

# Determination of the occlusal plane in completely edentulous patient by computerized cephalometric method (A comparative study). Part I

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## ABSTRACT

**Aim:** to determine the validity of the ala–tragus technique in orienting the occlusal plane in complete denture construction for edentulous patients by evaluation of the edentulous patient response. **Materials and methods:** Twenty edentulous patients were selected according to specific criteria. Sixty sets of complete dentures (three sets for each edentulous patient) with three different occlusal planes parallel to the imaginary line between the inferior border of the ala of the nose, and superior, middle and inferior borders of the tragus were constructed. The grade of participants' response in this research was studied to report the degree of their participation with the occlusal plane of the complete denture they used through answering of Denture Patient Satisfaction Questionnaire (DPSQ) after one month of using each of the three randomly selected complete dentures. Mean and percentage of all the scores (four scores totally satisfied and unsatisfied, fairly satisfied and unsatisfied) were calculated to give an idea about the participants' response. **Results:** showed greatest participants' satisfaction (75–90%) were obtained in the complete denture with middle and inferior occlusal planes. Patients satisfaction with denture 2 range between 80–90% regarding speech and chewing ability. Denture 3 (inferior occlusal plane) showed the greatest fairly satisfaction in 60% of patients originated from mandibular denture. **Conclusion:** most patients were satisfied with the dentures having occlusal plane be oriented parallel to the middle and inferior ala–tragus lines.

**Key Words:** Ala–tragus line, occlusal plane, complete dentures.

Hatim NA, Jawad IA. Determination of the Occlusal Plane in Completely Edentulous Patient by Computerized Cephalometric Method (A Comparative Study). Part I. *Al-Rafidain Dent J*. 2006; 6(SPIS): 1S–9S.

**Received:** 4/4/2005

**Accepted for Publication:** 24/4/2005

## INTRODUCTION

Tooth loss is the dental equivalent of mortality. Loss of natural permanent teeth is called edentulism.<sup>(1)</sup> The prevalence of edentulism is decreasing, but the proportion of aging individuals in the population generates the needs for oral health care services including removable complete dentures.<sup>(2, 3)</sup>

The objective of complete denture construction is to make a prosthesis that accurately fulfills the anatomic, physiologic, and psychological requirements of the patient while maintaining the components of the stomatognathic system as well as the whole body in good health.<sup>(1, 4)</sup>

Therefore, the practice of complete

denture prosthesis is a challenging endeavor. It requires a broad background of information, knowledge, and skill in how to manipulate complete denture design to carry out successful treatment<sup>(2, 5)</sup>, and this depends on the step of occlusal plane determination.<sup>(6)</sup> Ideal occlusal plane position is well defined by functional and anatomical requirements.<sup>(7)</sup>

Several methods are available for artificial occlusal plane orientation in complete dentures<sup>(8)</sup>, or by using computerized program.<sup>(9)</sup> The ala–tragus line (Camper's Line) technique is well documented and is the most widely used method all over the world<sup>(10)</sup> with controversy of the exact point reference for this line.<sup>(10–15)</sup>

The purpose of this study was to determine the validity of the ala–tragus technique in orienting the occlusal plane in the complete denture construction for edentulous patients by evaluation of edentulous patient response.

## **MATERIALS AND METHODS**

The sample consisted of 20 completely edentulous participants (10 males and 10 females), with age range of 44–82 years, completely edentulous for at least 1 year, no apparent facial asymmetry and history of facial trauma, and good mental and general health. Absence of flabby ridges and tissue undercuts, and tongue with normal position and movement.

Each patient was fully informed, and agreed about the nature of the study. Information about each patient name, age, and dental history was taken. The patient was examined, and evaluated extra- and intra-orally by using case sheet especially organized for this study.

Three sets of complete dentures similar to each other in all denture properties were made for each edentulous patient except for the difference in artificial teeth arrangement in relation to the level of occlusal plane (total number 60 sets complete maxillary and mandibular dentures).

For each patient, primary impressions of putty silicone material, rim lock trays with spacer were made according to Sowler.<sup>(14)</sup> Final impressions were made using light body silicone material, and poured with die stone to get master casts.

