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Comparison of posterior occlusal patterns on the same denture base (*)

Senih ÇALIKKOCAOĞLU (**)

The medical and dental profession agree quite readily that food should be chewed thoroughly before deglutition. Because proper chewing to a degree of fineness facilitates the function of digestive organs. For that, the designing of special occlusal forms for artificial posterior teeth is one of the most important undertakings in denture prosthodontics. During the past four decades numerous occlusal patterns have been invented. The major objective in this movement for special occlusal forms is the increased efficiency in mastication as well as the preservation of supporting structures.

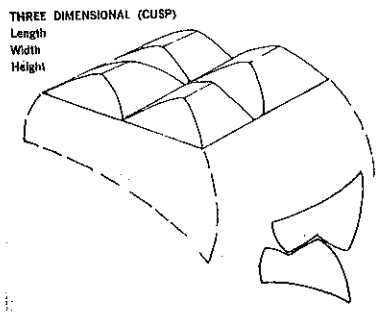

Fig. 1
Cusp occlusion. Three-dimensional

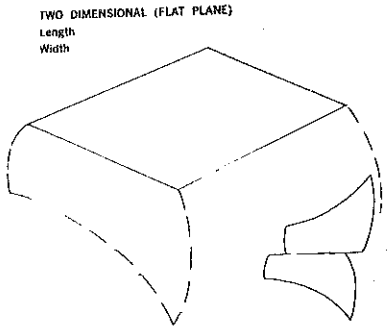

Fig. 2
Flat-plane occlusion. Two-dimensional

The geometric classification of occlusal patterns in centric occlusion may be classified as cusp occlusion (three-dimensional) (Fig. 1) and flat-plane occlusion (two dimensional) (Fig. 2); and all of the

(*) This summary is taken from a thesis submitted by the author for the partial fulfillment of Associate Professorship's degree, Faculty of Dentistry, University of Istanbul, Turkey.

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posterior tooth designs which have been available in the market until Centrimatic teeth fall into either one of these categories as stated by Frush (1). Recently, the Swissedent company with Mr. Goddart's extensive experience over a period of nearly twenty years introduced

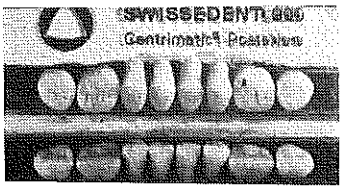

Fig. 3
A set of posterior Centrimatic teeth

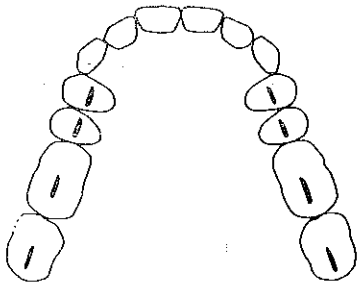

Fig. 4
A straight line contact

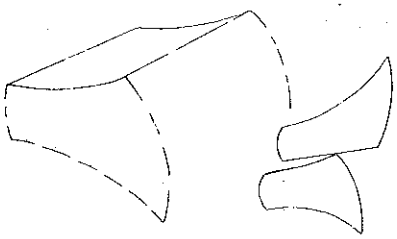

Fig. 5
Linear occlusion. One-dimensional

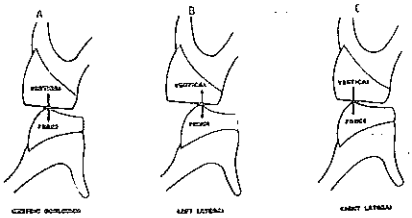

Fig. 6
Linear occlusion in Centric and lateral excursions

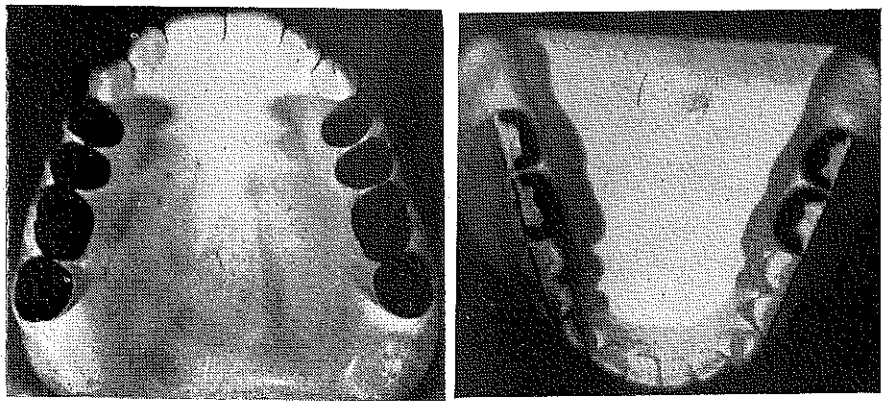

Fig. 7
Upper and lower Centrimatic teeth

a new design which is called Centrimatic teeth (2). The Centrimatic teeth provide «Linear closure» which is one-dimensional occlusion (Fig. 3, 4, 5, 6, 7). Linear occlusion allows us to complete the geometric classification of occlusion by providing a one-dimensinal occlusal design.

