Comparison of the impact of removable partial dentures on the oral health-related quality of life of older adults

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ABSTRACT

Purpose: This study aimed to determine the effect of metal base removable partial dentures (MRPDs) and acrylic base removable partial dentures (ARPDs) on oral health-related quality of life.

Design/methodology/approach: The study was conducted on 40 patients. Twenty received ARPDs (nine in the maxilla and eleven in the mandible), and twenty received MRPDs (nine in the maxilla and eleven in the mandible). The patients were 45–65 years old. The impact of RPDs on the patient's quality of life was analysed with the Oral Health Impact Profile (OHIP-ALB14) questionnaire.

The differences in OHIP-14 between the two dentures at three different time points were estimated. All statistical analyses were performed using SPSS software, version 22 (IBM), and a p-value<0.05 was considered statistically significant.

Findings: The OHIP-ALB14 score for both denture types was high at T1 and then remarkably decreased at T2 (p<0.05) and T3 (p<0.05), with no significant differences between MRPDs and ARPDs users. For ARPD users, the satisfaction level significantly increased (<0.001) after one year for the dimensions of Physical Pain, Functional limitation, and Psychological Discomfort. Whereas, for MRPD users, satisfaction level significantly increased (<0.001) in the dimensions of Functional limitation, Psychological Discomfort, and Psychological Disability after a year of denture use.

Research limitations/implications: The findings from this study can be taken as the first step towards future research with a longer post-operative follow-up that can analyse the differences between dentures if any.

Practical implications: The comparative analysis between ARPD and MRPD and their impact on the oral soft tissues will help prosthodontists reach accurate treatment decisions.

Originality/value: This study has not been conducted in the region of Kosovo before. Moreover, the engineers manufacturing dental prostheses will know about the effect of their product on oral health.

Keywords: Removable partial dentures, Oral health impact profile, Oral health-related quality of life, Patient satisfaction, Quality of life

Case study

BIOMEDICAL AND DENTAL ENGINEERING AND MATERIALS

1. Introduction

Several measurement instruments have been introduced to gauge the influence of oral health on an individual's quality of life. One of the most sophisticated and vastly employed instruments is the Oral Health Impact Profile (OHIP) [1]. It was developed in the late 1990s by American, Australian, and Canadian researchers with the collaboration of the World Health Organization (WHO) [2-4]. Two questionnaires exist, the primary type with 49 items and the shorter version with fourteen questions [5]. Because of the longer duration (approximately fifteen minutes) and an increased non-response rate of some of the items from the basic version, the shorter version was introduced. When the OHIP-49 was shortened to 14 items, it was produced in two forms [6], the first form was a "regression" short form created by Slade et al., and the second one was an "impact" form created by Locker et al. [3,4]. Both, however, take less time to complete than the extended version and are more practical. The information in the OHIP-14 questionnaire could help dentists plan a particular treatment to enhance patients' oral and general health. Hence, the OHIP-ALB14 questionnaire was developed for Albanian speakers. It was then used in diagnostic and treatment procedures due to its excellent psychometric properties [7].

Patient satisfaction with removable partial denture (RPD) treatment is an increasingly important criterion in prosthodontic treatment [8]. Oral health problems faced by patients getting prosthodontic treatment are essential for the diagnosis and success of prosthodontic therapy [9,10].

Patient satisfaction with denture retention, the ability to speak, chew, aesthetics, and comfort were independent of Kennedy's class of partial edentulism, material, base shape, and denture support [8].

RPDs of all types remain a common treatment modality in the maxillary and mandibular partial edentulous arches [11]. A literature review has identified three types of removable partial dentures that are part of a daily dental treatment routine: acrylic tissue-supported dentures (ARPDs) and cast-metal frameworks (MRPDs) with a clasp or with attachments. Creugers et al. [12] have suggested that these dentures can be used to restore interrupted tooth arches, free-ending tooth arches, and a combination of interrupted and free-ending tooth arches [12].

