.995	2	199.998	14.468	.000
	Within Groups	7575.308	548	13.824		
	Total	7975.303	550			

Multiple Comparisons

Dependent Variable		(I) 1=patril 2=CD	(J) 1=patril 2=CD	Mean	Std. Error	Sig.	95% Confidence Interval	
				Difference (I-J)			Lower Bound	Upper Bound
Age	Bonferroni	.00	1.00	-1.01141	.52941	.170	-2.2827	.2599
			2.00	-1.96215*	.79178	.041	-3.8635	-.0608
		1.00	.00	1.01141	.52941	.170	-.2599	2.2827
			2.00	-.95074	.87231	.829	-3.0455	1.1440
		2.00	.00	1.96215*	.79178	.041	.0608	3.8635
			1.00	.95074	.87231	.829	-1.1440	3.0455
NT	Bonferroni	.00	1.00	8.44853*	.51976	.000	7.2004	9.6967
			2.00	16.18213*	.77735	.000	14.3155	18.0488
		1.00	.00	-8.44853*	.51976	.000	-9.6967	-7.2004
			2.00	7.73360*	.85640	.000	5.6771	9.7901
		2.00	.00	-	.77735	.000	-18.0488	-14.3155
			1.00	16.18213*	.85640	.000	-9.7901	-5.6771
NRT	Bonferroni	.00	1.00	-1.58203*	.37787	.000	-2.4894	-.6746
			2.00	-2.29226*	.56513	.000	-3.6493	-.9352
		1.00	.00	1.58203*	.37787	.000	.6746	2.4894
			2.00	-.71024	.62260	.763	-2.2053	.7849
		2.00	.00	2.29226*	.56513	.000	.9352	3.6493
			1.00	.71024	.62260	.763	-.7849	2.2053

*. The mean difference is significant at the 0.05 level.

1-1-3. Education: High school or more or less (Chi-squared)

Crosstab

		1=high school or more 0=less than high school		Total	
		.00	1.00		
0=Dentate 1=PD 2=CD	.00	Count	273	98	371
		% within 1=patril 2=CD	73.6%	26.4%	100.0%
		% within 1=high or more	65.2%	74.2%	67.3%
	1.00	Count	105	26	131
		% within 1=patril 2=CD	80.2%	19.8%	100.0%
		% within 1=high or more	25.1%	19.7%	23.8%
	2.00	Count	41	8	49
		% within 1=patril 2=CD	83.7%	16.3%	100.0%
		% within 1=high or more	9.8%	6.1%	8.9%
Total	Count	419	132	551	
	% within 1=patril 2=CD	76.0%	24.0%	100.0%	
	% within 1=high or more	100.0%	100.0%	100.0%	

Chi-Square Tests

	Value	df	Asymptotic Significance (2- sided)
Pearson Chi-Square	4.011 ^a	2	.135
Likelihood Ratio	4.176	2	.124
Linear-by-Linear Association	3.909	1	.048
N of Valid Cases	551		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 11.74.

1-1-4. Smoking (Chi-Squared)

Crosstab

		1=yes 0=no		Total	
		.00	1.00		
0=Dentate 1=PD 2=CD	.00	Count	278	93	371
		% within 1=patril 2=CD	74.9%	25.1%	100.0%
		% within 1=yes	71.1%	58.1%	67.3%
	1.00	Count	85	46	131
		% within 1=patril 2=CD	64.9%	35.1%	100.0%
		% within 1=yes	21.7%	28.7%	23.8%
	2.00	Count	28	21	49
		% within 1=patril 2=CD	57.1%	42.9%	100.0%
		% within 1=yes	7.2%	13.1%	8.9%
Total	Count	391	160	551	
	% within 1=patril 2=CD	71.0%	29.0%	100.0%	
	% within 1=yes	100.0%	100.0%	100.0%	

Chi-Square Tests

	Value	df	Asymptotic Significance (2- sided)
Pearson Chi-Square	9.727 ^a	2	.008
Likelihood Ratio	9.405	2	.009
Linear-by-Linear Association	9.661	1	.002
N of Valid Cases	551		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 14.23.

1-1-5. Alcohol drinking (Chi-squared)

Crosstab

		0=no 1=yes		Total	
		.00	1.00		
0=Dentate 1=PD 2=CD	.00	Count	122	249	371
		% within 1=patril 2=CD	32.9%	67.1%	100.0%
		% within 0=no	64.9%	68.6%	67.3%
	1.00	Count	43	88	131
		% within 1=patril 2=CD	32.8%	67.2%	100.0%
		% within 0=no	22.9%	24.2%	23.8%
	2.00	Count	23	26	49
		% within 1=patril 2=CD	46.9%	53.1%	100.0%
		% within 0=no	12.2%	7.2%	8.9%
Total	Count	188	363	551	
	% within 1=patril 2=CD	34.1%	65.9%	100.0%	
	% within 0=no	100.0%	100.0%	100.0%	

Chi-Square Tests

	Value	df	Asymptotic Significance (2- sided)
Pearson Chi-Square	3.932 ^a	2	.140
Likelihood Ratio	3.772	2	.152
Linear-by-Linear Association	2.262	1	.133
N of Valid Cases	551		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 16.72.

1-1-6. Periodontitis (Chi-squared)

Crosstab

		1=PD>5mm		Total	
		0=no perio			
		.00	1.00		
0=Dentate 1=PD 2=CD	.00	Count	277	94	371
		% within 1=patril 2=CD	74.7%	25.3%	100.0%
		% within 1=PD>5mm	69.6%	61.4%	67.3%
	1.00	Count	86	45	131
		% within 1=patril 2=CD	65.6%	34.4%	100.0%
		% within 1=PD>5mm	21.6%	29.4%	23.8%
	2.00	Count	35	14	49
		% within 1=patril 2=CD	71.4%	28.6%	100.0%
		% within 1=PD>5mm	8.8%	9.2%	8.9%
Total	Count	398	153	551	
	% within 1=patril 2=CD	72.2%	27.8%	100.0%	
	% within 1=PD>5mm	100.0%	100.0%	100.0%	

Chi-Square Tests

	Value	df	Asymptotic Significance (2- sided)
Pearson Chi-Square	3.939 ^a	2	.139
Likelihood Ratio	3.840	2	.147
Linear-by-Linear Association	1.902	1	.168
N of Valid Cases	551		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 13.61.

