A study to evaluate changes in maxillomandibular relationships in long term complete denture wearer following new prosthesis fabrication by using jarabak ratio

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Abstract
Background: *Determination of maxillomandibular relationships in long term complete denture wearer following fabrication of new prosthesis by radiographic method has been performed by several investigators. If radiographic evaluation can be used to re-establish the maxillomandibular relationship, it would act as a boon to the stomatognathicsystem of elderly long standing complete denture wearing patient.The aim of the study wasto evaluate cephalometricallychange in maxillomandibular relationship between worn existing prostheses and newly fabricated complete dentures.*
Material and Methods: *A total of fifteen completely edentulous individuals from 68 to 85 years fulfilling the inclusion criteria were included in thestudy. Cephalometric radiography was performed in all the patients with existing old denture with four year duration. This was followed by conventional new complete denture fabrication.Once the patient was satisfied and comfortable with the new prosthesis, new cephalometric radiography was recorded. Cephalograms were traced manually and proposed cephalometric points were joined. Frankfort-Mandibular plane (FH-MP) angle, Sella-Nasion Mandibular plane (SN-MP)angleand Jarabak ratio were measured and compared before and after fabrication of new prosthesis.*
Results:*It was observed that there was an increase in the FH-MP and SN-MP angle post insertion of new prosthesis showing improvement in the vertical height of the patient. Also, there was slight decrease in Jarabak ratio in the patients, after the fabrication and insertion of new prosthesis, suggesting an increase in the posterior facial height post treatment.*
Conclusion:*Owing to greater number of geriatric population using complete denture, it is prudent for dental care providers to be aware of the consequences of faulty, old denture use over anatomy and physiology of temporomandibular joint and patients should be instructed for prosthesis after 4years of wearing.*
Keywords:*Cephalometry,Jarabak ratio, TMJ disorder, Denture*

I. Introduction

Fabrication and delivery of a prosthesis that is in harmony with the stomatognathic system of the patient is the key to a successful prosthodontic treatment.[1]The facial collapse in complete denture wearer resulting from occlusal wear of the artificial teeth, deterioration of the dentures, and residual ridge resorption is well documented in clinical context as well as in literature.[2-9]As a result, the stomatognathic system eventually adapts to the new maxillomandibular and occlusal relationships and thereby continues to function.However, in patients who use the same dentures for several decades without the advantage of relining or rebasing may surpass the limit between adapted physiology and pathosis, leading to a facial appearance resembling an Angle Class III relationship (distinct mandibular protrusion).This significant wear and tear of the occlusal surfaces of artificial teeth in long standing complete denture wearing patients also drastically affect the normal physiology of TMJ (at rest and function) and thus in turn affecting the condylar guidance.[10] Hence it becomes necessary for clinician to determine that whether this appearance is result of skeletal Class III relationship or is simply the

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outcome of denture wear, residual ridge resorption, mandibular forward rotation. Clinician must also consider whether the new dentures will correct the maxillomandibular relationship and facial collapse or not.[11,12]A few dentists have made attempts to usecephalometry as a diagnostic tool in prosthodontics to evaluate the results of prosthodontic rehabilitation and its influence on TMJ, particularly the condylar guidance.[1,13-15]

Thepresent study was designed to assessthe changes in maxillomandibular relationship of a group of patients wearing dentures for four years with the help of cephalometry.

II. Material And Methods

Fifteen patients (age range 68 to 85 years; mean age 75.5 years) who visited the OPD (outpatient department) of Department of Prosthodontics, Crowns and bridges, seeking complete denture fabrication were included in this study. All patients who have used their dentures for certain period of time with no alterations may be selected if they obey given inclusion and exclusion criteria.

Patients having True class III relationship were excluded from the study. Also patient suffering from congenital and acquired defect of maxillomandibular relation were excluded. None of the patients presenting any clinical signs or symptoms of temporomandibular disorder were included.

After obtaining the informed consent from the institution's ethical committee, a thorough clinical examination was done, after which the patients were referred to the Department of Orthodontic for cephalometric radiography. Cephalometric analyses were performed on the obtained cephalograms with the intermaxillary relationship being determined by the existing dentures.

The participating prosthodontist was not told about the results of the cephalometric analyses so as to avoid any bias during the fabrication of new dentures for the patients. A standard method of denture fabrication was followed for all the patients.

The procedures of establishing the rest position of the mandible and the maxillomandibular relationships were cross checked by two other operators amid new denture fabrication as well as during the subsequent recall examinations. This routine served as an inter-operator validation of the method used. Heat-processed acrylic resin denture bases were fabricated using preliminary and final impressions, wax occlusion rims were added, and maxillomandibular relationships were established as follows:

1. The occlusal plane was initially established using the center of the retromolar pads as posterior reference points and the lip commissures and the vermilion border of the lower lip as anterior reference points. The occlusal plane was made parallel to the interpupillary line. The rest position of the mandible was then determined by measuring the distance between two arbitrarily selected points, one on the nose and one on the chin, with the patient seated in an upright position looking directly forward, head unsupported, following swallowing and jaw relaxation. The mean of the distance recorded by the operators was used when the measured distance was not found consistent.

