IJRAR.ORG E-ISSN: 2348-1269, P-ISSN: 2349-5138

INTERNATIONAL JOURNAL OF RESEARCH AND ANALYTICAL REVIEWS (IJRAR) | IJRAR.ORG

An International Open Access, Peer-reviewed, Refereed Journal

EFFECT OF DIFFERENT BORDER MOLDING MATERIAL AND TECHNIQUES ON RETENTION OF COMPLETE DENTURE PROSTHESIS: A SYSTEMATIC REVIEW

[1]Namrata Bhadwal, [2]Anju Aggarwal, [3]Punit R.S. Khurana

[1]PG Student, [2]Professor, [3]Professor and Head of the department

[1]Department of prosthodontics, crown and bridge, maxillofacial prosthodontics and oral implantology,

[1]ITS dental college, hospital and research center, Greater Noida, UP.

Abstract: This study has been undertaken to assess the effect of different border molding material and techniques on retention of complete denture prosthesis. A systematic search in the National Library of Medicine's PubMed Database, Google Scholar, Scielo, Medline, Wiley, Cochrane Central Register of Controlled Trials, Science Direct and ProQuest was performed to identify all peer-reviewed articles using a specific search strategy. From a total of 39 records, 11 studies were included in the review, based on specific selection criteria. It was concluded from the present review that subjects treated using single-step border molding could be a viable and advantageous alternative to conventional border molding and can be accomplished using injectable heavy viscosity addition silicone. The choice of a particular border molding technique should be based on clinical indications, operator skill, and convenience.

IndexTerms **– Border molding, complete denture, retention, green stick**

I. INTRODUCTION

The fabrication of conventional complete denture is an indirect prosthetic process.[1] The various factors responsible for the retention of complete dentures may be broadly grouped as biological, physical and mechanical.[2] The biologic factors are the size and quality of the denture bearing area. The physical factors that arbitrate the retention of a complete denture are adhesion, cohesion, salivary film thickness, surface tension, and atmospheric pressure.[3] The greater the surface tension and thinner the fluid film, the greater will be the retention. The mechanical factors include presence of undercuts and denture adhesives.

These factors of retention can be achieved by means of an accurate border molding followed by an accurate final impression.[4] Border molding promotes the development of border seal which is necessary for the maintenance of contact of the denture border with the adjacent vestibular tissues during rest as well as in functional activity and aids in providing retention.[5] This will form peripheral seal around the denture margins and prevent ingress of air thus improving the retention.

Impression modeling plastic has been used for border molding impression trays since 1907 but it has certain limitations. The introduction of elastomeric impression materials has several advantages like simplicity, ease of manipulation, decreased discomfort to the patient, short chair time and accurate reproduction of undercut areas, acceptable tear strength and sufficient elasticity.[1]

Comparison of various materials such as impression compound, green stick, tissue conditioner, polyether, putty PVS, heavy viscosity PVS, and monophase PVS for accuracy of border molding were considered for research. Furthermore, a comparison of retention of mandibular denture bases fabricated with sectional and single-step border molding was also considered.

The aim of this systematic review was to synthesize scientific data related to border molding techniques and materials in completely edentulous patients.

II. METHODOLOGY

A systematic search in the National Library of Medicine's PubMed Database, Google Scholar, Scielo and ProQuest was performed to identify all peer-reviewed articles in the English literature dealing with the border molding techniques and materials according to the search strategy described in the following sections. The studies which were included for review were assessed independently by the 2 authors on the basis of a structured reading of articles approach.

Search strategy and literature selection

A search with Medical Subjects Headings (MeSH) terms was first used, and the following terms were used to identify a list of potential articles to be included in the review: -

"Border molding, complete denture retention, retention, green-stick compound, poly-ether, low-fusing compound"

The search was limited to articles on adult populations (+18 years) in the English language.

PICO criteria

(**P**) Patients: Adult completely edentulous patients who are in need for complete denture prosthesis.