1-1-7. Metabolic Syndrome (Chi-squared)

Crosstab

		1 positive		Total	
		.00	1.00		
0=Dentate 1=PD 2=CD	.00	Count	144	227	371
		% within 1=patril 2=CD	38.8%	61.2%	100.0%
		% within 1 positive	61.3%	71.8%	67.3%
	1.00	Count	60	71	131
		% within 1=patril 2=CD	45.8%	54.2%	100.0%
		% within 1 positive	25.5%	22.5%	23.8%
	2.00	Count	31	18	49
		% within 1=patril 2=CD	63.3%	36.7%	100.0%
		% within 1 positive	13.2%	5.7%	8.9%
Total	Count	235	316	551	
	% within 1=patril 2=CD	42.6%	57.4%	100.0%	
	% within 1 positive	100.0%	100.0%	100.0%	

Chi-Square Tests

	Value	df	Asymptotic Significance (2- sided)
Pearson Chi-Square	11.278 ^a	2	.004
Likelihood Ratio	11.191	2	.004
Linear-by-Linear Association	10.422	1	.001
N of Valid Cases	551		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 20.90.

1-2. Raw data by SPSS statistics for Table 2.

1-2-1 Denture Status : dentate, partial denture, complete denture . Crude mean \pm standard deviation (ANOVA)

Descriptives

total_OF= Newton

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
.00	371	471.817	367.9996	19.1056	434.248	509.386	4.2	1870.0
1.00	131	284.641	217.3606	18.9909	247.070	322.212	4.2	1181.1
2.00	49	256.476	246.3129	35.1876	185.726	327.225	4.3	1130.3
Total	551	408.166	340.5618	14.5084	379.667	436.665	4.2	1870.0

ANOVA

total_OF= Newton

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4629423.808	2	2314711.904	21.441	.000
Within Groups	59160859.911	548	107957.774		
Total	63790283.719	550			

Homogenous Subsets.

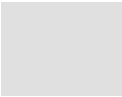
Multiple Comparisons

Dependent Variable: total_OF= Newton

		(I) 1=PD 2=CD	(J) 1=PD 2=CD	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Bonferroni	.00	1.00	1.00	187.1758*	33.3931	.000	106.987	267.364
		2.00	2.00	215.3415*	49.9421	.000	95.413	335.270
	1.00	.00	-187.1758*	33.3931	.000	-267.364	-106.987	

	2.00	28.1657	55.0211	1.000	-103.959	160.291
2.00	.00	-215.3415*	49.9421	.000	-335.270	-95.413
	1.00	-28.1657	55.0211	1.000	-160.291	103.959
	1.00	-28.1657	55.0211	.866	-157.471	101.139

*. The mean difference is significant at the 0.05 level.



1-2-2. NT Crude Mean \pm standard deviation. (ANOVA)

Descriptives

total_OF= Newton

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
.00	174	264.878	220.9126	16.7473	231.823	297.934	4.2	1392.1
1.00	201	408.535	344.1428	24.2740	360.669	456.401	4.2	1870.0
2.00	176	549.404	374.7552	28.2482	493.653	605.155	12.7	1723.4
Total	551	408.166	340.5618	14.5084	379.667	436.665	4.2	1870.0

ANOVA

total_OF= Newton

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	7083369.038	2	3541684.519	34.226	.000
Within Groups	56706914.680	548	103479.771		
Total	63790283.719	550			

Multiple Comparisons

Dependent Variable: total_OF= Newton

	(I)	(J)	Mean		Sig.	95% Confidence Interval	
			Difference (I-J)	Std. Error		Lower Bound	Upper Bound
Bonferroni	.00	1.00	-143.6567*	33.3097	.000	-223.645	-63.668
		2.00	-284.5258*	34.3899	.000	-367.108	-201.944
	1.00	.00	143.6567*	33.3097	.000	63.668	223.645
		2.00	-140.8692*	33.2081	.000	-220.614	-61.125
	2.00	.00	284.5258*	34.3899	.000	201.944	367.108
		1.00	140.8692*	33.2081	.000	61.125	220.614

1-2-3. NRT Crude Mean \pm standard deviation (ANOVA)

Descriptives

total_OF= Newton

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
.00	17	265.424	347.8287	84.3609	86.587	444.261	4.2	1392.1
1.00	91	299.648	277.8282	29.1243	241.788	357.509	7.0	1768.4
2.00	443	435.935	346.7625	16.4752	403.556	468.314	4.2	1870.0
Total	551	408.166	340.5618	14.5084	379.667	436.665	4.2	1870.0

ANOVA

total_OF= Newton

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1759610.013	2	879805.007	7.772	.000
Within Groups	62030673.706	548	113194.660		
Total	63790283.719	550			

Multiple Comparisons

Dependent Variable: total_OF= Newton

	(I)	(J)	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Bonferroni	.00	NTR_28_3G					
		NTR_28_3G	-34.2248	88.8955	1.000	-247.694	179.245
	1.00	.00	34.2248	88.8955	1.000	-179.245	247.694
		2.00	-170.5115	83.1506	.122	-370.185	29.163
	2.00	.00	170.5115	83.1506	.122	-29.163	370.185
		1.00	-136.2866*	38.7223	.001	-229.273	-43.301
			136.2866*	38.7223	.001	43.301	229.273

1-2-4 Denture Status: dentate, partial denture, complete denture.

Adjusted Mean \pm standard error. (ANCOVA)

Estimates

Dependent Variable: total_OF= Newton

1=PD 2=CD	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
.00	468.331 ^a	17.115	434.710	501.952
1.00	289.833 ^a	28.754	233.350	346.315
2.00	268.989 ^a	47.696	175.297	362.681

a. Covariates appearing in the model are evaluated at the following values: 1=M 2=F = 1.70, year = 75.8079, 1=Periodontitis>5mm = .2777, 1=high or more = .2396, 1=yes = .2904, 0=no = .6588, 1 positive = .5735.

Pairwise Comparisons

Dependent Variable: total_OF= Newton

(I) 1=PD 2=CD	(J) 1=PD 2=CD	Mean Difference (I-J)	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
					Lower Bound	Upper Bound
.00	1.00	178.498*	33.710	.000	97.545	259.452
	2.00	199.343*	51.117	.000	76.587	322.098
1.00	.00	-178.498*	33.710	.000	-259.452	-97.545
	2.00	20.844	55.227	1.000	-111.780	153.469
2.00	.00	-199.343*	51.117	.000	-322.098	-76.587
	1.00	-20.844	55.227	1.000	-153.469	111.780

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Bonferroni.