Acrylic removable partial dentures consist of an acrylic denture base, acrylic replacement teeth, and metal retentive components. The maxilla ARPDs consist of a denture base that can cover the palate, whereas, in the mandible, it is much lesser in bulk as it has to provide space for the tongue. The denture base has an extension called the flange that extends to the labial or buccal vestibular fornix and, similarly to, the lingual aspect of the mandible. The artificial teeth are set on the acrylic resin denture base, and the areas of the denture that grip the natural teeth are termed "cuffs" or "collars" [13]. Properly fabricating the denture base is vital for its stability and retention of the ARPD [14]. Figure 1 shows an ARPD (acrylic resin) replacing posterior teeth in the mandible, which has a direct retainer in the form of metal wire clasps.

Metal base removable partial dentures (MRPDs) are removable partial dentures that consist of artificial teeth attached to a metal framework with acrylate that mimics gum and alveolar ridge.

A rigid cast metal framework is usually made from cobalt and chromium (Co-Cr) alloy that can be cast thinner than the acrylic denture base [15].

Retention and stability are provided by the denture framework that works in tandem with the other components of the MRPD. MRPDs have various components, including major connectors, minor connectors, direct retainers, indirect retainers, physical retainers, saddles, and artificial teeth. Major connectors can be an anterior-posterior palatal strap, single palatal strap, U-shaped palatal connector, lingual bar, and lingual plate. Direct retainers come in various designs: cast circumferential clasp (Akers', half and half, back-action, and ring clasp), roach clasp (I-bar, T-bar, Y-bar, 7-bar). Artificial teeth are generally made of acrylic or composite resin. With the development of CAD-CAM technologies, denture frameworks can be made from various other metals and alloys by milling or 3D selective laser melting [16]. Figure 2 shows MRPDs with a cast metal framework (Co-Cr) for the maxillary and mandibular regions utilized in this study.

Fig. 1. Samples of lower ARPDs delivered to patients enrolled in this study

Fig. 2. The maxillary (A) and mandibular (B) MRPDs on the day of delivery

The denture base material may have a critical impact on denture-supporting tissues, and the risk of treatment was five times higher ARPDs with acrylic resin bases compared to MRPDs with Co-Cr frameworks.

However, ARPDs may cause problems with the abutment teeth more frequently than Co-Cr bases, and acrylic is not as rigid as Co-Cr alloys, making it prone to denture fracture [17]. One study has shown that ARPDs are more likely to cause inflammation of gingival tissues than MRPDs [18]. Treatment with ARPDs may result in a rapid loss of the remaining natural teeth and can pose a higher risk for complete edentulism. A study among general dentists in Ireland showed that the average survival rate of an ARPD is 5.7 years, whereas the rate for MRPDs is 10.6 years [19].

For many people, substantial oral health developments such as tooth loss impact their quality of life [20]. Szentpetery et al. observed that it also affects the capability to chew, average speech, dissatisfaction with physical appearance, and pain, among others [21]. Biazevic et al. utilized OHIP to evaluate the influence of oral conditions on the quality of life in elderly patients. They concluded that it was related to denture needs [22,23].

The OHIP questionnaire was also used to assess variables such as the type of denture, gender, age, level of education, and area of residence [5]. Every population has another perception of their oral health status and quality of life, depending on their lifestyle, healthcare system access, and socioeconomic status [24]. Barreto et al. evaluated the satisfaction of rehabilitated patients with RPDs after two years of use. They confirmed that before the delivery of RPDs and after three months of use, OHIP scores fell drastically to 33% with a high statistical significance, meaning that patients' quality of life had improved. They also observed that the patients' OHIP scores after three months were similar to those obtained after two years [25].

However, the comparison between two types of RPDs, ARPD, and MRPD, is not made; therefore, our study aims to assess the impact of two removable partial dentures, an acrylic removable partial denture (ARPD) and a metal base removable partial denture (MRPD), on the quality of life in the initial 12 months of denture use.