(**I**) Intervention: Complete denture prosthesis for the patients with missing teeth in upper and lower arches using different border molding techniques and materials.

(**C**) Comparison: Different materials and techniques used for border molding and final impression.

(**O**) Outcomes: The effect of different materials and techniques on the retention of the complete denture prosthesis.

(**S**) Study design: Clinical human studies, including controlled trials, controlled clinical trials and case series with the aim of comparing the materials and techniques that provide the best retention for the complete denture prosthesis.

TABLE 1: INCLUSION AND EXCLUSION CRITERIA

INCLUSION CRITERIA	EXCLUSION CRITERIA
Studies including patients of all age group requiring the complete denture prosthesis.	Studies published in languages other than English.
Studies published in English	Studies that do not compare the effect on retention of the complete denture prosthesis.
Studies including techniques and materials for border molding	

Effect Of Different Border Molding Material And Techniques On Retention Of Complete Denture Prosthesis: A Systematic Review

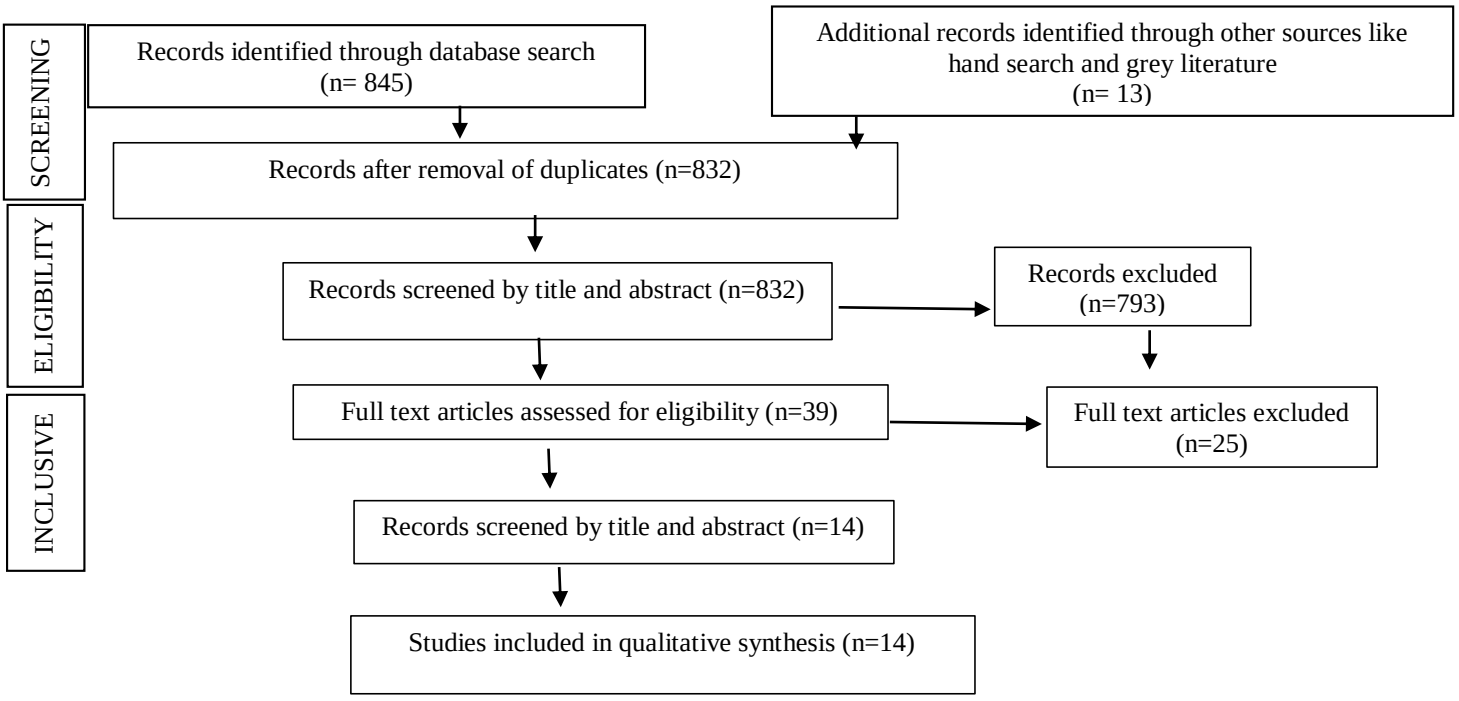
Data collection

Data were collected from studies that explained the materials and techniques that provide the best retention for the complete denture prosthesis.

Study selection

For article selection or first approach, two researchers independently selected potentially eligible articles by title and abstract. Articles that met PICO and exclusion criteria are included in the review for the final analysis. The articles which compared the retention among the maxillary denture bases were selected.

III. RESULTS



PRISMA FLOWCHART (Figure 1)

Author	Duration	Measuring device	Control or comparison	Outcome	Conclusion
Renu Gupta (2015)	20	Metallic stand and a digital force gauge	Sectional/incremental method with low fusing compound (green stick) Final impression with Zinc oxide eugenol paste. The single-stage/simultaneous border molding with heavy bodied addition silicone (putty) Final impression using light bodied polyvinyl silloxane.	