Univariate Tests

Dependent Variable: total_OF= Newton

	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Contrast	3871970.653	2	1935985.326	18.181	.000	.063
Error	57607314.156	541	106483.021			

The F tests the effect of 1=patril 2=CD. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

1-2-5. NT Adjusted mean, standard error (ANCOVA)

Estimates

Dependent Variable: total_OF= Newton

NT_28_3G	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
.00	262.363 ^a	24.932	213.388	311.338
1.00	411.242 ^a	22.569	366.909	455.575
2.00	548.799 ^a	24.657	500.364	597.234

a. Covariates appearing in the model are evaluated at the following values: 1=M
 2=F = 1.70, year = 75.8079, 1=PD>5mm = .2777, 1=high or more = .2396, 1=yes
 = .2904, 0=no = .6588, 1 positive = .5735.

Pairwise Comparisons

Dependent Variable: total_OF= Newton

(I)	(J)	Mean Difference (I- J)	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
					Lower Bound	Upper Bound
.00	1.00	-148.879 [*]	33.768	.000	-229.970	-67.788
	2.00	-286.436 [*]	35.948	.000	-372.763	-200.108
1.00	.00	148.879 [*]	33.768	.000	67.788	229.970
	2.00	-137.557 [*]	33.403	.000	-217.772	-57.341
2.00	.00	286.436 [*]	35.948	.000	200.108	372.763
	1.00	137.557 [*]	33.403	.000	57.341	217.772

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Bonferroni.

Univariate Tests

Dependent Variable: total_OF= Newton

	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Contrast	6458152.603	2	3229076.302	31.750	.000	.105
Error	55021132.205	541	101702.647			

The F tests the effect of NT_28_3G. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

1-2-6. NRT Adjusted Mean, standard error (ANCOVA)

Estimates

Dependent Variable: total_OF= Newton

NRT_28_3G	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
.00	284.575 ^a	81.571	124.340	444.809
1.00	292.547 ^a	35.187	223.427	361.668
2.00	436.659 ^a	15.843	405.537	467.780

a. Covariates appearing in the model are evaluated at the following values: 1=M

2=F = 1.70, year = 75.8079, 1=periodontitis>5mm = .2777, 1=high or more

= .2396, 1=yes = .2904, 0=no = .6588, 1 positive = .5735.

Pairwise Comparisons

Dependent Variable: total_OF= Newton

(I)	(J)	Mean Difference (I-J)	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^b	
					Lower Bound	Upper Bound
.00	1.00	-7.973	88.443	1.000	-220.365	204.420
	2.00	-152.084	83.256	.205	-352.019	47.850
1.00	.00	7.973	88.443	1.000	-204.420	220.365
	2.00	-144.111 [*]	38.758	.001	-237.187	-51.036
2.00	.00	152.084	83.256	.205	-47.850	352.019
	1.00	144.111 [*]	38.758	.001	51.036	237.187

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Bonferroni.

Univariate Tests

Dependent Variable: total_OF= Newton

	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Contrast	1768031.734	2	884015.867	8.009	.000	.029
Error	59711253.075	541	110372.002			

The F tests the effect of NTR_28_3G. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

1-3 Raw data by SPSS statistics for Table 3

1-3-1 Model 1 Denture status (0-2) (Linear Regression)

Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.300 ^a	.090	.076	327.3138

Coefficients^a

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations		
	B	Std. Error				Beta	Lower Bound	Upper Bound	Zero order	Partial
1 (Constant)	763.4	233.1		3.27	.00	305.53	1221.3			
DS 0=dentate 1=PD 2=CD	-125.9	22.301	-.240	-5.64	.00	-169.67	82.05	-.255	-.236	-.23
1=Male 2=Female	-16.9	40.52	-.023	-.416	.68	-96.466	62.73	-.054	-.018	-.01
Age,year	-4.078	2.752	-.063	-1.48	.14	-9.484	1.327	-.114	-.064	-.06
0=no Perio 1=Perio	-60.9	31.66	-.080	-1.92	.05	-123.0	1.319	-.095	-.082	-.08

0=<high school 1=high more	40.358	34.197	.051	1.18 0	.23 8	-26.816	107.5 33	.098	.051	.048
Smoking 1=yes	39.040	41.215	.052	.947	.34 4	-41.921	120.0 02	.053	.041	.039
Alcohol 0=no 1=yes	24.462	30.829	.034	.793	.42 8	-36.096	85.02 1	.072	.034	.033
Metaboli c syndrome 0=no 1=yes	25.635	28.703	.037	.893	.37 2	-30.748	82.01 8	.061	.038	.037

a. Dependent Variable: total_OF= Newton

1-3-2. Model 2. NTR 28 (Linear Regression)

Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.252 ^a	.063	.049	332.0279

Coefficients^a

Model	Unstandardized Coefficients	Std. Error	Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations		
						Lower Bound	Upper Bound	Zero-order	Partial	Partial
1 (Constant)	445.7	256.5		1.735	.083	-58.85	948.98			
NTR_28	15.08	3.809	.169	3.96	.00	7.60	22.56	.167	.168	.165
1=M 2=F	-27.3	41.16	-.037	-663	.50	-108.12	53.58	-.054	-.028	-.03
Age, year	-5.60	2.772	-.086	-2.02	.044	-11.05	-.162	-.11	-.087	-.08
0=no 1=perio	-62.1	32.13	-.082	-1.93	.054	-125.2	.997	-.09	-.083	-.080
0=<high school 1=high school or more	48.77	34.62	.061	1.41	.16	-19.24	116.79	.098	.060	.059
0=non smoking 1=smoking	27.25	41.73	.036	.653	.514	-54.716	109.217	.053	.028	.027

1=alcohol	29.64	31.25	.041	.948	.34	-31.75	91.02	.072	.041	.039
0=no alcohol							7			
0=no Metabolic syndrome	51.54	28.93	.075	1.78	.07	-5.296	108.3	.061	.076	.074
1=Metabolic syndrome							8			



3-1-3 Model 3. NT (Linear Regression)

Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.393 ^a	.155	.142	315.3923

Coefficients^a

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations		
	B	Std. Error				Beta	Lower Bound	Upper Bound	Zero-order	Partial
1 (Constant)	377.501	230.462		1.638	.102	-75.208	830.209			
NRT_28	16.803	1.927	.364	8.721	.000	13.018	20.588	.357	.351	.344
1=M 2=F	-39.790	39.118	-.054	-1.017	.310	-116.632	37.052	-.054	-.044	-.040
Age, year	-3.252	2.650	-.050	-1.227	.220	-8.458	1.955	-.114	-.053	-.048
0=no perio 1=perio	-49.391	30.562	-.065	1.616	.107	-109.426	10.645	-.095	-.069	-.064
0=<high school 1=high school or more	10.900	33.259	.014	.328	.743	-54.432	76.233	.098	.014	.013
0=non smoking 1=smoking	65.317	39.899	.087	1.637	.102	-13.058	143.692	.053	.070	.065

1=alcohol	11.853	29.767	.017	.398	.691	-46.619	70.325	.07	.017	.016
0=no alcohol								2		
0=no Metabolic syndrome	34.007	27.479	.049	1.238	.216	-19.972	87.985	.06	.053	.049
1=Metabolic syndrome								1		

a. Dependent Variable: total_OF= Newton

1-4. Raw data by SPSS statistics for Table 4.

