Evaluation of tissue displacement in posterior palatal seal area with different impression techniques with varying palatal forms

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ABSTRACT

Background: This study was designed to measure the displacement pattern of posterior palatal seal (pps) area in different forms of the palate and with different impression techniques.
Materials and method: This study was used to measure the displacement pattern of (pps)in different palatal shapes by using different impression materials Korrecta wax No.4,Green compound and design of House for pps for each palatal forms by using a 3D Scanner of CAD/CAM and measuring the distance between 2 points in pps area by using Caural Threw.
Result: The results show highly significant differences between these techniques and the control group (impression with light body)
Conclusion: The physiological impression technique of pps with Korecta wax no.4 and design of House for each palatal forms give less displacement than the physiological impression with green compound.
Keywords: Maxillary complete dentures, posterior palatal seal. (J Bagh Coll Dentistry 2013; 25(4):17-25).

INTRODUCTION

The security of maxillary complete denture depends primarily on close peripheral contact between the denture and its supporting tissue. [1] The pps area has been defined as an area that is located at the junction of hard and soft palate and which is composed of a soft tissue, along which pressure will be applied by a denture, within the physiological limits of the tissue, to aid in denture retention[2].

A well fitting and retentive maxillary complete denture requires : a well fitting surface, a peripheral border compatible with the muscles and tissues which make up the muco-buccal and muco-labial space, so that a peripheral seal is created by soft tissues draping over them and finally by a pps[3] .

Brian and Robert discussed different materials for achieving a PPS of a maxillary complete denture which include arbitrary scraping of the cast prior to denture processing, the physiological impression technique and the selective pressure impression technique.[4]

Laney and Gonzales[5] discussed the need for knowledge of the oral cavity anatomy so that the static surface of the denture base can be balanced against one dynamic tissue surface.

In the pps area, the tissues are displaceable and the degree of displacement can be sensitized by palpation with "T" burnisher[6], by closing both nostrils of the patient and make him blow gently[7] or by noticing the vibrating line when the patient says "ah" [8]. The anterior and posterior vibrating lines are considered as two separate lines of flexion [9]. Also by measuring the tissue with various impression materials, a functional or physiological pps can be made as early as the maxillary final impression[10].

The posterior border of the maxillary denture extends into and through the pterygo-maxillary notches and along the vibrating line. The pterygo-maxillary notch is bounded posteriorly by the hamular process of the sphenoid bone and the lateral pterygyoid plate and anteriorly by the maxillary tuberosity [11]. The tensor palati muscle wraps around the hamular process and attaches to the posterior nasal spine to form the palatal aponeurosis[12].

The pterygo-mandibular ligament extends from the hamular process to the lingula of the mandible. Pendleton's[13] anatomic dissections and histological and clinical examination have shown this area to vary greatly in size, form and character.

The shape of palatal vault is related to the activity of the soft palate .The flat vault has the least movable soft palate and the widest area of displaceable tissue. In contrast, the high vault or "V" shaped palate often has a soft palate virtually at right angles to the hard palate and is extremely mobile. Thus, the area of tissue displaceability is very narrow .The intermediate palatal vault lies between these two extremes so that House classified the palatal form to class I flat palatal vault in the hard palate and class III a high vault and class II intermediate between them[14,15]. Nikoukari[16]measured the dimension and

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displacement of pps in different palatal shapes, he used different impression materials and found that the tissue displacement caused by ZOE was less than that caused by other materials.

This study was designed to detect the displacement pattern of pps in different palatal shapes with different impression techniques.

MATERIALS AND METHODS

A. Selection of patient:

Twenty one (21) patients with different palatal form (deep, medium and flat), were selected visually by a team of prosthodontics to determine the palatal form , from Prosthodontic Clinic , College of Dentistry , University of Baghdad ,seven for each group. The age ranges between 60-70 years without any posterior under cut.

B. Impression techniques:

The primary impressions were made with alginate. Then impressions were poured with stone (zeta, selensor, industriazingardi, Italy)

Three closed fit special tray and one spaced special tray were fabricated for different impression techniques.

