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ORAL STEREOGNOSIS AND ORAL MOTOR ABILITY, AN ASSESSMENT TO DENTURE ADAPTABILITY

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ABSTRACT

Oral stereognosis and oral motor ability tests are useful in considering the prognosis of treatment with dentures. The acute perceptive ability of the mouth is recognized even in the denture wearing patients, although in the area of fine discrimination they are at a slight disadvantage particularly if they are aged. Patients who have low denture tolerance generally tend to have high stereognostic ability and vice versa and older patients seem to have lower scores than younger in oral motor ability tests.

This is a part of the major investigation/study to evaluate responses of patients to variation in denture forms as determined by intra oral force measurements. Oral stereognosis and oral motor ability tests were performed to select a group of subjects who were believed to be orally of normal adaptability and have good prognosis in treatment with dentures.

INTRODUCTION

Stereognosis or form recognition is the appreciation of the forms of the objects by palpation without the aid of vision whereas Oral stereognosis is the recognition of forms in the mouth without the aid of vision.

Oral motor ability is a test of motor proficiency and was devised by Berry and Mahood (1966). In this the time taken by the patient to pick a pair of test pieces and to manipulate them so as to assemble them in his mouth was used as an indication of his motor proficiency.

LITERATURE REVIEW

There is a wide variety of tests available for stereognosis but the most promising measure of oral sensory function is form identification in the mouth.

Various studies have been conducted using oral stereognosis to assess oral perception (Grossman 1964), and has also been applied in the study of speech, in cleft palate patients (Hochberg and Kabcenell 1967), in patients who are excessively aware of the presence of dentures and retch (Wright 1981). This test has also been applied in dentate and edentulous subjects (Litvik et al 1971), to study oral muscular ability in different age groups (Landt and Fransson 1975), and as an aid to prosthetic treatment planning (Berry and Mahood 1966).

MATERIALS AND METHODS

Stereognostic Test Forms

The tests used were based on those described by Berry and Mahood (1966). Their stereognosis tests used five basic shapes, with a small and a large version, making ten test forms in all. Others have extended and modified those basic shapes by either altering their shapes or surfaces. The test forms used in this study were those modified by Hochberg and Kabcenell (1967) and Wright (1981).

Nine Perspex intra oral test pieces, based on cubes of 5mm dimension were made and used for this test (Fig 1). Nine larger plaster of Paris versions of the test forms, based on 25mm cubes were used for visual display (Fig 2).

The cubes were modified to provide a variety of stimuli. In series 1, one cube was completely smooth. Form 2 and 3 were scribed with one and three grooves of 0.5mm depth respectively, running along four of the six surfaces, to produce different textural qualities. These lines were scribed by using Swiss files which were of assorted shapes and forms. The depth of the lines were 0.5mm. Series II, were progressively altered. In all of these, the edges and corners of the cube were rounded to alter the basic shape of each cube, but the surfaces remained smooth. In series III the edges and corners were beveled at 45° by using flat Swiss file.

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Fig 1 Test-forms showing shapes and surfaces

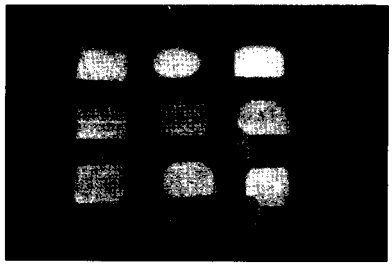


Fig 2 Plaster of Paris models of the test-forms

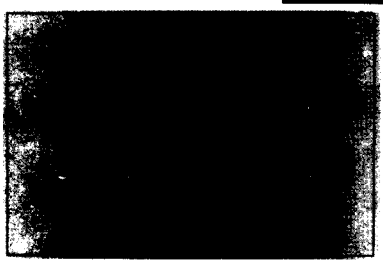
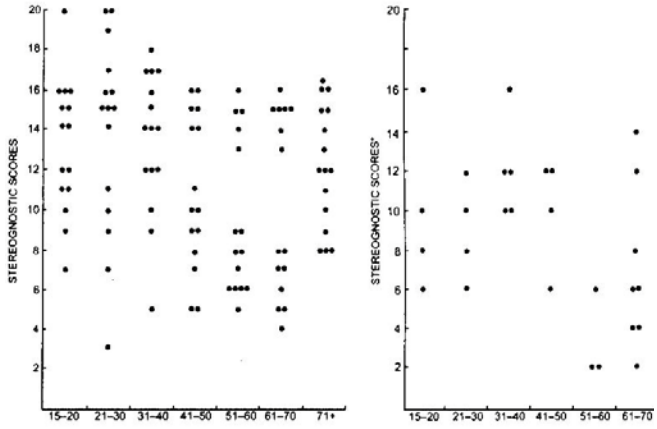
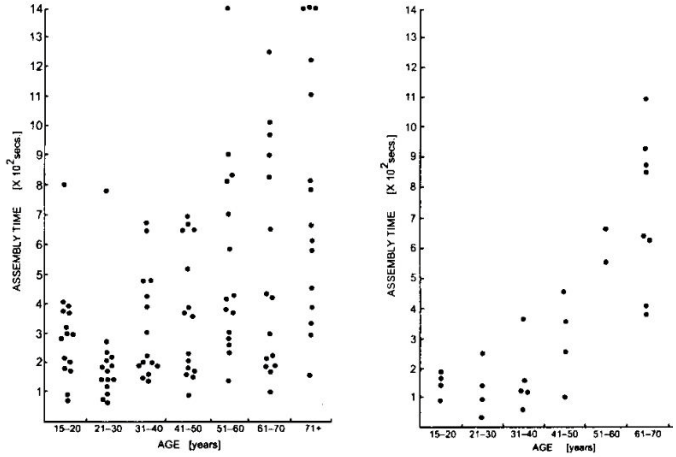


