CLINICAL RESEARCH

Evaluation of the design-driven prediction of removable partial denture retention

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Removable partial dentures (RPDs) are effective treatments for tooth replacement for partially edentulous patients.[1-4] This type of treatment is used by millions of patients worldwide; however, 66% of patients wearing RPDs are dissatisfied with their treatment, and 40% of them stop wearing them within the first few years of use.[5-7] Therefore, there is a need to improve this treatment option. Complications associated with RPDs are mainly related to inadequate quality and poor design.[1,4,6,7] Improvement in the fabrication process by using digital technologies has improved treatment quality and patient satisfaction.[8,9] However, poor RPD design remains the main reason for patient dissatisfaction as it often

ABSTRACT

Statement of problem. Removable partial dentures (RPDs) are a cost-effective treatment designed to replace missing teeth for partially edentulous patients. However, RPDs often have insufficient retention, which results in treatment failure and patient dissatisfaction.

Purpose. The purpose of this clinical study was to investigate the factors related to RPD retention that affect patient satisfaction, to clinically validate a newly published model for predicting RPD retention based on the number and position of missing teeth and clasps, and to identify the predictions of patient satisfaction to improve the guidelines for RPD design.

Material and methods. Seventy-five patients treated with 107 RPDs delivered at the McGill University Dental Clinic (Montreal, Canada) and Estaing University Hospital (Clermont-Ferrand, France) participated in this study. Data on the RPD design were collected from the clinical records, and the retention of each RPD was tested with the mathematical model designed for predicting RPD retention. Data on patient satisfaction with their RPDs were collected by using a standardized questionnaire (McGill Denture Satisfaction Instrument). Statistical analysis of factors related to RPD retention and patient satisfaction was performed by using the chi-square test and Mann-Whitney test, while the developed model for predicting RPD retention was evaluated by using sensitivity and specificity analysis.

Results. The average satisfaction score for all RPDs was 8.2 ±1.7 out of 10. Patients were more satisfied with RPDs in the maxillary arch, tooth-supported, or retained by ≥3 clasps than with RPDs in the mandibular arch, with distal extension bases, or retained by <3 clasps. The materials used for RPD fabrication (metal-based or acrylic resin-based), the number of missing teeth, and the presence of indirect retention were not associated with patient satisfaction. Participants were significantly more satisfied with RPD designs predicted by the developed mathematical model to have enough retention than with RPD designs predicted to have insufficient retention. The mathematical model for predicting the RPD retention showed a clinical specificity of 83% in predicting patient satisfaction.

Conclusions. RPD retention predicted from the number and position of clasps and missing teeth might help to determine patient satisfaction. In addition, patient satisfaction with RPDs was influenced by the arch type, the presence of a distal extension base, and the number of clasps. (J Prosthet Dent 2020;124:357-64)

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> ## Clinical Implications
> The model for calculating RPD retention may help design better RPDs with more predictable treatment outcomes.

results in poor retention, a main reason for RPD failure.[1,5,7]

Designing RPDs is challenging because there are 65 534 possible presentations of partial edentulism in each jaw, and no current guideline is able to determine the optimal RPD design for each situation.[10-12] Thus, RPDs are usually designed subjectively based on the preference and experience of dental professionals, which may result in poor designs.[12] Recently, it has been reported that predicting the retention of an RPD is possible by using a straightforward calculation based on the RPD design.[12] This mathematical model was developed based on experimental data collected on forces produced by different types of food and clasps (suprabulge and infrabulge clasps) on each tooth.[12] This model determines the amount of dislodging force generated by food mastication and the retention force provided by the clasps. The differences between these 2 values (Fig. 1) could predict whether an RPD design will provide sufficient retention during mastication.[12] Although the model has been validated experimentally in the laboratory, the clinical evidence is still lacking.

Patient satisfaction is an important tool for evaluating the success of treatment,[1,13-19] and patient feedback and opinions are important in RPD treatments because patient dissatisfaction will lead to underuse and subsequent treatment failure.[1,13,15] Patient satisfaction with RPD treatment can be influenced by social and demographic factors such as age, sex, socioeconomic status, general health, lifestyle, and experience with previous dentures, as well as clinical factors such as, comfort, appearance, speech, hygiene, mastication, and denture retention.[8,13-21] Factors related to RPD retention such as the number and location of clasps or missing teeth influence the mechanical performance of the RPD and subsequently patient satisfaction.[21] Wetherell and Smales[22] reported that RPDs with distal extension denture bases fail more often than those in the more retentive tooth-supported situations. This indicates the possible importance of the location of missing teeth on patient satisfaction. However, few studies have investigated this relationship,[14,15] and further research on the factors determining RPD retention could help improve the design of RPDs.

