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A Clinical study on the stresses developed in complete dentures with one, two and three dimensional occlusion (*)

Senih ÇALIKKOCAOĞLU (**)

The most important prerequisite for proper treatment is thorough diagnosis. An understanding of the elements that enter into making a diagnosis is the mark of a professional man that sets him apart from a technician or therapist, or from a layman.

In making a dental diagnosis a long list of elements must receive consideration, with emphasis placed in those areas which merit special attention in the opinion of the examining dentist. One area frequently overlooked or neglected is the occlusion - the key to oral function. However, this tendency to take for granted the occlusion is quite understandable. No dental subject has had a more controversial history, with more divergent opinions and conflicting theories than has dental occlusion. The function of the temporo-mandibular joint defies understanding in the minds of some people, but dentists are agreed that there is an interaction between this joint and the occlusion.

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(**) Ass. Prof. Dept. of Removable Denture Prosthodontics, University of İstanbul, Faculty of Dentistry, İstanbul, Turkey.

Years of research and study have led to current concepts of occlusion which are more acceptable to the profession because they are based on accurate data that meet the strict requirements of the scientific method. By the use of a machine which reproduces accurately all the functional movements of the jaw, it is now possible to study outside the mouth the interaction of the occlusal surfaces of the teeth and the temporo-mandibular joint. The information thus gained is extremely important in making the diagnosis and this knowledge, properly applied, results in great benefits for the patient.

Occlusion in complete denture prosthodontics received much attention in the last quarter of the century. Years ago, prosthodontists were primarily concerned with the retention of dentures during the act of mastication and they only proposed eccentric balance to aid this retention (10). Soon it became apparent that the smallest bolus of food on the working side eliminated the probability of balance on the nonworking side, and opponents of balanced articulation have created a motto «Enter bolus - Exit balance» (2). However, eccentric balance was not completely abandoned, but the rationale of its use was only changed. The proponenes of balance, on the other hand, suggested that it was necessary during the many aimless excursive movements that the patients performed between meals (10).

Full balance in complete dentures with cusp teeth are best obtained by setting the teeth according to the laws of articulation on an adjustable articulator as suggested by Hanau (4). Balance in nonanatomic (flat plane) tooth forms can either be accomplished in three-point contact (10) or Pleasure curve (8).

In this respect, the contact between the two opposing surfaces of posterior teeth and/or the geometrical design of occlusal patterns of artificial teeth play an important role in the field of occlusion.

Until recently, the geometrical classification of occlusion was divided into two categories (3): The first one is cusp occlusion which has three dimensions between the opposing surfaces. These dimensions are the width, the length and the depth of occluding surfaces. All of the cusp teeth which you can find in the market fall into this category.

The second one is flat plane occlusion which has two dimensions between the opposing surfaces. These dimensions are the width and

the length of occluding surfaces. All of the flat plane teeth are in this category.

In 1964, a new type of occlusal pattern developed and named as Centrimatic teeth (11). The Centrimatic teeth due to their specific design of occlusal surfaces reduced the dimensional contact into one, and this was called the «Linear Occlusion».

I first heard of Centrimatic teeth at the end of 1966 when I read an article on Linear Occlusion at the Illinois Dental Journal written by Dr. John P. Fruch (3). Since then, I have had a few chance to try them in dentures and the results were not bad at all. However, I must say that these were short term clinical works. Since I did not follow the cases, I can not state any opinion on their long term effects, particularly on the Temporo-Mandibular-Joint which, I believe, is worth of studying extensively before to reach a definite evaluation of Centrimatic teeth.

The main features of Centrimatic teeth are the fact that the lower bicuspids and molars have blades which are localized on the occlusal surfaces near the buccal parts. These blades being always in the form of straight line, geometrically constitutes «length» in occlusal contact when the teeth are set regularly since the food tables lingual to the bladesare a little bit of low level. This Linear occlusion is provided by the upper teeth having a flat surface.

