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ORIGINAL ARTICLE

Prevalence of partial edentulism and RPD design in patients treated at College of Dentistry, Imam Abdulrahman Bin Faisal University, Saudi Arabia

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Abstract This study aimed to investigate the prevalence of partial edentulism, RPD type, design, and components and their frequency of use by patients at the prosthodontic clinics of the College of Dentistry, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia. The prepared surveys, laboratory authorization forms, and images of the RPD metal frameworks on casts were used for data collection. Two calibrated investigators studied the digital photographs to identify the Kennedy classification, type of RPD, major connector, clasp assembly, and other details. Data was collected and analyzed statistically. The results showed that the most common class of partial edentulism was Kennedy class I, whereas class IV was the least ($p < 0.001$). Sixty two percent of fabricated RPDs had metal frameworks, whereas 37.2% were frameless. RPI was the most frequently used clasp assembly (38.9%), a significant finding in Kennedy class I($p < 0.01$). The maxillary anteroposterior palatal strap and mandibular lingual plate were the most commonly used major connectors, at 41.2% and 60.8%, respectively. Conclusions: Simple RPD design that accomplishes the treatment objectives as well as proper communication with a well-trained dental technician would promote the success of RPDs.

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1. Introduction

In spite of the reduced rate of tooth loss, the need for removable prosthodontic treatment is still high (Ettinger et al., 1984; Gad, 2017). The most important reason to seek prosthetic replacement of missing teeth is to improve

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appearance (Ettinger et al., 1984; Al-Quaran et al., 2011). Other reasons include the restoration of speech, mastication, confidence, and psychological well-being (Olusile and Esan, 2002). Removable partial dentures (RPD) are a versatile, cost-effective, and reversible treatment modality to replace missing teeth in partially edentulous patients (Al-Quaran et al., 2011). In low socioeconomic areas, acrylic resin–based RPDs are preferred to metal alloy–based RPDs because they are more affordable, in addition to being easy to fabricate and alter if further tooth loss occurs (Graqham et al., 2006).

Prosthetic rehabilitation must preserve the remaining structures and coordinate with the masticatory system (Carr and Brown, 2011). If the fabricated RPD does not follow the biological and mechanical considerations, considerable damage might occur to remaining hard and soft tissues (Carr and Brown, 2011; Phoenix et al., 2008). The resulting quality of a dental prosthesis depends on meticulous intraoral examination, diagnosis, proper planning, and execution to obtain the best retention and stability properties of a prosthesis (Lechne et al., 1998). RPDs are commonly stereotyped for being inefficient, destructive to remaining oral structures, painful, and esthetically lacking (Lechne et al., 1998) because some clinicians delegate the task of RPD design to dental technicians after making primary impressions for the patient without any prior intraoral preparation.

Although the incidence of tooth loss in patients treated with RPDs has been studied (Ettinger et al., 1984; Manski et al., 2001; Graqham et al., 2006), details regarding treatment procedure are yet to be investigated. Therefore, this survey-based study was done to identify the prevalence of different classes of partial edentulism, the most commonly used types of RPDs, direct retainers and major connectors, and their frequency of use among patients attending prosthodontic clinics at the College of Dentistry, Imam Abdulrahman Bin Faisal University, Saudi Arabia. Moreover, this study aimed to assess the most common technical or planning failures of RPDs. This will enable the establishment of a database of RPD treatments and provide valuable clinical information for the purpose of training. Further analysis of the type of prostheses requested, design instructions given, compliance of lab technicians to given instructions may clarify some of the reasons for defective RPDs.

2. Materials and methods

This cross-sectional study included partially edentulous patients who attended the prosthetic dental clinics at the College of Dentistry, Imam Abdulrahman Bin Faisal University, between September 2016 and May 2018. The patients were treated by undergraduate students and interns under the supervision of faculty members. After proper history taking, clinical examination, treatment planning, designing, mouth preparing, and final impression making, master casts and laboratory authorization forms were sent to different dental laboratories in the Eastern Province. Data was collected using a survey (Fig. 1) filled out by the operator and appended to a copy of the lab authorization form and photos of RPD metal framework on master casts.