2. Methods

Our prospective clinical study was conducted at the University Dental Clinic of Kosovo, Department for Prosthodontics and Private Dentistry Polyclinic Mdent-Family Dentistry in Pristina, Kosovo, and in cooperation with the Department for Prosthodontics, Faculty of Medicine, the University of Ljubljana. The study population was exclusively the inhabitants of the Republic of Kosovo.

It was conducted between 2016-2017 and adhered to the principles outlined in the Declaration of Helsinki (1975) for biomedical research, including human subjects, as revised in 2013. Voluntary participation from the patients was obtained after their written consent. Ethical approval was taken from the Hospital and University Clinical Service of Kosovo Ethics Committee and the University Clinical Centre of Kosovo (Page No.01 Prot No: 555/18.05.2017). The inclusion criteria were: Patients aged 45-65 (females and males), partially edentulous jaws with Kennedy Class I and patients' need for new RPD treatment.

The exclusion criteria were patients with osteoporosis, diagnosed addictions, habits such as bruxism, patients who had previously been treated with RPD, patients with the unstable periodontal condition, patients with untreated carious lesions, patients with non-vital teeth, patients with fixed restorations, and patients with physical disabilities.

The RPDs were obtained from prosthodontists and dental technicians working in the University Dental Clinic of Kosovo, Chair of Prosthodontics, and Private Dentistry Polyclinic Mdent-Family Dentistry Pristina, Kosovo.

Forty patients participated in this study. Among them, 20 patients received 20 ARPDs (9 maxillary and 11 mandibular), and 20 received 20 MRPDs (9 maxillary and 11 mandibular). Socio-demographic details such as gender, age, education level, and residence area were obtained. Patients were instructed about oral hygiene and the care of dentures. The condition of the opposite dental arch, including the status of the jaws with/without prosthodontic treatment, was analyzed and classified into:

1. Complete dental arch with natural teeth with or without fixed prosthodontic treatment;
2. Partially edentulous jaw with or without an RPD;
3. Completely edentulous jaw with or without complete dentures.

The examiners provided the OHIP-ALB14 questionnaire in Albanian and all necessary clarifications to the patients. The OHIP-ALB14 questionnaire has been validated in one study [7]. They filled out the questionnaire at three different time intervals. It consisted of 14 items that broadly covered five domains: functional limitation, psychological discomfort, physical pain, physical disability, and social disability. The responses were distributed on a scale (0 – hardly, 1 – hardly ever, 2 – occasionally, 3 – reasonably often, 4 – very often) where zero indicated that patients did not experience any problems and higher scores corresponded to poor oral health.

The statistical analysis was done using SPSS software version 22.00.

A p-value of <0.05 was considered statistically significant. Descriptive statistics were done for demographic

characteristics. The normality of data was checked using the Kolmogorov-Smirnov test. A comparison of OHIP scores between both groups of patients was carried out using a mixed model analysis of variance (ANOVA) for repeated measures and the post-hock analyses using Bonferroni corrections, where the analysis included both "between group" and "within the group" comparisons. Levene's test of equality of error variance was performed to check for any error in variance, and the Mauchly test of sphericity was done to evaluate the sphericity of the data. Student T-test and Mann-Whitney U test were performed to check OHIP's association with age and gender.

3. Results

3.1. Basic patient data

The study was conducted on 40 patients – 16 males (40%) and 24 females (60%) – with a mean age of 53.6 years (±8.60), of which 32.5% were living in rural areas and 67.5% in urban areas. The frequency distribution of the patients' socio-demographic details, type of denture, and antagonist jaw is presented in Table 1.

3.2. Oral health and quality of life in patients with ARPDs and MRPDs

This analysis assessed the association between the two denture groups and OHIP-14 mean scores (Fig. 1). The ANOVA for repeated measures test was employed, and "between-subjects" and "within-subjects" factors were included. Before running the analysis, we checked whether all assumptions were met. There were no outliers in this data set, and Levene's test of equality of error variance revealed that the error of variance of the dependent variable was equal across all groups (p-value<0.05). The Mauchly test of sphericity revealed that the data violated the assumption of sphericity, which is why Greenhouse-Geisser values were included in the analysis (Tab. 2).

