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RESEARCH ARTICLE

Removable Partial Denture Design in Dental Practice: Epidemiological Study in The Region of Rabat-Sale-Kenitra (Part 2)

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ABSTRACT

Introduction

Despite the enrichment of our therapeutic panoply by the integration of implants and CAD/CAM techniques, the removable partial denture with metallic infrastructure (RPD) will remain an unavoidable alternative in the rehabilitation of partial edentulous teeth. The purpose of this survey, divided into three parts, is to evaluate the knowledge, attitudes, and practices of dentists in private practice in the Rabat-Sale-Kenitra region regarding the design of removable partial dentures, to provide information on the means of communication with laboratory technicians, and to investigate possible correlations between the failure of the prosthetic project and certain adopted practices.

Materials and methods

The study concerned a sample of 101 dentists practicing in the region of Rabat-Sale-Kenitra to whom we sent an anonymous 4-page printed questionnaire containing 28 questions on the design of metal frames in PAPM. A descriptive and analytical statistical study was conducted to process the data.

Results Following the results of the statistical study, only 8% of the practitioners performed more than ten partial removable prostheses per month, 17% did not perform a clinical examination, 20% did not perform a study model, 69% did not perform the RPD design by themselves and entrusted this task to the dental technician. In comparison, 89% did not use a Dental Surveyor.

Conclusion This survey showed that many practitioners do not follow the rules of good practice and that they lack knowledge of RPD design. Therefore, postgraduate training is envisaged to eventually help practitioners implement these good practices and improve this knowledge. However, it was noted that only 58% of the practitioners in our sample were interested in such training.

KEYWORDS: Removable Partial Denture; Design-partial edentulous.

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INTRODUCTION

Although the indications for of implantology and Computer-Aided Design / Computer-Aided Manufacturing CAD/CAM are becoming more and more widespread, the removable dental prosthesis (RDP) can constitute the solution of choice for patients whose financial constraints, clinical situations, and general state of health constitute an obstacle to benefit from treatments by fixed prosthesis on natural teeth or on implants provided that the practitioner is able by this procedure to answer their hopes in aesthetics and comfort. [1] [2]

The prosthetic rehabilitation of a partially edentulous patient has the task of restoring aesthetics and function, ensuring the durability of the remaining dento-periodontal structures, minimizing ridge resorption, and guaranteeing the balance of the prosthesis during oral functions. [3]

The metal framework design requires a perfect clinical examination of the dento-periodontal and osteo-mucosal bearing surfaces, completed by a radiographic assessment, an occlusal study, and an analysis of the diagnostic cast on a Dental Surveyor.

The respect of the main principles of a rationalized treatment, simple and inadequate with the acquired data of science, is indisputable independently of the method of design used to carry out the framework, conventional or assisted by computer. [4]

This article presents a survey conducted in private practices in the Rabat-Sale-Kenitra region. The main objective of this descriptive and analytical cross-sectional study is to evaluate dental practices in the RPDM design and, as a secondary objective, the research of possible correlations between prosthetic failure and these practices.

MATERIALS AND METHODS

The survey conducted is cross-sectional, descriptive, and analytical conducted among general dentists practicing in the private sector in the Rabat-Sale-Kenitra region who are on the official list of the Order of Dentists. The survey period was from 23/09/2019 to 29/11/2019.

The study included general dentists practicing in the private sector in the Rabat-Sale-Kenitra region and listed in the official list of the Order of Dentists. Dentists practicing an exclusive specialty were excluded from the sample.

A questionnaire was formulated to collect in its first part personal and professional data. The rest of the questionnaire concerned the clinicians' practices to develop a RPDM design.

We used two types of questionnaires: the first on paper and the second digital via Google Forms. We were able to collect 101 responses.

- The software "Statistical Package for Social Science (SPSS) version 13.0" was used for the statistical analysis and Microsoft Office Excel 2016 for the realization of the graphs
- The tests used were: the Chi-square test or Fisher's exact test. The difference is considered statistically significant when the p-value is less than 0.05.
- Multinomial logistic regression was used to search for explanatory factors of prosthetic failure.

DESCRIPTIVE RESULTS

General characteristics of the sample

The sample consisted of 49 men (48%) and 52 women (52%). Of these, 63 were between 25 and 40 years of age (62%), 27 were between 40 and 55 years of age (27%), and 11 were over 55 years of age (11%).