Patients reporting poor RPD retention are often dissatisfied with the treatment; however, the authors are unaware of objective retention assessments correlated with patient satisfaction, and adequate tools are lacking. The newly developed mathematical model to predict RPD retention allows for objective assessments, but investigations as a predictor of patient satisfaction are lacking.[12] The hypothesis of the present clinical study was that patient satisfaction with an RPD depends on its estimated retention. Accordingly, the purpose of this clinical study was to investigate the factors related to RPD retention that affect patient satisfaction and to validate the model for predicting RPD retention based on the number and position of missing teeth and clasps. The goal was to identify the predictors of patient satisfaction to improve the guidelines for RPD design.

MATERIAL AND METHODS

The research protocol was approved by the Institutional Review Board of the Faculty of Medicine at McGill University (A01-B07-16B) and by the Ethics Committee of Clermont-Ferrand University Hospital (CE-CIC GREN-09-12; IRB number 5044). Partially edentulous patients treated with a removable partial denture (RPD) at the McGill University Dental Clinic (Montreal, Quebec, Canada) between 2012 and 2017 and at the Estaing University Hospital (Clermont-Ferrand, France) between 2014 and 2017 were selected for the study. The study design is shown in Figure 2. Patients who met the inclusion criteria were invited to participate in the study, and the research protocol was explained to those who agreed to participate by giving written or verbal consent at their follow-up appointments or by telephone.

The inclusion criteria were partially edentulous patients (>18 years old; of any sex) who had been using RPDs for at least 12 months; this period was chosen because RPD clasps can present fatigue deformation after a few months.[23,24] No restrictions on patient's medical status, type of RPD, type of edentulism, tooth anatomy, or occlusion were imposed. Patients who were deceased, did not answer the telephone, or with no RPD design available in their records were excluded from the study. Also, participants who refused to participate or who were unable to provide written or oral answers in English or French were also excluded.

The participants were asked to answer the McGill Denture Satisfaction questionnaire (Table 1)[25]; patients with both maxillary and mandibular RPDs were asked to answer 2 questionnaires, one for each RPD. The questionnaire had 26 questions that evaluated 8 aspects of patient satisfaction. Participants were asked to answer each question from 0 to 100, where zero meant not satisfied and 100 meant very satisfied, and the scale was then converted to a 10-point scale. An overall satisfaction measurement for each patient was calculated by combining the responses of the 8 satisfaction
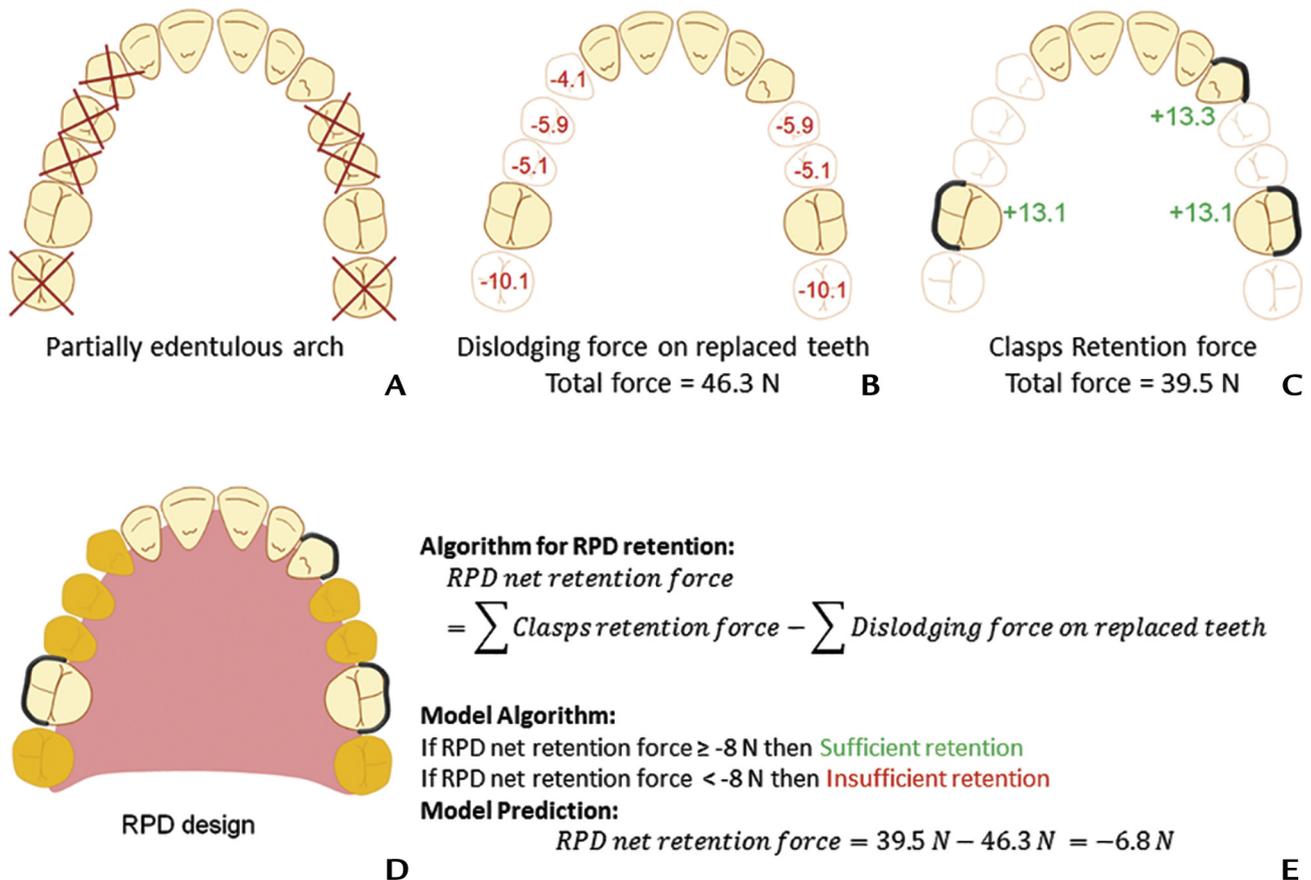
Figure 1. Example of testing RPD retention by model for RPD retention prediction. A, Partial edentulous arch. B, Determining dislodging force by food mastication on missing teeth. C, Determining retention force of RPD clasps. D, RPD design. E, Model algorithm and prediction result.[12] RPD, removable partial denture.