I. Final impression (control group) by using spaced special tray and taking impression with light body (elastic impression material) ,then poured with stone .The cast considered as control was marked 1,as shown in fig (1).

II. Physiological pps impression technique by using Korecta wax No.4 and another one by using low –fusing modeling compound with the following steps:

1. The posterior border of the special tray should be trimmed and adjusted one to two mm distal to the vibrating line.
2. Border molding should be done and the final impression was taken by using zinc oxide eugenol (ZOE) paste.
3. The vibrating line should be marked in the mouth with indelible pencil by asking the patient to say “ah” with nose blowing and using the fovea palatine in locating the vibrating line (anterior and posterior vibrating line) and transferring the location to the ZOE impression[17].
4. Kerr Korecta wax No.4 and low fusing modeling compound were used to record the pps by painting it on pps area of impression.
5. The impression should be returned to patient mouth and held it in place for about 3 minutes. Patient is guided to tip its head forward to approximately 30^{o} from the vertical position and place his tongue against tray handle [18-20].
6. Impression is removed and excess material removed with Bard-parker blades. Then impression is reseated for 5 to 8 minutes.
7. Impression is carefully beaded and boxed and poured with stone .These 2 castes were marked 2 with Korrecta wax and 3with modeling compound as shown in fig (2) and (3).

III. Ordinary impression technique with ZOE

1. The same steps 1, 2 and 3 which were done in the previous technique are done here.
2. The impression then was poured with stone and the master cast was marked 4.
3. Scraping cast 4 for incorporation of pps to carve certain design by using No.4 round bur with lacron carver[21] .The patients were classified (visually) into groups according to House’s classification of palatal form.

Group A (deep palatal form)

A1=control group with light body impression.

A2=physiological impression of pps with Kerr Korrecta wax No.4

A3=physiological impression of pps with low –fusing molding compound.

A4=scraping casts No.4 in pps area according to House- single bead 1mm depth and width[22].

Group B (intermediate palatal form)

B1=control group with light body impression.

B2= physiological impression of pps with Kerr Korrecta wax No.4

B3=physiological impression of pps with low –fusing molding compound.

B4=scraping casts No.4in pps area according to House –modified butterfly 2-3mm wide and 1mm depth.

Group C (Flat palatal form)

C1=control group with light body impression.

C2=physiological impression of pps with Kerr Korrecta wax No.4.

C3=physiological impression of pps with low-fusing modeling compound.

C4=scraping casts No.4 in pps area according to House –modified butterfly 3-4mm wide and 1mmdepth[22].

C. Preparing working casts

I. On the working casts (No.1) indicate the incisive papilla and the position of fovea palatine on the midline, 1/3distance between these two points indicated as point 1 near fovea palatine on midline. Indicate the crest of hamular notch on the cast and put a point on the end of hamular notch on the ridge on both sides, which are indicated as points 3 and 7.

Draw a straight line between points 3 and 7 and put point No.5 on the midline .Half the distance between point 3 and 5, put point 4. Half the distance between points 5 and 7 put point 6. Put a point on the location of fovea palatine on the midline indicate as point 9, draw a horizontal straight line from point 9 on the center of crest of ridge on both sides and indicated as points 2 and 8, half the distance between points 9 and 2, put point 10 ,half the distance between points 9 and 8, put point 11 . Also half the distance between points 9 and 10 put point 12 and half the distance between 9 and 11 put point 13 .These points 10, 11, 12, 13 are used to measure the depth of pps area .as shown in fig (4).

II. A splint was made on the control casts No.1 by using cold cure acrylic[23] (Ivoclar).fig (5), these points were transferred on the cast to the splint by indelible pencil and a hole was made on the splint by using round bur No.4. Then this splint was used on the other casts No.2, 3 and 4 and the location of these points should be transferred to the casts fig (6).

III. For measuring the width of tissue displacement in pps area ,scanner of these casts should be made by using three dimension (Laser Denta) of CAD/CAM (Computer-Aided Design/Computer-Aided Manufacture) 3 dimension scanner to take a picture with its original dimensions of the casts as shown in Fig. (7 and 8) ,these pictures were directly evaluated and measured through data analyzed in the computer by using Caural Threw program to measure the distance between points 1-3, 1-4, 1-5, 1-6, and 1-7 and distance between points 2-9 and 8-9 to show the displacement pattern in post dam area for each impression technique in millimeters [24,25].