One-dimensional occlusion appears to provide a definite improvement in comfort, stability and chewing as claimed by the manufacturer. One of the most important features in constructing dentures with Centrimatic teeth is that there must be a straight line contact in the occlusion. If one lower posterior is buccal or lingual to the intended straight line, a second dimension is immediately incorporated into the occlusion. The same occurs if the lower posterior teeth are set in an arch curve. For that, the operator must investigate the slightest deviation from one-dimensional occlusion and correct it accordingly (Fig. 8, 9).

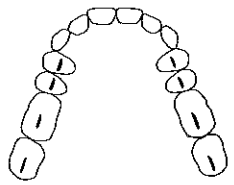

Figure 4
Even Bilateral Contacts in Centric Chop

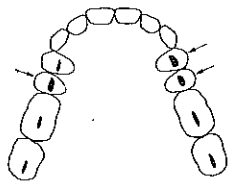

Figure 5
Wider Red Carbon Marks are Wrong

Fig. 8
Correction of Linear occlusion

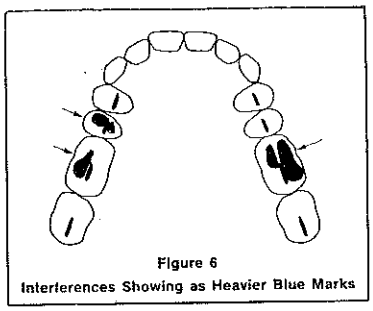

Figure 6
Interferences Showing as Heavier Blue Marks

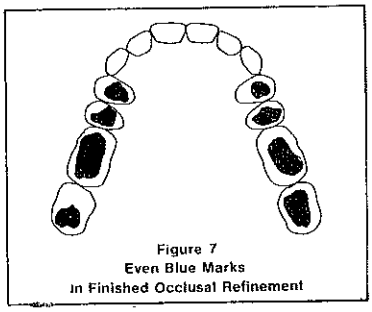

Figure 7
Even Blue Marks
in Finished Occlusal Refinement

Fig. 9
Interferences and occlusal refinement in Linear occlusion

Many fine research workers have conducted the investigations before concerning chewing efficiency of cusped and flat-plane teeth of special made. Now the reason I have decided to undertake a study

along the same line is that the Centrimatic teeth are a new product in the market and not enough controlled studies are performed with them.

So the objective of this investigation is 1) to test the relative efficiency of three types of posterior occlusal patterns, namely the cusped (33° degree) (Fig. 10), flat-plane (0° degree) (Fig. 11) and Centrimatic teeth 2) Patient's preference to dentures constructed with these various occlusal patterns and 3) To compare the dentures' stability.

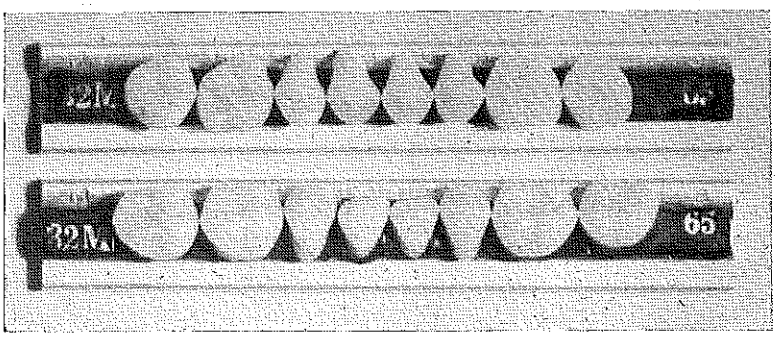

Fig. 10
High-cusped teeth (33° degree)

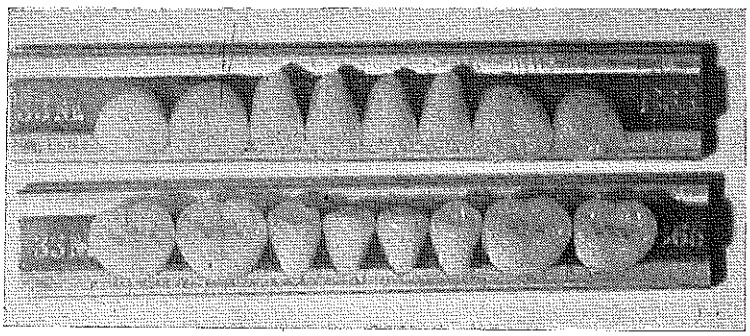

Fig. 11
Flat-plane teeth (0° degree)

Materials and method :

In this investigation, six patients were taken with a cross section of age, sex and different personalities. Among them, two never had any previous denture experience and the rests already were complete wearers.