Of the 101 practitioners interviewed, 40% had graduated from the Faculty of Dentistry in Rabat and 17% from the Faculty of Dentistry in Casablanca. The remaining dentists obtained their degrees outside Morocco: France (14%), Tunisia (10%), Ukraine (7%), Senegal (6%), Russia (4%) Romania (2%).

Regarding seniority, the sample was classified into three categories:

- Less than 10 years of experience (59%)
- Between 10 and 20 years of experience (26%)
- More than 20 years of experience (15%)

85% of the practitioners surveyed practiced in urban areas and 15% in rural or suburban areas. 63% practiced alone and 37% in groups.

Information on metal framework design practices and knowledge

We started our investigation with questions about the number of removable partial dentures with metallic infrastructure (RPDM) made per month, and the results were as follows:

- 74% of practitioners were performing less than five partial removable dentures per month.
- 18% performed between 5 and 10.
- 8% performed more than 10

We asked the dentists in our sample about the steps necessary for developing the RDP design: clinical examination, development of the study model, and use of the Dental Surveyor.

83% of practitioners performed a complete and detailed clinical examination of the patient, while

17% did not

Concerning the realization of a study model, 80% of the practitioners interviewed realize it, which is not the case for the remaining 20%.

Only 24% of practitioners use a Dental Surveyor, while 76% do not.

We note that more than half of the practitioners do not analyze the guiding surfaces and shrinkage zones (52%).

Based on the assumption that it was very likely that prostheses were made without prior drawing by the practitioner, we included a question to find out the percentage of practitioners who draw the frame by their care.

Only 31% of the practitioners surveyed carry out the framework's design themselves, and 69% delegate this task to their dental technician.

We asked the dentists what to do in teeth with a reserved prognosis.

Apart from 2 copies with no response, the rest of the practitioners opted for:

- An evolutionary design (19%).
- Multiplying Occlusal Rest Seats (14%).
- Spare doubtful teeth from Rest Seats (36%).
- Extraction of questionable teeth (31%).

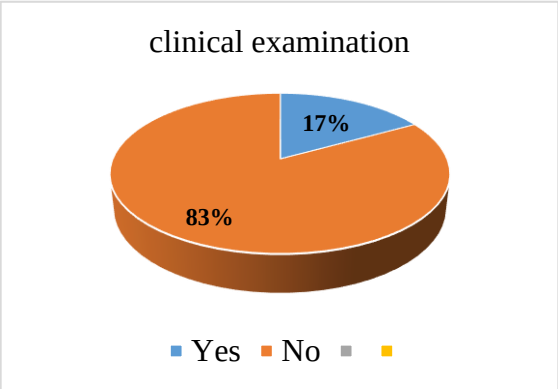
We were interested in whether or not practitioners scheduled follow-up sessions.

The results show 92% of the practitioner's scheduled check-ups while 8% did not.

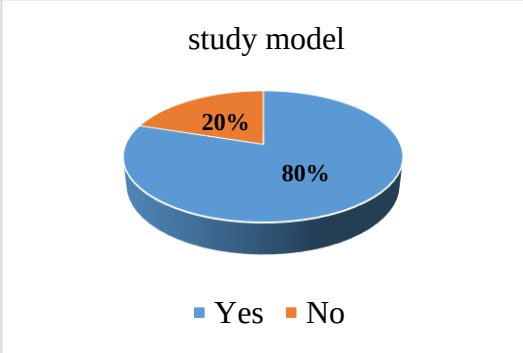
We asked the dentists what the most common complaints of their patients were. One copy was obtained without response. For the rest, the results were as follows:

- Association of more than one complaint (58%)
- Appearance of injuries (22%).
- Prosthetic instability (13%).
- Retention problem (7%).

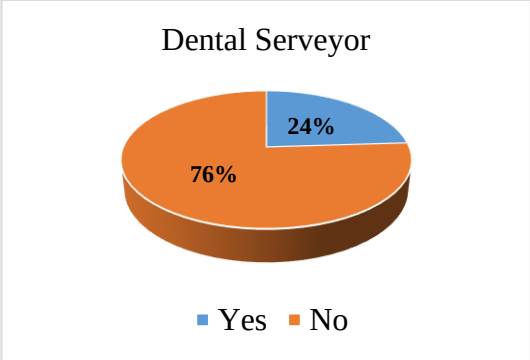
Graph 1: Percentage of practitioners performing a clinical examination