In dental literature, there are quite a few posterior tooth forms which may be similar to Linear occlusion. However, as far as the geometrical system of occlusal design classification is concerned, the reason confusing them with the Linear occlusion will be obvious. The Sears' Channels, the French posteriors and the cutter bars which are imbedded in the posterior teeth to increase the chewing efficiency are the types of teeth which may be confused with Linear occlusion. These teeth are two dimensionals. Simply because, every part of the occluding surfaces are on the same level. Whereas in Centrimatic teeth, the food table lingual to the blades is lower than the blades themselves, and that makes the difference between the Centrimatic teeth and the other tooth forms.

Stress investigations are very important in the field of engineering and applied sciences such as Dentistry. Stresses in a body may be investigated by means of different techniques, and acording to the direction of forces which acts upon a body, different types of stresses may be produced. Since the chewing force is a blend of forces

which direct to the bone tissu e via complete denture in many directions, it would be reasonable to expect that the structure (complete denture) will react to this external force internally. This internal reaction which is equal in intensity and opposite in direction to the external force is called «stress». (7)

There are some stress investigations in dental literature concerning complete dentures (5, 6, 9). However none of them compared the stress trajectories in relation to different types of occlusal design.

At first glance, this study may be thought to be similar to the one which I had undertaken last year (1). But, the last year's study was made on complete dentures with cusp teeth, and the dentures were also not very well balanced. At the same time, the stress distributions in metal base dentures versus plastic base dentures were also observed. Whereas differences in stress concentrations in complete dentures with one, two and three dimensional balanced articulation is the objective of this study. Any attempt to measure or to evaluate the stresses is not within the capacity of this paper. Only the stress trajectories, if any, are tried to be demonstrated.

At the beginning, I would very much like to draw your attention to the point that I had only the occlusal pattern of the teeth changed

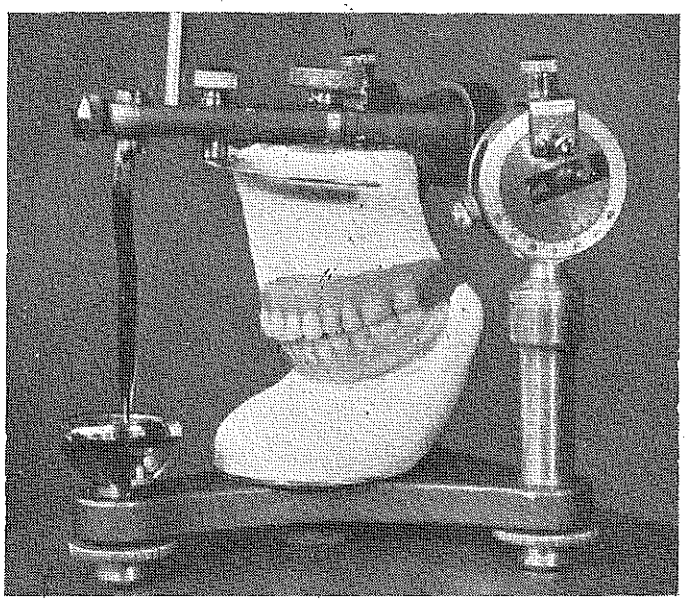

Fig. 1

in this study. In other words, there is only one variable here whereas it would have been much more variables if an uncontrolled study had undertaken.

The case which I am going to present to you now is an edentulous male who has been wearing complete upper and lower dentures for about 7 years.

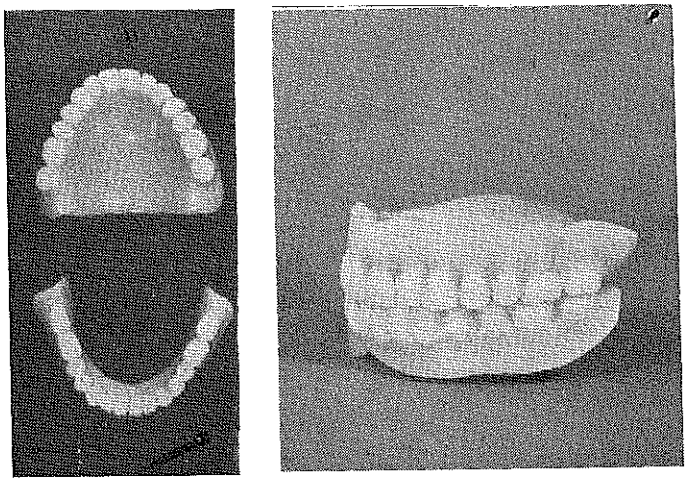

Fig. 2
Complete denture with Centrimatic teeth.