IV. Measuring the depth of pps at different points. The acrylic splint which is used for transferring the points was put on the cast No. 1 (control) and pins were put on both sides of points 2 and 8 to fix the split on the cast. Then by using a pin like (reamer which is used for endodontic treatment) with stopper to determine the length of pins which were inserted inside points 10, 11, 12 and 13 to measure the depth of pps in this area and then should be measured by vernier .This procedure should be repeated on casts No. 2, 3 and 4 to measure the depth of pps for all the patients for each group as shown in fig 9.

RESULTS

1. Measurement of width of pps area:

Group A (deep palatal vault)

The mean values, SD and ANOVA of the statistical analysis for the data of the distance between the 2 points for group A were shown in table 1. Whereas the result of LSD (multiple comparison) between the four groups (A1, A2, A3 and A4) were shown in table 2.

The results show that there were highly significant differences in data between the groups A1, A2, A3 and A4 except for the data of distance 1-5 between A1 and A4 which show that there were non significant differences.

The mean differences for each distance for group A2,A3 and A4 with the control A1 show that the least tissue displacement were in group A4 (design of House single bead)followed by A2 (physiological impression with Korecta wax)also show the least displacement while A3(low-fusing compound)which show more displacement.

Group B (intermediate palatal vault).

The mean values, SD and ANOVA of statistical analysis for the data of distance between 2 points for group B were shown in table 3.Whereas the result of LSD between the 4 groups B1, B2, B3 and B4 were shown in table 4.

The results explained that there were very highly significant differences between the data of each group (B1, B2, B3 and B4).

The mean differences for the data of each distance between the groups (B2, B3, and B4) with the control group B1 show the least displacement were in groups B2 (Korrecta wax) and B4 (design of House).While the most displacement was in group B3 (low-fusing compound).

Group C (Flat palatal vault)

The mean values, SD and ANOVA of statistical analysis for the data of distance between 2 points for group C were shown in table 5. Whereas the result of LSD between the four groups is shown in table 6.

The result explained that there were highly significant differences between the four groups C1, C2, C3 and C4 for each distance except that there was a non significant difference for data of distance 1-4 points between C2 and C3 groups.

The mean difference between groups C2, C3 and C4 with C1 for the result shows that the least displacement were in groups C2 (Korrecta Wax) and C4 (design of House) and more displacement was in group C3 (Low-fusing Compound).

2. Measurements of the depth of points in pps area:

Tables 7 , 8 , 9 , 10 , 11 and 12 give readings for deep , medium and flat palates respectively

with ANOVA and LSD multiple comparison , Which show highly significant differences between these groups.

The results indicated that the tissue displacement caused by elastic materials (control group) was less than that caused by other materials in all three types of palatal shape.

The casts in which the pps area was obtained with modeling compound had the highest displacement readings; this result was found for all three types of palatal shapes; while the measurements obtained from Korecta Wax and design of House were between those readings of control group and modeling compound.

DISCUSSION

The pps area has been defined as an area that is located at the junction of hard and soft palat and which is composed of a soft tissue, along which pressure will be applied by a denture within the physiological limits of the tissue to aid in denture retention[2].

The results of all groups indicated that the tissue displacement caused by Kerr Korecta wax No.4 was less than the green compound tracing impression technique this due to the fact that this wax is a fluid and the mouth temperature wax is more preferable for this procedure .It flows sufficiently at mouth temperature to avoid displacement of tissues, and as the wax continues to exhibit its property of flow in the mouth ,it permits the tissues in the area of pps to rebound ,establishing a degree of displacement that is physiologically acceptable[18] .This result agrees with Nikoukari [16].,who stated that casts in which the pps area obtained with modeling compound had a higher displacement than that obtained by Korrecta wax No.4.