Before duplication (three times) of the original master cast, the incisive papilla was relieved, and post dam was prepared. For each master cast, cold cure acrylic record base was made with wax occlusion rim carrying a number (1, 2 and 3). All the three maxillary occlusion rims were trimmed anteriorly to the level of the upper lip, and parallel to the inter-pupillary line for each patient measured by digital vernier and were checked from the esthetic and phonetic standpoints. Therefore, the only difference was in the inclination of the occlusal plane posteriorly.

Each patient was seated in an upright position. Three dots were marked on superior, middle, and inferior points of the tragus of the ear to denote the posterior term-

ination of the three ala–tragus lines carrying a numbered 1, 2 and 3 respectively from superior to inferior.

The first maxillary occlusion rim was oriented to be parallel to the superior ala–tragus laterally using Fox bite plane and a rigid ruler to have parallel relation between the side of the ruler and the side of the Fox bite plane. The parallelism was assessed comparing the records on two small rulers attached to the side of the anterior and posterior terminals of the main ruler. The second and third occlusion rims were oriented in the same manner.

Rest vertical dimension was done using two methods: Swallowing and phonetic of “m” letter.<sup>(17)</sup> The maxillary cast with the first occlusal plane was mounted in an average value articulator (ARTEK). The centric jaw relation was recorded by chin guidance method, and transferred to the articulator to complete the mounting of the mandibular cast. The same jaw relation records (vertical and horizontal) of the first mounted maxillary and mandibular casts were also used for the two sets of complete dentures with their own occlusion planes.

For each edentulous patient, the same sets of artificial teeth (anatomic acrylic teeth Flori–Dent) were chosen. Patient’s satisfaction about the selected teeth was obtained. Maxillary artificial teeth were arranged on a plane surface according to the occlusal plane proposed for each one of the three sets of complete dentures. The mandibular artificial teeth were arranged in coincide with their maxillary antagonist teeth.<sup>(15)</sup> The dentures were constructed in the conventional method.

One randomly selected of the three sets of complete dentures for each patient was delivered at the first time. Good oral hygiene instructions were explained and an adjustment appointment was given every two days.

After one month, the patient was requested to answer the patient denture satisfaction questionnaire (DPSQ).<sup>(18, 19)</sup> The technical quality of each maxillary and mandibular dentures and the validity of the questionnaire were evaluated and recommended by three authors' experts in Prosthodontics. The second and third sets of complete dentures were delivered in the same

manner; i.e., every month and followed by questionnaire. Each question could be answered in four grades and scored (totally satisfied and unsatisfied, fairly satisfied and unsatisfied) to represent the degree of satisfaction with the dentures. Mean and percentages of all the scores were calculated to give an idea of the distribution of the patient's response.

## RESULTS

According to Patient Denture Satisfaction Questionnaire (PDSQ). The sixty questionnaire sheets (thirty for males and thirty for females) were obtained about the patient's satisfaction of their complete dentures (three questionnaires of each set of complete dentures for each patient) and shown in Table (1).

Table (1): Distribution of the response to "patient denture satisfaction questionnaire"

Question Number		Totally Satisfied		Fairly Satisfied		Fairly Dissatisfied		Totally Dissatisfied		Total
		No.	%	No.	%	No.	%	No.	%	
1	D1	2	10	7	35	5	25	6	30	20
	D2	15	75	2	10	2	10	1	5	
	D3	16	80	2	10	1	5	1	5	
2	D1	3	15	7	35	5	25	5	25	20
	D2	11	55	6	30	2	10	1	5	
	D3	11	55	6	30	2	10	1	5	
3	D1	4	20	4	20	6	30	6	30	20
	D2	17	85	1	5	2	10	0	0	
	D3	16	80	3	15	0	0	1	5	
4	D1	3	15	3	15	7	35	7	35	20
	D2	4	20	9	45	6	30	1	5	
	D3	4	20	10	50	5	25	1	5	
5	D1	3	15	3	15	7	35	7	35	20
	D2	12	60	6	30	1	5	1	5	
	D3	10	50	6	30	2	10	2	10	
6	D1	10	50	3	15	5	25	2	10	20
	D2	10	50	6	30	3	15	1	5	
	D3	10	50	4	20	5	25	1	5	
7	D1	4	20	4	20	6	30	6	30	20
	D2	17	85	1	5	2	10	0	0	
	D3	16	80	3	15	0	0	1	5	
8	D1	3	15	3	15	7	35	7	35	20
	D2	6	30	7	35	6	30	1	5	
	D3	3	15	12	60	4	20	1	5	
9	D1	0	0	5	25	8	40	7	35	20
	D2	3	15	13	65	3	15	1	5	
	D3	4	20	13	65	2	10	1	5	

