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Research Article

The Evaluation and Comparison of Removable Dentures Constructed with The SR-IVOCAP System and The Traditional System.

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Abstract: The treatment of edentulous patients is still a challenging problem. Acrylic resin is the most used material for constructing removable denture bases. The main disadvantage of this material is resin shrinkage, which occurs during and after polymerization. Our study aimed to evaluate the denture parameters regarding patient satisfaction regarding the removable dentures constructed with two different processing techniques: compression molding and injection. 80 patients, who came in the University Dental Clinic, Tirana were examined and evaluated. Those who fulfilled the criteria were treated with removable dentures. The patients were divided into two groups: in the first group, 40 patients were treated with removable dentures constructed with the compression molding technique, and in the second group, 40 patients were treated with removable dentures constructed with the injection molding technique. All the clinical and laboratory procedures until the processing technique were identical. After denture delivery, all the patients were re-scheduled to fulfill a questionnaire regarding four parameters of the removable dentures: denture stability, mastication efficiency, denture comfort, and quality of dentures in general. Results. The descriptive statistics of the data were done. Sample t-test showed that the SR IVOCAP dentures had higher mean values for all the parameters than the traditional dentures. Based on our study, the satisfaction of the patients treated with removable dentures with the SR-IVOCAP system for all the parameters evaluated was higher compared to the patient satisfaction treated with traditional removable dentures.

Keywords: SR IVOCAP Dentures, Compression, Molding, Injection, Patient Satisfaction.

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1. INTRODUCTION

Removable dentures are still an important option for treatment although the high development of implant-prosthetic restorations. The proper rehabilitation of edentulous patients is important to restore proper function, speech, and aesthetics. It has been proven that patients' satisfaction is closely related to the quality of life, thus making the quality of the removable denture much more important, which restores the loss functions. Polymethyl methacrylate (PMMA) is the most used material for constructing removable denture bases. It has several advantages, such as easy manipulation, adequate mechanical properties, and low cost. One of the main disadvantages of this material is the dimensional change, which occurs during and after the polymerization process, in the range of 0.45-0.9 %. [1-3] The denture base should fit precisely to achieve optimal stability. Resin shrinkage during the compression molding and processing technique influences denture stability and retention by directly reducing patient satisfaction and, as a result, the patient's quality of life. The compression molding and processing technique was introduced 80 years ago.[4] Different techniques and materials have been used to overcome the resin shrinkage.[5,6] Pryor introduced the injection molding technique to increase the dimensional stability of the removable dentures.[7] The Ivoclar Company tried 1970 a resin injection molding technique. From then and now, different companies have introduced their systems. Different in vitro studies have compared the polymerized specimens' properties with two different techniques. However, there needs to be more research regarding the processing and polymerization technique of removable dentures on the patient satisfaction term. Only some clinical studies are available regarding comparing dentures constructed with the two techniques. They evaluate parameters such as retention and stability. The study aimed to construct the removable dentures using conventional flasking and polymerization methods and the SR-Ivocap method. The purpose was to determine and compare the patient's satisfaction regarding the parameters of the removable dentures, such as the stability, mastication efficiency, denture comfort constructed with both methods and the patient's satisfaction regarding the general quality of dentures.

2. MATERIALS AND METHODS

80 patients aged 40-80 came to the University Dental Clinic, Tirana, Albania, and were treated with removable dentures. Inclusion criteria were: edentulous patients, adequate oral hygiene**,** cooperative patients, no serious systemic disease, and no TMJ disorders. Exclusion Criteria: Serious systemic problem, patients with xerostomia, logistic or physical reasons that could influence follow-up, psychiatric diseases, medically compromised patients, and those with neuromuscular disorders. After clinical examination (Fig.1), patients who fulfilled the inclusion criteria were selected. The patients were divided into two groups: In the first group, 40 patients were included, who were treated with removable dentures constructed with the SR-Ivocap polymerization method. In the second group, 40 patients were included, who were treated with removable dentures constructed with the conventional flasking and polymerization method. All the phases were done with the same technique and materials until the flasking and polymerization. The preliminary impression was made with alginate (Fig.2). The individual tray was constructed (Fig.3). The sectional border molding of the individual tray was realized. The final impression was made (Fig. 4), and the centric occlusion record was determined (Fig. 5) based on the three steps: occlusal plane determination, the centric occlusal height determination, and the most posterior position of the mandibula (centric relation) was recorded. In the try-in stage, the centric occlusion, aesthetic and phonetic were evaluated (Fig. 6). Necessary modifications were done. The traditional polymerization cycle was followed for the first group of traditional removable dentures (Fig.7). The SR IVOCAP technique was followed for the second group of dentures.