categories of the questionnaire.[21] Then, the degree of satisfaction was created by dichotomizing the overall satisfaction measurement by using a cutoff point of 8.0 (close to the median value of 8.4), and the patients were divided into 2 categories, satisfied (≥8.0) and dissatisfied (<8).[21]

The RPD designs and other factors affecting RPD retention were retrieved from the participants' files. The data were categorized into groups according to arch type (maxillary or mandibular), RPD type (acrylic resin or metal), type of edentulism (distal extension bases or tooth-supported), number of missing teeth (≤5 or ≥6), number of clasps (2 or ≥3), and presence of indirect retention. The factors related to RPD retention were tested for associations with patient satisfaction scores. The retention of the selected RPDs was calculated by using the mathematical model (Fig. 1)[12] available online at www.ebhnow.com. The participants were unaware of the calculating process. To calculate the retention of each RPD by using the mathematical model, the missing teeth and the type and position of the clasps were used as the input. Then, the model calculated the retention force (net force) of the RPD, which was the sum of the retention force provided by all the clasps minus the dislodging force generated on all the replaced teeth.[12] Then, the model predicted the RPD retention as either sufficient (RPD net force ≥ 8 N) or insufficient (RPD net force < 8 N). Finally, the predictions of the mathematical model were compared with the results of the questionnaire.