1: Are you satisfied with your denture? 2: Are you satisfied with the appearance of your denture? 3: Are you satisfied with how well your upper denture stays in place? 4: Are you satisfied with how well your lower denture stays in place? 5: Are you satisfied with how well your chew food is with your denture? 6: Are you satisfied with how you speak with your dentures? 7: Are you satisfied with the comfort of your upper denture? 8: Are you satisfied with the comfort of your lower denture? 9: Are you satisfied with how well other people like your denture?

• Question 1 was about the patients overall satisfaction with the dentures (Figure 1). *Denture 1*: Only 2 patients

(10%) were totally satisfied, while results of *denture 2 and 3* showed 75% – 80% total satisfactions.

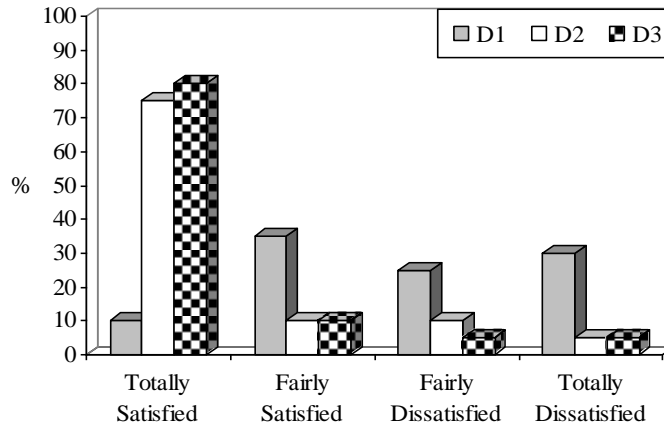


Figure (1): Distribution of patients according to their overall satisfaction with their dentures.

• Question 2 was gauging the patient's opinion about the denture esthetics (Figure 2). *Denture 1*: Only 3 patients

(15%) showed total satisfaction, while *Dentures 2 and 3*: Showed similar values.

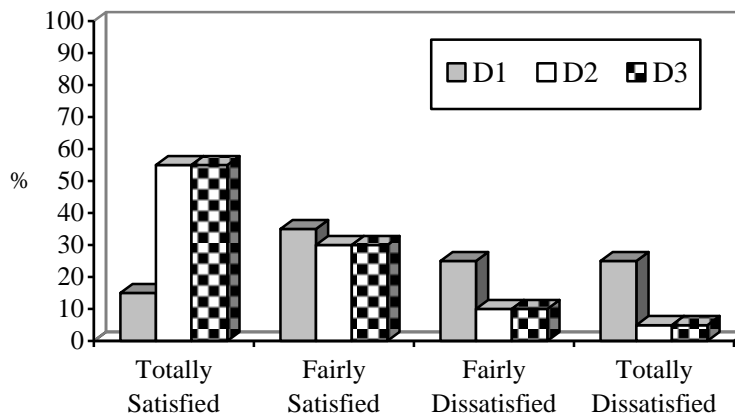


Figure (2): Distribution of patients according to their overall satisfaction with their denture esthetics.

• Questions 3 and 4 regarding the denture retention (Figures 3, 4): *Maxillary dentures 2 and 3* showed higher percentages of satisfaction (90% and 95%)

respectively than *Mandibular dentures 2 and 3*; while the *maxillary denture 1* showed only 40% satisfaction.