2.1 Ethical committee approval

The University of Medicine Tirana, Nr's Ethical Committee approved the study. 1587/2. Written consent of the patients was taken.

Fig 1. Patient Examination.

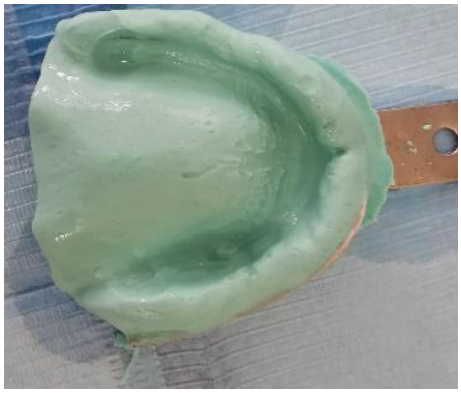

Fig. 2 Preliminary Impression

Fig. 3 Individual Tray

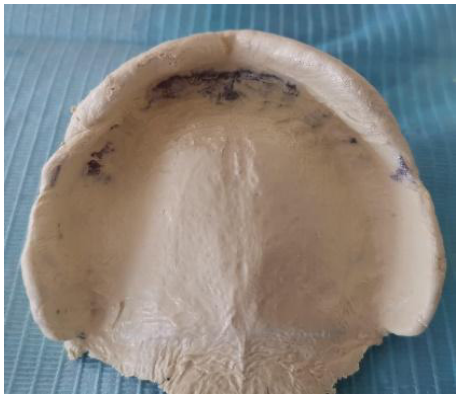

Fig. 4 Final Impression

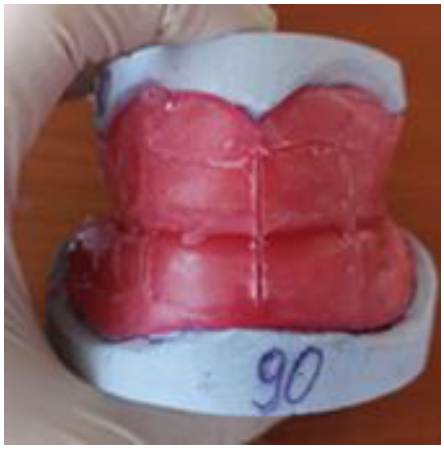

Fig. 5 Centric Occlusion Record

Fig. 6 Try in Stage

2.2 SR IVOCAP DENTURES

There are specific SR IVOCAP types of flasks. Channels of wax are positioned in each flask (Fig. 8). The flasks are then positioned in boiled water, after which the wax is eliminated (Fig.9). The isolation of plaster is realized. The SR-IVOCAP resin is in capsules: polymer and monomer (Fig. 10). The polymer is in the state of powder, and the monomer is in the state of liquid. The capsules are pre-dosed. They are mixed for 5 minutes in the Vibro Cap equipment. The flasks are positioned in the clamping frame, The pressure is applied over the clamping frame with the flask in a hydraulic press. The ratchet is situated in the right direction. The clamping frame is removed from the press. The capsule is fully inserted. The pressure apparatus is mounted. The polymerization cycle lasts 35 minutes. The resin is injected under pressure by replacing resin shrinkage, which occur during the compression molding technique (Fig.11). The system consists of denture flasks, a vibro-cap, a hydraulic press, and a water-curing bath.

Fig.7 Flasking and Polymerization with The Conventional Method.

Fig. 8 Wax Channels in SR IVOCAP Flasks

Fig. 9 Wax Elimination

Fig. 10 SR IVOCAP Resin Capsules

Fig. 11 Resin Polymerization

Fig.12 Processed Dentures

After the denture application, all the patients were rescheduled to answer a questionnaire regarding the four parameters: denture stability, mastication efficiency, dentures comfort, and the quality of dentures in general (Tab.1).