The mixed ANOVA with repeated measures with the Greenhouse-Geisser correction showed no interaction between denture groups and time points (F(1.202), p-value=0.225).

The results regarding gender for the patients with MRPD dentures show that there are no differences in OHIP mean values at any of the time points (Tab. 3): Time 1(p=0.776), Time 2(p=0.276), Time 3(0.112). The results regarding gender for the patients with ARPD dentures show that there are no differences in OHIP mean values at any of the time points: Time 1(p=0.296), Time 2(p=0.383), and Time

3(0.136). The differences in mean OHIP values regarding age are also insignificant at any of the time points: Time 1(p=0.597), Time 2(p=0.233), and Time 3(0.499).

Table 1.
Descriptive statistics and frequency distribution of variables, such as age, gender, patients' education, type of denture, and antagonist jaw

Variables (N=40)	Mean, Std. dev	Frequency	Percentage, %
Age	53.63 (±8.60)		
Gender			
Female		24	60.0
Male		16	40.0
Region			
Rural		13	32.5
Urban		27	67.5
Education			
<4 years		1	2.5
5–8 years		18	45.0
9–12 years		20	50.0
>12 years		1	2.5
Type of denture			
MRPD		20	50
ARPD		20	50
Jaw and type of denture			
MRPD Upper		9	22.5
ARPD Upper		9	22.5
MRPD Lower		11	27.5
ARPD Lower		11	27.5
Antagonist Jaw			
Complete denture		3	7.5
Partial denture		15	37.5
Subtotal denture		5	12.5
Natural teeth with a fixed restoration		8	20.0
Natural teeth		9	22.5

Furthermore, the analysis showed that both groups had higher OHIP-14 scores at the beginning of T1 and that average scores decreased significantly at T2 (p-value<0.05) and T3 (p-value<0.05) (Fig. 3).

Table 2.
The results of Mixed ANOVA for repeated measures with the Greenhouse-Geisser correction for OHIP scores

	Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Time	Sphericity Assumed	47.279	2	23.640	238.736	0.000
	Greenhouse-Geisser	47.279	1.202	39.331	238.736	0.000
	Huynh-Feldt	47.279	1.252	37.753	238.736	0.000
	Lower-bound	47.279	1.000	47.279	238.736	0.000
Time * Type	Sphericity Assumed	0.304	2	0.152	1.536	0.222
	Greenhouse-Geisser	**0.304**	**1.202**	**0.253**	**1.536**	**0.225**
	Huynh-Feldt	0.304	1.252	0.243	1.536	0.225
	Lower-bound	0.304	1.000	0.304	1.536	0.223
Error(Time)	Sphericity Assumed	7.526	76	0.099		
	Greenhouse-Geisser	7.526	45.679	0.165		

Table 3.
Mean OHIP dimension values in relation to time: before, after six months and after 1year of ARPD and MRPD use

		Baseline				6 months				1 year			
Variable	N	Mean	S.D	Median	p	Mean	S.D	Median	p	Mean	S.D	Median	p
MRPD													
Gender													
Male	8	1.41	0.53	1.54	0.776	0.44	0.31	0.39	0.276	0.17	0.15	0.14	0.112*
Female	12	1.48	0.48	1.39		0.30	0.22	0.21		0.07	0.10	0.00	
Age													
Up to 46	10	1.49	0.55	1.71	0.704	0.42	0.24	0.43	0.180*	0.13	0.16	0.07	0.811*
Over 46 year	10	1.41	0.44	1.29		0.29	0.29	0.18		0.09	0.10	0.07	
ARPD													
Gender													
Male	8	1.89	0.74	2.25	0.296*	0.29	0.14	0.32	0.383	0.10	0.09	0.07	0.136
Female	12	1.50	0.57	1.43		0.35	0.17	0.36		0.18	0.12	0.14	
Age													
Up to 46	11	1.58	1.50	0.59	0.597	0.29	0.13	0.29	0.233	0.13	0.10	0.14	0.499
Over 46 year	9	1.75	0.76	1.79		0.37	0.19	0.43		0.17	0.14	0.14	

Note. *Student T-test, **Mann-Whitney U test

Further in the analyses, each time point was descriptively explained using the mean and standard deviation of the OHIP dimensions. The normality of the data was checked using the Kolmogorov-Smirnov test, and the association between the time points was checked using repeated measure ANOVA and post-hock analyses using Bonferroni corrections.