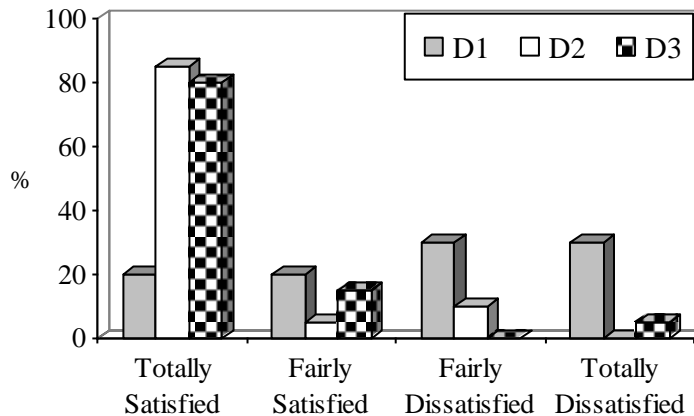


Figure (3): Distribution of patients according to their overall satisfaction with retention of maxillary denture

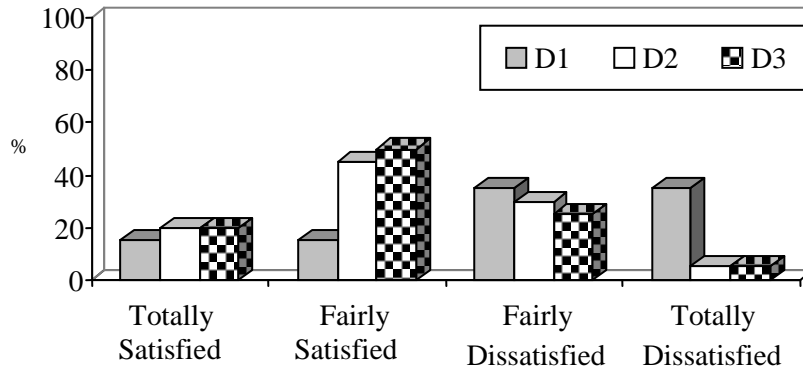


Figure (4): Distribution of patients according to their overall satisfaction with retention of mandibular denture

• Questions 5 and 6 regarding denture function (Figure 5): *Denture 1*: Only 3 patients (15%) were totally satisfied with the chewing efficiency, while Dentures 2 and 3 get 60% and 50% res-

pectively totally satisfied for each one. The answers of Question 6 concerning speaking ability showed approximately similar results with the three dentures.

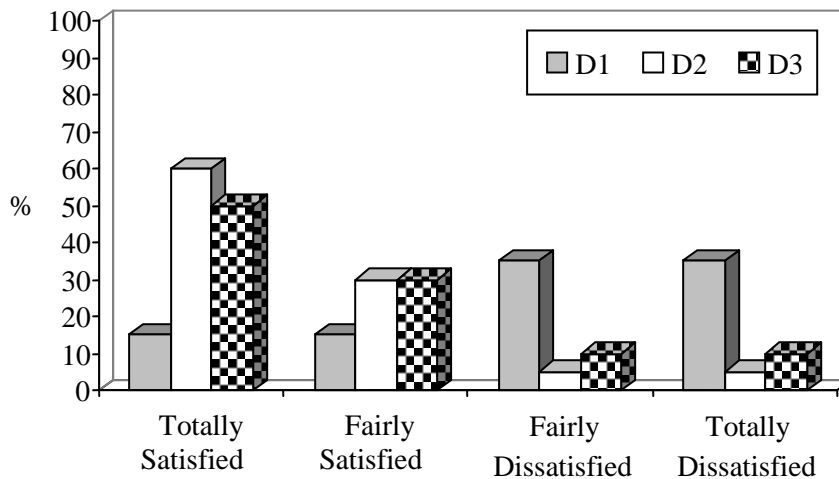


Figure (5): Distribution of edentulous patients according to their satisfaction with chewing ability

• Questions 7 and 8. Concerning patients' comfort with their maxillary and mandibular dentures (Figures 6 and 7). *Maxillary dentures 2, and 3* obtained

total satisfaction range between 80%–85) in relation to *mandibular Dentures 2, and 3*. The same results were obtained in the answers of Question 9.