To calculate the sample size for this study, the correlation coefficient was anticipated to be 0.5 (r), giving a sample size of at least 64 participants for a power of 90%, type I error α=.05 and type II error β=.01. The chi-square test was used to determine significant relationships between patient satisfaction outcomes and factors affecting RPD retention. The Mann-Whitney U test was used to test for significant differences between the categorized groups for each satisfaction item. Multiple regression analysis was used to identify the predictions of RPDs retention with the factors associated with patient satisfaction. The validity of the model for predicting RPD retention was tested with sensitivity and specificity analyses. A statistical software program (IBM SPSS Statistics, v23.0; IBM Corp) was used for all statistical analyses (α=.05).
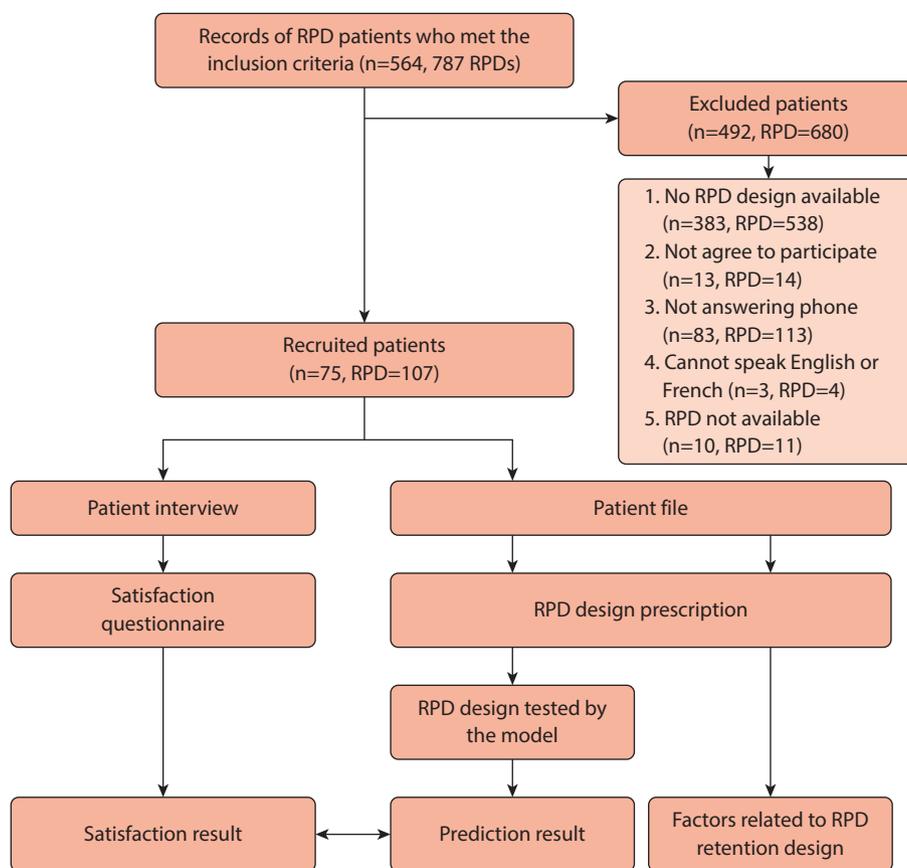
Figure 2. Flow diagram showing study design.

RESULTS

In total, 107 RPDs were worn by 75 participants, and participants were satisfied with 72 of these RPDs (67%). Table 2 shows the distribution of 6 factors related to RPD retention and their association with patient satisfaction. A significantly larger portion of participants were satisfied with maxillary RPDs (n=47) compared with mandibular RPDs (n=60) (P=.026), with tooth-supported RPDs (n=23) than compared with distal extension base RPDs (n=84) (P=.023), and with RPDs with ≥3 clasps (n=65) compared with 2 clasps (n=42) (P=.026). No statistically significant association (P>.05) was found between patient satisfaction and RPD type (metal-based RPDs, n=97; and acrylic resin-based RPDs, n=10), the number of missing teeth (≥6, n=51 and ≤5, n=56), or presence of indirect retention (present, n=51; and not, n=56).

The average satisfaction score for all RPDs was 8.2 ±1.7. Maxillary RPDs had higher general satisfaction scores than mandibular RPDs (P=.035) (Table 3). Patients were more satisfied with the comfort (P=.002), appearance (P=.025), retention (P=.007), mastication (P=.004), and oral condition (P=.021) of tooth-supported RPDs than with distal extension base RPDs. Patients with ≤5 missing teeth were more satisfied than patients with ≥6 missing teeth in terms

of ease of cleaning (P=.017) and speech (P=.028). RPDs with ≥3 clasps had higher satisfaction scores than RPDs with 2 clasps in terms of retention (P=.024) and mastication (P=.003).

The model for predicting RPD retention was validated clinically (Table 4). Patients were more satisfied with RPDs predicted by the model to provide sufficient retention than with those predicted to provide insufficient retention in terms of comfort (P=.007), appearance (P=.010), retention and stability (P=.008), and mastication ability (P<.001) (Table 3). In addition, among the 43 RPDs predicted to have acceptable retention by the model, 37 were reported to be satisfactory by the patients. Only 6 RPDs did not follow the positive prediction. Similarly, 29 of 64 RPDs predicted by the model to have insufficient retention were considered unsatisfactory by the participants. However, the other 35 RPDs predicted by the model to have insufficient retention were found satisfactory by the participants. Thus, the model for predicting RPD retention had a specificity of 83%, a sensitivity of 51%, a positive predictive value of 86%, a negative predictive value of 45%, and accuracy of 62%.