The results regarding the patients using MRPD showed that after six months of wearing the denture, the satisfaction level about all dimensions increased (values decreased), except for Incapacity. Incapacity for these patients did not change over time (p=0.188). The satisfaction level also significantly increased after one year for the following dimensions: Functional limitation, Psychological Discomfort, and Psychological Disability; for other dimensions like Physical Pain, Physical Disability, and Social Disability, the satisfaction level did not change from 6 months to 1 year. (Tab. 4).

The satisfaction level of patients using ARPD showed that after six months of wearing the denture, all dimensions increased (values decreased) except for Incapacity. Incapacity for these patients did not change over time (p=0.163). The satisfaction level also significantly increased after one year for the following aspects: Physical Pain, Functional limitation, and Psychological Discomfort; for other dimensions, such as Social Disability, Physical Disability, and Psychological Disability, the satisfaction did not change from 6 months to 1 year. (Tab. 4).
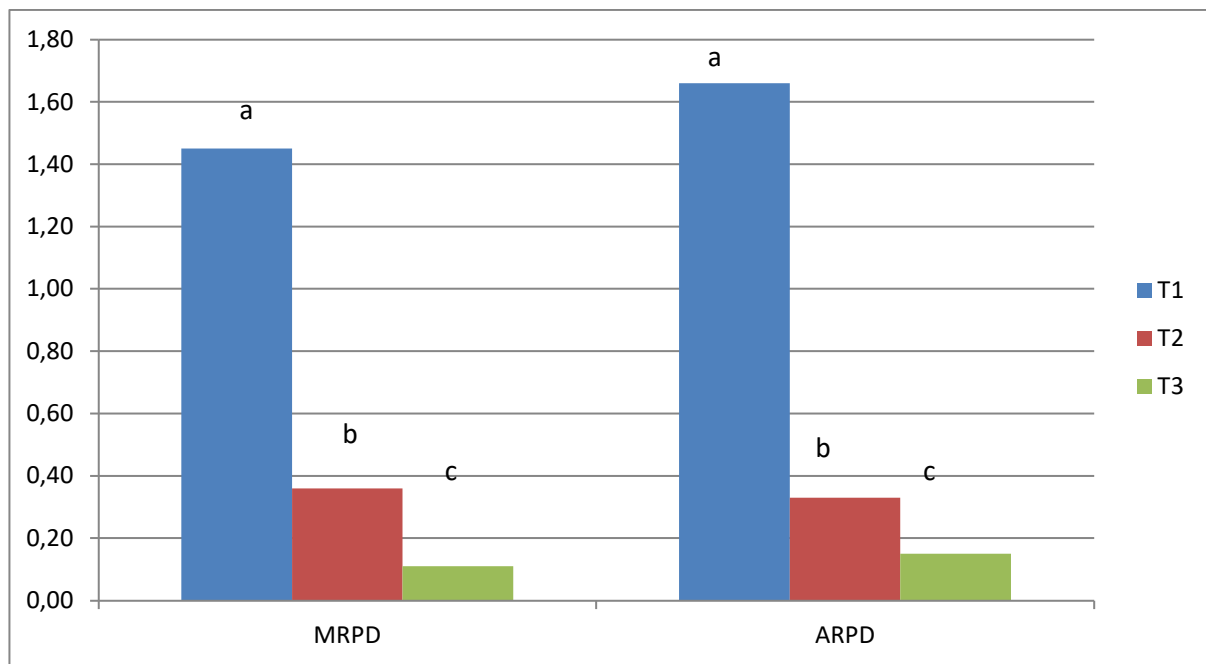
Fig. 3. Mean OHIP scores for patients with MRPDs and ARPDs were measured at the three-time points. The different subscript letters denote that the mean values of an OHIP score differ significantly from one another at the 0.05 level