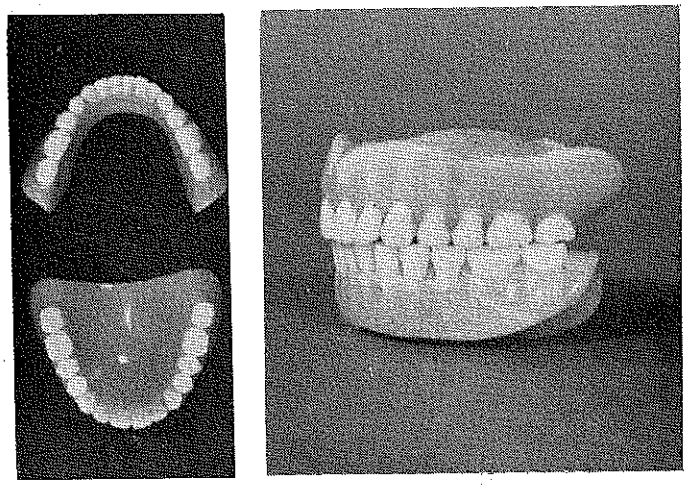

Fig. 3
Complete denture with French posteriors.

First, by using the Dentatus articulator, I have constructed a full upper and lower dentures which were perfectly balanced for this patient with Centrimatic teeth according to the conventional mucostatic tehnique. (...) Fig. 1 and Fig. 2 (...) I have also followed the cardinal rules when making a Centrimatic denture (3).

I have then constructed two more duplicate dentures for the same patient. The first one was with the French posteriors which

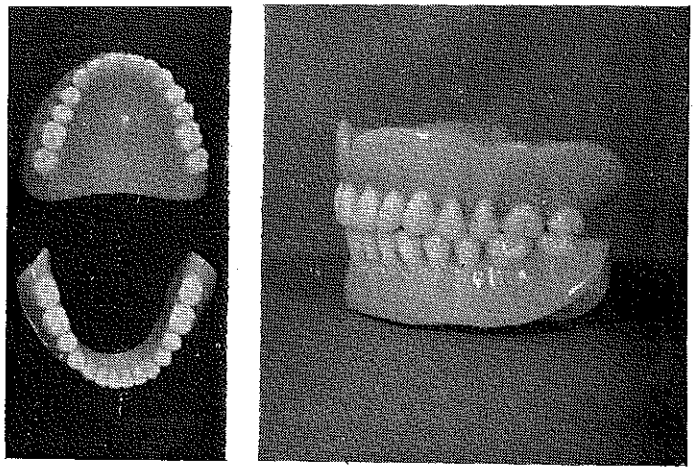

Fig. 4
Complete denture with Trubyte posteriors.

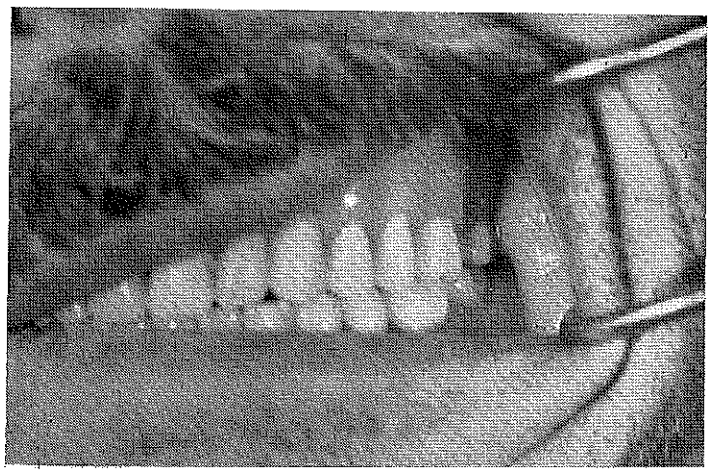

Fig. 5
Complete denture with Trubyte posteriors in the mouth.

were two dimensionals; Fig. 3 and the second one with the Trubyte posteriors which were three dimensionals; Fig. 4.