The mean force required to dislodge the upper trial dentures bases was 1497.9gms for green stick compound and metallic oxide wash and 1946.317 gms for putty and light body rubber base wash. Putty and light body rubber base showed the higher mean value. However, on clinical evaluation the retention received by both the denture bases was acceptable.	Heavy bodied polyvinylsiloxane and simultaneous border molding technique was better as compared to conventional technique, using low fusing impression compound and sectional border molding.
J.R Patel (2010)	30	Stereomicroscope	Low fusing impression compound, putty addition silicon and pattern resin.	Mean border values obtained with all the three border molding materials (putty silicone: 22.774 sqmm, low fusing impression compound: 20.5007sqmm and pattern resin: 14.1266 sqmm.) were significantly different compared to that of the control (tissue conditioner: 11.5380 sqmm) (p=0.000). However, the means show that the border area recorded using pattern resin is closest in dimension to that obtained using tissue conditioner.	pattern resin may be used as a border molding material next to tissue conditioner.
Vinay Kumar K (2019)	7	Digital force meter	single step border molding techniques and sectional border molding technique.	The denture bases formulated by sectional border molding technique has more retention as compared to single step technique.	Sectional border molding is more efficient.
Tameem Khuder Jassim (2020)	10	Digital force gauge	Addition vinyl silicone for single-step border molding, followed by light-body final-wash impression. The green stick compound for sectional border molding, followed by a final wash using a zinc oxide eugenol impression material.	retention values for with addition vinyl silicon impression border molding material with a light-body final impression were significantly greater than those with green stick impression compound material for border molding with a zinc oxide-eugenol final impression.	Addition vinyl silicone material with a light-body final impression material and the single-step technique resulted in superior retention in the acrylic denture base over the denture base formed with the use of the green stick and zinc-oxide eugenol as the final impression material using the sectional technique

