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THE COMPARATIVE AND ANALYTICAL STUDY ON DIE SPACER

Prosthodontics

Dr Sonali Vikas Gaikwad	Assistant professor, GDC, Aurangabad
Dr Wahab Ayub Shaikh*	Assistant professor, GDC, Aurangabad *Corresponding Author
Dr Priya Singh	Assistant professor, GDC, Aurangabad
Dr Datta Bhajibhakre	PG student, CSMSS, Dental College, Auranagabad

ABSTRACT

For desirable result of any fixed restoration each small step is equally important, so here i am focusing on most neglected but important step to evaluate the ideal number of layer of application of die spacer to achieve ideal precementation space for proper cementation and fit of complete crown restoration, it also shows the correlation between commercially available die spacer, number layers applied and their effect on precementation space.

So in this study i compared Picofit and DFS die spacer which are most widely used commercially available die spacer also compared different layers of die spacer and it is found that to achieve ideal precementation space two layer of both the die spacers are required and are our market products are giving desirable thickness to achieve ideal precementation space.

KEYWORDS

Die spacer, precementation space, fit of fixed restoration , layers of die spacer.

II INTRODUCTION:

Todays era is of digital dentistry, still majority of practitioners are not able to give it to every patient because of the unavailability of the instruments , cost factor and many other factors . so it comes to the traditional treatment.

For the success of fixed restoration every step is equally important but the most neglected and important step is precementation space for proper cementation and fitting of restoration which is laboratory step.

Fixed dental prosthesis or Crown and Bridge is very widely accepted treatment modality by the patient over removable dental prosthesis because of it has less post-insertion problems and esthetically acceptable results. In recent years, the implant supported prosthesis is much supported and the best option for replacement of missing teeth. However there are some factors like bone quality and quantity, systemic factors, technical facilities and cost of treatment, which prevail us to opt for crown and Bridge therapy.[1]

Kasloff said that: to fulfill the requirement of ideal restoration casting must be made to fit prepared tooth intimately.[1] but the excess cement creates premature contact, alteration of contact area of adjacent tooth, discrepancy of marginal fit of crown which ultimately leads to failure of crown. So to relive this hydrolic pressure venting and internal relief of casting is done.

Internal relief can be achieved by aqua regia eaching of casting, electrochemical milling , mechanical grinding of intaglio surface of casting, carving of wax pattern, die spacing[2,3,4,5,6,7]

Among all the above method, die spacing is most preferred method because of following advantage:-

1. It is a simple technique for obtaining internal relief.
2. When it is used properly, it will gives accurate and uniform cement space.
3. It can be followed for metal ceramic restoration also.[8]

The American dental association specification no.8 has established a maximum film thickness of 25um for a luting cement.[9,10] Pre-cementation space less than this value have been shown to result in incomplete seating of restoration or decrease in retention which leads to the failure of fixed restoration.

Hence this study is planned to evaluate the ideal number of layers of application of die spacer for proper cementation and fit of complete crown restoration, it also shows the co-relation between commercially available die spacer, number of layers applied and their effect on precementation space.

There are several studies which provide the data on precementation space or cement thickness for varying layers of die spacers but very limited data is available which shows correlation between commercially available die spacers, number of layers applied and their effect on precementation space.

III. MATERIAL AND METHOD:

Material : For obtaining master model:

- Nickel chromium alloy, Bellbond plus,: Bego, Bremen, Germany

For making impression:

- Addition silicone, Aquasil soft putty (Regular set): Dentsply De Tray GmbH, Konstanz, Germany
- Addition silicone, Aquasil ultra light viscosity material: Dentsply DeTray GmbH, Konstanz, Germany

For obtaining the dies:

- Surfactant liquid, Debubbalizer: Prime dental products pvt. Ltd., Kalher Dist. Thane, India
- Vacuum mixer, Vacustir, Puneet Industries, Mumbai, India
- Type IV gypsum product, ultrarock : made in India

For fabrication of metal copings:

- Die hardener: Renfert GmbH, Hilzingen, Germany
- Die spacer, Pico fit: Renfert GmbH, Hilzingen, Germany
- Die spacer, Durolan : Durolan Riedenburg, Germany
- Die lubricant, Picosep: Renfert GmbH, Hilzingen, Germany
- Casting wax, Crowax: Renfert GmbH, Hilzingen, Germany
- Spruing wax, Sigmadent, S K Industries, Mumbai
- Investment powder, Bellavest SH,: Bego, Bremen, Germany
- Investment liquid, Begosol,: Bego, Bremen, Germany
- Burnout furnace, EWL Type 5640: KaVo dental, North Carolina, USA
- Nickel chromium alloy, Bellbond plus,: Bego, Bremen, Germany
- Induction casting machine, LC- Cast: VOP dental equipment manufacturing, Botevgrad, Bulgaria

For seating of copings on the die:

- Fit indicating material, Fit Checker II: GC Corporation, Tokyo, Japan
- Universal testing machine (EPOCH, Bangalore): at Varroc

Engineering Pvt. Ltd.
- Orangewood sticks.

For sectioning fit indicting material bucco-lingually:
- Marker pen
- Scissor

For measuring thickness of fit indicating material:
- Micrometer (Mitutoyo, Tokyo, Japan):at Varroc Engineering Pvt. Ltd. Aurangabad

METHODOLOGY:

A die model made up of metal is fabricated, indicating the tooth preparation for full coverage metal ceramic restoration. Impression has been made by addition silicon putty wash technique which was then poured to make total of 80 die samples.

These samples were divided in to two groups, group A (Pico fit die spacer) and group B (DFS die spacer), to test the two types of commercially available die spacer. Each group will be again divided into four subgroups.

In first subgroup:-1 layer of die spacer was applied
In second subgroup: - 2 layer of die spacer was applied
In third subgroup: - 3 layer of die spacer was applied
In fourth subgroup: - 4 layer of die spacer was applied.

Wax pattern was fabricated, invested and casted to form metal copings on each die of total 80 die samples. Each coping was then seated on master die with fit indicating material, under a constant load.

Pre-cementation space record was then removed from copings and their thicknesses were measured at three sites: near the finish line, mid axial and mid occlusal site. Also the marginal fit of crown was evaluated with master model.

0.5 to 1 mm of axial surface of die near the finish line was not covered with die spacer. The care was taken so that strokes should not overlap each other. Likewise entire axial surface was covered. The die spacer was carefully applied on the occlusal surface. Second layer was applied after one minute of drying of applied layer of die spacer, hence not to blend with successive layer. This design was proposed by **Eames et al[4].**

As suggested by **Reiger[53]**, the bottles were shaken after every application and kept closed between applications. The brush was cleaned frequently with thinner. The same procedure was repeated for each of the remaining dies.

As suggested by **Reiger[53]**, the bottles were shaken after every application and kept closed between applications. The brush was cleaned frequently with thinner. The same procedure was repeated for each of the remaining dies.

All the measurements were compiled and data analyzed statistically.

FIGURE NO 1:Master Model

FIGURE NO2:Picofit, DFS, Fit indicating material

FIGURE NO 3: dies with die spacer material applied

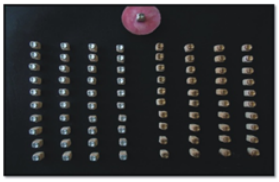


FIGURE NO 4: Dies with coping

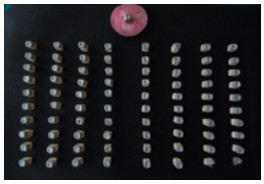


FIGURE NO 5:Universal testing

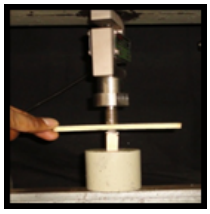


FIGURE NO7:Fit checker separated from coping Machine with constant load

FIGURE NO 8: Micrometer checking the thickness of fit checker

Table 1: Shows the mean precementation space for picofit and DFS die spacer and their standard deviation at different layers