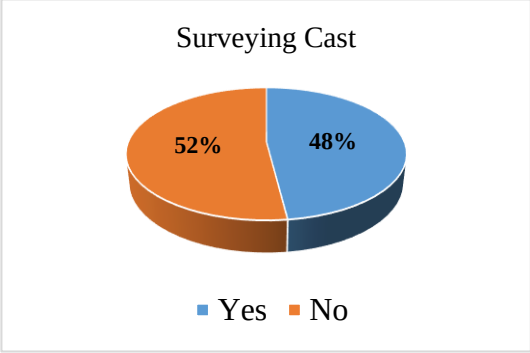
Graph 2: Percentage of practitioners who produce a study model



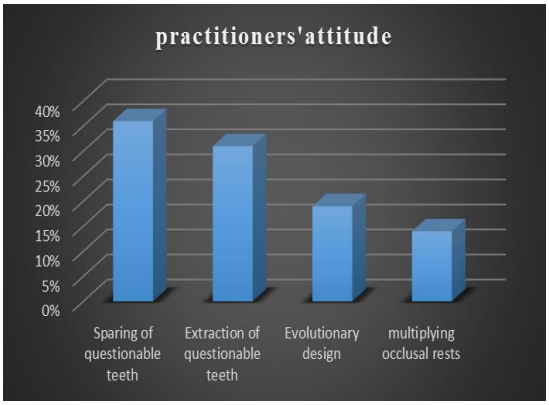
Graph 3: Percentage of practitioners using a Dental Surveyor



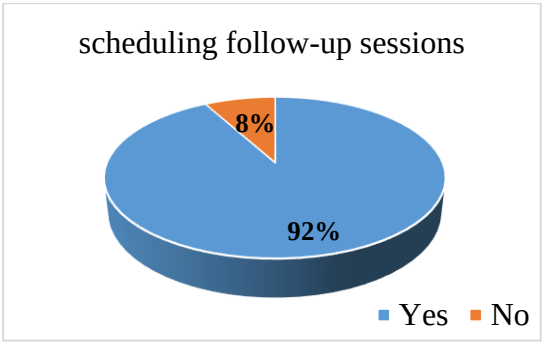
Graph 4: Percentage of practitioners performing Surveying cast



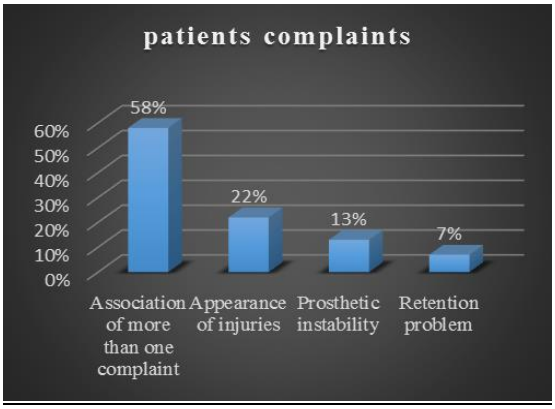
Graph 5: practitioners' attitude towards a tooth with a reserved prognosis



Graph 6: Percentage of practitioners scheduling follow-up sessions



Graph 7: The most noticed complaints of the patients



ANALYTICAL RESULTS

Relation between and general practitioner characteristics and dentists' practices

We wanted to know the relationship between and general practitioner characteristics and practitioners' practices by looking at:

*The use of a study model or not.

*The analysis of the guiding surfaces and shrinkage areas or not

We observe that only 13% of the women do not use a study model while 27% of the men do not, which is statistically non-significant (p=0.1).

Again, the results were almost the same. 52% of the women did not analyze these surfaces compared to 51% of the men, which was not statistically significant (p=0.928).

We also wanted to know the relation between experience and the two previous practices.

The use of a study model was mostly observed in dentists with 10 to 20 years of experience with a percentage of 96%. The least experienced dentists used the study model 72% of the time, but this was not statistically significant (p=0.26).

Again, the percentage of practitioners who did not perform this analysis was high among those with 10-20 years of experience (73%), in contrast to new graduates who more often applied the instructions received during their training years (58%), and this was statistically significant (p=0.027).

We wanted to know the relation between the practitioners' college of studies (national or foreign) and the design rules studied.

22% of the practitioners surveyed who had studied in Morocco did not use a study model, whereas 17% of those who had studied abroad did, and this was statistically insignificant (p=0.055)

60% of the practitioners surveyed who had studied in Morocco did not perform this analysis, compared to only 46% of those who had studied abroad, which is statistically significant (p=0.012).

Since the place of practice can influence the practices of the practitioners, we were interested in its relationship with the previous practices.