Statistically significant associations were found between the predictions for RPD retention generated by the

Table 1. List of items on patient satisfaction questionnaire

N	Question Statement
1	How difficult is it to clean your prosthesis?
2	In general, are you satisfied with your prosthesis?
3	How difficult is it for you to speak because of your prosthesis?
4	Are you satisfied with the comfort of your prosthesis?
5	Are you satisfied with the appearance of your prosthesis?
6	Are you satisfied with the retention (tightness) of your prosthesis?
7	Are you satisfied with the ease of removal of your prosthesis?
8	Does your denture rock forward and backward when you chew?
9	Do you find that your denture comes out easily while chewing?
10	Do you find that your denture comes out easily while speaking?
11	Do you find that your denture comes out easily with your tongue?
12	In general, do you find it difficult to chew food because of your prosthesis?
13	How difficult is it to eat fresh white bread because of your prosthesis?
14	How difficult it is for you to eat hard cheese because of your prosthesis?
15	How difficult it is for you to eat raw carrots because of your prosthesis?
16	How difficult it is for you to eat sliced steak because of your prosthesis?
17	How difficult it is for you to eat raw apples because of your prosthesis?
18	How difficult it is for you to eat lettuce because of your prosthesis?
19	In general, is your food well chewed before swallowing?
20	Are pieces of fresh white bread well chewed before swallowing?
21	Are pieces of hard cheese well chewed before swallowing?
22	Are pieces of raw carrot well chewed before swallowing?
23	Are pieces of sliced steak well chewed before swallowing?
24	Are pieces of raw apple well chewed before swallowing?
25	Are pieces of lettuce well chewed before swallowing?
26	In general, are you satisfied with your oral condition?

Table 2. Distribution of categorical variables in study and association between patient satisfaction and 6 factors that might be related to RPD retention

Factors	Average Satisfaction Score	Satisfied Patient, N (%)	Dissatisfied Patient, N (%)	P	OR (95% CI)
Arch					
Mandibular	7.8 ±1.7	35 (58%)	25 (42%)		1
Maxillary	8.5 ±1.5	37 (79%)	10 (21%)	.026*	2.64 (1.11-6.28)
RPD type					
Acrylic resin	7.8 ±1.8	5 (50%)	5 (50%)		1
Metallic	8.1 ±1.6	67 (70%)	30 (30%)	.221	2.23 (0.60-8.29)
Type of edentulism					
Distal extension bases	8.0 ±1.6	52 (62%)	32 (38%)		1
Tooth-supported	9.0 ±1.2	20 (87%)	3 (13%)	.023*	4.10 (1.13-14.92)
Number of missing teeth					
≤5	8.3 ±1.5	42 (75%)	14 (25%)		1
≥6	7.9 ±1.7	30 (59%)	21 (41%)	.075	0.48 (0.21-1.10)
Number of clasps					
2	7.7 ±1.6	23 (55%)	19 (45%)		1
≥3	8.4 ±1.6	49 (75%)	16 (15%)	.026*	2.53 (1.10-5.80)
Indirect retention					
Present	8.4 ±1.4	36 (65%)	20 (35%)		1
Not	8.0 ±1.9	36 (70%)	15 (30%)	.488	1.16 (0.49-2.75)

OR, odds ratio; RPD, removable partial denture. Satisfied patients defined as those reporting overall satisfaction score of 8 or above. *Significant difference at P<.05.

model and patient satisfaction (P=.015), the type of edentulism (P≤.001), the number of clasps (P=.002), and the number of missing teeth (P≤.001) (Table 5). No association was found between the predictions for RPD retention and arch location of the RPD (P=.861), the type of RPD (P=.176), or the presence of indirect retention (P=.486).