The scraping method according to House classification of palatal vault of pps for each group showed that the best result (the lowest displacement) approximately nearer to the result of Kerr korecta wax .This result occurred because in group C (flat palatal vault)the vibrating line was further posteriorly, resulting in the broadest pps area ,so that the design of House is 3-4 mm butterfly .Where as in the deep vault (group A), the posterior extension of pps area was less than in group B (medium vault)so the design of House in deep vault single bead is 1 mm in depth and width.

This result agrees with the observation of Swenson and Terkla who observe that the direction of vibrating line differ with the shape of the palate .The higher the vault the more abrupt and forward is the vibrating line. In a mouth with a flat vault, the vibrating line is usually further posteriorly and has a gradual curvature affording a broader pps area [26,27].

As conclusions; one of the most important problems that associated with poor retention of the maxillary complete denture is a faulty pps

It can be concluded from this study the following:

1- The physiological impression with Korecta wax No.4 for pps area gives less tissue displacement than other materials.

2- The palatal form aids in the selection of the type of posterior palatal seal needed .The House design of pps for each type of palatal forms gives less displacement in this area.

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Table 1: Means, standard deviation (SD) and ANOVA of each distance between 2 points of group A (deep palatal vault) width of pps in (mm)

Distance between 2 points	A1 Control		A2 Korrectawa		A3 Tracing compound		A4 Single bead		Sig.
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
1-3	31.21	.0283	32.68	.01582	33.6	.00708	32.3	.0079	.000
1-4	27.24	.01225	30.2	.0083	31.1	.01581	29.25	.0077	.000
1-5	22.86	.0100	23.18	.00707	23.6	.01581	22.86	.0592	.000
1-6	27.24	.0173	32.95	.00707	33.3	.01582	28.24	.01732	.000
1-7	31.84	.0100	33.52	.01581	34.56	.0083	32.82	.0158	.000
9-2	21.6	.0123	24.0	.012	24.3	.0273	22.78	.00708	.000
9-8	22.0	.0255	24.53	.00707	24.63	.02236	23.11	.01000	.000

Table 2: LSD multiple comparisons between the groups of each distance between 2 points for group A(for width of pps)

Groups		1-3		1-4		1-5		1-6		1-7		9-2		9-8	
		Mean diff	sig	Mean diff	sig	Mean diff	Sig	Mean diff	sig	Mean diff	sig	Mean diff	Sig	Mean diff	Sig
A1	**A2**	-1.47	.000	-2.96	.000	-.32	.000	-5.71	.000	-1.68	.000	-2.4	.000	-2.53	.000
A1	**A3**	-2.39	.000	-3.86	.000	-.74	.000	-6.06	.000	-2.72	.000	-2.7	.000	-2.63	.000
A1	**A4**	-1.09	.000	-2.01	.000	.00	1.00	-1.0	.000	-.98	.000	-1.18	.000	-1.11	.000
A2	**A3**	-.92	.000	-.90	.000	-.42	.000	-.35	.000	-1.04	.000	-.30	.000	-.10	.000
A2	**A4**	.38	.000	.95	.000	.320	.000	4.71	.000	.70	.000	1.22	.000	1.42	.000
A3	**A4**	1.3	.000	1.85	.000	.74	.000	5.06	.000	1.74	.000	1.52	.000	1.52	.000

The mean differences are significant at the .05 level

Table 3: Means, standard deviation (SD) and ANOVA of each distance between 2 points of group B (intermediate palatal vault) width of pps in (mm)

Distance between 2 points	B 1 control		B2 Korrecta wax		B3 Tracing compound		B4 Butterfly 2-3mm		Sig.
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
1-3	30.68	.0282	31.1	.1000	32.66	.01581	30.9	.00707	.000
1-4	23.4	.00707	23.85	.03803	23.95	.0308	24.12	.0187	.000
1-5	18.22	.0158	18.44	.0169	19.02	.01000	18.32	.00707	.000
1-6	23.38	.0173	23.6	.00707	23.95	.01581	24.12	.01581	.000
1-7	30.56	.010101	31.32	.0123	31.93	.01225	30.77	.0123	.000
9-2	22.11	.01225	24.08	.01581	24.98	.00837	23.02	.01000	.000
9-8	24.23	.0255	26.2	.00707	26.45	.02236	25.99	.01000	.000