It was found that 19% of urban practitioners did not use a study model compared to 27% of suburban and rural practitioners, which was statistically insignificant (p=0.47).

The percentage of practitioners not performing the cast analysis was high among those practicing in cities (53%). This percentage was lower among doctors practicing in suburban or rural areas (40%), which is not statistically significant (p=0.335). **(Table 1)**

Relation between complaints and dentists' practices

Table 2 illustrates the relationship between complaints and dentists' practices.

Not using the study model resulted in an association of complaints with 71%. The percentage was lower when the study design was used (62%) and was statistically insignificant (p=0.12). We note that practitioners performing the analysis of the guiding surfaces and shrinkage zones encountered the combination of more than one complaint in 63% of cases. In contrast, practitioners not doing so encountered it in 65% of cases. This is statistically insignificant(p=0.875) **(Table 2)**

Correlation between the performance of a clinical examination and general practitioner characteristics

We wanted to know the relationship between the performance of a clinical examination and the general characteristics of practitioners by looking at: Years of experience/Location of practice/Number of prostheses performed.

We observed that 75% of practitioners with experience between 1 and 10 years performed a clinical examination compared to 92% of practitioners with experience between 10 and 20 years. All practitioners with experience over 20 years performed a clinical examination in a statistically significant manner (p=0.024).

We found that 85% of urban practitioners performed a clinical examination compared to only 73% of rural practitioners, which was not statistically significant (p=0.27).

We noticed that 81% of the practitioners who performed less than five prostheses per month performed a clinical examination against 94% of the practitioners who performed between 5 and 10 prostheses per month and 75% of the practitioners who performed more than 10. This was not statistically significant (p=0.33). **(Table 3)**

Relation between Dental Surveyor use and general practitioner characteristics

We are interested in the relationship between the use of the Dental Surveyor and the three previous characteristics. We found that 4% of practitioners with experience between 1 and 10 years used a Dental Surveyor compared to 8% of practitioners with experience between 10 and 20 years, while 40% of practitioners with experience over 20 years used it. This was statistically significant (p=0.01).

12% of urban practitioners used a Dental Surveyor compared to 13% of rural practitioners, which was not statistically significant (p=0.851).

11% of the practitioners who performed less than five prostheses per month used a Dental Surveyor against 17% of the practitioners who performed between 5 and 10 prostheses per month. In comparison, 3% of the practitioners who performed more than ten prostheses per month used it. This was not statistically significant (p=0.778). **(Table 4)**

Correlation between scheduling of checkups and general practitioner characteristics

We were interested in the relationship between the programming of control sessions and the three previous characteristics.

Follow-up sessions were scheduled by 88% of practitioners with experience between 1 and 10 years and by all practitioners with experience between 10 and 20 years, and by those with experience of more than 20 years. This was statistically insignificant (p=0.073) 93% of both urban and rural practitioners scheduled follow-up sessions, with a statistical significance of 0.956.

Follow-up sessions were scheduled by 92% of the practitioners who performed less than five prostheses per month, 94% of the practitioners who performed between 5 and 10 prostheses per month, and 100% of the practitioners who performed more than ten prostheses per month. This was not statistically significant (p=0.705). **(Table 5)**

Correlation between prosthetic failure based on number of complaints and different dentist practices (Ordinal Logistic Regression)

We looked for a statistically significant relationship between different dental practices and prosthetic treatment success. We did this by performing an ordinal logistic regression. First, a univariate analysis, to select the variables related to prosthetic failure or success in a significant way with $p<0.2$, then a multivariate analysis which to identify the variables having a statistically significant link with the prosthetic success and this in a way dependent on the other variables. The results are interpreted at the 5% significance level.

We defined prosthetic failure as a fracture of the abutment teeth of the RPDM or by a combination of more than two complaints declared by the patient (occurrence of injuries, prosthetic instability, and lack of prosthetic retention).