2.1. Data collection

2.1.1. Survey, photographs, and lab authorization form

Three hundred fifty surveys were distributed, of which 171 fulfilled the requirements of inclusion criteria of being appended to lab authorization forms and digital photos of metal framework on master casts. Cases missing one or more of the requirements were excluded. All photographs were taken by one operator using a digital camera. The digital photographs were examined on a PC monitor to record investigated characteristics. All photos were examined by two calibrated prosthodontic faculty members to record Kennedy classification, RPD type, major connector, direct retainers, and other details. Metal frameworks were studied for RPD components and their requirements and specifications (Carr and Brown, 2011; Phoenix et al., 2008; Davenport et al., 2000a; 2001a, 2001b, 2001c, 2000b). Lab authorization forms were used to compare the metal framework to the planned RPD design.

Statistical Package for Social Sciences (SPSS, version 19) was used for data entry and analysis. Cross-tabulations were used to present descriptive statistics. In inferential statistics, comparison of means between two independent samples was required, and the two-independent-sample *t*-test was used. Runs test was used to check the occurrence of an outcome among various possible outcomes within a variable. Similarly, if two outcomes would be possible, one sample binomial test was used.

3. Results

A total of 248 photographed casts and 171 surveys were used for data collection. The average age of the patients was 49.18 ± 12.16 years. There were 98 (57.3%) male patients and 73 (42.7%) female patients with average ages of 49.5 ± 11.89 years and 48.75 ± 12.7 years, respectively. Fig. 2 shows the descriptive data pertaining to patients' ages and gender. As shown in Fig. 3, out of 248 RPDs, 157 (63.3%) were definitive and 91 (36.7%) were interim RPDs. Definitive RPDs were significantly more numerous in the mandible (*P*-value = 0.022), accounting for 97 (68.8%). While maxillary definitive RPDs numbered 60 (56.1%). According to Kennedy classification (Table 1), class I dentures were found in nearly half the cases in both jaws, which was significantly higher (*P*-value < 0.001) than other classes (n = 118, 47.58%), followed by classes II and III, accounting for 71 (28.62%) and 50 (20.16%), respectively, whereas class IV was the least frequently occurring classification with statistical significance (*P*-value < 0.001). For both jaws, classes without modifications (no additional edentulous spaces) represented the majority of cases for class I (80.1%) in the maxilla and class II (81.6%) in the mandible, while modifications were more common in class II for the maxilla (42.4%) and class III for the mandible (28.6%).

The type and distribution of maxillary major connectors are listed in Table 2. The anteroposterior (A-P) palatal strap connector ranked first (41.7%), followed by full palatal plate (28.3%); the single palatal bar was the least common major connector (1.7%). For mandibular major connectors (Table 2), the use of a lingual plate (60.8%) was significantly greater than

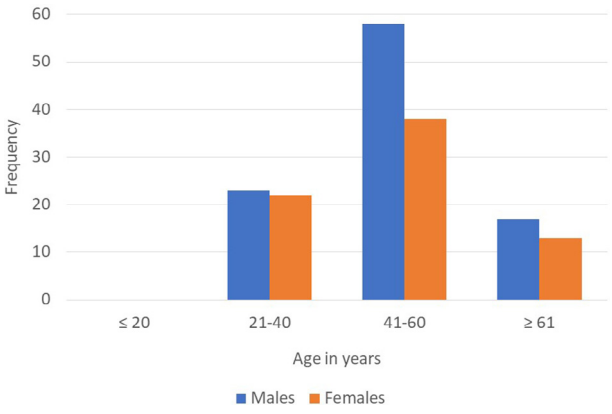

Fig. 2 Age and gender distribution of the patients.