The dentures were completed in conventional manner using Dentatus articulator and its face-bow. The centric relation is determined by intraoral tracing device and the condyle inclination is secured by Christensen phenomenon. The incisal guide angle is chosen zero degree for all cases.

The changing of new posterior teeth is made in the articulator which has the patient's records by means of cold cure acrylic resin (Fig. 12, 13). However, before proceeding with changing the teeth, the buccal surfaces of polished areas are secured by plaster index (Fig. 14).

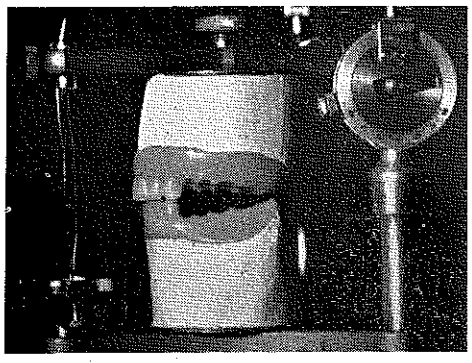

Fig. 12
Dentures in the articulator are ready to take new posterior teeth

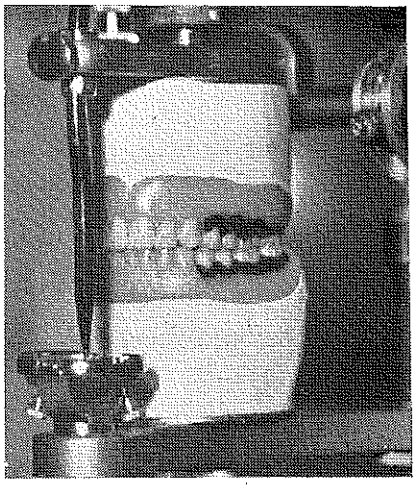

Fig. 13
Waxing new posterior teeth in the articulator

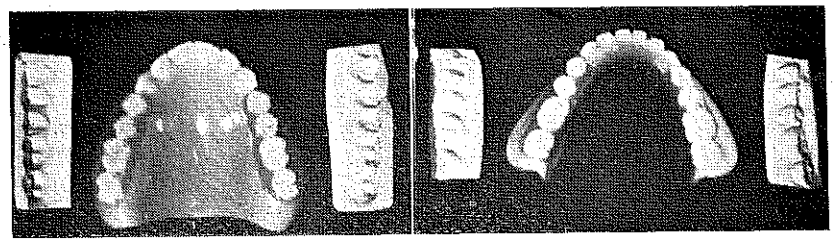

Fig. 14
Plaster index of buccal polished surfaces

Table I shows the specifications of posterior teeth used in this study.

Material	Occlusal pattern	Mould	Shade	Manufacturer	Geometric Classification
Porcelain	33° Degree Anatomic High cusped	32	65	The Dentists' Supply Co. of New York	3-Dimensional
Porcelain	0° Degree Non-anatomic Flat-plane	33	D 65	The Dentists' Supply Co. of NewYork	2-Dimensional
Porcelain	Centrimatic Linear	5 S	902	Swissodent	1-Dimensional

Table I
Specifications of Artificial Teeth

In order to compare three types of posterior occlusal patterns, our observations are limited to a few criteria:

1. The efficiency of teeth platform (Chewing ability).
2. The patient's preference (Subjective analysis).
3. Photographing the basal seat area afterwards to ascertain the displacement.

To evaluate the efficiency of tooth platform in different occlusal patterns, the chewing tests were made with peanut, raw carrot and smoked beef meat in a given weight (4285 Gr.). The chewing strokes were also counted and was suggested to the patients that they can chew on either side or both, any manner which seemed most comfortable to them. When patients felt that it was about time to swallow the bolus of food, it was requested not to do so, instead to expectorate the particles into a cup and rinse their mouths with water. This water was also added to the cup. Tap water was then used to wash up the particles for one minute after the content of the cup was emptied on top of the four series of mesh screens (Fig. 15).

Four different mesh screens were used to study remaining particle size (Fig. 16).

Table II shows the specifications of mesh screens.