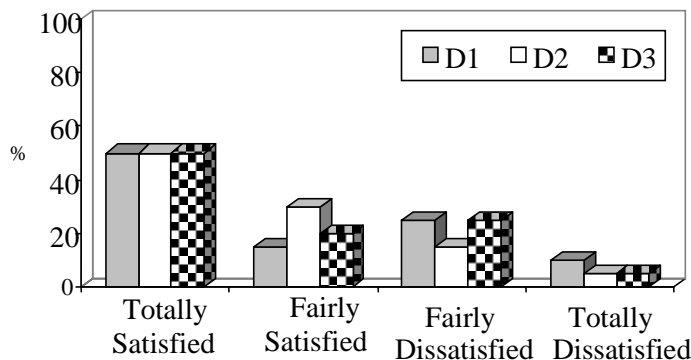


Figure (6): Distribution of edentulous patients according to their satisfaction with comfort of maxillary denture

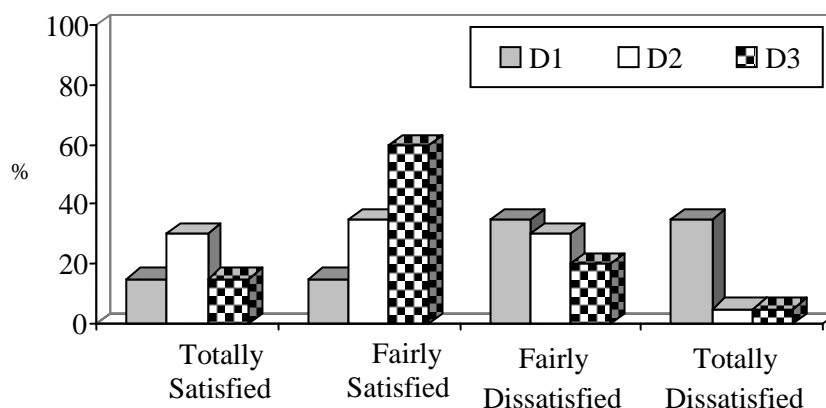


Figure (7): Distribution of edentulous patients according to their satisfaction with comfort of mandibular denture

Goodman and Kruskal Tau test, and Chi-square distribution test were used as nonparametric test to estimate if there was any difference between the patients' satisfaction with their different complete dentures based on 60 observations (the results of 60 sheets of PDSQ).

The 95% confidence interval or level means that, if this exact study was conduc-

ted numerous times, in 95% of the trials, the difference was still between the upper and lower limits of the confidence interval as shown in Table (2). No significant differences exist in the patients' satisfaction between any of the three sets of dentures and the other and between all of them at  $p \leq 0.05$ .

Table (2): The difference of patients' satisfactions with the three complete dentures

Dentures	Chi-square	p-value	95% Confidence Interval		Significance
			Lower Limit	Upper Limit	
1, 2 and 3	0.05375	0.1466	0.0	0.1186	Not significant
1 and 2	0.05317	0.1013	0.0	0.1317	Not significant
1 and 3	0.06207	0.064	0.0	0.1427	Not significant
2 and 3	0.001996	0.972	0.0	0.01777	Not significant

## DISCUSSION

All technical factors involved in the construction of complete dentures used in this study should be uniform in order to restrict the variables that could affect the patient's response. This was enhanced by the use of the same materials and techniques for all the edentulous patients.

According to the result of PDSQ which was used to measure patient attitudes and feeling about their dentures (Table 1): One subject registered total satisfaction with the all dentures. It is interesting to note that the case sheet of this patient showed critical personality. This suggests that the total dissatisfaction of this patient was an outgrowth of the subject's perceptions rather than based on objective reality. Adapta-

tion to the dentures, even of a very high quality, was a difficult task for this type of patients.

Functional dentures represent the golden goal eagerly essayed by every dental practitioner, and plaintively and confidently expected by every denture patient.<sup>(20)</sup>

In the functional categories (speech and chewing abilities) (Figures 1, 2), denture 2 got satisfaction of 80% of the edentulous patients regarding speech aspect and 90% regarding chewing ability in relation to denture 3. This slight decrease in patients' satisfaction with the function of denture 3 may be due to the lower posterior level of the occlusal plane of the mandibular denture of this set. Which will lead to forward displacement of mandibular denture du-

ring mastication and unfavorable spreading of the tongue posteriorly during speaking.