Only the neglect of a complete and detailed clinical examination of the patients and the delegation of the framework design to the prosthetist explain the failure of the prosthetic project and this in a statistically significant way (p=0.027) for the non-realization of a clinical examination and (p=0.001) for the design made by the prosthetist. **(Table 6)**

Table 1: Relationship between general practitioner characteristics and dentists' practices

		Use of a study model		Surveying cast	
		YES	NO	YES	NO
Gender	Male	73%	27%	49%	51%
	Female	87%	13%	48%	52%
	p	0,1		0,928	
Years of experience	Between 1 and 10 years	72%	28%	58%	42%
	Between 10 and 20 years	96%	4%	27%	73%
	More than 20 years	87%	13%	47%	53%
	p	0,26		0,027*	
College	National	78%	22%	40%	60%
	foreign	83%	17%	54%	46%
	p	0,055		0,012*	
practice location	In town	81%	19%	47%	53%
	Suburban or Rural	73%	27%	60%	40%
	p	0,47		0,335	

Table 2: relation between complaints and dentists' practices

		Complaints				p
		Prosthetic instability	Retention problem	Appearance of wounds	Association	
Use of a study model	YES	5%	5%	28%	62%	0,12
	NO	0%	29%	0%	71%	
Surveying cast	YES	5%	5%	27%	63%	0,875
	NO	4%	12%	19%	65%	

Table 3: Relationship between completion of a clinical examination and general practitioner characteristics

		Completion of a clinical examination		p
		YES	NO	
Years of experience	Between 1 and 10 years	75%	25%	0,024*
	Between 10 and 20 years	92%	8%	
	More than 20 years	100%	0%	
practice location	In town	85%	15%	0,27
	Suburban or Rural	73%	27%	
RPDM performed per month	Less than 5	81%	19%	0,33
	Between 5 and 10	94%	6%	
	More than 10	75%	25%	

Table 4: Relation between the use of a Dental Surveyor and general practitioner characteristics

Discussion

		Dental Surveyor use		p
		YES	NO	
Years of experience	Between 1 and 10 years	4%	92%	0,01*
	Between 10 and 20 years	8%	96%	
	More than 20 years	40%	60%	
practice location	In town	12%	88%	0,851
	Suburban or Rural	13%	87%	
RPDM performed per month	Less than 5	11%	89%	0,778
	Between 5 and 10	17%	83%	
	More than 10	13%	87%	

Table 5: Relationship between scheduling of monitoring sessions and the 3 previous characteristics.

		scheduling of monitoring sessions		p
		Oui	Non	
Years of experience	Between 1 and 10 years	88%	12%	0,073
	Between 10 and 20 years	100%	0%	
	More than 20 years	100%	0%	
practice location	In town	93%	7%	0,956
	Suburban or Rural	93%	7%	
RPDM performed per month	Less than 5	92%	8%	0,705
	Between 5 and 10	94%	6%	
	More than 10	100%	0%	

Table 6: Factors associated with prosthetic failure in univariate and multivariate analysis

Associated factors	Univariate analysis			Multivariate analysis		
	OR	CI 95%	p	OR	CI 95%	p
No perform a clinical examination	2,233	[0,722-6,902]	0,1	4,597	[1,189-17,78]	0,027 *
Not using a study model	1,000	[0,373-2,678]	0,655			
No analysis of the the guiding surfaces and shrinkage zones	1,476	[0,669-3,259]	0,168	1,195	[0,439-3,252]	0,727
No use of a Dental Survoyer	1,256	[0,376-4,202]	0,287			
Not drawing the framework design	5,620	[2,172-14,53]	0,005	7,933	[2,697-23,32]	0,001 *
No schedule of check-ups	1,137	[0,374-3,378]	0,476			

*p<0,05
OR: odds ratio
CI: 95% confidence interval (lower bound - upper bound)
Univariate significance level p<0.2
Multivariate significance level p<0.05

DISCUSSION

In our study, we tried to evaluate dentists' practices in the region of Rabat-Sale-Kenitra concerning the design of removable partial dentures with metal infrastructure and their impact on the failure of the prosthetic achievement.
The realization of a DPR can be a challenge for the newly-qualified graduate dentist to achieve a satisfactory and comfortable prosthesis due to the variety of patients' oral situations and complex indications of the different metal framework elements. **[5]**
The dental scientific literature is replete with evidence of the harmful effects of inappropriate DPR design on the patient's oral structures and support. **[6]**
It is important to keep in mind that the pre-prosthetic reflection aims to evaluate the therapeutic possibilities to rehabilitate the edentulous while preserving the remaining oral structures in a healthy state for the longest possible period. **[2]**
To achieve this aim, "primum non nocere" would be the clinician's first concern. **[6]**
A thorough clinical examination, proper diagnosis, treatment planning, and clinical procedures adapted to the clinical situation are the key steps for successful prosthetic rehabilitation with removable partial dentures. **[7]**
Before starting the RPD design, a complete oral examination with vitality tests and periodontal probing is essential, complemented by an intraoral radiographic examination.
Clinical findings are enhanced by the examination of correctly oriented casts on an appropriate articulator. the pre-prosthetic reflection is made after the collection and the synthesis of all these clinical data with the Surveying cast and will involve several biological, biomechanical, and aesthetic parameters and will thus be concretized by design made according to the rules of ethics **[8] [2]**
An encouraging finding from this study is that majority of the interviewed practitioners, 83%, perform a complete and detailed examination of their patients. 17% of them do not, and the practitioners with the most years of experience were those who performed the adequate clinical examination and produced study models.
Another factor deserves to be highlighted. It is derived from the study design. We found that 80% of the