The remaining particles that failed to pass through four different size of mesh screens after mastication by the patients were then left

Mesh No.	Meshes per linear inch	Diameter of wire	Width of opening	Open area
1	18	.330 mm. .013 inch	1.08	58.8 %
2	32	.305 mm. .012 inch	.65	54.3 %
3	45	.191 mm. .0075 inch	.37	43.8 %
4	55	.178 mm. .007 inch	.28	37.9

(Table II (*)
Specifications of Mesh Screens

(*) Table II is prepared according to the results of physical examination of the mesh screens by the research laboratory of the W. S. Tyler Company in Menton, Ohio, U.S.A.

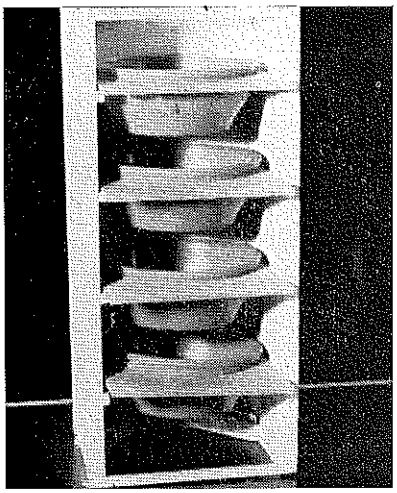

Fig. 15
Series of meshes

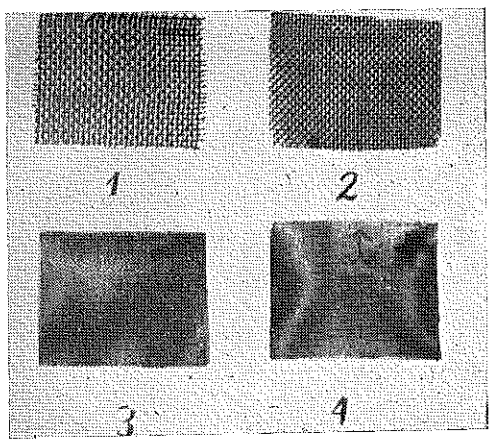

Fig. 16
Four different mesh screens

to dry in a room without air current for about one day and then weight again (Fig. 17, 18, 19). (*)

In the end of each chewing test, subjects were also asked to comment on different occlusal patterns in relation to chewing ability

(*) Electrical scale. E. Mettler, Zurich, Switzerland.

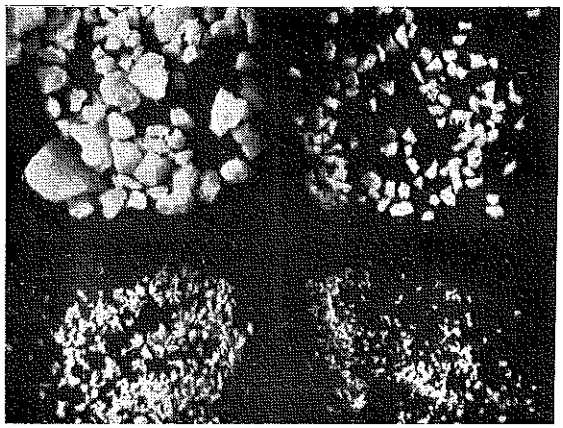

Fig. 17
Peanut particles left on the mesh screens with flat-plane teeth

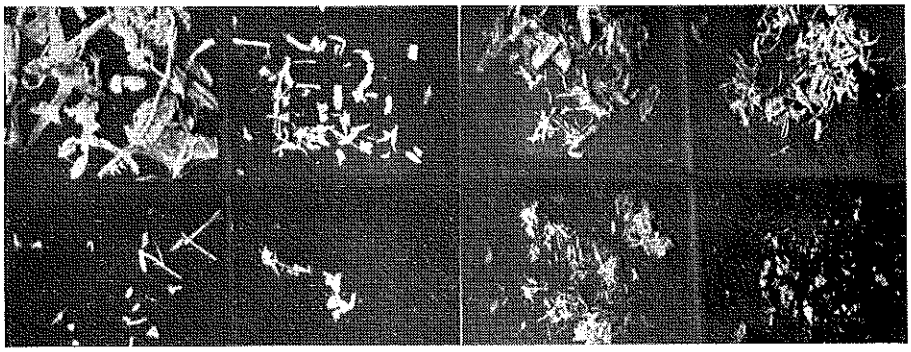

Fig. 18
Carrot particles left on the mesh screens with Centrimatic teeth

Fig. 19
Beef meat particles left on the mesh screens with high-cusped teeth

and comfort of the dentures, which was the second criteria called patient's preference or subjective analysis.

Also, at the same sitting in which the chewing tests were performed, P.I.P (**) was applied to the mucosal surface of the dentures and patients were requested to perform accentric movements for

(**) P.I.P. Pressure Indicating Paste. Mizzy, Inc., Clifton Forge, Va., U.S.A.