1-4-1 Male: DS ; Dentate, Partial denture, Complete denture (Linear Regression)

Model Summary^{a,c}

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.303 ^b	.092	.051	337.5388

a. 1=M 2=F = male

b. Predictors: (Constant), 1 positive, 1=Periodontitis>5mm, year, 0=no, 1=high or more, 1=yes, 1=PD 2=CD

c. Dependent Variable: total_OF= Newton

Model	Unstandardized Coefficients		Standardized Coefficients Beta	t	Sig.	95.0% Confidence Interval for B		Correlations		
	B	Std. Error				Lower Bound	Upper Bound	Std. Error	Beta	Partial r
1 (constant)	842.587	393.625		2.141	.034	65.103	1620.072			
DS,0=dentate 1=partial 2=CD	-97.856	41.362	-.194	-2.366	.019	-179.554	16.157	-.239	-.186	-.180
Age, year	-6.416	5.041	-.099	-1.273	.205	-16.373	3.541	-.090	-.101	-.097

0=no perio 1=periodontitis	9.979	60.468	.013	.165	.869	- 109.457	129.415	-.007	.013	.013
1=high school or more	68.593	54.932	.098	1.249	.214	- 39.909	177.095	.138	.099	.095
0=non smoker 1=smoker	10.692	62.514	.014	.171	.864	- 112.784	134.169	.003	.014	.013
0=no alcohol 1=alcohol	76.227	69.423	.088	1.098	.274	- 60.897	213.352	.139	.087	.084
0=no metabolic syndrome 1=metabolic syndrome	58.834	53.678	.085	1.096	.275	- 47.190	164.858	.125	.087	.083

1-4-2 Female: DS ; Dentate, Partial denture, Complete denture (Linear Regression)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.309 ^b	.095	.079	324.1788

a. 1=M 2=F = female

b.Predictor: (constant), 1 positive, 1=yes, 1=Periodontitis>5mm, 1=high or more, 1=PD
2=CD, 0=no, year

c. Dependent variable: total_OF= Newton

Model	Unstandardized Coefficients		Standardized Coefficients Beta	t	Sig.	95.0% Confidence Interval for B		Std. Error	Correlations	
	B	Error				Lower Bound	Upper Bound		Beta	Partial r
1 constant	692.600	259.893		2.665	.008	181.583	1203.617			
DS,0=dentate 1=partial 2=CD	-135.3	27.079	-.253	-4.998	.000	-188.598	-82.108	-.271	-.249	-.245
Age, year	-3.246	3.372	-.050	-.963	.336	-9.877	3.385	-.125	-.049	-.047
0=no perio 1=periodontitis	-88.478	37.373	-.118	-2.367	.018	-161.964	-14.992	-.133	-.121	-.116

1=high school or more	24.353	44.853	.027	.543	.587	- 63.840	112.546	.059	.028	.027
0=non smoker 1=smoker	53.006	56.465	.047	.939	.348	- 58.019	164.031	.039	.048	.046
0=no alcohol 1=alcohol	15.382	34.973	.022	.440	.660	- 53.383	84.147	.037	.023	.022
0=no Metabolic syndrome 1=Metabolic syndrome	12.688	34.212	.018	.371	.711	- 54.582	79.958	.043	.019	.018

1-4-3 Male: NRT (Linear Regression)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.315 ^b	.099	.059	336.0838

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Std. Error	Correlations	
	B	Error	Beta			Lower Bound	B		Beta	Partial r
1 (constant)	382.308	420.418		.909	.365	-448.097	1212.713			
DS,0=dentate 1=partial 2=CD	16.492	6.230	.203	2.647	.009	4.187	28.797	.217	.207	.201
Age, year	-6.758	5.018	-.105	-1.347	.180	-16.670	3.153	-.090	-.107	-.102
0=no perio 1=periodontitis	4.638	60.140	.006	.077	.939	-114.149	123.426	-.007	.006	.006
1=high school or more	73.275	54.452	.104	1.346	.180	-34.278	180.827	.138	.107	.102
0=non smoker 1=smoker	.541	61.454	.001	.009	.993	-120.842	121.924	.003	.001	.001
0=no alcohol 1=alcohol	117.745	66.675	.136	1.766	.079	-13.951	249.441	.139	.140	.134

0=no metabolic syndrome 1=metabolic syndrome	69.811	52.931	.101	1.319	.189	-34.737	174.359	.125	.105	.100
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1-4-4 Female : NRT (Linear Regression)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.238 ^b	.057	.039	331.0776

a. 1=M 2=F = female

b. Predictors : (constant), 1 positive, 1=yes, 1=Periodontitis>5mm, 1=high or more, NRT_28, year, 0=no

c. Outcome variable : total_OF= Newton

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations		
	B	Std. Error				Lower Bound	Upper Bound	B	Std. Error	Partial r
1 (constant)	474.588	296.526		1.600	.110	-108.460	1057.636			
DS,0=dentate 1=partial 2=CD	14.079	4.868	.148	2.892	.004	4.507	23.651	.155	.147	.144
Age, year	-6.005	3.386	-.092	-1.774	.077	-12.662	.653	-.125	-.091	-.089
0=no perio 1=periodontitis	-87.7	38.256	-.117	-2.292	.022	-162.921	-12.478	-.133	-.117	-.115