Only two patients reported difficulty in their chewing ability (Figure 5) with denture 2 and four patients with denture 3. The introduction of a foreign object into the oral cavity may have caused muscular tension with accompanying anxiety. Mastication, swallowing and speech were thereby affected.<sup>(21, 22)</sup>

Regarding the retention of the dentures, fair dissatisfaction was reported by seven patients with denture 1, and denture 2, and five patients with denture 3 (Figures 3, 4). At least five patients reported their main dissatisfaction as originated from mandibular dentures of the three sets of complete dentures. These results were in agreement with Fornseca and Davis<sup>(23)</sup> who stated that the chief complaint of the edentulous patients is about the mandibular denture and this is concomitant with the degenerated mandibular ridge and psychological problem.<sup>(24)</sup> In addition, the amount of leverage that is exerted on the occlusal surface of mandibular denture is in direct proportion with the height of the occlusal plane above the supporting alveolar ridge. The amount of leverage may be established by the following formula: Torque equals force times the distance of the line of the application of the force to the fulcrum point.<sup>(13)</sup>

Patients' satisfaction with the denture comfort showed that the degree of their satisfaction were approximately similar to

that of denture retention. The greatest percentage of total satisfaction was gained with maxillary and mandibular denture (30%). Denture 3 showed the greatest fairly satisfaction, most of this fair was originated from mandibular denture (Figures 6, 7). The masticatory forces were exerted on too inclined occlusal planes, the forces were dissolved into components; horizontal along the occlusal plane leads to unfavorable loading especially the anterior part of the lower ridge and posterior part of the upper ridge, and perpendicular to the occlusal plane.

Denture 2 and denture 3 have got the highest number of esthetic satisfactions in relation to denture 1 (Figure 1). Lombardi<sup>(25)</sup> defined the structural lines as lines that give an object its shape, and considered the occlusal plane as a major structural line in the dental composition. Therefore, its location greatly affects dental esthetics. An elevated occlusal plane creates a composition that deprives the patient of dignity and is also unnatural.

The results of overall Satisfaction of the Edentulous Patients' with their Three dentures showed no significant difference exists between any of the three sets of complete dentures and the other and between all of them at  $p \leq 0.05$  (Table 2). It is clear that both dentures 2 and 3 have got the greatest overall satisfaction of their wearers in relation to patients with denture 1 (Figure 8).

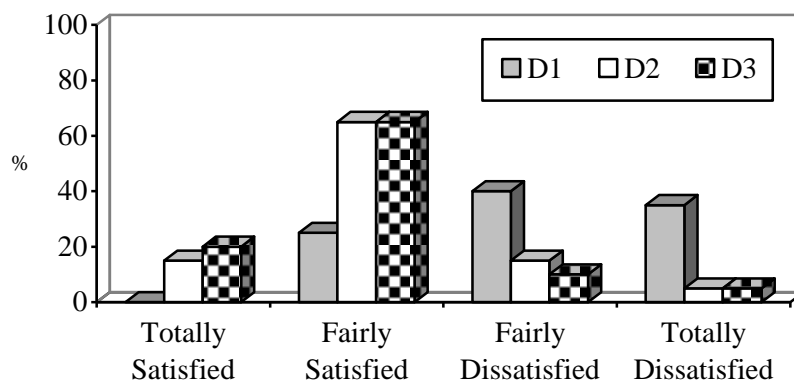


Figure (8): Distribution of edentulous patients according to their relative's opinion

With all efforts spent in this study to make all the aspects of the denture quality (except the difference in occlusal plane inclination) was same for each patient. The-

se results strongly indicate that the middle and inferior occlusal planes gained the performance of the edentulous patients more than the superior one.<sup>(6,7)</sup>

## CONCLUSIONS

There was no significant difference that exists in the patient's satisfaction between any of the three sets of complete dentures at  $p$ -value  $\leq 0.05$ . Eighty percent of patients got satisfaction with denture 2 regarding speech aspect, and 90% of chewing ability. Denture 3 showed the greatest fairly satisfaction (60%) of patients originated from mandibular denture. Most patients were satisfied with the dentures having occlusal plane be oriented parallel to the middle and inferior ala-tragus lines.