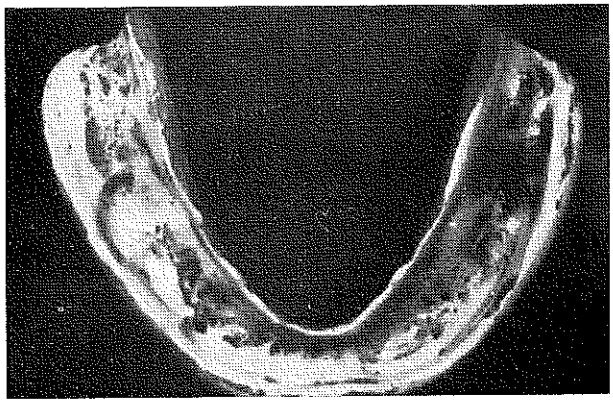

Fig. 20
Tissue displacement with high-cusped teeth

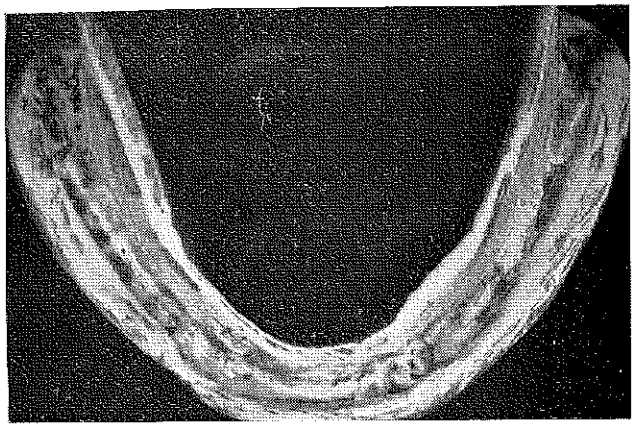

Fig. 21
Tissue displacement with flat-plane teeth

about one minute to see the displacement of tissues. Photographs were taken to indicate these areas (Fig. 20, 21).

Subjects are surely not informed about changing the posterior teeth in cold cure acrylic resin. Only, their dentures are kept for one day under the excuse of «polishing them in the lab».

Findings :

In the first 6 tables, (III, IV, V, VI, VII, VIII) readers will find the results of chewing performance for six patients used in this study. In the last 3 tables, (IX, X, XI) they will find the scattered diagrams of chewing efficiency of the subjects with three different occlusal patterns.

Case 1. (M.H.), Age : 41, Not denture wearer

		A	B	C	A	B	C	A	B	C
Food		PEANUTS			CARROTS			BEETS		
Chewing strokes		55	65	40	55	50	32	31	45	31
Weight of food		4285 Gr.			4285 Gr.			4285 Gr.		
Occlusal pattern		33°	0°	Cont.	33°	0°	Cont.	33°	0°	Cont
Mesh No:	1	1.916	1.030	2.595	0.184	0.297	0.675	0.776	0.981	1.491
	2	0.206	0,126	0.168	0.017	0.005	0.004	0.074	0.083	0.064
	3	0.253	0.163	0.107	0.007	0.004	0.003	0.214	0.150	0.078
	4	0.029	0.023	0.028	0.002	0.001	0.002	0.059	0.029	0.018
Total weight retained in mesh screens		2.404	1.342	2.898	0.210	0.218	0.684	1.123	1.243	1.651
Total weight drained from mesh screens		1.881	2.943	1.387	4.075	4.067	3.601	3.162	3.042	2.634
Lost of chewing efficiency per cent		22.76	14.55	30.89	10.51	10.53	11.39	13.55	14.08	16.26
Chewing efficiency per cent		77.22	85.45	69.11	89.49	89.47	88.61	86.45	85.92	83.74

Table III

Case 2. (F. D.), Age : 58, Denture wearer for 5 years

		A	B		A	B	C	A	B	
Food		PEANUTS			CARROTS			BEETS		
Chewing strokes		57	59	36	56	54	38	40	39	27
Weight of food		4285 Gr.			4285 Gr.			4285 Gr.		
Occlusal pattern		33°	0°	Cont.	33°	0°	Cont.	33°	0°	Cont
Mesh NO:	1	1.966	1.540	2.174	0.202	0.343	0.376	0.675	1.065	1.832
	2	0.116	0.213	0.725	0.007	0.013	0,007	0.151	0.070	0.041
	3	0.231	0.351	0.767	0.009	0.011	0.008	0.035	0.107	0.213
	4	0.019	0.058	0.016	0.003	0.002	0.001	0.013	0.016	0.017
Total weight retained in mesh screens		2.332	2.162	3.18 4	0.221	0.369	0.392	0,874	1.258	2.103
Total weight drained from mesh screens		1.953	2.123	1.101	4.054	3.916	3.893	3.411	3.027	2.182
Lost of chewing efficiency		21.94	20.15	36.91	10.54	10.84	11.00	12.56	14.15	19.62
Chewing efficiency per cent		78.06	79.85	61.09	89.46	89.16	89.00	87.44	85.85	80.38