Fig. 5, 6 and 7 show these three duplicate dentures in the mouth. So all the factors of the dentures being in common are provided by these dublicate dentures. Only in this manner, a controlled study can be perfomed and everything except the teeth remain constant throughout the tests as stated by Trapozzano (12) in his study on the chewing efficiency of different occlusal patterns.

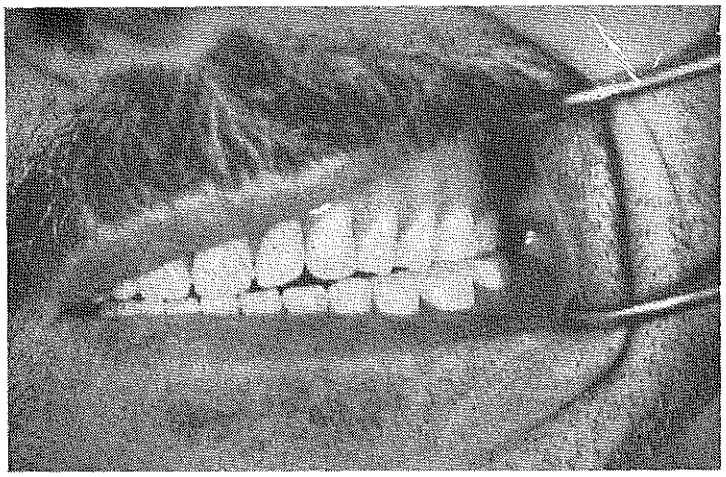

Fig. 6
Complete denture with French posteriors in the mouth.

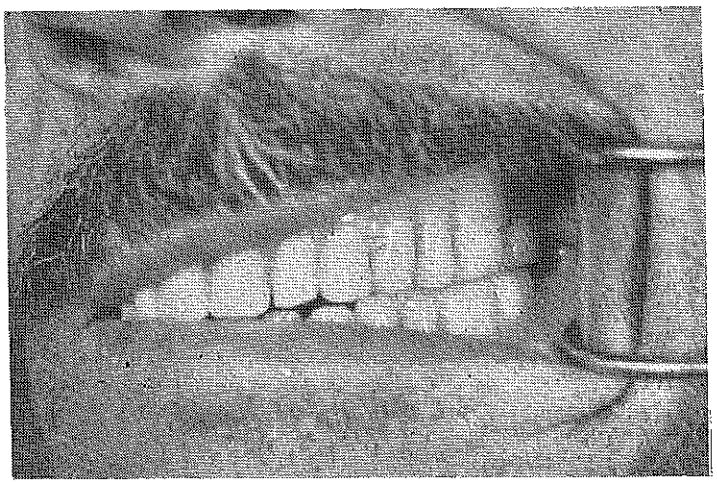

Fig. 7
Complete denture with Centrimatic teeth in the mouth.

The technique to show the stress trajectories is essentially a modified brittle lacquer coating technique in which a kind of synthetic resin is used as the brittle material.

In the chewing tests, roasted peanut and raw carrot were used. After the patient had swallowed the food, the dentures were taken from the mouth, rinsed with lukewarm water and inspected with magnified glass to see the cracks on the base.

At the end of chewing tests, neither peanut nor carrot cause the resin to crack on any denture base.

It was then thought to apply the resin to patient's old denture which was not very well balanced and also constructed thinner than usual, and asked him to chew the same types of food. This time the resin exhibited some cracks, especially on the chewing side.