DISCUSSION

The hypothesis of this study was confirmed by showing that patient satisfaction with RPDs can be predicted by the retention estimated from their design. As the biomechanical problems associated with RPDs could be mitigated by improving their design,[1,6,21] a new engineering model for predicting and optimizing the retention of RPDs was established.[12] The authors are unaware of a previous clinical study that evaluated and validated a model for predicting RPD retention that may improve RPD design and enhance the quality of life for millions of patients worldwide.[1,8,9]

The model was validated clinically as its predictions for RPD retention were associated with patient satisfaction (Table 5). Indeed, 86% of RPDs predicted to have sufficient retention presented high patient satisfaction during food mastication. This is probably because patient satisfaction depends on retention and mastication, which also affect comfort, appearance, and overall satisfaction

(Table 3). As expected, the model predictions for RPD retention were also associated with the number of clasps and missing teeth replaced by the RPDs.[12]

Only 6 RPDs failed to follow the positive predictions of the model, and the participants were dissatisfied with them despite being predicted to have sufficient retention. Four of these RPDs had cast frameworks, and patients were dissatisfied with the retention. This was expected because cast frameworks tend to have poorer retention than laser-sintered RPDs.[9] The other 2 RPDs were made of laser-sintered frameworks, and the participants were satisfied with the retention but dissatisfied with other factors such as comfort, speech, and oral conditions.

The ability of the model to predict dissatisfaction was deficient, as several participants were satisfied with RPDs predicted to have insufficient retention. This is probably because patient satisfaction is multifactorial. In summary, the model is excellent for predicting satisfactory RPDs but not for predicting unsatisfactory RPDs. Therefore, this model is an excellent tool for designing retentive RPDs.

This study showed that RPD retention and patient satisfaction are also influenced by factors such as arch type, presence of distal extension bases, and number of clasps. The positive association between patient satisfaction and the number of clasps was expected because clasps provide retention against the

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Table 3. Results of average satisfaction score (±SD) of each item in questionnaire according to categorical groups of 6 factors that might be related to RPD retention and outcomes of model prediction

Factors	Q1: Cleaning	Q2: General Satisfaction	Q3: Speech	Q4: Comfort	Q5: Appearance	Q6-11: Retention	Q12-25: Mastication	Q26: Oral Condition
All RPDs	9.0 ±1.8	8.0 ±2.4	8.2 ±2.6	7.8 ±2.4	9.0 ±1.7	8.3 ±2.1	7.8 ±2.0	8.3 ±2.1
Arch								
Mandibular	8.9 ±1.9	7.5 ±2.6*j	8.0 ±2.8	7.5 ±2.6	8.7 ±2.1	8.0 ±2.3	7.7 ±2.1	8.1 ±2.1
Maxillary	9.2 ±1.6	8.5 ±2.0*j	8.5 ±2.2	8.3 ±2.0	9.3 ±0.9	8.6 ±1.7	8.3 ±1.7	8.6 ±1.9
RPD type								
Acrylic resin	8.4 ±1.9	7.9 ±2.1	7.4 ±2.7	8.6 ±1.7	8.6 ±1.4	8.0 ±1.7	7.4 ±2.2	7.8 ±2.3
Metallic	9.1 ±1.8	8.0 ±2.5	8.3 ±2.5	7.8 ±2.4	9.0 ±1.8	8.3 ±2.1	8.3 ±2.0	8.2 ±1.7
Type of edentulism								
Distal extension bases	8.9 ±2.0	7.8 ±2.6	8.1 ±2.7	7.5 ±2.4*b	8.8 ±1.8*i	8.0 ±2.2*e	7.7 ±2.0*d	8.0 ±1.6*h
Tooth-supported	9.6 ±0.6	8.7 ±1.7	8.9 ±1.7	9.0 ±1.6*b	9.6 ±0.7*i	9.2 ±1.0*e	8.9 ±1.6*d	9.1 ±1.5*h
Number of missing teeth								
≤5	9.5 ±1.0*h	8.0 ±2.3	8.8 ±2.2*i	7.8 ±2.4	9.1 ±1.6	8.5 ±1.8	8.2 ±1.9	8.4 ±2.0
≥6	8.5 ±2.3*h	8.0 ±2.6	7.7 ±2.8*i	7.9 ±2.3	8.9 ±2.3	8.0 ±2.3	7.7 ±2.1	8.2 ±2.1
Number of clasps								
2	8.8 ±1.9	7.9 ±2.3	8.1 ±2.7	7.6 ±2.3	8.9 ±1.5	8.0 ±1.7*h	7.3 ±2.1*c	8.1 ±2.1
≥3	9.2 ±1.7	8.0 ±2.5	8.3 ±2.5	8.0 ±2.4	9.0 ±1.7	8.4 ±2.3*h	8.4 ±1.8*c	8.4 ±2.0
Indirect retentions								
Present	8.8 ±2.2	8.2 ±2.0	8.8 ±2.2	8.1 ±2.2	8.9 ±1.8	8.6 ±1.6	8.2 ±1.9	8.7 ±2.3
Not	9.5 ±1.1	7.8 ±2.9	7.9 ±2.8	7.4 ±2.6	9.2 ±1.7	7.9 ±2.6	7.8 ±2.1	8.0 ±2.3
Calculation retention								
Insufficient	8.8 ±2.0	7.7 ±2.6	7.9 ±2.7	7.4 ±2.4*e	8.7 ±1.8*g	7.9 ±2.2*f	7.5 ±2.0*a	8.0 ±2.2
Sufficient	9.4 ±1.5	8.5 ±2.1	8.8 ±2.2	8.4 ±2.2*e	9.4 ±1.5*g	8.7 ±1.7*f	8.7 ±1.7*a	8.7 ±1.8