Kheur M (2015)		Three experienced prosthodontists evaluated the border molding based on tissue contact, tissue displacement, bond to the tray and overall peripheral seal.	1) Low fusing Impression Compound Type I b, 2) Heavy bodied Elastomeric Material: Polyvinyl Siloxane and 3) Modified Zinc Oxide Eugenol Impression Paste.	Heavy Bodied Elastomeric Material- Polyvinyl siloxane has the best efficiency, while Low fusing Impression Compound Type I a had the least efficiency amongst the three when used for the purpose of border molding	Heavy Bodied Elastomeric Material- Polyvinyl siloxane proved to be most efficient amongst the three when used for the purpose of border molding.
Simrat Kaur (2016)	20	Weights were placed on the plate till the denture base dislodged.	Group 1: without border molding Group 2: with border molding	Mean force with border molding (2765.0 g) was larger than mean force without border molding (1805.0 g) at $P < 0.01$ level. In terms of percentage, too, the mean improvement (59.4%) in force of dislodgement was statistically highly significant (i.e. $P < 0.01$).	dentures made with border molding will provide better retentive force than the dentures made without border molding.
Anchal Qanungo (2016)	10	Digital force meter	single-step (Group 1) and sectional (Group 2)	The retention obtained in Group 2 (mean = 9.05 kgf) was significantly higher than that of Group 1 (mean = 8.26 kgf).	Sectional border molding technique proved to be more retentive as compared to single-step border molding
Aman Kumar Arora (2014)	15	Stereomicroscope	Tissue conditioner which was loaded on the borders of previous maxillary denture of the patient (control group), low fusing impression compound (Group 1), polyether (Group 2), Pattern resin (Group 3) and Peripheral wax (Group 4)	The mean width of the sulcus in Group 2 (14.132 ± 2.47 mm) was closest to the control group (14.335 ± 3.28 mm), Group 1 (17.638 ± 2.47 mm) was the farthest. The mean height of the sulcus in Group 2 (14.702±1.997mm) was closest to the control group (15.076 ± 1.039 mm) whereas Group 1 (13.651 ± 2.846 mm) was the farthest. The mean area of the sulcus in Group 2 (211.452±55.205mm) was closest to control group (216.582 ± 53.833 mm2) whereas Group 4 (303.823 ± 86.531 mm2) was farthest.	polyether was the best material for border molding which will give most accurate borders to a denture

Hikmat J. Al-Judy (2015)	15	Stereomicroscope	First two trays were fully border molded using green stick compound. The third and fourth trays were fully border molded using the putty type silicone. The fifth and sixth trays, labial flanges molded using green stick compound while the buccal and posterior palatal seal area molded using putty type silicone. The seventh and eighth the labial flanges molded using putty type silicone compound while the buccal and posterior palatal seal area were molded using the green stick. Final impressions made using metallic oxide in the first tray and light body silicon in the second try.	higher mean of retention forces were found in the denture bases were fabricated by using the full putty silicone border molding ccombined with light body silicone final impression, then follow by the denture bases were fabricated from anterior green stick tracing and posterior putty silicone border molding with light body silicone and metallic oxide final impression material, while the least retention forces of denture bases was indicated in the denture bases were fabricated from full green stick tracing and metallic oxide impression materials and in posterior tracing using green stick material a combined to metallic oxide and light body silicone final impression material.	Denture bases produced by full putty silicone and posterior putty silicone tracing material and light body silicone final impression materials showed the highest mean values of retention forces.
Anshu Garg (2020)	15	A digital force gauge (Precise Model SF 500)	Group 1: Border molding done using green stick compound. Group 2: Border molding done using putty addition silicone. Definitive impression was made with medium body polyether in both groups. Group 3: Impression made using polyether impression material in single step. Definitive impression with medium body polyether was made.	Insignificant difference in retention between group 1 and group 2 (p = 0.7185) and significant difference in retention values of group 1and group 3 (p = 0.0005) and group 2 and group 3 (0.0062)	Two step impression technique is more retentive as compared to one step impression technique.
Renu B Pachar (2018)	10	A digital force gauge	In group I, border molding done with green stick impression compound. In group II, border molding done with putty consistency addition silicone. In group III, border molding and final impression done by polyether	In group I, the overall mean value was 4.59 ± 0.81, in group II, it was 4.7 ± 0.81, and in group III, it was 6.72 ± 0.81.	Green stick compound with light body final wash showed the lowest mean values of complete denture retention. Dentures made using polyether final impression material showed the highest mean values of complete denture