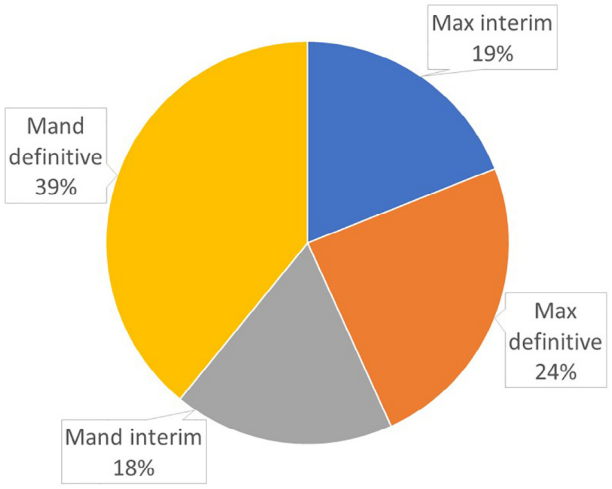

Fig. 3 Variation of treatment type (definitive or interim) for all cases.

the lingual bar (39.2%) (*P-value* = 0.05). Interestingly, neither a labial bar nor a swing-lock framework was used.

Regardless of the classification of edentulism, RPI was the most commonly used direct retainer in both jaws (*P-value* = 0.00) (Table 3). The two most common maxillary direct retainers were RPI clasps with 33.3% (n = 40) and Aker clasps with 18.3% (n = 22) whereas Roach and RPA clasps presented the lowest incidence of occurrence at 5.8% (n = 7) and 2.5% (n = 3), respectively. Similarly, mandibular most common direct retainers were RPI clasps representing 42.8% (n = 74) of all clasps followed by reverse Aker 15.6% (n = 27) while Roach clasp had the lowest number of encounters, with 4% (n = 7) (Table 3). Other clasp types, such as the combination, multiple circlet, extended arm, half and half, and back action clasps, were not seen in either arch.

3.1. Common errors in the casts and RPDs

A number of errors were observed while collecting the data for the study. Few ring clasps were fabricated as closed rings (10 out of 29, 35%) where ideal ring clasp should be opened at one end to engage the retentive undercut. Five out of 22 (22.7%) lingual bars did not extended to connect the most posterior clasp assembly that was connected to the minor connector for the denture base. Some cases had the clasp arms placed too close to the occlusal surface with retentive arms above the survey line. Arms of Aker clasps were away from tooth surfaces and considered extensions of the shoulder, which caused them to lack function. Fourteen of 60 (23.3%) maxillary major connectors lacked beading on the intaglio surface or were overextended distal to the last minor connector, causing unnecessary coverage of the soft tissues (seen in nine cases). A number of mandibular major connectors did not fulfill the requirements of a lingual plate (7 out of 59, 11.9%) or the lingual bar (11 out of 38, 28.9%). Improper design for step-back of the major connector for arches with diastemas, as well as leaving the external surface of the mandibular major connector textured were also seen in few cases. Fractures and chips of abutment teeth of final casts in addition to reassembling the fractured parts with superglue, which negatively affected the relation between abutment teeth and metal framework, were also seen in 18 of all cases. Minor connectors acting as approach arms for infra-bulge clasps were too short (seen in seven cases) which resulted in loss of flexibility. Almost all cases of mandibular Kennedy classes I and II, had the minor connector joining the denture base acrylic extended all the way to cover the retromolar pad. Few frameworks were returned from the lab with wax rims attached for jaw relation, which might interfere with metal framework fitting. All noticed errors were reported and new casts were sent back to the laboratory for new metal framework fabrication.

4. Discussion

An RPD that restores missing structures and minimizes harm to remaining hard and soft tissues is considered a practical and feasible mode of treatment. Framework design is required to

Table 1 Distribution of dentures demanded according to Kennedy classification. (No Mod. = no.