RPD, removable partial denture; SD, standard deviation. *Significant difference between categorized groups P: a<.001, b=.002, c=.003, d=.004, e=007, f=.008, g=.01, h=.02, i=.03, j=.04.

Table 4. Validity of predicting RPD retention by mathematical model at different satisfaction degrees of overall patient satisfaction and for different types of edentulism

Cut Points	Specificity (95% CI)	Sensitivity (95% CI)	Positive Predictive Value (95% CI)	Negative Predictive Value (95% CI)	Accuracy (95% CI)
Satisfaction score of 6.0	73% (45-92%)	45% (34-55%)	91% (81-96%)	18% (13-23%)	48% (39-58%)
Satisfaction score of 7.0	76% (53-92%)	48% (37-59%)	89% (79-95%)	26% (21-33%)	53% (43-63%)
Satisfaction score of 8.0	83% (66-93%)	51% (39-63%)	86% (74-93%)	45% (39-52%)	62% (52-71%)
Satisfaction score of 8.5	78% (63-88%)	58% (45-71%)	76% (64-84%)	61% (53-69%)	67% (58-76%)
Satisfaction score of 9.0	70% (57-80%)	63% (46-78%)	53% (42-64%)	77% (69-84%)	67% (58-76%)
Satisfaction score of 8.0 for tooth-supported RPDs	NC	95% (75-100%)	86% (85-85%)	NC	83% (61-95%)
Satisfaction score of 8.0 for distal extension bases	91% (75-98%)	35% (22-49%)	86% (66-95%)	46% (40-52%)	56% (45-67%)

CI, confidence interval; NC, cannot be calculated; RPD, removable partial denture.

dislodging forces of mastication and oral movements.[1,2] A greater number of clasps would be expected to provide additional retention. In this study, participants were more satisfied with maxillary RPDs, probably because of the better stability provided by the palatal support than the reduced stability caused by ridge resorption and tongue movement in mandibular RPDs.[14,21] The better stability of maxillary RPDs results in enhanced speech, comfort, retention, mastication, and oral condition. In addition, restoring anterior maxillary teeth is more important for patients in terms of appearance.

This study also showed that patients with tooth-supported RPDs were more satisfied than patients with distal extension base RPDs, especially regarding comfort and oral condition. This is probably because distal extension base RPDs present more biomechanical problems, discomfort, pain, clasp failure, and subsequent loss of retention than tooth-supported RPDs.[3,14,21,22] Indeed, patients are more likely to keep using tooth-supported RPDs than distal extension base RPDs.[14]

This study showed that 67% of RPDs were considered satisfactory by patients. This satisfaction rate is higher than the 33% satisfactory rate reported by another study.[6] This difference might be because most of the RPDs in the present study were fabricated by laser-sintering, which results in RPDs of better

Table 5. Results of association between predictions of model for predicting RPD retention and outcomes of overall patient satisfaction set at score of above 8 and factors related to RPD retention