Table 4.
OHIP values of the respective dimensions in relation to time: before, after three months and after two years of MRPD and ARPD use

Dimension	n	1-time point		2-time point		3-time point		p-value
		Mean	SD	Mean	SD	Mean	SD	
MRPD								
Functional limitation	20	1.83[a]	0.878	0.93[b]	0.634	0.28[c]	0.380	<0.001
Physical Pain	20	2.40[a]	0.598	0.33[b]	0.438	0.23[b]	0.302	<0.001
Psychological Discomfort	20	2.55[a]	0.724	0.85[b]	0.630	0.25[c]	0.380	<0.001
Physical Disability	20	1.13[a]	0.841	0.15[b]	0.401	0.00[b]	0.000	<0.001
Psychological Disability	20	1.65[a]	0.860	0.18[b]	0.245	0.03[c]	0.112	<0.001
Social Disability	20	0.53[a]	0.716	0.05[b]	0.154	0.00[b]	0.000	0.007
Incapacity	20	0.08	0.183	0.03	0.112	0.00	0.000	0.188
OHIP	20	1.45[a]	0.486	0.36[b]	0.263	0.11[c]	0.130	<0.001
ARPD								
Functional limitation	20	2.35[a]	1.052	0.93[b]	0.568	0.40[c]	0.417	<0.001
Physical Pain	20	2.65[a]	0.780	0.48[b]	0.343	0.20[c]	0.251	<0.001
Psychological Discomfort	20	2.28[a]	0.866	0.60[b]	0.348	0.38[c]	0.358	<0.001
Physical Disability	20	1.45[a]	1.063	0.03[b]	0.112	0.00[b]	0.000	<0.001
Psychological Disability	20	2.00[a]	0.932	0.18[b]	0.335	0.00[b]	0.000	<0.001
Social Disability	20	0.83[a]	0.693	0.08[b]	0.245	0.05[b]	0.154	<0.001
Incapacity	20	0.05	0.154	0.00	0.000	0.00	0.000	0.163
OHIP	20	1.66[a]	0.66	0.33[b]	0.160	0.15[c]	0.117	<0.001

Note. Repeated-measures ANOVA test. Same letters, no significant difference; different letters, a considerable difference.

4. Discussion

Prosthodontics has been continuously evolving in response to patients' changing needs, and its role in edentulism treatment has a crucial impact on oral health. The recent trend indicates that validated measuring instruments like OHIP is being immensely used to discover the impact of prosthodontic and implant treatment on patients' satisfaction and OHRQoL [26-28].

To the best of our knowledge, this was the first prospective clinical study to compare ARPD and MRPD treatment in terms of their impact on oral health indicators. Overall, it was observed that both the ARPD and MRPD groups had higher OHIP-ALB14 scores at the study's beginning, and these scores dropped drastically at 6- and 12-month follow-ups. This finding suggests that at the beginning of the study, the quality of patients' oral health was poor, as evidenced by high OHIP-ALB14 scores; however, as the study progressed, the continued use of RPDs reduced the OHIP scores, and this resulted in improvement in patients' oral health quality of life.

A meta-analysis and a systematic review by Ali et al. included 23 studies (two randomized controlled trials and 21 cohort research). The oral health-related quality of life was assessed after prosthodontic treatment of partially edentulous patients [29]. The result showed that RPDs positively affected patients' oral quality of life at follow-ups of over nine months [29]. The possible reasons suggested in the review were maintenance-related issues, changes in the denture's fit due to distortion, periodontal disease, and changes in outcome expectations. The systematic review findings are similar to those observed in this study. OHIP attempts to measure the social influence of oral disorders by making use of the theoretical hierarchy of oral health results and provides a comprehensive overview of disability, discomfort, and dysfunction which arise from oral conditions on a self-reported basis. Similar to our study was another study conducted by Jenei et al., where the median OHIP score decreased at one and twelve months after the procedure, which points towards an enhancement in the patient's health-related quality of life [30]. The clinicians must explain to the patients that their expectations may vary with time and pay attention to patients' complaints.