Table 1: The questionnaire related to the project funded by the National Agency for Scientific Research and Innovation, NASRI, Albania)

	Fully satisfied	Satisfied	Somehow satisfied	Not satisfied
How do you assess denture stability?				
How do you assess mastication efficiency?				
How do you assess the denture's comfort?				
How do you assess the quality of dentures in general?				

The comparison between removable dentures constructed with the SR IVOCAP system and the traditional system. (Tab.1)

3. RESULTS

The descriptive statistics of the data were done. The results are shown in the Tab.Nr. 2. The total number of observations was 80, with a mean of around 3.3. We have encoded in the following way:
1= not Satisfied
2= Somehow satisfied
3= Satisfied
4= Fully Satisfied

The average response is 3.3, which means the average response is satisfied for all observations. Of 80, 40 responses are SR IVOCAP DENTURE, and 40 are Traditional Denture.

Table 2: Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
How do you assess denture stability	80	1	4	3.29	0.917
How do you assess mastication efficiency	80	1	4	3.31	0.894
How do you assess the denture's comfort	80	1	4	3.28	0.826
How do you assess the quality of dentures in general	80	1	4	3.31	0.866
Valid N (listwise)	80				

Sample T-Test was conducted to compare the means of the two independent groups and to evaluate if there is statistical evidence that the means of the associated populations are significantly different. The parametric test was the Independent Samples t Test or the Independent t-Test. Upper and lower limits were also defined, and we could evaluate the significant level in the Tab. No. 3, row No. 1 is related to SR IVOCAP DENTURE and row Nr. 2 is related to Traditional Denture.

Table 3: Group Statistics

	Type of denture	N	Mean	Std. Deviation	Std. Error Mean
How do you assess denture stability	1	40	3.74	0.442	0.071
	2	40	2.85	1.038	0.162
How do you assess mastication efficiency	1	40	3.77	0.427	0.068
	2	40	2.88	1.005	0.157
How do you assess the denture's comfort	1	40	3.74	0.442	0.071
	2	40	2.83	0.863	0.135
How do you assess the quality of dentures in general	1	40	3.92	0.27	0.043
	2	40	2.73	0.837	0.131

The sample t-test showed that the SR IVOCAP dentures had higher mean values (Tab.3, 4) for all the parameters than traditional dentures. Based on the provided statistics, let's compare the mean values of the two groups:
1. How do you assess denture stability?
SR IVOCAP DENTURE: Mean = 3.74
TRADITIONAL DENTURE: Mean = 2.85
SR IVOCAP dentures had a higher mean value in this category, indicating better denture stability.
2. How do you assess mastication efficiency?
SR IVOCAP dentures: Mean = 3.77
Traditional dentures: Mean = 2.88
Again, SR IVOCAP dentures had a higher mean value, indicating better mastication efficiency.
3. How do you assess the denture's comfort?
SR IVOCAP DENTURE: Mean = 3.74
TRADITIONAL DENTURE: Mean = 2.83
SR IVOCAP DENTURE had a higher mean value, suggesting better denture comfort.
4. How do you assess the quality of dentures in general?
SR IVOCAP DENTURE: Mean = 3.92
TRADITIONAL DENTURE: Mean = 2.73

Once again, SR IVOCAP DENTURE had a higher mean value, indicating better overall denture quality. Based on these comparisons, SR IVOCAP DENTURE appears to have better assessments in all categories than Traditional Denture. The standard error mean for SR IVOCAP DENTURE is lower than that of Traditional Denture. Therefore, SR IVOCAP DENTURE is considered better overall.

Table 4: Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
How do you assess denture stability	Equal variances assumed	26.511	.000	4.942	78	.000	.890	.180	.531	1.248
	Equal variances not assumed			5.029	54.628	.000	.890	.177	.535	1.245
How do you assess mastication efficiency	Equal variances assumed	26.630	.000	5.116	78	.000	.891	.174	.544	1.238
	Equal variances not assumed			5.206	54.548	.000	.891	.171	.548	1.234
How do you assess the dentures comfort	Equal variances assumed	14.485	.000	5.916	78	.000	.914	.155	.607	1.222
	Equal variances not assumed			6.004	60.298	.000	.914	.152	.610	1.219
How do you assess the quality of dentures in general	Equal variances assumed	41.376	.000	8.474	78	.000	1.191	.141	.911	1.471
	Equal variances not assumed			8.650	48.607	.000	1.191	.138	.915	1.468