Table 4: LSD multiple comparisons between the groups of each distance between 2 points for group B (for width of pps in (mm))

Groups		1-3		1-4		1-5		1-6		1-7		2-9		9-8	
		Mean diff	sig	Mean diff	sig	Mean diff	sig	Mean diff	sig	Mean diff	sig	Mean diff	Sig	Mean diff	Sig
B1	B2	-.42	.000	-.45	.000	-.22	.000	-.22	.000	-.76	.000	-1.97	.000	-1.97	.000
B1	B3	-1.98	.000	-.55	.000	-.80	.000	-.57	.000	-1.37	.000	-2.87	.000	-2.22	.000
B1	B4	-.22	.000	-.72	.000	-.10	.000	-.74	.000	-.21	.000	-.91	.000	-1.76	.000
B2	B3	-1.56	.000	-.10	.000	-.58	.000	-.35	.000	-.61	.000	-.902	.000	-.25	.000
B2	B4	.20	.000	-.27	.000	.12	.000	-.52	.000	.55	.000	1.06	.000	.21	.000
B3	B4	1.76	.000	-.17	.000	.70	.000	-.17	.000	1.16	.000	1.962	.000	.46	.000

The mean difference is significant at the .05 level.

Table 5: Means, standard deviation (SD) and ANOVA of each distance between 2 points of group C (flat palatal vault) for width of pps in (mm)

Distance between 2 points	C 1 control		C2 Korrecta wax		C3 Tracing compound		C4 Butterfly 3-4mm		Sig.
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
1-3	33.38	.01581	34.28	.01581	35.06	.02074	33.98	.01225	.000
1-4	25.1	.07071	26.74	.03162	26.78	.01581	26.57	.05148	.000
1-5	18.50	.02236	18.8	.01871	18.95	.02915	18.6	.03536	.000
1-6	24.72	.01582	25.1	.00707	25.92	.01581	25.32	.01581	.000
1-7	35.07	.03391	35.79	.01225	36.28	.01581	35.95	.03162	.000
9-2	25.32	.01581	26.33	.01671	26.92	.01591	26.8	.02345	.000
9-8	27.71	.0133	28.63	.0123	28.93	.0273	28.42	.0122	.000

Table 6: LSD multiple comparison between the groups of each distance between 2 points for group C (for width of pps in (mm))

Groups		1-3		1-4		1-5		1-6		1-7		2-9		9-8	
		Mean diff	sig	Mean diff	sig	Mean diff	Sig	Mean diff	sig	Mean diff	sig	Mean diff	Sig	Mean diff	Sig.
C1	C2	-.90	.000	-1.64	.000	-.30	.000	-.38	.000	-.72	.000	-1.01	.000	-.92	.000
C1	C3	-1.68	.000	-1.68	.000	-.45	.000	-1.2	.000	-1.21	.000	-1.6	.000	-1.22	.000
C1	C4	-.60	.000	-1.47	.000	-.10	.000	-.60	.000	-.88	.000	-1.48	.000	-.71	.000
C2	C3	-.784	.000	-.04	.199	-.150	.000	-.82	.000	-.49	.000	-.59	.000	-.30	.000
C2	C4	.30	.000	.17	.000	.20	.000	-.22	.000	-.16	.000	-.47	.000	.21	.000
C3	C4	1.084	.000	.21	.000	.35	.000	.60	.000	.33	.000	.12	.000	.51	.000

The mean difference is significant at the .05 level.