It is noted that aesthetics may be a major complaint, but over time, the complaints may shift towards functional importance or maintenance. Literature has studies that correlate the OHRQoL instruments with various variables such as socioeconomic factors [31], demographic characteristics [32], and dental treatment needs [33]. However, in our study, we did not find any significant differences across these variables. Similar findings were reported in a study conducted in Brazil, where no difference was seen in the OHRQoL score among genders [32].

Moreover, in a study conducted in Australia, gender and age had no significant impact on OHRQoL [34]. Whereas, in another study by John et al., minimal differences in the mean OHIP scores were found concerning age and gender [35]. These demographic, social, and clinical factors must be assessed on a larger scale in large sample sizes to get a thorough perspective of differences among various ethnic populations [36].

Our study saw no significant differences in physical pain and disability over one year. This finding differs from one research in India, where disability and physical pain were the most commonly affected domains [37].

On the other hand, in the same study, psychological discomfort was not affected, but in our research, psychological discomfort improved over a year.

The other two studies revealed that functional limitation and psychological disability were the most troublesome aspects, which contrasts with our study, in which these two aspects improved over time [38,39]. This research revealed that the long-term use of RPD, regardless of the type, is associated with good patient acceptance, oral health condition, and satisfaction. We also found that decreased OHIP led to an increase in OHRQoL.

Time duration played a considerable role in improving RPD wear in our patients. Other factors such as denture cleaning, oral health, number of teeth, and duration of RPD wear should also be considered to check the relevance of comfort.

At the T1 interval, the ARPD and MRPD groups had higher OHIP-ALB14 scores, which decreased considerably after 6 and 12 months, with no significant differences between both groups. This decline indicates that patients' satisfaction with both types of RPDs improved over time. In the aspects of Functional limitation, Psychological Discomfort, and Physical Pain, the satisfaction levels of both ARPD and MRPD patients improved over time, giving credit to the duration of time to let patients acknowledge the use of RPD in their daily lives. The clinical implication of this study is that RPD wearers must be allowed time to adjust to the complicated process of being accustomed to a removable denture. It is a strenuous process that can result in good oral health and quality of life with effective strategy and dental care. We did not find a negative correlation between oral health-related quality of life and RPD use.

The primary limitations of the study were the small sample of people included in the study, which rendered the results not to be generalized to the whole Kosovan population. A study of a longitudinal nature with a more extensive timeline and incorporating other factors related to RPD use would prove beneficial in the future.

5. Conclusions

At the T1 interval, the ARPD and MRPD groups had higher OHIP-ALB14 scores, which decreased considerably after 6 and 12 months, with no significant differences between both groups. This decline indicates that patients' satisfaction with both types of RPDs improved over time.

In the aspects of Functional limitation, Psychological Discomfort, and Physical Pain, the satisfaction levels of both ARPD and MRPD patients improved over time, giving credit to the duration of time to let patients acknowledge the use of RPD in their daily lives.

The clinical implication of this conclusion is that RPD wearers must be allowed time to adjust to the complicated process of being accustomed to a removable denture. It is a strenuous process that can result in good oral health and quality of life with effective strategy and dental care. We did not find a negative correlation between oral health-related quality of life and RPD use.

List of abbreviations

ARPDs: Acrylic base removable partial dentures
OHIP: Oral Health Impact Profile
OHRQoL: Oral health-related quality of life
MRPDs: Metal base removable partial dentures
RPD: Removable partial denture
WHO: World Health Organization

Ethical approval

Ethical approval was obtained from the Hospital and University Clinical Service of Kosovo Ethics Committee and the University Clinical Centre of Kosovo (Page No.01 Prot No: 555/18.05.2017).

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