Fig 3 The test-pieces for testing oral motor ability. These were numbered 1-5 from left to right



(a) Adapted from Berry and Mahood (1966) (b) Current investigation

Fig 4. Comparison of Oral Stereognostic Scores with results of Berry and Mahood (1 966)



(a) Adapted from Berry and Mahood (1966) (b) Current investigation

Fig 5. Comparison of Oral Motor Ability with results of Berry and Mahood (1966)

* Scores doubled to make the comparison possible

Oral Motor Ability Test Forms

The oral motor ability test was a two-part assembly test. The subjects were required to assemble the test pieces in the mouth and were timed while doing so. The difficulty of the test was related to the number of ways in which the pieces could be assembled. The five pairs of test pieces were based on the extension by Landt and Hedegard (1974) and Wright (1981), of the original test design of Berry and Mahood (1966).

These test forms were made from perspex sheet. The assembled blocks were 1.2cms x 1.2cms x 0.2cms in size. One part of each pair (the patrix) had a raised central projection which would fit into a matching hole into the other part (the matrix). The first pair of test pieces presented round dowel which fitted into a round hole. The female portion could be presented either way round.

The second and the fourth pair had a square and rectangular dowel respectively, fitting into corresponding hole. Again, the female portions could be presented in two ways. These were shaped using the same technique. The dowels were cut and shaped accordingly and joined with quick setting epoxy resin. Care was taken that when the patrix and matrix were assembled they were of the same dimension with no raised edges.

The third pair had a semi-circular dowel fitting into a semi-circular hole. In this case the hole was blind, and the female portion could be presented in one

TABLE 1. MEAN AGES (YEARS) OF DENTATE (D) AND DENTURE-WEARING (DW) GROUPS

Groups	Subjects			Females			Males		
	No	Age	Mean	No	Age	Mean	No	Age	Mean
D	17	19-51	31.0	15	19-51	28.2	2	30-37	33.5
D.	16	39-82	65.0	12	39 82	62.9	4	66-81	74.7

TABLE 2. STEREOGNOSTIC TEST: SCORES FOR DENTATE AND DENTURE-WEARING SUBJECTS

Subjects	Stereognostic Scores	
	D (17)	DS (16)
1	6	3
2	8	7
3	5	2
4	4	3
5	4	4
6	2	2
7	4	4
8	8	3
9	5	3
10	5	1
11	5	2
12	2	1
13	6	3
14	1	2
15	5	1
16	6	6
17	6	

TABLE 3. STEREOGNOSTIC TEST: RECOGNITION OF TEST-FORMS BY DENTATE AND DENTURE-WEARING SUBJECTS

Series	No	Test-forms	Dentate (17)	D.W (16)
I	1		13	6
	2		12	2
	3		5	2
II	4		13	9
	5		9	5
	6		8	2
III	7		4	4
	8		9	6
	9		6	4

TABLE 4a. OMA TEST: MEAN TIME TAKEN BY DENTATE AND DENTURE-WEARING SUBJECTS TO ASSEMBLE THE TEST-FORMS

Test-forms	DENTATE (17)			D.W (16)		
	Time (minutes)					
	≤3	≤6	≤9	≤3	≤6	≤9
	16	0	1	14	0	2
	17	0	0	11	3	2
	16	0	1	9	5	2
	16	0	1	9	5	2
	16	0	1	8	3	5

TABLE 4b. OMA TEST: MEAN TIME TAKEN BY DENTATE AND DENTURE-WEARING SUBJECTS TO ASSEMBLE THE TEST-FORMS. TIMES GROUPED AS INDICATED

Test-forms	DENTATE (17)			D.W (16)		
	Time (minutes)					
	≤1	≤2	≤3	≤1	≤2	≤3
	16	0	0	12	2	0
	16	1	0	6	3	2
	12	4	0	2	4	3
	11	3	2	1	4	4
	10	4	2	0	5	3

way. The fifth pair was the most complex; the matrix had a semi-circular shape at one end and the other edge a small depression which was cut halfway through the thickness. The corresponding patrix had two projections, one semi-circular dowel and the other section corresponding to the depression.