		Group A				Group B			
		One Layer	Two Layer	Three Layer	Four Layer	One Layer	Two Layer	Three Layer	Four Layer
Finish Line	Mean	39.00	44.00	45.20	49.90	34.60	41.70	42.20	46.00
	SD	12.90	7.97	11.63	6.62	9.87	8.36	10.77	4.92
Mid Axial	Mean	53.90	73.10	91.70	96.40	52.50	68.90	87.10	100.70
	SD	9.20	10.68	5.67	7.47	10.82	11.43	13.01	9.74
Mid occlusal	Mean	95.90	110.40	115.40	118.10	93.40	101.60	118.50	121.10
	SD	14.18	13.40	5.12	2.80	9.33	10.31	7.95	3.69

Table 2: Shows the comparison of mean value of different layer in group A & group B (picofit& DFS die spacer)at Mid-axial site.

Mid Axial	Layers	Mean	SD	F-value	P-value
Group A	Layer One	53.90	9.20	52.44	P = 0.0000 S
	Layer Two	73.10	10.68		
	Layer Three	91.70	5.67		
	Layer Four	96.40	7.47		
Group B	Layer One	52.50	10.82	34.59	P = 0.000 S
	Layer Two	68.90	11.43		
	Layer Three	87.10	13.01		
	Layer Four	100.70	9.74		

Table 3: Shows the comparison of mean difference between two layers in Group A& Group B at the mid-axial site

		Mean Difference	P-value
Group A	Layer one Vs Layer Two	19.20	P=0.000 S
	Layer one Vs Layer Three	37.81	P=0.000 S
	Layer one Vs Layer Four	42.50	P=0.000 S
	Layer Two Vs Layer Three	18.60	P=0.000 S
	Layer Two Vs Layer Four	23.30	P=0.000 S
	Layer Three Vs Layer Four	4.30	P=0.606 NS
Group B	Layer one Vs Layer Two	16.40	P=0.013 S
	Layer one Vs Layer Three	34.00	P=0.000 S
	Layer one Vs Layer Four	48.00	P=0.000 S
	Layer Two Vs Layer Three	18.20	P=0.005 S
	Layer Two Vs Layer Four	31.80	P=0.000 S
	Layer Three Vs Layer Four	13.60	P=0.051 NS

Table 4: Shows comparison of the mean value between different layers in Group A& Group B at mid occlusal site

Mid Occlusal	Layers	Mean	SD	F-value	P-value
Group A	Layer One	110.40	13.40	9.43	P=0.0000 S
	Layer Two	95.90	14.18		
	Layer Three	115.40	5.12		
	Layer Four	118.10	2.80		
Group B	Layer One	101.60	10.31	26.12	P=0.000 S
	Layer Two	93.40	9.33		
	Layer Three	118.50	7.95		
	Layer Four	121.10	3.69		

Table 5: Shows the comparison of mean difference between two layers in Group A& Group B at mid occlusal site.

		Mean Difference	P-value
Group A	Layer one Vs Layer Two	14.50	P=0.015 S
	Layer one Vs Layer Three	5.00	P=0.693 NS
	Layer one Vs Layer Four	7.70	P=0.344 NS
	Layer Two Vs Layer Three	19.50	P=0.000 S
	Layer Two Vs Layer Four	22.20	P=0.000 S
	Layer Three Vs Layer Four	2.70	P=0.934 NS
Group B	Layer one Vs Layer Two	8.20	P=0.134 NS
	Layer one Vs Layer Three	16.90	P=0.000 S
	Layer one Vs Layer Four	19.50	P=0.000 S
	Layer Two Vs Layer Three	25.10	P=0.000 S
	Layer Two Vs Layer Four	27.70	P=0.000 S
	Layer Three Vs Layer Four	2.60	P=0.894 NS

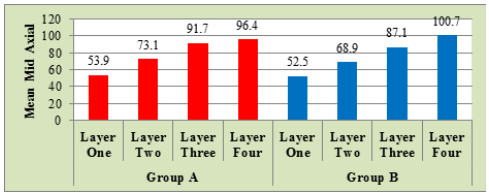
Table 6: Shows the comparison of the mean value between two groups Picofit and DFS in different layers at mid-axial site