Factors	Average Satisfaction Score	Calculated Retention, N		Crude		Adjusted[b]	
		Sufficient	Insufficient	P	OR (95% CI)	P	OR (95% CI)
Satisfied patients							
No	7.7 ±1.7	6	29		1		1
Yes	8.8 ±1.3	37	35	.001[a]	5.11 (1.89-13.79)	.015[a]	4.63 (1.35-15.92)
Arch							
Mandibular	7.8 ±1.7	21	39		1		1
Maxillary	8.5 ±1.5	22	25	.150	1.63 (0.75-3.57)	.861	0.92 (0.34-2.47)
Type of edentulism							
Distal extension bases	8.0 ±1.6	21	63		1		1
Tooth-supported	9.0 ±1.2	22	1	<.001[a]	66.0 (8.39-519.9)	<.001[a]	67.70 (8.41-544.89)
Number of clasps							
2	7.7 ±1.6	4	38		1		1
≥3	8.4 ±1.6	39	26	<.001[a]	14.25 (4.54-44.70)	.002[a]	6.47 (1.94-21.45)
RPD type							
Acrylic	7.8 ±1.8	3	7		1		1
Metallic	8.1 ±1.6	40	57	.370	1.63 (0.40-6.72)	.176	5.76 (0.45-73.03)
Number of missing teeth							
≤5	8.3 ±1.5	35	21		1		1
≥6	7.9 ±1.7	8	43	<.001[a]	0.11 (0.04-0.28)	<.001[a]	0.45 (0.01-0.22)
Indirect retention							
Yes	8.4 ±1.4	19	32		1		1
No	8.0 ±1.9	21	25	.264	0.70 (0.31-1.56)	.486	1.46 (0.50-4.26)

CI, confidence interval; OR, odds ratio; RPD, removable partial denture. [a]Significant difference at $P<.05$. [b]Ratio adjusted for type of arch and type of edentulism.

quality and higher patient satisfaction.[8] However, dissatisfied patients may be less likely to respond or agree to participate in the study, which may lead to overestimation of the level of satisfaction.

Limitations of this study should be considered for future improvement of models for better RPD designs. The model presented here only considered RPD retention and did not account for other factors such as comfort, esthetics, and oral condition. In addition, the accuracy of the model for predicting the retention of RPDs with distal extension bases is lower than that for tooth-supported RPDs. One important reason is that distal extension base RPDs are supported by the residual ridges and the indirect retainers that prevent RPD denture base movement; these were not accounted for in this model.[4] Also, other details that influence RPD frame design such as the position of the undercuts, number and location of rest seats, and distribution of missing teeth were not considered in this version of the model.

CONCLUSIONS

Based on the findings of this clinical study, the following conclusions were drawn:

1. The model for predicting RPD retention was an excellent tool for designing retentive RPDs and predicting patient's perception of RPD retention.

2. Participants were likely to be satisfied with RPDs designed according to the predictions of the new model designed for optimizing RPD retention.
3. Participants were more satisfied with maxillary RPDs, tooth-supported RPDs, and RPDs with ≥3 clasps.

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Noteworthy Abstracts of the Current Literature

Patient-reported outcomes of metal and acrylic resin removable partial dentures: A systematic review and meta-analysis

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Purpose. Metal removable partial dentures (RPDs) are often considered long-term treatment options for partially edentulous patients, while acrylic resin RPDs are considered interim treatments. The aim of this review was to compare metal and acrylic resin RPDs regarding patient-reported outcomes for partially edentulous individuals.

Material and methods. Four databases (MEDLINE, EMBASE, CENTRAL, and Web of Science) were systematically searched for observational studies and randomized controlled trials comparing patient-reported outcomes between metal and acrylic resin RPDs. The primary outcome was patient satisfaction. Included studies were assessed for risk of bias using the Cochrane risk of bias in nonrandomized studies of interventions tool (ROBINS-I) and the Cochrane Collaboration Risk of Bias Tool for Randomized Controlled Trials. The level of evidence was evaluated using Oxford Center for Evidence-based Medicine tool. A random-effects model was used to analyze the data.

Results. A total of 15 studies were included in the systematic review; 10 in the meta-analysis. The pooled effect size for patient satisfaction and oral health-related quality of life showed no statistical significant difference between metal and acrylic resin dentures (0.22, 95% confidence interval -0.01, 0.45, $P=0.06$; 1.45, 95% confidence interval -2.43, 5.33, $P=0.46$, respectively). Compliance with using RPDs was significantly higher in patients with metal compared to patients with acrylic resin dentures (pooled odds ratio=0.57, 95% confidence interval 0.45, 0.73, $P<0.001$). Most studies had critical to serious risk of bias and low level of evidence.

Conclusions. The reviewed studies showed that there was no significant difference between metal and acrylic resin RPDs in patient satisfaction and oral health-related quality of life. Metal dentures were associated with higher patient compliance rates and were preferred more by patients compared to acrylic resin dentures. However, the reviewed studies had low levels of evidence and therefore, high-quality randomized controlled trials are needed to conclusively address the question of this review.

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