## REFERENCES

1. Marcus PA, Joshi A, Jones JA, Morgano SM. Complete edentulism and denture use for elders in New England. *J Prosthet Dent*. 1996; 76: 260–266.
2. Wazeer GhJ. Treatment with complete denture in elderly patients. *The Syrian J Stomatol*. 2002; 38(2): 69–75.
3. Zarb GA, Bolender CL, Carlsson GE. Boucher's Prosthodontic Treatment for Edentulous Patients. 11<sup>th</sup> ed. Mosby Year-Book, Inc. Philadelphia, London, Toronto. 1997.
4. Watanabe I. Influence of wearing complete dentures on body balance in edentulous elderly. *Kokubyo Cakkai Zasshi Mar*. 1999; 66(1): 8–14.
5. Fenlon MR, Sherriff M, Walter JD. Association between the accuracy of intermaxillary relation and complete denture usage. *J Prosthet Dent*. 1999; 81(5): 520–525.
6. N'dindin AC, N'dindin-Guinan BA, Guinan JC, Lescher J. Apport de la te'le'radiographie dans la de'termination du plan d'occlusion re'fe'rentielle chez le'dente' total. Nume'ro 91 Sptembre. 2000.
7. Mack MR. Perspective of facial esthetics in dental treatment planning. *J Prosthet Dent*. 1996; 75(2): 169–176.
8. Williamson RA, Williamson AE, Bowley J, Toothaker R. Maximizing mandibular prosthesis stability utilizing linear occlusion, occlusal plane selection, and centric recording. *J Prosthodont* 2004; 13(1): 55–61.
9. Naitoh M, Katsumata A, Nohara E, Ohsaki C, and Ariji E. Measurement accuracy of reconstructed 2-D images obtained by multi-slice helical computed tomography. *Clinic Oral Implant Reserch* 2004; 15(5): 570–574.
10. Ricketts RM. Perspectives in the clinical application of cephalometrics. *The Angle Orthod*. 1981; 51(2): 115–150.
11. Monteith BD. Evaluation of a cephalometric method of occlusal plane orientation for complete denture. *J Prosthet Dent*. 1986; 55: 64–69.
12. Academy of Prosthodontics. Glossary of prosthodontics terms. *J Prosthet Dent*. 1994; 71(1): 50–112.
13. Boucher CO. Swenson's Complete Dentures. 6<sup>th</sup> ed. The CV Mosby Co. Philadelphia, London, Toronto. 1970.
14. Spratley MH. A simplified technique for determining the occlusal plane in full denture construction. *J Oral Rehabil*. 1980; 7: 31.
15. Sowter HB. Dental Laboratory Technology Prosthodontic Techniques. University of North Carolina in United States of America. 1968.
16. Kazanji MN. Occlusal plane orientation with an extra cranial posterior point of reference. *Al-Rafidain Dent J*. 2002; 2(2): 192–197.
17. Kazanji MN. Clinical measurement and evaluation of vertical dimension. *Iraqi Dent J*. 1999; 24: 143–151.
18. Farhood IK. The impact of psycho-neurotic status of complete denture wearers and some other factors on patient satisfaction. MSc thesis. College of Dentistry. University of Baghdad. 2000.
19. Guckes AD, Smith DE, Swoope CC. Counseling and related factors influencing satisfaction with dentures. *J Prosthet Dent*. 1978; 39: 259–267.
20. Jaffe VN. The functionally generated path in full denture construction. *J Prosthet Dent*. 1954; 4(2): 214–221.
21. Frank RP, Milgrom P, Levoux BG, Hawkins NR. Treatment outcomes with mandibular removable partial dentures. A population-based study of patient satisfaction. *J Prosthet Dent*. 1998; 80(1): 36–45.
22. Albercht G, Hoogstraten J. Satisfaction as a determinant of compliance. *Community Dent Oral Epidemiol*. 1998; 26(2): 139–146.
23. Fornseca TJ, Davis WH. Reconstructive Preprosthetic Oral and Maxillofacial Surgery. WB Saunders Co. 1986.



24. Morin C, Lund JP, Sioufi C, Feine JS. Patient satisfaction with dentures made by dentists and denturologists. *J Can Dent Assoc.* 1998; 64(3): 205–208.
25. Lombardi RE. A method for the classification of errors in dental esthetics. *J Prosthet Dent.* 1974; 32(5): 501–513.