			impression material in a single step.		retention followed by putty rubber base border molding with light body final wash.
Silvia Pridana (2019)	10	Push and pull gauge	Procedure done with either heavy body or putty polyvinylsiloxane material with fuctional or manual technique.	The statistical significance of retention value and morphologic detail of pheriferal tissue was tested with univarian dan unpaired T test. Mean value at morphologic detail of pheriferal tissue with heavy body polyvinylsiloxane is smaller than with putty polyvinylsiloxane. Higher mean value of retention at putty with functional technique is (48,00 + 6.65) N.	Putty polyvinylsiloxane with functional technique can be recommended for border molding procedure.
Rameshbabu Yarapatineni (2013)	7	Weights were loaded to the pan gradually and the weight at which the custom tray got dislodged was recorded.	sectional border molding (Group I) (custom impression trays border molded with green stick compound) and single step border molding (Group II) (border molding with condensation silicone (putty) impression material)	compared at three stages 1) Border molding (test-A), 2) impression (test B), and denture base (test-C) Group II was significantly higher (mean=8011.43) than Group I (mean=5777.43) in test-A. Group I was significantly higher (mean=6718.57) than Group II (mean=5224.29) in test -B. Group II was higher (mean=4025.14) than Group I (mean=3835.07) in test -C.	Border molding custom tray with low fusing green stick compound provided similar retention as compared to custom impression tray with condensation silicone in permanent denture base.
Amr A Rady (2017)	12	Digital force meter	(Sectional border moulding of a special tray with low fusing compound and final wash with medium bodied silicone material, sectional border tracing of a special tray with putty elastomeric impression material followed by a final wash with medium bodied silicone material and third impression with special tray without border moulding.	The means of time for border moulding materials were 2.31 minutes for putty rubber base and 5.39 minutes for low fusing compound. means for of impression techniques were 63.65 for border moulding with low fusing compound with final wash of medium bodied silicone material, 62.125 for border moulding with putty silicone material with final wash of medium bodied silicone material and 62.975	Medium body silicone material in special tray without border moulding yielded highly retentive impression comparable to those with different border tracing materials.

				for direct impression with medium bodied silicone material without border moulding.	

Results of the search are indicated in the PRISMA flow chart (Figure 1). Eight hundred and forty-five records were generated. A total of 13 duplicate records were removed, leaving 832 records which were assessed for eligibility. After reading titles and abstracts, a further 793 records were excluded. Full texts of the remaining 39 records were retrieved. A total of 14 articles were used for this review. There were no deviations from the protocol during the search.

III. DISCUSSION

Boucher laid out 5 primary objectives of complete denture impressions: retention; stability; support; esthetic value; and the preservation of the alveolar ridge. The retention may be influenced by various physical factors, including the denture and the mucosa adhesion, saliva cohesion, salivary consistency, and salivary flow. Furthermore, the type of impression material used and the selected border molding technique both highly impact the retention force of a complete denture.

Study conducted by Kaur et al[9] suggests that the mean force of dislodgement with border molding (2765.0 g) was larger than mean force without border molding (1805.0 g) which was measured by trying to dislodge the denture using weights.

This systematic review was developed to answer the question: "In the edentulous adult patients, what would be the effect of different border molding material and technique on the retention of complete denture prosthesis?" Following the search strategy, various studies were included in an attempt to answer the question. The studies showed high levels of heterogeneity in terms of study design, sample (size, gender), type of material, technique, instrument used to measure.

There are two techniques documented in literature, the sectional and the single-step border molding. Kheur M et al. in their study to compare the effectiveness of three materials for the purpose of one step border molding concluded that Polyvinyl siloxane has the best efficiency, whereas Low fusing Impression Compound Type I a had the least efficiency when used for the purpose of border molding. [6]

Yarapatineni (2013), Qanungo (2016) and K. Kumar V (2019) conducted studies wherein the efficacy of sectional and single-step border molding techniques using various materials on the retention of maxillary complete denture was evaluated. A digital force meter was used to record the retention of the denture base. [16,10,2]

From the results of the above-mentioned studies, it was concluded that both the techniques of border molding discussed offer satisfactory retention, however, sectional border molding was more efficient with respect to the retention. Clinically the retention appeared comparable as it was tested among maxillary dentures providing large surface area leading to better retention.