2. The occlusal vertical dimension was established by subtracting 3 to 4 mm from the rest position.

3. The interocclusal space was verified using phonetic and esthetic evaluations.

4. Centric relation was then carefully recorded using Aluwax against the notched opposing wax rim, through guided closure with bilateral manipulation. This method was chosen because of its ease of reproducibility verification.

This was followed by conventional complete denture fabrication technique and post insertion appointment. Once the patient was comfortable with his prosthesis, cephalogramwas repeated and cephalometric analysis was performed. It was ensured that the cephalogram were recorded by same operator and patient position was kept the same as before.

The values obtainedwere compared by Wilcoxon signed rank test. Statistical significance was set at P<0.05. The values were not averaged. SPSS 10.0 software was used for statistical analysis of all data.

III. Results

Table 1 shows the comparison of thecephalometric measurements with old and new denture. The prognathic mandibular appearance of the patients became normal maxillomandibular relationships and appeared Class I. After the placement of the new dentures, the vertical dimension was increased statistically.

Table 1:Comparison of the cephalometric measurements with old and new denture

S.No.	FH-MPangle		SN-MP angle		Jarabak ratio = Posterior facial height/Anterior facial height x 100 Jarabakratio: Sella-Gonion/Nasion-Menton X 100	
	Old denture	New denture	Old denture	New denture	Old denture	New denture
1.	21°	30°	26°	32°	80/116X100= 68.96	81/118X100= 68.64
2.	20°	28°	24°	29°	81/118X100= 68.64	81/119X100= 68.06
3.	19°	25°	22°	27°	72/106X100= 67.92	72.5/107X100= 67.75
4.	22°	28°	29°	34°	83/117X100= 70.94	83/118X100= 70.33
5.	21°	30°	25°	32°	79/116X100= 68.10	80/119X100= 67.22

6.	23°	27°	29°	33°	83/118X100= 70.33	83.5/119X100= 70.16
7.	18°	21°	23°	27°	79/115X100= 68.69	80/117X100= 68.37
8.	22°	27°	26°	32°	80/118X100= 67.79	82/121X100= 67.76
9.	21°	26°	27°	32°	80/115X100= 69.56	80/115.5X100= 69.26
10.	23°	29°	26°	32°	83/116X100= 71.55	84/119X100= 70.58
11.	19°	24°	22°	28°	79/111X100= 71.17	81/114X100= 71.05
12.	20°	26°	23°	28°	81/116X100= 69.82	81.5/117X100= 69.65
13.	21°	27°	27°	32°	80/115X100= 69.56	83/119X100= 69.74
14.	21°	25°	26°	30°	81/116X100= 69.82	83/119X100= 69.74
15.	22°	28°	28°	33°	80/115X100= 69.56	81/117X100= 69.23

There was an increase in FH-MP as well as SN-MP angle suggesting an increase in vertical dimension post insertion of new denture. Also, there is increase in anterior and posterior facial height after placement of new denture.

Table 2: Summary of the cephalometric measurements with old and new denture

Parameter	Old Denture				New Denture			
	Mean	SD	Min	Max	Mean	SD	Min	Max
FH-MP angle	20.87	1.46	18.00	23.00	26.73	2.37	21.00	30.00
SN-MP angle	25.53	2.33	22.00	29.00	30.73	2.34	27.00	34.00
Jarabak ratio	69.49	1.17	67.79	71.55	69.17	1.16	67.22	71.05

Table 3: Comparison of Pre &Post-Operative results of the cephalometric measurements with old and new denture

Parameter	Pre vs Post Difference		t - value	p-value
	Mean	SD		
FH-MP angle	5.87	1.73	-13.16	<0.001
SN-MP angle	5.20	0.86	-23.37	<0.001
Jarabak ratio	0.32	0.31	3.99	0.001

The FH-MP angle pre operatively, with old denture was measured to be $20.87\pm1.46°$ (range $18 - 23°$) which increased to $26.73\pm2.37°$ (range $21 - 30°$) post insertion of new denture. So the highly significant (t=13.16, p<0.001) increase of 5.87 ± 1.73 was found.

Similarly the SN-MP angle pre operatively was measured to be $25.53\pm2.33°$ (range $22 - 29°$) which post-operatively increased to $30.73\pm2.34°$ (range $27 - 34°$). Again a highly significant (t=23.37, p<0.001) increase of 5.20 ± 0.86 was found.