Table 7: Means, standard deviation and ANOVA of depth of points in pps area in (mm) of Group A (deep palatal vault)

Points	A1 control		A2 Korecta wax		A3 tracing comp.		A4 single beed		ANOVA
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Sig.
10	5	.30	7.6	.37	9.5	.30	6.5	.38	.000
11	5	.36	7.3	.58	8.9	.74	6.8	.6	.000
12	6.2	.2	7.9	.6	8.2	.3	7.5	.32	.000
13	6.5	.38	8.2	.31	9	.41	7.6	39	.000

Table 8: LSD multiple comparison between the groups of group A (deep palatal vault) for depth of pps

Groups		10 point		11		12		13	
		Mean diff.	Sig.	Mean diff.	Sig.	Mean diff.	Sig .	Mean diff.	Sig.
A1	A2	-2.6	.000	-2.3	.000	-1.7	.000	-1.7	.000
A1	A3	-4.5	.000	-3.9	.000	-2.0	.000	-2.5	.000
A1	A4	-1.5	.000	-1.88	.000	-1.3	.000	-1.1	.000
A2	A3	-1.9	.000	-1.5	.001	-.30	.269	-.80	.004
A2	A4	1.1	.000	.44	.265	.4	.146	.6	.023
A3	A4	3.0	.000	2.02	.000	.70	.017	1.4	.000

The mean differences are significant at the .05 level

Table 9: Means, standard deviation and ANOVA of depth of points in pps area in (mm)of group B (intermediate palatal vault)

Points	B1 control		B2 Korecta wax		B3 tracing comp.		B4 butterfly 2-3 mm		ANOVA Sig.
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
10	5.7	.18	7.9	.53	8.9	.6	7.2	.46	.000
11	5.5	.33	7.5	.53	8.9	.6	6.9	.34	.000
12	6.2	.67	7.9	.25	8.7	.3	7.7	.18	.000
13	6.2	.38	7.8	.3	8.9	.25	7.8	.29	.000

Table 10: LSD multiple comparisons between the groups of group B (intermediate palatal vault) for depth of pps

Groups		10 point		11		12		13	
		Mean diff.	Sig.	Mean diff.	Sig.	Mean diff.	Sig .	Mean diff.	Sig.
B1	**B2**	-2.2	.000	-2.0	.000	-1.7	.000	-1.5	.000
B1	**B3**	-3,2	.000	-3.4	.000	-2.5	.000	-2.6	.000
B1	**B4**	-1.5	.000	-1.4	.000	-1.5	.000	-1.52	.000
B2	**B3**	-1.0	.005	-1.4	.000	-.80	.006	-1.1	.000
B2	**B4**	.7	.038	.60	.068	.20	.444	.000	1.0
B3	**B4**	1.7	.000	2.0	.000	1.0	.001	1.1	.000

The mean differences are significant at the .05 level

Table 11: Mean, standard deviation and ANOVA of depth of points in pps area in (mm) of group C (flat palatal vault)

Points	C1 control		C2 Korecta wax		C3 tracing comp.		C4 Butterfly 3-4mm		ANOVA Sig.
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
10	5.0	.30	7.2	.29	7.8	.36	6.5	.38	.000
11	5.3	.18	7.3	.14	7.9	.122	6.6	.46	.000
12	5.4	.10	7.0	.37	7.4	.32	6.3	.44	.000
13	5.5	.12	7.0	.37	7.3	.17	6.4	.41	.000

Table 12: LSD multiple comparisons between the groups of group c (flat palatal vault) for depth of pps

Groups		10 point		11		12		13	
		Mean diff.	Sig.	Mean diff.	Sig.	Mean diff.	Sig.	Mean diff.	Sig.
C1	**C2**	-2.2	.000	-2.0	.000	-1.6	.000	-1.5	.000
C1	**C3**	-2.8	.000	-2.6	.000	-2.0	.000	-1.8	.000
C1	**C4**	-1.5	.000	-1.3	.000	-.9	.001	-.9	.000
C2	**C3**	-.6	.013	-.6	.003	-.4	.079	-.3	.133
C2	**C4**	.7	.005	.70	.001	.70	.005	.6	.006
C3	**C4**	1.3	.000	1.3	.000	1.1	.000	.9	.000