Now in concluding my paper, I would like to tell you what this study has taught me, and also like to be very cautious in expressing my opinions since this was a very limited study and not statistically valid at all.

1. Under normal conditions, the brittle lacquer coating technique seems not adequate to show the stress trajectories in plastic base dentures. I feel that strain gauges device is probably better in a clinical investigation like this since it is more sensitive.

2. It also seems that the balanced articulation and the close adaptation of the denture base to the supporting tissues may contribute the evenly distribution of stresses which are not localized in any specific area.

3. The difference in thickness of the denture bases and the chewing force exerted by the patients may also count in this field.

4. It may be reasonable to assume that thinner the denture base and stronger the chewing force, the more stress trajectories will be seen, particularly on the chewing side. This must be directly proportioned to the chewing pressure aplpied.

5. The heat in the mouth (37° C.) may increase the plasticity of the resin and this may be one of the additional factors for the resin not to crack.

6. I have the inclination to believe that there would be no damage to the denture base from the stress concentration induced

by the chewing force regardless of occlusal design of artificial teeth if everything is right.

Thank you for your kind attention.

ÖZET

Bu araştırma farklı oklüzal şekillere malik olan azı dişleri ile, aynı hastaya yapılan üç dublikat tam protez üzerinde yapılmıştır. Başka bir deyimle tam protezlerin bütün faktörleri aynıdır, fakat değişken olarak sadece azı dişleri ve bunların oklüzal yüzey şekilleri söz konusudur. Protezlerin cilâlı yüzeylerine 1 mm. yi geçmemek şartiyle çok kırılgan sentetik bir reçine sürülmüş ve hastaya çeşitli besin maddeleri yedirilmek suretiyle stress birikim alanları gözlenmiştir.

Elde edilen sonuçlar şöyle özetlenebilir:

Bilimsel kurallara uygun bir tam protez yapıldığında oklüzal şeklin farklılığı sonucu stress birikimleri bakımından kaide plağı üzerinde herhangi bir zarar olmayacaktır.

LİTERATURE

1 — **Çalıkkocaoğlu, S.** : Stress Distribution in Complete Dentures, İ. Ü., Dişhek. Fak. Dergisi, 6: 335 - 371, 1972.

2 — **Fenn, H. R. B., Liddelow, K. P. & Gimson, A. P.** : Prosthetic Dentistry, 2 ed., Staples Press, London 1961.

3 — **Fruch, J. P.** : Linear Occlusion, Illinois Dent. J., Vol. 35, No: 12, Dec. 1966.

4 — **Hanau, R.** : Full Denture Prosthesis, Intra Oral Technique for Hanau Articulator Model H, 4 ed., 1930.

5 — **Koivumaa, K. K.** : On the Properties of Flexible Dentures, A Theoritical and Experimental Survey. Acta Odont. Scandinav., 16: 175, 1958.

6 — **Lambrecht, J. R. & Kydd, W. L.** : A Functional Stress Analysis of the Maxillary Complete Denture Base, J. Pros. Den., 12: 865 - 872, 1962.

7 — **Peyton, F. A. & Craig, R. G.** : Restorative Dental Materials, 4. ed., The C. V. Mosby Co., St. Louis 1971.

8 — **Pleasure, M. A.** : Prosthetic Occlusion - A Problem in Mechanics, J. A. D. A., 24: 1303 - 1318, 1937.

9 — **Regli, C. P. & Kydd, W. L.** : A Preliminary Study of the Lateral Deformation of Metal Base Dentures in Relation to Plastic Base Dentures, J. Pros. Den., 3: 326, 1953.

10 — **Sharry, J. J.** : Editor. Complete Denture Prosthodontics, McGraw-Hill Book Co., Inc., The Blakiston Division, New York, Toronto, London 1962.

11 — Swissedent Cmpany, The Centrimatic Teeth (Booklet).

12 — **Trapozzano, V. R.** : Testing of Occlusal Patterns on the Same Denture Base, J. Pros. Den., 9: 53 - 69, 1959.