The test pieces were numbered 1 to 5 in order of presentation (Fig 3).

TEST PROCEDURE

The test procedure had the following aims:

- to compare the findings of the measurement technique with those of other workers, so to confirm that not only the test forms but also the test procedure was comparable
- to measure the scores ofpotential participants so to exclude those with potential excessive denture wearing problems
- to determine that these tests are useful in assessing the prognosis of treatment with dentures

Seventeen dentate subjects and sixteen potential participants in the study were used in these tests. The age of the dentate subjects ranged from 19-51 years with a mean range of 31 years and including 15 females and two males. The potential participants' ages ranged from 39-83 years with a mean age of 65 years and including 12 females and four males. Dentate subjects were used due to problems in obtaining a suitable group of denture wearing subjects. Denture wearers used their dentures during the test.

TABLE 5a. COMPARISONS OF THE TEST SCORES OF ORAL STEREOGNOSIS, ORAL MOTOR ABILITY AND AGES WITH THE TEST SCORES OF SUCCESSFUL DENTURE WEARERS OF BERRY AND MAHOOD (1966)

Patient	Age	OS (20)	OMA (1620)
1	66	5	639
2	65	6	961
3	85	10	1400
4	52	9	695
5	58	7	426
6	66	8	867
7	56	6	820
8	66	5	227
9	68	7	288
10	52	6	885
11	62	7	1005
12	71	12	1400
Average Scores	63.9	7.3	801

Subject	Age	OS* (18)	OMA (2700)
1	70	6	924
2	67	14	845
3	74	4	768
4	42	6	453
5	67	8	389
6	67	4	872
7	67	8	1097
8	78	6	946
9	58	6	548
10	81	2	1353
11	67	4	401
12	55	2	681
13	70	12	621
14	61	4	625
Average Scores	66	6.14	752

(a) Adapted from Berry & Mahood (1966) (b) Current possible investigation * Scores doubled to make compansons

TABLE 5b. TEST OF SIGNIFICANCE BETWEEN THE CURRENT STUDY AND BERRY AND MAHOOD (1966)

	Berry and Mahood mean scores	Current investi-gation mean scores	P-value
OS	7.3	6.1	p=0.29 (NS) p=0.14 (Mann Whit)
OMA	801	752	p=0.71 (NS) p=0.62 (Mann Whit)
Age	63.9	66	p=0.58 (NS)

Oral Stereognosis Test (OS)

A test form was placed on the tip of the tongue and the subject asked to identify it by placing it in his mouth, without using his teeth. As soon as he had identified it, he was to point at the corres-ponding large form, all nine of which were in constant view.

Test-forms were presented to each subject in a standardized random order. The tests were timed, by it was emphasized that speed was not an important factor.

The number of test-forms correctly identified gave the OS score.

The mean time taken to identify the test forms was also calculated.

Oral Motor Ability Test (OMA)

The test pieces were shown to the subject and their assembly demonstrated. The same random order of presentation was used. The patrix and matrix were placed side by side on the back of subject's right hand. It was suggested that the subject could arrange these pieces in a more favourable relationship if he or she wished. The separated pieces were picked up by the lips simultaneously and taken into the mouth where they were manipulated in order to assembly them. The subject was to indicate when he had achieved this, by opening his mouth to show the pieces assembled. If he had not succeeded he was to try again. The time taken (in seconds) by the subject to assemble each pair of test pieces was recorded. A maximum of three minutes was allowed for the assembly for each pair of test pieces. If the subject failed to assemble them within that time the score was recorded as 180 seconds.

The time taken for the assembly of five pairs of pieces three times was totaled to give that individuals OMA score time. The maximum time possible for the test was thus 15 x 180 =2700 seconds.

RESULTS AND DISCUSSIONS

These tests were employed on the potential subjects and the results were compared with Berry and Mahood (1966).

Oral Stereognosis (OS)

In this study 17 dentate and 16 denture wearers participated. The tests on the dentate subjects were carried out to see if the conduct of these tests was similar to that of Berry and Mahood (1966), and then extended to the denture wearing subjects who were part of this study.

All except one of the subjects under 51 years in this study were dentate. Although Berry and Mahood (1966) did not distinguish between the dentate and denture wearing subjects in the initial part of their study the majority of their subjects under 51 years were dentate Mahood (1989). Fig 4a shows that the under 51 age group of Berry and Mahood's subjects had high stereognostic scores; Fig 4b suggests that the dentate subjects in the present study had similarly high scores. However, statistical analysis shows that there was a small difference in stereognostic scores between the two studies for the under 51 age group ($p = .02$, Mann Whitney Test). The mean stereognostic scores were 12.85 in the Berry and Mahood (1966) study and 10.35 in the current study. Therefore it would be safe to state that the test was valid.