1=high school or more	28.635	45.846	.032	.625	.53	-	118.780	.059	.032	.031
0=non smoker 1=smoker	46.244	57.855	.041	.799	.42	-	160.003	.039	.041	.040
0=no alcohol 1=alcohol	4.350	35.897	.006	.121	.90	-	74.933	.037	.006	.006
0=no metabolic syndrome 1=metabolic syndrome	44.215	34.895	.064	1.26	.20	-	112.828	.043	.065	.063

a. 1=M 2=F = female

b. Outcome variable: total_OF= Newton

1-4-5. Male: NT (Linear Regression)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.426 ^b	.182	.145	320.3393

Model	Unstandardized Coefficients		Standardized Coefficients Beta	t	Sig.	95.0% Confidence Interval for B		Correlations		
	B	Std. Error				Lower Bound	Upper Bound	B	Std. Error	Partial
1 (constant)	385.373	382.145		1.008	.315	-369.436	1140.182			
DS 0=dentate 1=PD 2=CD	17.733	3.656	.379	4.850	.000	10.512	24.954	.400	.361	.350
Age	-4.700	4.801	-.073	-.979	.329	-14.182	4.782	-.090	-.078	-.071
0=no perio 1=periodontitis	34.629	57.688	.045	.600	.549	-79.316	148.574	-.007	.048	.043
0=<high school 1=high school or more	46.108	52.345	.066	.881	.380	-57.283	149.499	.138	.070	.064

0=no smoking 1=smoking	38.989	59.368	.050	.657	.51 2	- 78.274	156.251	.003	.052	.047
0=no alcohol 1=alcohol	41.168	65.573	.048	.628	.53 1	- 88.350	170.687	.139	.050	.045
0=no metabolic syndrome 1=metabolic syndrome	44.870	50.825	.065	.883	.37 9	- 55.519	145.259	.125	.070	.064

a. 1=M 2=F = male

b. : total_OF= Newton



1-4-6. Female :NT (Linear Regression)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.387 ^b	.150	.134	314.3061

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations		
	B	Std. Error				Lower Bound	Upper Bound	B	Std. Error	Partial r
1 (constant)	321.890	261.237		1.232	.219	-191.771	835.550			
DS,0=dentate 1=partial 2=CD	16.343	2.295	.351	7.120	.000	11.830	20.856	.357	.344	.338
Age, year	-3.195	3.243	-.049	-.985	.325	-9.571	3.182	-.125	-.051	-.047
0=no perio 1=periodontitis	-81.06	36.267	-.108	-2.235	.026	-152.369	-9.749	-.133	-.114	-.106
1=high school or more	-12.73	43.995	-.014	-.289	.772	-99.236	73.775	.059	-.015	-.014

0=non smoker 1=smoker	84.88	55.121	.076	1.540	.124	-23.495	193.270	.039	.079	.073
0=no alcohol 1=alcohol	2.61	33.950	.004	.077	.939	-64.140	69.369	.037	.004	.004
0=no metabolic syndrome 1=metabolic syndrome	29.05	32.936	.042	.882	.378	-35.709	93.811	.043	.045	.042



1-4-7. Age<75 : DS (Linear Regression)

Model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.340 ^b	.115	.083	358.7018

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations		
	B	Std. Error				Lower Bound	Upper Bound	Std. Error	Beta	Partial
1 (constant)	1930.964	683.781		2.82	.01	583.26	3278.7			
DS 0=dentate 1=PD 2=CD	-162.85	43.135	-.253	-3.8	.00	-247.9	-77.83	-.26	-.25	-.24
1=male 2=female	-84.225	70.936	-.102	-1.2	.24	224.0	55.587	-.04	-.08	-.08
Age	-18.453	9.371	-.131	-1.97	.05	36.92	.017	-.12	-.13	-.12
0=no perio 1=periodontitis	-46.357	59.003	-.052	-.78	.43	162.7	69.94	-.08	-.05	-.05

0=<high school 1=high school or more	106.186	56.448	.123	1.88	.06	- 5.071	217.44 2	.162	.127	.120
0=no smoking 1=smoking	-76.266	70.327	-.096	- 1.08	.27 9	- 214.9	62.346	-.03	-.07	-.07
0=no alcohol 1=alcohol	40.263	53.874	.049	.747	.45 6	- 65.92	146.44 6	.085	.051	.048
0=no Metabolic syndrome 1=Metabolic syndrome	-7.447	49.520	-.010	-.15 0	.88 1	- 105.0 4	90.155	.005	-.01 0	-.01 0

1-4-8. Age ≥ 75 : DS (Linear Regression)

Model Summary^c

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.315 ^b	.099	.077	300.9726

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations		
	B	Std. Error				Beta	Lower Bound	B	Upper Bound	Std. Error
1 (constant)	565.265	430.780		1.312	.190	-282.295	1412.825			
DS 0=dentate 1=PD 2=CD	-112.4	25.181	-.247	-4.466	.000	-162.003	-62.915	-.250	-.244	-.238
1=male 2=female	6.079	48.809	.009	.125	.901	-89.953	102.112	-.070	.007	.007
Age	-2.281	5.227	-.024	-.436	.663	-12.565	8.003	-.057	-.025	-.023
0=no perio 1=periodontitis	-57.110	36.420	-.085	-1.568	.118	-128.767	14.547	-.095	-.088	-.084
0=<high school 1=high school or more	-19.570	42.674	-.026	-.459	.647	-103.530	64.391	.041	-.026	-.024

0=no smoking 1=smoking	121.119	50.703	.170	2.389	.017	21.361	220.877	.117	.133	.128
0=no alcohol 1=alcohol	1.224	37.439	.002	.033	.974	-72.437	74.884	.053	.002	.002
0=no metabolic syndrome 1=metabolic syndrome	60.083	34.737	.095	1.730	.085	-8.262	128.429	.103	.097	.092



1-4-9. Age < 75: NRT (Linear Regression)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.308 ^b	.095	.062	362.7968

<75 NRT

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations		
	B	Std. Error				Lower Bound	B	Std. Error	Beta	Partial r
1 (constant)	1118.083	716.965		1.559	.120	-295.024	2531.190			
NRT	20.043	6.658	.207	3.010	.003	6.920	33.166	.218	.200	.194
1=male 2=female	-100.537	72.207	-.121	-1.392	.165	-242.854	41.781	-.040	-.094	-.090
Age	-15.116	9.483	-.107	-1.594	.112	-33.807	3.575	-.119	-.108	-.103
0=no perio 1=periodontitis	-11.682	60.436	-.013	-.193	.847	-130.800	107.435	-.079	-.013	-.012
0=<high school 1=high school or more	114.020	56.983	.132	2.001	.047	1.709	226.331	.162	.135	.129
0=no smoking 1=smoking	-88.793	70.906	-.112	-1.252	.212	-228.545	50.960	-.033	-.085	-.081
0=no alcohol 1=alcohol	58.804	54.044	.072	1.088	.278	-47.715	165.322	.085	.074	.070