Table IV

Case 3. (M. T.), Age : 60, Edentulous for 15 years

		A	B	C	A	B	C	A	B	C
Food		PEANUTS			CARROTS			MEAT		
Chewing strokes		59	61	50	57	53	38	37	39	32
Weight of food		4285 Gr			4285 Gr.			4285 Gr.		
Occlusal pattern		33°	0°	Cent.	33°	0°	Cent.	33°	0°	Cent.
Mesh No:	1	1.790	1.780	2.042	0.164	0.235	0.362	0.729	0.763	0.727
	2	0.147	0.075	0.149	0.003	0.002	0.063	0.049	0.057	0.062
	3	0.195	0.081	0.184	0.002	0.003	0.018	0.069	0.051	0.145
	4	0.022	0.008	0.007	0.001	0.001	0.003	0.005	0.002	0.032
Total weight retained in mesh screens		2.154	1.944	2.382	0.170	0.241	0.209	0.852	0.873	0.966
Total weight drained from mesh screens		2.131	2.341	1.903	4.115	4.044	3.039	3.433	3.412	3.319
Lost of chewing efficiency per cent		20.10	16.30	22.51	10.41	10.59	11.16	12.48	12.55	12.91
Chewing efficiency per cent		79.90	81.70	77.49	89.59	89.41	88.84	87.52	87.45	87.09

Table V

Case 4. (F.A.), Age : 54, Denture wearer for 5 years.

		A	B	C	A	B	C	A	B	C
Food		PEANUTS			CARROTS			MEAT		
Chewing strokes		50	52	47	45	43	34	36	38	31
Weight of food		4285 Gr.			4285 Gr.			4285 Gr.		
Occlusal pattern		33°	0°	Cent.	33°	0°	Cent.	33°	0°	Cent.
Mesh No:	1	1.765	1.557	2.138	0.279	0.287	0.385	0.695	1.120	1.090
	2	0.289	0.161	0.390	0.006	0.029	0.026	0.189	0.026	0.068
	3	0.345	0.230	0.305	0.006	0.018	0.067	0.047	0.022	0.115
	4	0.062	0.027	0.026	0.003	0.006	0.005	0.018	0.003	0.019
Total weight retained in mesh screens		2.461	1.975	2.859	0.294	0.340	0.483	0.949	1.171	1.292
Total weight drained from mesh screens		1.824	2.310	1.426	3.991	3.945	3.802	3.336	3.114	2.993
Lost of chewing efficiency per cent		23.49	18.54	30.04	10.73	10.86	11.27	12.84	13.76	14.31
Chewing efficiency per cent		76.51	81.46	69.96	89.27	89.14	88.73	87.16	86.24	85.69

Table VI

Case 5. (T.Z.), Age : 55, Denture wearer for 6 years.

		A	B	C	A	B	C	A	B	C
Food		PEANUTS			CARROTS			MEATS		
Chewing strokes		62	64	47	42	41	31	33	37	30
Weight of food		4285 Gr.			4285 Gr.			4285 Gr.		
Occlusal pattern		33°	0°	Cont.	33°	0°	Cont.	33°	0°	Cont.
Mesh No:	1	0.695	1.177	1.090	0.232	0.525	0.002	0.895	1.198	1.485
	2	0.290	0.116	0.215	0.019	0.023	0.008	0.084	0.018	0.043
	3	0.345	0.139	0.350	0.007	0.049	0.005	0.198	0.042	0.095
	4	0.030	0.013	0.014	0.008	0.002	0.002	0.056	0.003	0.004
Total weight retained in mesh screens		1.568	1.437	2.681	0.647	0.679	0.817	1.223	1.251	1.627
Total weight drained from mesh screens		2.717	2.845	1.704	3.638	3.606	3.468	3.062	3.034	2.658
Lost of chewing efficiency per cent		15.77	15.04	23.75	11.77	11.81	12.35	13.99	14.12	16.12
Chewing efficiency per cent		84.23	84.96	76.25	88.23	88.19	87.65	86.01	85.88	83.88

Table VII

Case 6. (H.A.), Age : 58, Denture weare for 6 years.