The mean differences are significant at the .05 level

Fig. 1: Final impression with Spaced special tray by using light body

Fig. 2: Final impression with Korecta wax

Fig. 3: Final impression with Modeling Compound

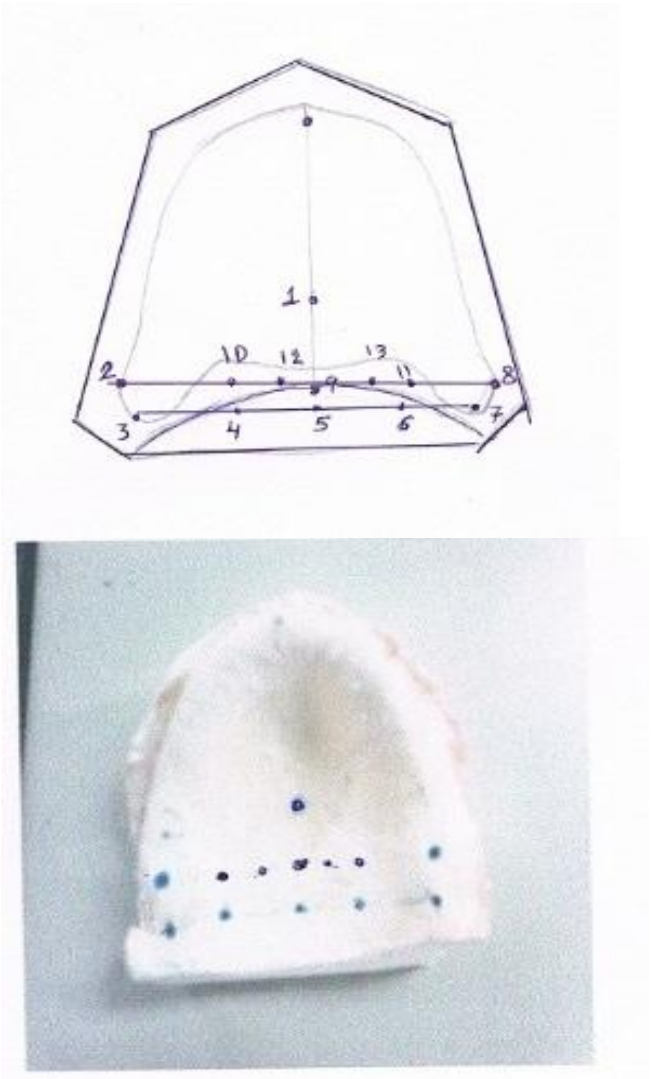
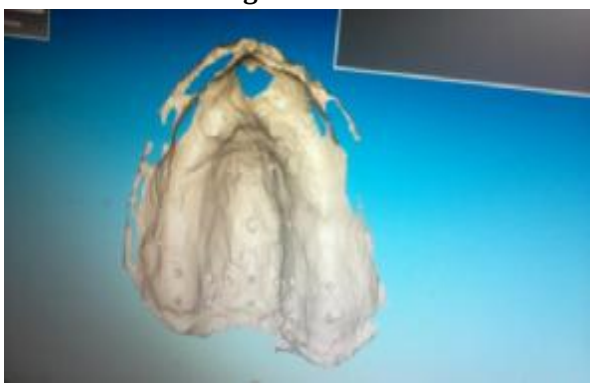


Fig. 4: Selection of 13 point for measuring Tissue displacement

Fig. 5: Acrylic splint of cast No. 1

Fig. 6: Casts No. 2, 3 and 4 after transferring the points by the splint

Fig. 7: 3D Three Dimension Scanner Laser Dent of CAD/CAM



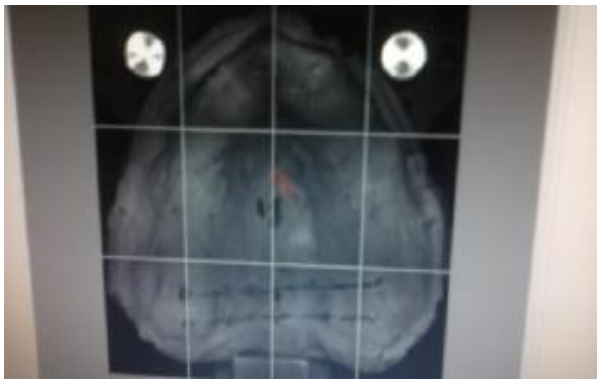


Fig. 8: 3D Three Dimensions Image of Stone Cast

Fig. 9: Using reamer on the splint to measure the depth of PPS65