0=no metabolic syndrome 1=metabolic syndrome	35.077	49.964	.046	.702	.483	-63.400	133.554	.005	.048	.045
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1-4-10. Age \geq 75 : NRT (Linear Regression)

Model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.248 ^b	.061	.038	307.2521

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations		
	B	Std. Error	Beta			Lower Bound	B	Std. Error	Beta	Partial r
1 (constant)	348.109	465.863		.747	.455	-568.476	1264.694			
NRT	11.589	4.598	.140	2.521	.012	2.543	20.635	.130	.140	.137
1=male 2=female	-5.705	49.792	-.008	-.115	.909	-103.670	92.260	-.070	-.006	-.006
Age	-3.752	5.325	-.039	-.705	.482	-14.228	6.725	-.057	-.040	-.038
0=no perio 1=periodontitis	-72.249	37.018	-.107	-1.952	.052	-145.082	1.583	-.095	-.109	-.106
0=<high school 1=high school or more	-7.460	43.432	-.010	-.172	.864	-92.913	77.993	.041	-.010	-.009
0=no smoking 1=smoking	105.879	51.605	.148	2.052	.041	4.347	207.411	.117	.115	.112
0=no alcohol 1=alcohol	1.173	38.248	.002	.031	.976	-74.080	76.426	.053	.002	.002

0=no metabolic syndrome 1=metabolic syndrome	79.883	35.178	.127	2.271	.024	10.670	149.097	.103	.127	.124
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1-4-11. Age < 75: NT (Linear Regression)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.399 ^b	.159	.128	349.7751

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Std. Error	Correlations	
	B	Std. Error				Lower Bound	B		Beta	Partial
1 (constant)	1329.346	668.623		1.988	.048	11.519	2647.173			
NT	16.788	3.279	.339	5.119	.000	10.325	23.252	.345	.328	.319
1=male 2=female	-69.422	107.520	-.130	-1.549	.123	-29.308	244.348	-.040	-.105	-.096
Age,	-14.875	9.135	-.105	-1.628	.105	-32.880	3.129	-.119	-.110	-.101
0=no perio 1=periodontitis	-39.644	57.517	-.044	-.689	.491	-153.008	73.720	-.079	-.047	-.043

0=<high school 1=high school or more	75.671	55.690	.088	1.359	.176	-34.092	185.433	.162	.092	.085
0=no smoking 1=smoking	-57.079	68.778	-.072	-.830	.408	-192.638	78.480	-.033	-.056	-.052
0=no alcohol 1=alcohol	39.480	52.321	.048	.755	.451	63.643	142.602	.085	.051	.047
0=no metabolic syndrome 1=metabolic syndrome	15.044	47.851	.020	.314	.754	79.269	109.357	.005	.021	.020

1-4-12. Age ≥ 75 NT (Linear Regression).

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.422 ^b	.178	.157	287.5674

b

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Std. Error	Correlations	
	B	Std. Error				Beta	Lower Bound		Upper Bound	Partial
1 (constant)	103.140	419.397		.246	.806	-928.304	722.024			
NT	16.823	2.333	.388	7.211	.000	12.233	21.413	.360	.376	.368
1=male 2=female	-46.614 13.404		-.020	-.288	.774	-78.309 105.117		-.070	-.016	-.015
Age	-.475	4.998	-.005	-.095	.924	-9.359 10.310		-.057	-.005	-.005
0=no perio 1=periodontitis	-34.927 40.418		-.060	-.115	.248	-28.301 109.138		-.095	-.065	-.059
0=<high school 1=high school or more	-41.047 45.590		-.061	-.111	.268	-35.171 126.351		.041	-.062	-.057

0=no smoking 1=smoking	150.05 5	48.720	.210	3.08 0	.00 2	54.199	245.91 2	.117	.171	.157
0=no alcohol 1=alcohol	- 13.671	35.859	-.021	-.38 1	.70 3	- 84.224	56.882	.053	-.02 1	-.01 9
0=no metabolic syndrome 1=metabolic syndrome	59.405	33.044	.094	1.79 8	.07 3	-5.610	124.41 9	.103	.101	.092



1-5. Raw data by SPSS statistics for Figure 1

1-5-1. Occlusal force according to Denture status

Correlations

		total_OF=		
		Newton	1=patril 2=CD	
Spearman's rho	total_OF= Newton	Correlation Coefficient	1.000	
		Sig. (2-tailed)	.	
		N	551	
	1=patril 2=CD	Correlation Coefficient	-.272**	1.000
		Sig. (2-tailed)	.000	.
		N	551	551

** . Correlation is significant at the 0.01 level (2-tailed).

**1-5-2. Occlusal force according to NT
Correlation**

			NT_28	total_OF= Newton
Spearman의 rho	NT_28	상관계수	1.000	.382**
		유의확률 (양측)	.	.000
		N	551	551
	total_OF= Newton	상관계수	.382**	1.000
		유의확률 (양측)	.000	.
		N	551	551

** . 상관관계가 0.01 수준에서 유의합니다(양측).

1-5-3. Occlusal force according to NRT

Correlations

			total_OF= Newton	NTR_28
Spearman's rho	total_OF= Newton	Correlation Coefficient	1.000	.115**
		Sig. (2-tailed)	.	.007
		N	551	551
	NTR_28	Correlation Coefficient	.115**	1.000
		Sig. (2-tailed)	.007	.
		N	551	551

** . Correlation is significant at the 0.01 level (2-tailed).

1-6. Raw data by SPSS statistics for Figure 2.

1-6-1. Occlusal force according to Sex. (ANCOVA)

Value

Outcome variable: total_OF= Newton

1=M 2=F	평균	표준오차	95% 신뢰구간	
			하한	상한
male	421.422 ^a	32.513	357.556	485.288
female	402.499 ^a	19.002	365.172	439.826

a. Following model considered the following variables .: year = 75.8079, 1=PD>5mm = .2777, 1=high or more = .2396, 1=yes = .2904, 0=no = .6588, 1 positive = .5735.

total_OF= Newton

(I) 1=M 2=F	(J) 1=M 2=F	평균차이(I-J)	표준오차	유의 확률 ^a	차이에 대한 95% 신뢰구간 ^a	
					하한	상한
male	female	18.923	41.656	.650	-62.904	100.750
female	male	-18.923	41.656	.650	-100.750	62.904

a. Multiple comparison test by: Bonferroni

ANOVA

종속변수: total_OF= Newton

	제곱합	자유도	평균제곱	F	유의 확률	부분 에타 제곱
대비	23363.446	1	23363.446	.206	.650	.000
오차	61479284.808	543	113221.519			

F-검정으로 효과 1=M2=F을(를) 검정합니다. 이 검정은 추정되는 주변 평균 사이의 선형독립의 대응별 비교에 기초합니다.