Layer	Group	N	Mean	SD	t-value	P-value
Layer One	Group A	10	53.90	9.20	0.312	P=0.759 NS
	Group B	10	52.50	10.82		
Layer Two	Group A	10	73.10	10.68	0.849	P=0.759 NS
	Group B	10	68.90	11.43		
Layer Three	Group A	10	91.70	5.67	1.02	P=0.319 NS
	Group B	10	87.10	13.01		
LayerFour	Group A	10	96.40	7.47	1.11	P=0.283 NS
	Group B	10	100.70	9.74		

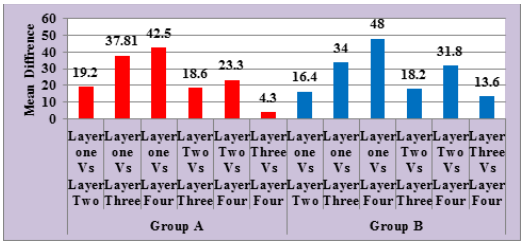
Table 7: Shows the comparison of the mean value between two groups Picofit and DFS in different layers at mid-occlusal site

Layer	Group	N	Mean	SD	t-value	P-value
Layer One	Group A	10	110.40	13.41	1.64	P=0.117 NS
	Group B	10	101.60	10.30		
Layer Two	Group A	10	95.90	14.18	0.466	P=0.647 NS
	Group B	10	93.40	9.34		
Layer Three	Group A	10	115.40	5.12	1.04	P=0.314 NS
	Group B	10	118.50	7.94		
LayerFour	Group A	10	118.10	2.80	2.04	P=0.056

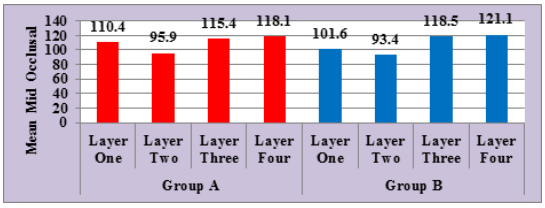
Graph No.1 : Shows the comparison of mean value of different layer in group A & group B (picofit& DFS die spacer)at Mid-axial site.



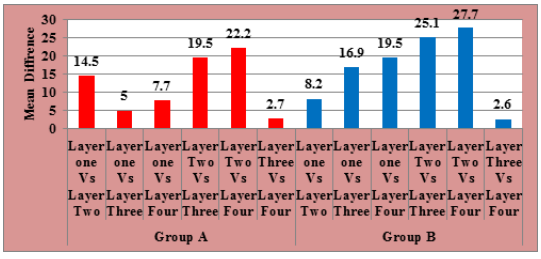
Graph No.2 :Shows the comparison of mean difference between two layers in Group A & Group B at the mid-axial site



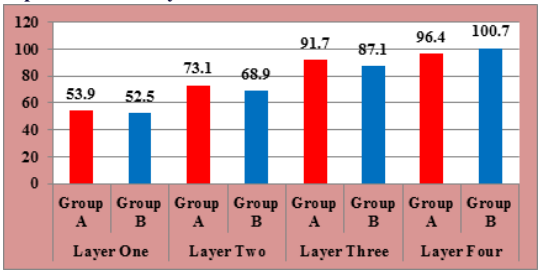
Graph No 3 Shows comparison of the mean value between different layers in Group A& Group B at mid occlusal site



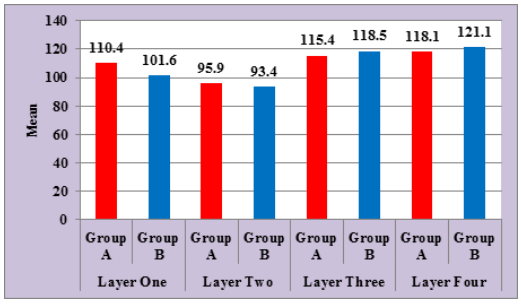
Graph No 4 Shows the comparison of mean difference between two layers in Group A& Group B at mid occlusal site.