Table 5: Correlations

		How do you assess denture stability	How do you assess mastication efficiency	How do you assess the denture's comfort	How do you assess the quality of dentures in general
How do you assess denture stability	Pearson Correlation	1	.985**	.947**	.874**
	Sig. (2-tailed)		0	0	0
	N	80	80	80	80
How do you assess mastication efficiency	Pearson Correlation	.985**	1	.944**	.886**
	Sig. (2-tailed)	0		0	0
	N	80	80	80	80
How do you assess the denture's comfort	Pearson Correlation	.947**	.944**	1	.905**
	Sig. (2-tailed)	0	0		0
	N	80	80	80	80
How do you assess the quality of dentures in general	Pearson Correlation	.874**	.886**	.905**	1
	Sig. (2-tailed)	0	0	0	
	N	80	80	80	80

. Correlation is significant at the 0.01 level (2-tailed).

The correlation matrix (Tab.5) shows strong positive correlations among all four assessment categories: denture stability, mastication efficiency, denture comfort, and general denture quality. The Pearson correlation coefficients ranged from 0.874 to 0.985, indicating a high degree of linear association between the variables. These correlations are

statistically significant at the 0.01 level (2-tailed). The results suggest that individuals who assess denture stability higher also tend to rate mastication efficiency, denture comfort, and general denture quality higher, and vice versa. These findings indicate a consistent pattern of positive relationships between different aspects of denture assessment, implying that improvements or issues in one area may have a corresponding impact on other areas.

4. DISCUSSION

Research studies until now have demonstrated that removable dentures constructed with PMMA material, processed with the traditional technique, have a dimensional change during and after the polymerization process, which causes reduced retention and stability.[8-11] The reduced stability and retention are related to reduced patient satisfaction and comfort. [12-13] This is why our study focused on patient satisfaction regarding different parameters of removable dentures and patient satisfaction regarding the general quality of the dentures. The traditional method of flasking and polymerization is the most used method for polymerizing acrylic resin because of its simplicity and accuracy. This is why this technique has been used in different studies as the reference point for comparison with other methods. The injection molding technique has always been the focus, as it reduces the resin shrinkage by injecting resin under pressure layer after layer.[14] In our study, the SR-Ivocap system was used to construct the "experimental" dentures, as the dentures can also be relined, and the dimensional stability is higher.[15] Similar to our study, complete removable dentures were used in several studies by Jackson[16], Nogueira[17], Abby[18], and Venus[19]. According to Jackson, no statistical differences were found in the accuracy of the denture bases polymerized with the two techniques. According to Venus, more than the two resins, the processing method was more important related to the dimensional changes. While in contrast to our study, Baydas[20]and Salim[21]used rectangular acrylic resin plates for dimensional change evaluation. According to Bahra[22,] specimens constructed with the IVOBASE injection molding technique revealed superiority compared to the other tested resins. In the study of Keenan[23,] the dentures constructed with the injection molding technique showed a slighter, less vertical dimension increase than the compression molding technique.

5. LIMITS OF OUR STUDY

Parameters such as size and shape, denture thickness, different kinds of dentures, denture materials, and the presence of teeth[24-27] can affect dimensional changes during denture processing. In the present study, patient satisfaction regarding removable dentures was examined. By this approach, the physical properties were not directly related to acrylic resin.

6. CONCLUSIONS

Within the limits of our study, the processing technique for constructing removable dentures affects the patients' satisfaction. The removable dentures constructed with the SR IVOCAP system demonstrated higher patient satisfaction for the following parameters: denture stability, mastication efficiency, comfort of dentures, and quality of dentures in general. Further research is suggested on the correlation between patient satisfaction and processing removable dentures techniques.

7. AUTHORS CONTRIBUTION STATEMENT

Prof. Edit Xhajanka, Dr. Neada Hysenaj, Prof. Vergjini Mulo, Dr. Dorina Mele, Dr. Tedi Verçani, Dr. Endrit Paparisto conceptualized and designed the study and collected and analyzed the data. They all contributed to the final version of the manuscript.

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9. CONFLICT OF INTEREST

Conflict of interest declared none.

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