		A	B	C	A	B	C	A	B	
Food		PEANUTS			CARROTS			MEATS		
Chewing strokes		64	68	46	56	53	35	35	38	30
Weight of food		4285 Gr.			4285 Gr.			4285 Gr.		
Occlusal pattern		33°	0°	Cont.	33°	0°	Cont.	33°	0°	Cont.
Mesh No:	1	0.766	1.098	2.513	0.166	0.138	0.451	0.724	0.966	1.53
	2	0.264	0.111	0.126	0.011	0.093	0.009	0.083	0.038	0.016
	3	0.398	0.110	0.194	0.009	0.009	0.007	0.254	0.237	0.011
	4	0.052	0.008	0.030	0.004	0.002	0.002	0.013	0.021	0.007
Total weight retained in mesh screens		1.480	1.327	2.863	0.190	0.242	0.469	1.074	1.262	1.573
Total weight drained from mesh screens		2.805	2.958	1.422	4.095	4.043	3.816	3.211	3.023	2.712
Lost of chewing efficiency per cent		15.27	14.48	30.13	10.46	10.59	11.22	13.34	14.17	15.20
Chewing efficiency per cent		84.73	85.52	69.87	89.54	89.41	88.78	86.66	85.83	84.80

Table VIII

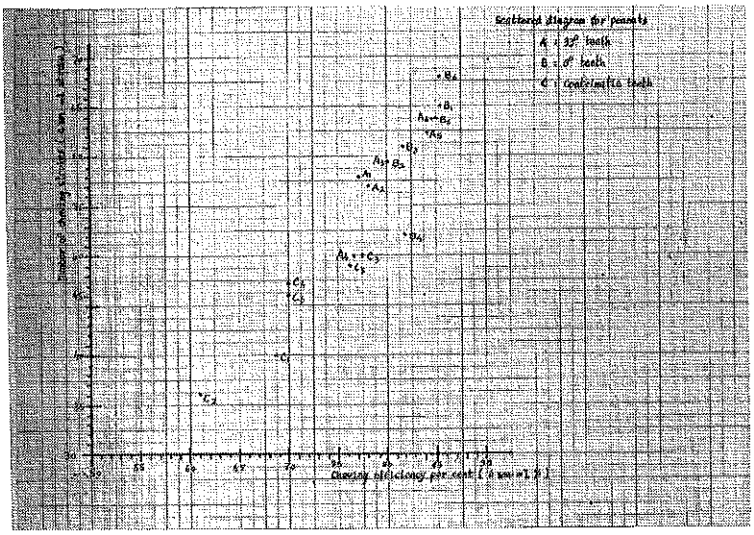

Table IX

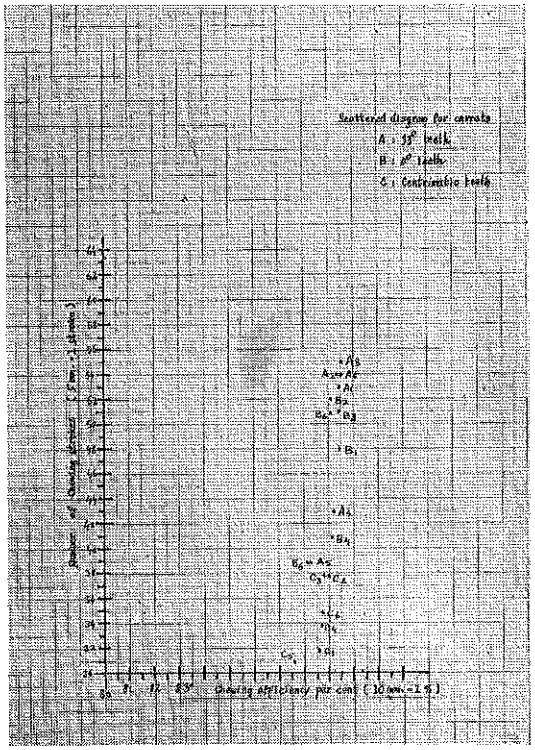

Table X

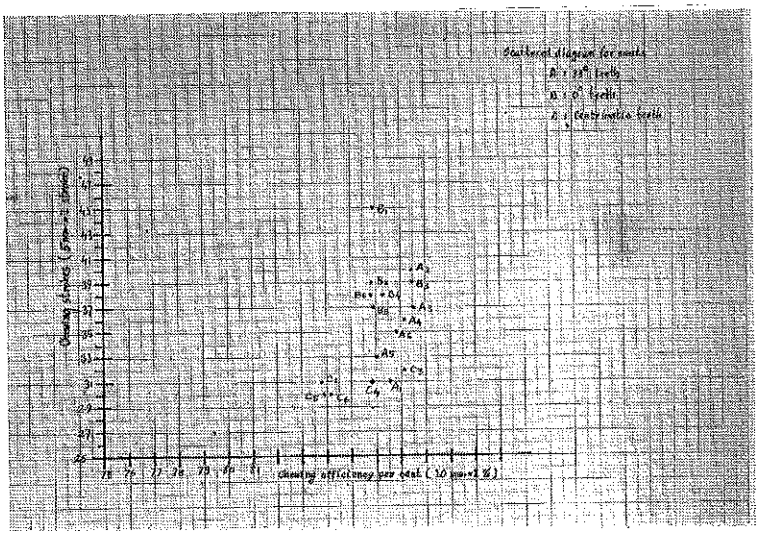

Table XI

Discussion

The main problem of an investigation to test the chewing efficiency of different types of occlusal patterns appear to be the designing of various interchangeable tooth sections. In literature, there are many techniques reported:

Thompson (3) used interchangeable tooth sections which could be attached by screws. Belger (4) fixed them to the vulcanized denture base with pins in postero-anterior direction.

Some of the investigators used either stable metal bases (5, 6) or metal reinforced acrylic resin bases (7).

Again, some authors (8) used only different subjects with complete dentures and tested various occlusal patterns.

Some prepared duplicate dentures to test different artificial teeth (9).

Ehrlich and Michmann (10) prepared through-like grooves for interchangeable tooth sections and used horizontal pins for fixation them into the base.

Although some of the above ingenious techniques are quite

reliable to test the chewing ability of artificial teeth, I have the inclination to believe that anything that might change the original factors may influence the final results of this study, whether or not the subject is aware of such alterations. Firstly, a simple common base is a must for all changes of occlusal patterns. Only in this manner a controlled study can be performed and the type of impression, its extension, fullness, adaptation and retention remain constant throughout the tests as reported by Trapozzano (11). In this case, changing the subjects and/or the dentures in such a study should not be considered reliable. It may give the investigator an idea about the chewing efficiency of different occlusal patterns, but many factors may disturb the requirements of a controlled study.

So it seems to me that the only scientific approach to such a study is to fix the posterior teeth one by one in articulator. This is also the simpliest and the easiest way to do it. As long as we have articulator records from the previous denture, we can always reposition the case on the articulator and maintain the same relationship. With this means, not only the base will be identical but also we will have a proper full balance of the case, and surprisingly the simple cold cure is the most dimensionally stable material (12).