Graph No 5 Shows the comparison of the mean value between two groups in different layers at mid-axial site



Graph No 6 Shows the comparison of the mean value between two groups in different layers at mid-occlusal site



MASTER CHART 1

Pico Fit	One Layer			Two Layer			Three Layer			Four Layer		
Sr No.	Finish Line	Mid Axial	Mid Occlusal	Finish Line	Mid Axial	Mid Occlusal	Finish Line	Mid Axial	Mid Occlusal	Finish Line	Mid Axial	Mid Occlusal
1	40	51	87	42	62	104	62	89	110	52	87	115
2	62	54	120	46	80	98	61	102	125	62	97	121
3	42	55	115	40	89	116	49	100	123	42	105	116
4	41	53	95	57	83	106	42	87	106	46	98	118
5	28	43	108	50	82	99	43	89	114	52	102	121
6	30	41	120	51	80	83	20	88	116	41	89	116

7	27	58	131	39	64	88	45	88	121	51	92	118
8	28	48	98	32	62	65	42	86	120	46	86	121
9	32	65	116	49	68	102	46	92	122	49	102	105
10	60	71	114	34	61	98	42	96	116	58	106	122

MASTER CHART 2

Pico Fit	One Layer			Two Layer			Three Layer			Four Layer		
Sr No.	Finish Line	Mid Axial	Mid Occlusal	Finish Line	Mid Axial	Mid Occlusal	Finish Line	Mid Axial	Mid Occlusal	Finish Line	Mid Axial	Mid Occlusal
1	38	55	90	43	59	88	45	68	115	41	89	118
2	30	46	113	49	82	104	63	108	119	46	91	121
3	41	51	91	47	86	87	52	104	99	42	98	119
4	48	59	104	55	77	100	40	91	139	48	105	125
5	23	38	87	43	69	103	43	87	118	39	121	129
6	27	44	116	48	80	98	36	88	140	43	91	116
7	39	50	109	36	60	83	40	75	116	51	101	121
8	30	43	97	31	58	76	21	71	123	49	99	139
9	21	71	110	35	63	97	43	88	121	55	102	117
10	49	68	99	30	55	98	39	91	139	46	110	127

IV. DISCUSSION :

The following statistical analysis were performed in this study-

- Mean
- Standard deviation
- ANOVA
- Tukay's Post hoc test
- Student t test
- Results of the present study were compiled and mean and standard deviations were calculated. The mean precementation space achieved for one, two, three and four layers of both Pico-fit and DFS die spacers as shown in Table no. I in the present study are in agreement with precementation space achieved for one, two and three layers of die spacer at the same three locations measured by **EmtiazS.**[13]
- The mean precementation spaces for one layer of both die spacers for the three locations as shown in Table No. I are comparable to cement thickness achieved when manicure liquid was used for internal relief by **Fusayama**[14]**.**
-

Results of midocclusal measurements show that four layers of die spacer created a mean precementation space 118u – 121u which coincided with results by **Valderrama**[15], who also found cement thickness at the midocclusal area to range from 86 µ to 134 µ. **Fusayama**[14] measured cement thickness under complete coverage restorations and found film thickness exhibiting more than 90 µ on the occlusal surfaces. Similarly, Carter[16] found the midocclusal precementation space greater than the midaxial precementation space. One explanation for the larger values obtained with occlusal measurements as compared to axial values, is that the inner relief did not allow sufficient slipping of the crowns toward cervical, improving only the adaptation in the lateral walls[17].

As suggested by **Fusayama**[14], cement thickness under castings was generally greater than the original space thickness. Cement film thickness may be greater than the maximum film thickness specified for cement and even more on occlusal area compared to axial areas.

The range of 34.60u-49.90u near finish line is consistent with mean measurements reported by White. **Grajower**[18] **et al** reported that an average cement thickness of 36µ near finish line. This range of 34.60u-49.90µ precementation spaces near finish line indicates, copings were not completely seated on the die or prepared tooth, as die spacer was not applied near the finish line.

Fusayama[14] **and Van Nortwick**[19] supported this finding seeing that, increasing marginal opening of a crown will invariably occur with introduction of a luting agent regardless of the relief method used.