Various different materials have been tried for border molding in the past. Bolouri[18] described the technique of border molding using wax and self-cure acrylic resin. Jones and Sobieralski[19] reported an alternative technique of border molding using acrylic resin to conventional border molding using green stick compound. Kirk and Holt[20] described one-step border molding technique using perio-pack. Allen and Worrollo[21] demonstrated a technique for border molding with a green stick compound heated in the microwave oven. Chaffee et al. [22] described a technique for border molding edentulous impressions using vinyl polysiloxane material. Olivieri et al.[23] described a technique for border molding using light polymerized resin. Solomon[24] studied the single stage silicone border molded closed mouth impression technique.

They concluded that using addition vinyl silicone material together with a light-body final impression material along with the single-step technique resulted in a superior retention in the acrylic denture base over the denture base that was formed with the use of the green stick and zinc-oxide eugenol as the final impression material using the sectional technique.

These findings indicate that there is a strong advantage in changing to the new technique which uses addition vinyl silicon for border molding, followed by a light-body material for the final impressions employing the single-step technique.

IV. CONCLUSION

The history of complete denture impression procedures has been largely influenced by the development of new impression materials and techniques. There are various researches for achieving an optimum impression in different ways by different researchers. The problem of retention still plays a main challenging role in mandibular complete denture construction. The present systematic review covered articles published over the past decade which compare the retention using maxillary denture bases, and the following suggestions can be drawn:

- The dentures made with border molding will provide better retentive force than the dentures made without border molding.
- Sectional border molding technique proved to be more retentive as compared to single-step border molding
- The denture bases made using medium body rubber base for border molding and light body final wash impression making showed the highest mean values of mandibular complete denture retention followed by heavy body rubber base and light body final wash.
- Elastomers are considered famous among dentists, but the only limitation is the smell of PVS material, staining, and unstable manipulation time of polyether. Overextended and thick borders obtained by PVS are other drawbacks.

- One step border molding is a viable and advantageous alternative to conventional border molding (sectional border molding) as it results in reduction of chairside time, less discomfort for the patient and less efforts for the dentist.
- Heavy Bodied Elastomeric Material- Polyvinyl siloxane proved to be most efficient when used for the purpose of one step border molding.

It can be concluded from the present review that subjects treated using single-step border molding could be a viable and advantageous alternative to conventional border molding and can be accomplished using injectable heavy viscosity addition silicone. The choice of a particular border molding technique should be based on clinical indications, operator skill, and convenience.

V. ACKNOWLEDGMENT

I would like to thank everyone who contributed to this review.