1-6-2. Occlusal force according to Age group (ANCOVA)

Value

total_OF= Newton

75+	평균	표준오차	95% 신뢰구간	
			하한	상한
<75	434.001 ^a	22.566	389.673	478.328
=>75	390.201 ^a	18.778	353.314	427.088

a 계산됩니다.: 1=PD>5mm = .2777, 1=high or more = .2396,
1=yes = .2904, 0=no = .6588, 1 positive = .5735.

Comparison

Outcome variable: total_OF= Newton

(I) 75+	(J) 75+	평균차이(I-J)	표준오차	유의확률 ^a	차이에 대한 95% 신뢰구간 ^a	
					하한	상한
<75	=>75	43.800	29.523	.138	-14.193	101.793
=>75	<75	-43.800	29.523	.138	-101.793	14.193

a. For multiple comparison: Bonferroni

1-6 Figure 3. Raw data for SPSS statistics

1-6-1. Occlusal force according denture status for High (24-28 teeth) group

		N	평균	표준화	표준화	평균에 대한		최소값	최대값
				편차	오류	95% 신뢰구간	하한		
total_OF=	.00	285	521.416	371.6887	22.0169	478.079	564.753	12.7	1870.0
Newton	1.00	112	289.359	217.3093	20.5338	248.670	330.048	4.2	1181.1
	2.00	46	263.207	249.8749	36.8420	189.003	337.410	4.3	1130.3
	전체	443	435.935	346.7625	16.4752	403.556	468.314	4.2	1870.0
NTR_28	.00	285	26.6877	1.37535	.08147	26.5274	26.8481	24.00	28.00
	1.00	112	27.3571	1.08102	.10215	27.1547	27.5596	24.00	28.00
	2.00	46	27.4783	1.18770	.17512	27.1256	27.8310	24.00	28.00
	전체	443	26.9391	1.32958	.06317	26.8149	27.0632	24.00	28.00
NT_28	.00	285	23.5860	4.19806	.24867	23.0965	24.0754	1.00	28.00
	1.00	112	13.5625	5.18275	.48972	12.5921	14.5329	3.00	23.00
	2.00	46	5.5652	3.08870	.45540	4.6480	6.4824	.00	12.00
	전체	443	19.1806	7.67106	.36446	18.4643	19.8969	.00	28.00
NTR_post_28	.00	285	14.7544	1.33850	.07929	14.5983	14.9104	12.00	16.00
	1.00	112	15.4643	.98574	.09314	15.2797	15.6489	12.00	16.00
	2.00	46	15.5000	1.16905	.17237	15.1528	15.8472	12.00	16.00
	전체	443	15.0113	1.28597	.06110	14.8912	15.1314	12.00	16.00
NT_post_28	.00	285	12.6000	3.10973	.18420	12.2374	12.9626	.00	16.00
	1.00	112	5.6964	2.90957	.27493	5.1516	6.2412	.00	12.00
	2.00	46	2.3043	1.82415	.26896	1.7626	2.8461	.00	6.00
	전체	443	9.7856	4.88340	.23202	9.3296	10.2415	.00	16.00

ANOVA

		제곱합	자유도	평균제곱	F	유의 확률
total_OF= Newton	집단-간	5861169.990	2	2930584.995	27.269	.000
	집단-내	47286782.598	440	107469.960		
	전체	53147952.588	442			
NTR_28	집단-간	50.955	2	25.477	15.348	.000
	집단-내	730.400	440	1.660		
	전체	781.354	442			
NT_28	집단-간	17593.542	2	8796.771	459.907	.000
	집단-내	8416.011	440	19.127		
	전체	26009.553	442			
NTR_post_28	집단-간	52.779	2	26.390	17.122	.000
	집단-내	678.164	440	1.541		
	전체	730.944	442			
NT_post_28	집단-간	6704.810	2	3352.405	384.549	.000
	집단-내	3835.818	440	8.718		
	전체	10540.628	442			

다중비교

종속변수		(J)		평균차이(I-J)	표준화 오류	유의 확 률	95% 신뢰구간	
		(I) 1=patril 2=CD	1=patril 2=CD				하한	상한
total_OF= Newton	Bonferro ni	.00	1.00	232.0569*	36.560	.000	146.080	318.034
			2.00	258.2093*	52.090	.000	135.710	380.708
	1.00	.00	- 232.0569*	36.560	.000	-318.034	-146.080	
		2.00	26.1524	57.409	.892	-108.856	161.161	
	2.00	.00	- 258.2093*	52.090	.000	-380.708	-135.710	
		1.00	-26.1524	57.409	.892	-161.161	108.856	
NTR_28	Bonferro ni	.00	1.00	-.66942*	.14369	.000	-1.0073	-.3315
			2.00	-.79054*	.20472	.000	-1.2720	-.3091
	1.00	.00	.66942*	.14369	.000	.3315	1.0073	
		2.00	-.12112	.22563	.853	-.6517	.4095	
	2.00	.00	.79054*	.20472	.000	.3091	1.2720	
		1.00	.12112	.22563	.853	-.4095	.6517	
NT_28	Bonferro ni	.00	1.00	10.02346*	.48774	.000	8.8765	11.1705
			2.00	18.02075*	.69493	.000	16.3865	19.6550
	1.00	.00	- 10.02346*	.48774	.000	-11.1705	-8.8765	
		2.00	7.99728*	.76589	.000	6.1962	9.7984	
	2.00	.00	- 18.02075*	.69493	.000	-19.6550	-16.3865	
		1.00	-7.99728*	.76589	.000	-9.7984	-6.1962	
NTR_post_	Bonferro	.00	1.00	-.70990*	.13845	.000	-1.0355	-.3843

28	ni		2.00	-.74561*	.19727	.001	-1.2095	-.2817	
			1.00	.70990*	.13845	.000	.3843	1.0355	
			2.00	-.03571	.21741	.985	-.5470	.4756	
			2.00	.74561*	.19727	.001	.2817	1.2095	
			1.00	.03571	.21741	.985	-.4756	.5470	
NT_post_28	Bonferro	.00	1.00	6.90357*	.32928	.000	6.1292	7.6779	
			2.00	10.29565*	.46915	.000	9.1924	11.3989	
	ni	.00	1.00	-.690357*	.32928	.000	-7.6779	-6.1292	
			2.00	3.39208*	.51706	.000	2.1761	4.6080	
			2.00	.00	-	.46915	.000	-11.3989	-9.1924
					10.29565*				
			1.00	-3.39208*	.51706	.000	-4.6080	-2.1761	
			2.00	3.39208*	.51706	.000	2.1221	4.6620	

*. 평균차이는 0.05 수준에서 유의합니다.