practitioners questioned tended to use it, but 20% did not see the need for it, which deprives them of an essential part of the information necessary for pre-prosthetic reflection.
The Dental Surveyor is a diagnostic instrument very useful to find relative parallelism of two or more surfaces of the teeth or other parts of the cast, to determine the path of placement and removal, and to plan and execute the surfaces modifications of the abutment teeth involved in the support, stabilization, and retention of the prosthesis. **[2][7]**
In its 2005 report, the **British Society for the Study of Prosthetic Dentistry** recommends that the clinician's responsibility to produce the highest quality RDPs under ethical and legal obligations respecting mechanical and biological principles. Furthermore, it states that "*the dentist should examine the cast and choose the most appropriate insertion path for the prosthesis*. "**[9]**
Unfortunately, the results are impressive since only 24% of the practitioners use it, and 48% analyze the guiding planes and retentive areas. The least experienced dentists (between 1 and 10 years old) perform the most analysis.
These results agree with those of a study made in **Senegal (2020),** which showed that 73% of the dental technicians are permanent or occasional users of the Dental Surveyor. This means that a vast majority of the models received in the laboratory do not contain any information relating to the path of placement and removal and the analysis of the guiding planes and retentive areas. **[10]**
Another study conducted in **Toulouse 2013** reveals that 23% of practitioners used a Dental Surveyor**. [11]**
KILFEATHER and Al **(U.K 2009)** report that only 6% had provided surveyed casts. **[12]**
This is missing for practitioners who risk losing an important source of information that is sometimes the key to success.
Another factor of the success of prosthetic rehabilitation is the programming of the control and maintenance sessions. Periodic evaluations and follow-up treatment and care are essential to the successful wearing and functioning of the prosthesis. They are intended to minimize post-insertion problems resulting from one or more of the following difficulties: comfort, function, esthetics, and phonetics. **[2] [7]**
According to the results of this study, 92% of practitioners schedule follow-up sessions, while 8% do not. The most common complaints experienced by their patients are the appearance of wounds (22%), prosthetic instability (13%), retention problems (7%), or a combination of more than one complaint (58%).
In a study conducted in the **United States**, **Hummel and Al** reported that among the 1303 removable partial dentures included in this study, 65% had at least one defect, ranging from fractured clasps to prosthetic instability, including degradation of the abutment teeth and retention problems. **[13]**
Defining prosthetic failure by a fracture of the RPD abutment teeth or by a combination of more than two complaints declared by the patient (occurrence of injuries, prosthetic instability, and absence of prosthetic retention), we tried to evaluate through ordinal logistic regression the relationship between the prosthetic failure and the dentists' practices.
We find that only the negligence of the adequate clinical examination and the delegation of the design to the prosthetist intervene in the occurrence of the prosthetic failure. **[14]**

CONCLUSION

The lack of clinician control over the prosthesis design exposes the patient to the risk of caries and periodontal disease, prosthetic instability, and problems of patient acceptability and tolerance. They can be minimized by ensuring adequate oral health of the remaining teeth and periodontal tissues and by following biological and biomechanical guidelines when designing the RPD. How can we explain these practices of dentists? Is it a laxity of the practitioner who tends to allege an overload of work? A lack of professional experience? Or are they a reflection of the dentist's degree of training? Dentists with specialized training - and therefore a greater degree of knowledge and skill - perform appropriate designs, while other, perhaps less qualified, colleagues do not? The answers to these questions are beyond the scope of this study but will be explored in the future.

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AUTHORS' CONTRIBUTIONS
The participation of each author corresponds to the criteria of authorship and contributorship emphasized in the Recommendations for the Conduct, Reporting, Editing, and Publication of Scholarly work in Medical Journals of the International Committee of Medical Journal Editors. Indeed, all the authors have actively participated in the redaction, the revision of the manuscript, and provided approval for this final revised version.

COMPETING INTERESTS
The authors declare no competing interests with this case.

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None.

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