REFERENCES

1. Gupta, Renu et al. "comparative analysis of two border molding techniques and materials on maxillary complete denture retention- an in-vivo study." (2015).
2. K. Kumar V, LN Akshatha, Chandrasekhar L, Topajiche SS, H G Suhas. Comparative Analysis of two Border Molding Techniques and Materials on Maxillary Complete Denture Retention. J Adv Med Dent Scie Res 2019;7(6): 10-13.
3. Chalapathi Kumar VH, Surapaneni H, Ravikiran V, Chandra BS, Balusu S, Reddy VN. Retention of denture bases fabricated by three different processing techniques - An in vivo study. J Int Soc Prev Community Dent. 2016 May-Jun;6(3):245-50.
4. Skinner EW, Campbell RL, Chung P. A clinical study of the forces required to dislodge maxillary denture bases of various designs. J Am Dent Assoc. 1953;47:671–80.
5. Solomon EGR. Functional impression technique for complete denture construction with silicone elastomer. J Indian Dent Assoc 1973;45:29
6. Kheur Patel JR, Sethuraman R, Chaudhari J. Comparative evaluation of border morphology produced by three different border molding materials. Int J Contemp Dent 2010; 1:82- 8.
7. Jassim TK, Kareem AE, Alloaibi MA. In vivo evaluation of the impact of various border molding materials and techniques on the retention of complete maxillary dentures. Dent Med Probl. 2020;57(2):191–196.
8. Kheur, M. et al. "A comparative evaluation of three different techniques for single step border molding." (2015).
9. Kaur S, Datta K, Gupta SK, Suman N. Comparative analysis of the retention of maxillary denture base with and without border molding using zinc oxide eugenol impression paste. Indian J Dent. 2016 Jan-Mar;7(1):1-5.
10. Qanungo, A., Aras, M. A., Chitre, V., Coutinho, I., Rajagopal, P., & Mysore, A. (2016). Comparative evaluation of border molding using two different techniques in maxillary edentulous arches: A clinical study. *Journal of Indian Prosthodontic Society*, *16*(4), 340–345.
11. Arora AK, Goyal I, Sehgal M. Comparative evaluation of reproducibility of peripheral tissues produced by different border molding materials in edentulous patients: An in vivo study. J Indian Prosthodont Soc. 2015 Apr-Jun;15(2):102
12. Al-Judy, Hikmat. (2015). Comparison of the effect of sectional border molding using different molding and final impression materials on the retention of maxillary complete denture bases.
13. Anshu Garg., et al. "To Evaluate Maxillary Permanent Denture Base Retention with Two Step and Single Step Impression Technique Using Polyether Impression Material: An In Vivo Study". EC Dental Science 19.4 (2020): 123-132.
14. Pachar RB, Singla Y, Kumar P. Evaluation and Comparison of the Effect of Different Border Molding Materials on Complete Denture Retention: An in vivo Study. J Contemp Dent Pract 2018;19(8):982-987.
15. Pridana S, Nasution I D, Nasution I, Ritonga P W U, Effect of border molding materials and techniques on peripheral tissue morphology and retention of denture bases in edentulous patients at RSGM USU. Int J Oral Health Dent 2019;5(1):14-19
16. Yarapatineni R, Vilekar A, Kumar JP, Kumar GA, Aravind P, Kumar PA. Comparative evaluation of border molding, using two different techniques in maxillary edentulous arches - An in vivo study. J Int Oral Health. 2013 Dec;5(6):82-7. Epub 2013 Dec 26.
17. Rady, A., El Naby, N. THE INFLUENCE OF BORDER MOLDING ON RETENTION AND TIME OF COMPLETE DENTURE IMPRESSION. Egyptian Dental Journal, 2017; 63(Issue 3 - July (Fixed Prosthodontics, Dental Materials, Conservative Dentistry & Endodontics)): 2863-2869.
18. Bolouri A. The use of wax and self-curing acrylic resin in border molding. J Prosthet Dent 1977;37:89-91.
19. Jones JD, Sobieralski J. An alternative approach to conventional border molding. J Prosthet Dent 1985;53:745-6.
20. Kirk GA, Holt JE. One-step border molding. J Prosthet Dent 1985;53:598-9.
21. Allen P, Worrollo S. Border molding with composition heated in a microwave oven. J Prosthet Dent 1991;65:325.
22. Chaffee NR, Cooper LF, Felton DA. A technique for border molding edentulous impressions using vinyl polysiloxane material. J Prosthodont 1999;8:129-34.
23. Olivieri A, Zuccari AG, Olivieri D. A technique for border molding with light-polymerized resin. J Prosthet Dent 2003;90:101.
24. Solomon EG. Single stage silicone border molded closed mouth impression Technique-part II. J Indian Prosthodont Soc 2011;11:183-8.