The older subjects in the two studies did not seem to be performing equally well. In contrast to the remark of Berry and Mahood that increasing age did not appear to affect performance, the subject being tested did display noticeably low scores (correlation coefficient of age v stereognostic score= -0.51, $p < .001$). Further more there was also a statistical significant relation in the Berry and Mahood's study ($r = -.25$, $p < .004$), though not to the extent found in this study. It is very likely that the use of the more complicated shapes of Hochberg and Kabcenell (1967) and Wright (1981) proved too difficult for the older people in the present study. The fact that all these subjects were wearing dentures would be expected to reduce their perception of shape and surface detail.

Tables 1 and 2 show the mean ages of all the subjects tested and their stereognostic scores. It can be been seen that the older age group, i.e., denture wearers performed much less well than the dentate subjects. Although all subjects displayed poorer achievements as the test forms became more difficult, the denture wearers' scores were poorer at all levels (Table 3). This supports the work of Litvik et al (1971).

Oral Motor Ability (OMA)

These test forms were also augmented and used on dentate subject to evaluate them and the method of use. It was clear from fig 5a and 5b that oral motor ability declined with age ($r = .57$, $p<.001$). Figs 5a and 5b also demonstrate that the subjects examined by Berry and Mahood and the subjects of the present study performed similarly ($p=.80$ (NS) Mann Whitney Test, $p=.99$ (NS) when adjusted for age. The presence of better scores in some of the older subjects of the 1966 study can be explained by the fact that many of these subjects were dentate (Mahood 1989). None of the older subjects in the present study was dentate.

Table 4a presents the times taken to assemble to OM test pieces. It can be seen that the dentate group performed well in all the tests but in the other group the time taken increased with the complexity of the assembly.

The performance of all the subjects who completed the assembly in three minutes or less was closely examined. Table 4b shows that the overall performance of the dentate subjects was very much better than that of the denture wearing group. However, the majority of the subjects in the denture wearing group assembled the simpler test forms in a minute or less. As the complexity of the assembly increased, a longer time was required.

Two subjects in the denture-wearer group failed to complete the OM tests and were given a score of nine minutes. The most likely reason was that they were both over 80 years of age. Another subject of over 80 performed very poorly, and though he did not abandon the tests but eventually got very tired and bored. This suggests that age does affect the ability of some subjects assemble tests-forms. This study produced similar findings to those of Berry and Mahood (1966) and therefore was used to assess oral motor ability and to exclude potential subjects with high scores.

The 14 subjects remaining were compared with the successful denture wearers in the Berry and Mahood

study. Table 5a shows the oral stereognostic and oral motor ability scores of 12 successful patients of Berry and Mahood and the oral stereognostic and the oral motor ability scores of 14 subjects of the present study. It can be seen that the performances of the subjects were very similar. A non-parametric (Mann Whitney rank test) statistically test applied to the scores of these two groups confirmed this (Table 5b). It was thus considered that the 14 remaining subjects in the study were unlikely to exhibit abnormal muscular behaviour and encounter prosthetics problems thereby.

CONCLUSIONS

It may be concluded therefore, that stereognostic tests are useful in considering the prognosis of treatment with dentures. Patients who have low denture tolerance generally tend to have high stereognostic ability and vice versa and older patients were seen to have lower scores than younger in oral motor ability tests. It is therefore difficult to use oral motor ability tests as a diagnostic procedure as most complete denture wearers are in fact old.

The presence of foreign object (prostheses) in an edentulous mouth is bound to elicit difficult stimuli in the sensory-motor system, which in turn influences oral motor behaviour. Both exteroceptors and proprioceptors are probably affected by the size, shape, position, pressure from and mobility of the prosthesis (Zarb et al 1978, Zarb 1979 and Hickey and Zarb 1980).

Patients' comments

Many subjects reported that oral stereognosis depended on the tongue and that the palate functioned mainly as a rigid surface against which the tongue could manipulate the test-forms. This agrees with the study of Grossman (1964), who noted that lingual anesthesia reduced oral stereognosis considerably. It also supports the study of Hochberg and Kabcenell (1967), that oral forms and oral manipulation procedures are performed largely in the anterior part of the mouth, between the tongue and the front of the palate.

Some of the subjects confessed to guessing, particular when they felt that they were too slow. Others were anxious to be helpful and worked hard at the tests despite the fact that their tongues were sore or their mouths dry. One of the older subjects said the tests were of his patience rather than skill, and it was thus possible to eliminate two potential participants whose scores suggested poor oral motor abilities.

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