Even though in such a procedure, the amount of cold cure used as parts of polished surface should be kept in minimum to prevent influencing oral sensory mechanism as well as changing the muscle coordination. For that, the plaster index is obtained from the polished surfaces of buccal side and the form of these surfaces is always kept the same.

The reason of choosing carrots and peanuts as test materials is explained in detail by Trapozzano and Lazzari (5). We are in full agreement with them. However, the reason of adding meats into our study is that meat is a fibrous food representing its category as well as an essential requirement of building elements of the human body.

We must also state that we do not fully believe the reliability of patients' preference per se. However, among the criterias which I have observed, if having used properly, the subjective analysis may also give some valuable information in toto.

The evaluation of P.I.P tests did not show any significant differences in tissue displacement. This must be directly related with the balanced articulation obtained on the Dentaus articulator.

Our findings are partly similar to the results of other investigators. However, so far as the maceration of peanuts is concerned, our findings are not in agreement in which high cusped teeth are more effective in this field.

Centrimatic teeth which are a new product in the market are quite successfull in obtaining balanced articulation easily as the manufacturer reports. We agree with it. But these are less effective in mastication.

Summary and Conclusion

Some masticatory function tests have been carried out on 6 selected patients for the purpose of obtaining clues concerning chewing ability of different posterior occlusal patterns. To make it more valid, the subjective analysis as well as the study of tissue displacements were also tested.

In such a study, it appears that in order to reach scientific conclusions, there mus be two rules to abide by:

I — A common base for all the posterior teeth to be tested.

II — A proper full balance of the dentures.

The findings of this investigation may be summarized as follows :

1. Peanuts are more finely ground with flat-plane teeth.
2. High cusped teeth seem more effective for carrots and beef meats.
3. Centrimatic teeth are less effective in all the occlusal patterns in relation to chewing efficiency.
4. The differences in chewing efficiency are not significant among the posterior patterns to test. This also explains the uncertainty of patient's preference.
5. Mucosal irritation is not shown in neither of the occlusal patterns. This must be related with balanced articulation of dentures.
6. Having accustomed to dentures is directly proportional with the duration of wearing them.
7. The chewing efficiency is also directly proportional with the number of chewing strokes.
8. High cusped teeth is responsible in tissue displacement. However, this is quite difficult to differentiate it from the improper balanced articulation. Centrimatic teeth seem the best in this matter.
9. The homogenity of food seems important in the field of chewing efficiency.

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