1-6-2. Occlusal force according to denture status for Moderate (16-23 teeth) group.

집단통계량

	1 PD+CD	N	평균	표준화 편차	표준오차 평균
total_OF= Newton	.00	70	325.417	298.6381	35.6941
	1.00	21	213.752	172.0170	37.5372
NTR_28	.00	70	20.5000	2.14510	.25639
	1.00	21	21.3810	1.90987	.41677
NT_28	.00	70	17.6571	3.65896	.43733
	1.00	21	12.3810	4.90384	1.07011
NTR_post_28	.00	70	9.2429	1.88384	.22516
	1.00	21	10.9048	1.81397	.39584
NT_post_28	.00	70	7.7429	2.33862	.27952
	1.00	21	5.6667	2.86938	.62615

독립표본 검정

		Levene의 등분산 검정		평균의 동일성에 대한 T 검정						
		F	유 의 확 률	t	자유 도	유의 확률 (양측)	평균차 이	표준오 차 차이	차이의 95% 신뢰구간	
									하한	상한
total_O F= Newton	등분산을 가정함	2.98 7	.087	1.630	89	.107	111.664 8	68.497 6	- 24.438	247.768 1
	등분산을 가정하지 않음			2.156	58.62 7	.035	111.664 8	51.798 7	8.0019	215.327 6
NTR_2 8	등분산을 가정함	.436	.511	-1.690	89	.094	-.88095	.52114	- 1.9164	.15453 4
	등분산을 가정하지 않음			-1.800	36.48 8	.080	-.88095	.48932	- 1.8728	.11097 7
NT_28	등분산 을 가정함	5.33 6	.023	5.338	89	.000	5.27619	.98847	3.3121 3	7.24025
	등분산 을 가정하 지 않음			4.564	27.02 0	.000	5.27619	1.1560 2	2.9043 2	7.64806
NTR_post_ 28	등분산 을 가정함	.391	.533	-3.575	89	.001	-1.66190	.46486	- 2.5855	-.73823 8

	등분산 을 가정하 지 않음			-3.649	34.00 4	.001	-1.66190	.45540	- 2.5873 8	-73643
NT_post_28	등분산 을 가정함	2.51 8	.116	3.381	89	.001	2.07619	.61402	.85615	3.29623
	등분산 을 가정하 지 않음			3.028	28.43 8	.005	2.07619	.68571	.67256	3.47982

Appendix 2. Strengthening the Reporting of Observational studies (STROBE) in Epidemiology guideline

STROBE Statement.

Checklist of items that should be included in reports of observational studies

	Item	Recommendation	
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	P2-3. Yes. In abstract
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	P2,3. Yes In abstract
Introduction			
Background/ rationale	2	Explain the scientific background and rationale for the investigation being reported	P6. Yes. In Intro
Objectives	3	State specific objectives, including any prespecified hypotheses	P7. Yes. In Intro
Methods			
Study design	4	Present key elements of study design early in the paper	P7. Yes. In Methods
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	P8. Yes In Methods.
Participants	6	(a) <i>Cross-sectional Study</i> Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> — Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls	P7-8. Yes In Methods

	<i>Cohort Study</i> — Give the eligibility criteria, and the sources and methods of selection of participants	
	<i>(b) Cohort study</i> — For matched studies, give matching criteria and number of exposed and unexposed	
	<i>Case-control study</i> — For matched studies, give matching criteria and the number of controls per case	
Variables	7 Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	8-10. Yes. In Methods
Data sources/ measurements	8* For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	P8-10. Yes. In Methods
Bias	9 Describe any efforts to address potential sources of bias	P9-10.
Study size	10 Explain how the study size was arrived at	Yes. In Methods
Quantitative variables	11 Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	P10,11 In Methods
Statistical methods	12 (a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> — If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> — If applicable, describe analytical methods taking account of sampling strategy	P10,11. In Methods. P10. Yes In Methods. P8. Yes in Methods.

(g) Describe any sensitivity analyses

Results

Partici 13 (a) Report numbers of individuals at each stage of study— P11-13.
 pants * eg numbers potentially eligible, examined for eligibility, confirmed eligible, incl Yes In
 Results.
 uded in the study, completing follow-up, and analysed
 (b) Give reasons for non-participation at each stage
 (c) Consider use of a flow diagram

Descri 14 (a) Give characteristics of study participants (eg demographic, clinical, social) a P11.
 ptive d * nd information on exposures and potential confounders Yes In
 Results.
 ata (b) Indicate number of participants with missing data for each variable of interes
 t
 (c) *Cohort study*—Summarise follow-up time (eg, average and total amount)

Outco 15 *Cohort study*—
 me dat * Report numbers of outcome events or summary measures over time
 a *Case-control study*—
 Report numbers in each exposure category, or summary measures of exposure
Cross-sectional study— P11-13.
 Report numbers of outcome events or summary measures
 Yes In
 Results.

Main 16 (a) Give unadjusted estimates and, if applicable, confounder- P11-13
 result adjusted estimates and their precision (eg, 95% confidence interval). Make clear Yes In
 s which confounders were adjusted for and why they were included Results
 (b) Report category boundaries when continuous variables were categorized
 (c) If relevant, consider translating estimates of relative risk into absolute risk fo
 r a meaningful time period

Other 17 Report other analyses done— P10-11.
 analys eg analyses of subgroups and interactions, and sensitivity analyses Yes In
 es Methods

Discussion

Key 18 Summarise key results with reference to study objectives P13-15.
 results Yes In

		Discussion
Limitations	19 Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	P15-16. Yes In Discussion
Generalisability	21 Discuss the generalisability (external validity) of the study results	P15-16. Yes In Discussion

Other information

Funding	22 Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based
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*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.