Class	Maxilla				Mandible				Total
	No Mod.	Mod.	Total	%	No Mod.	Mod.	Total	%	
I	38	9	47	43.9	52	19	71	50.3	118
II	19	14	33	30.8	31	7	38	26.9	71
III	15	7	22	20.6	20	8	28	19.6	50
IV	5	–	5	4.7	4	–	4	2.8	9
Total	77	30	107		107	34	141		248

Variation in Kennedy classification in maxilla was not significantly different (0.89) (Runs test).
Variation in Kennedy classification in mandible was not significantly different (0.92) (Runs test).

Table 2 Maxillary and mandibular major connectors (MC) per Kennedy class.

Arch	MC	Class I	Class II	Class III	Class IV	Total (%)
Maxilla	Palatal Bar	1	–	–	–	1 (1.7)
	Single Strap	–	6	3	–	9 (15)
	A-P Strap	11	9	5	–	25 (41.7)
	U-Shape	–	2	5	1	8 (13.3)
	Full Plate	12	4	–	1	17 (28.3)
Mandible	Lingual Bar	15	10	12	1	38 (39.2)
	Lingual Plate	41	14	4	–	59 (60.8)

Variation in major connectors was not significantly different for the maxilla (P = 0.716) (Runs test).
Use of lingual plate was significantly higher compared to lingual bar in the mandible (P = 0.05) (one sample binomial test).

Table 3 Maxillary and mandibular direct retainer distribution per Kennedy class.

Direct retainer	Maxilla					Mandible				
	Class I	Class II	Class III	Class IV	Total (%)	Class I	Class II	Class III	Class IV	Total (%)
Aker	3	9	10	–	22 (18.3)	4	8	10	1	23 (13.3)
Embrasure	–	9	10	2	21 (17.5)	–	6	5	1	12 (7)
Reverse Aker	9	7	3	–	19 (15.8)	18	7	2	–	27 (15.6)
Ring	1	5	2	–	8 (6.8)	1	10	10	–	21 (12.1)
RPA	–	2	1	–	3 (2.5)	5	1	3	–	9 (5.2)
RPI	21	15	4	–	40 (33.3)*	50	17	7	–	74 (42.8)*
Roach	4	1	1	1	7 (5.8)	3	3	1	–	7 (4)
Total	38	48	31	3	120 (1 0 0)	81	52	38	2	173 (1 0 0)

* Denotes statistical significance ($P < 0.001$) among different groups (retainer type) within the arch.

make a denture of adequate strength and durability that will not deform a restored occlusion (Öwall et al., 1995; Fej'erdy et al., 2008). Therefore, the RPD design and related information, as well as efficient communication with lab technicians, are mandatory for RPD success. To attain these objectives in the current study, in addition to the examination of metal framework on the cast, digital photographs of casts were used.

The use of RPDs has increased in patients 41–60 years of age. The number of males (57.3%) treated in this study was significantly higher than that of the females. This frequency is similar to that reported by Öwall et al. (1995) and dissimilar to others, such as Toremalm and Öwall (1988), and Fej'erdy et al. (2008).

The current study showed that (63.3%) of the RPDs were definitive with metal frameworks, and only (36.7%) were frameless RPDs (acrylic dentures). This is in agreement with Öwall and Taylor (1989), who found that 95% of analyzed RPDs had cast metal frameworks. This might be explained by the fact that treatment was provided in a school setting, following the academic guidelines of treatment. In addition, Kennedy class I and II cases comprised a higher percentage of cases in which metallic RPDs were recommended rather than acrylic. Contrary to the current study, acrylic resin RPDs are far more common than cast metal framework RPDs in several other countries (Radhi et al., 2007; Lynch and Allen, 2007; Schwarz and Barsby, 1980). The capabilities of the dental laboratory, level of education, and intraoral conditions all appear to influence the treatment option selected (Schwarz and Barsby, 1980).

Other findings indicated lower prevalence of RPDs for maxillary arche than for mandibular one, which might be related to esthetic considerations. Many patients would refuse treatment with RPDs in the maxilla to avoid the display of metallic components.