The Jarabak ratio pre-operatively was measured to be 69.49 ± 1.17 (range $67.79 - 71.55$) which post-operatively decreased to 69.17 ± 1.16 (range $67.22 - 71.05$). The observed values were found to be significant with an increase of 0.32 ± 0.31.

IV. Discussion
The last decades have witnessed a paradigm shift in the number of elderly people in the population. Advancing age is commonly associated with increased periodontal problems, dental decay, loss of teeth and resultant increased use of denture.

On the other hand, last decades have also witnessed the application of cephalometryin prosthodontic reconstruction (rehabilitation). It has emerged as an adjunct to reestablish the spatial position of lost structures such as the teeth, apart from its routine use in orthodontics.This is accomplished by recognizing predictable relationships between the teeth and other cranial landmarks of interest that arenot subject to postextraction changes. Such a relationship has been shown to exist between the angle formed by the mandibular planerelative to the Frankfort Horizontal plane (the FH-MP angle) on the one hand and the angle between themandibular plane to that of cephalometric pointsella andnasion(the SN-MP angle) on the other. Where the natural dentition has been lost and occlusion been distorted, the orientation of the occlusal plane can be reconstructed by measuring these angles cephalometrically.[16-19]

Thepresent study assesses the changes in maxillomandibular relationships of denture wearer using cephalometrics. Our study also helps us to evaluate the association of temporomandibular changes occurring among long standing denture wearers due to altered stomatognathic system.

In our study we found that all the studied subjects had collapsed vertical dimension with old, worn-out dentures. The mean FH-MP and SN-MP angle in them were measured to be 20.87° and 25.53° respectively.

Lack of vertical dimension along with poor retention and lack of stability makes a complete denture inadequate for use.[20] Exacerbated loss of vertical dimension due to prolonged use of such inadequate denture disturbs the harmony of stomatognathic system and thus affecting the overall health of the masticatory system.[21,22] Apart from the deleterious effect on the masticatory system, complete denture wearer also suffer from temporomandibular disorder (TMD), as the condylar path or more precisely the condylar guidance is immensely affected by wearing of occlusal surface.[1,23] In fact, literature suggests a positive relationship between the incidence of temporomandibular disorder (TMD) and the duration of complete denture wearing.[24]

Thepatients wearing complete denture are usually subjected to unbalanced distribution of occlusal force resulting from abrasion affecting the posteriors as well as attrition affecting the anteriors. Following five long stretches of utilization, approximately 50% of complete denture patients require replacement.[25]Extensive wear of denture teeth could influence the patient's personal satisfaction and quality of life through destructive effect on the masticatory framework, especially the TMJ.[26] Disharmony in occlusion disrupts the path traversed by condyle during mandibular movement (horizontal condylar guidance) eventually causing failure of accomplishment of the main rationale of prosthodontic rehabilitation.[1]

It was Costen who initially concluded through clinical observations that diminishing occlusal vertical dimensionbrought about condylar displacement posteriorly causing compression of chorda tympani, auriculotemporal nerves and eustachian tubes.[27]

Serman et al., and Divaris et al., reported that patients with complete dentures had more TMD signs and symptoms than patients with natural teeth.[28,29] The majority of complete denture wearers may exhibit a sensibly reduced occlusal vertical dimension as a result of denture tooth wear and alveolar bone loss. It was thought that the most common causes of signs and symptoms of TMD in complete denture wearers was the incorrect vertical dimension as stated above.[30]This was in accordance to our current study.

In order to address the above stated problems, we fabricated new dentures for the subjects with the aim to reestablish the lost vertical dimension. Post insertion of new denture, we found a significant increase in the vertical dimension cephalometrically.

The mean FH-MP and SN-MP angle post new denture insertion increased to 26.73° and 30.73° respectively.

The observations in our study clearly states that the subjects were benefited with the new prosthesis, as the collapsed facial height was restoredas there was an increase in the FH-MP and SN-MP angle, which was similar to the study conducted by Sofouet al.[19] The difference in the mean values of FH-MP and SN-MP angle, before and after insertion of new denture were highly significant ($p<0.001$). Though they did not use the same parameters as we did, but the results outrageously stated an increase in the vertical dimension (height) of the patient post new prosthesis insertion.

Also, there was slight decrease in Jarabak ratio in the patients, after the fabrication and insertion of new prosthesis, suggesting an increase in the posterior facial height post-operatively.

Another significant finding in our study was that the facial appearance of the patient was significantly improved from Pseudo Class III to Class I, which was again similar to the study conducted by Sofou et al

V. Conclusion

Owing to greater number of geriatric population using complete denture, it is prudent for dental care providers to be aware of the consequences of faulty, old denture use over anatomy and physiology of temporomandibular joint.

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