The first hypothesis proposed was there is no difference between the precementation space achieved with one, two and three layers of die spacers both in vitro and in vivo.

At the 95% confidence interval, the 'P' values for ANOVA tests 1-4 as shown in Table No. 2-5 was less than 0.001. This analysis revealed that results were statistically significant. Similar results were reported by **EmtiazS**[13]**.**

This suggests that precementation space achieved with one layer, two layers three and four layers of die spacers differed from each others. This finding is supported by many researchers[9,12,18]. These authors mentioned that thickness of the spacers varied depending on the location on the die surface and the number of layers of the spacer[9,12].

Groups for Mid-axial measurements for both Pico-fit and DFS die spacers when compared, it was observed that there was a statistically no significant difference between layer three and layer four of both die spacers and rest of all shows statistically significant difference in all the subgroups.

Groups for Mid-occlusal measurements for Pico-fit die spacers when compared, it was observed that there was no statistically significant difference between the group with one layer and group with three layers and also between group with one layer and group with four layers, also there is no statistically significant difference between group with three layer and group with four layer. But there was a statistically significant difference between group with one layers and group with two layers, also group with two layer and group with three layer, also group with two layer and group with four layer

Groups for Mid-occlusal measurements for DFS die spacers when compared, it was observed that there was no statistically significant difference between the group with one layer and group with two layers and also between group with three layer and group with four layers. But there was a statistically significant difference between group with one layer and group with one layer and group with three layers, also group with one layer and group with four layer, also group with two layers and group with three layers, also group with two layers and group with four layers.

Differences in results for mid-occlusal groups as compared to mid-axial groups can be explained on the basis of findings of **Grajower**[18]. He suggested that when no spacer is used or at low spacer thicknesses, seating of the crown is arrested at the axial walls. With increasing spacer thickness, the elevation decreases until a certain spacer thickness value, seating of the crown becomes arrested at the shoulder margin.

Castings were elevated an additional 20 µ or more following cementation[4]. Passon[20] assumed that with complete coping seating, the cement should be uniformly distributed to a thickness equal to the die spacer thickness plus the thickness caused by the cement film thickness at the unrelieved margin. Cement thickness under castings was generally greater than the original space thickness[14]. The increase was slight when the original space was greater than 30 µ. The thickness, however, was markedly increased when the original space thickness was less than 30 µ[21].

The second hypothesis was proposed that there is no difference between the precementation space achieved with two die spacers i.e. between the Pico-fit and DFS die spacers.

To compare the groups with Pico-fit die spacer and DFS die spacer, student's or unpaired t-test was applied to test the significance of

difference between the mean values. Results are shown in Table no. 6 and 7. There was no statistically significant difference between the compared groups for the two die spacers.

Results suggest that, for one, two, three and four layers of Pico-fit die spacer provides precementation space equivalent to precementation space for one, two three and four layers of DFS die spacer for the mid-axial and mid-occlusal locations.

This can be explained as die spacer application technique, wax pattern fabrication, casting procedure, method of seating, material used for seating and precementation space measurement, all steps were similar for both the die spacers compared.

Review of literature suggests that no study was carried out to compare the Pico-fit and DFS die spacers.

For clinical trial two layers of die spacers found to be more valuable, however long term study with more laboratory and clinical material is recommended so as to arrive at definitive decision. If it is proved fruitful then this study can be utilized as blanket therapy and which can be boon to the profession.

CLINICAL IMPLICATIONS:

The eventual aim of cementation of indirect restoration is complete seating and perfect marginal seal. Though at present, complete seating and perfect marginal seal is seldom achieved clinically; what can be expected is marginal opening should result within the clinically acceptable range[22,4,17].

Within the limitations of the study:

1] Two layers of either die spacers, resulted in lesser mid-occlusal precementation space as compared to one and three layers, signifying greater seating of copings. Thus the application of two layers of Pico-fit or DFS die spacer is advisable.

2] When comparison is made between two commercially available die spacers i.e. picofit and DFS die spacers, it is found that there is no statistically significant difference between die spacers.

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