Kennedy class I RPD was found in nearly half of the cases (47.6%), which was significantly high, followed by classes II, III, and IV ($P < 0.001$). These results come in line with Curtis et al. (1992), who found that 40% of 327 work authorization forms were for Kennedy class I, followed by class II (33%), class III (18%), and class IV (9%) cases.

The percentages of Kennedy class II and III RPDs for both arches were 28.6% and 20.2%, respectively. It was somewhat expected to see a smaller number of class III cases due to the possibility of restoring many tooth-bounded edentulous areas with fixed dental prostheses. Previous studies have shown varying patterns of demand for RPDs. Fouda et al. (2017) reported Kennedy class III, Osborne and Lammine (1974) reported Kennedy class I, and Bassey (1985) reported Kennedy class IV as the most common edentulous arches for which patients demanded tooth replacement.

According to the results of this study (Table 2), the A-P strap was the most dominant maxillary major connector, followed by the full palatal plate. Although a full palatal plate was indicated for Kennedy class I and extensive maxillary edentulous areas (Carr and Brown, 2011; Phoenix et al., 2008), our results showed that the A-P strap was the most frequently used major connector, which could be due to patients' desire for minimal palatal coverage. The U-shaped major connector was less frequently used, in agreement with previous findings (Phoenix et al., 2008), possibly due to its mechanical deficiency and tendency to flex during handling or mastication (Pellizzer et al., 2012), contrary to the results of Öwall and Taylor, who found that the U-shaped major connector was used more (55.2%) than other maxillary major connectors (Öwall and Taylor, 1989). Others reported the single palatal strap as the most commonly used maxillary major connector,

at 70.5% (Curtis et al., 1992) and 53% (Öwall et al., 1995). The results of our study match those of LaVere and Krol (1973), who preferred the usage of a posterior palatal strap, A-P strap, and full palatal plate.

Based on the results of the present study, the use of the lingual plate (60.8%) was significantly higher than that of the lingual bar (p-value = 0.05) (Table 2). It is more likely that this was due to strength requirements for long span class I, when stability and indirect retention were required (Pun et al., 2011).

According to the results of the present study, the RPI clasp assembly was the most commonly used direct retainer in both arches (p-value < 0.001), followed by circumferential clasps. For tooth-tissue supported RPDs, stress-breaking systems were indicated. Whereas circumferential clasps were favored in tooth-supported partial dentures (Henderson et al., 1985). This relation between clasps and partial edentulism classification was confirmed by the results of this study, in which higher prevalence of classes I and II was recorded than classes III and IV.

In the present study, Aker clasps were found in 15.3% of situations contradicting the findings by Curtis et al. (1992), who stated that they were extensively used (62.7%), even with distal extension partial dentures. On the other hand, results showed that reverse Aker was widely used in both jaws with classes I, II, and III, contradicting the results of Keyf (2001) who reported that usage of the reverse Aker clasp was not seen. For unmodified classes II and III partial dentures, embrasure clasps were used on the contralateral side of the edentulous space. Similar results were reported by Keyf (2001) and Al-Dwairi (2006). The prevalence of ring clasps recorded in our study was 6.7% and 12.1% for the maxilla and mandible, respectively. This is in agreement with Al-Dwairi (2006), who found that ring clasps were more commonly seen in mandibular arches than in maxillary ones.

The present study found many errors in the metal frameworks, some of which were related to the operators, although the majority was due to technicians' infraction of laboratory authorization forms. Any failure in the components of RPDs may indicate negligence of fundamental biomechanical principles, contempt of the acquired knowledge or poor undergraduate training (Johnson and Wildgoose, 2010; Neto et al., 2010; Neto et al., 2011; Torres et al., 2011). Good communication and a properly completed work authorization form with clear and detailed instructions accompanied by the drawn design on the master cast are all essential components to fabricate a successful framework (Davenport et al., 2000c).

The results of the present study are beneficial in evaluating the quality of RPDs given to patients. It also provides important information for educational and training purposes. However, the relatively small sample and the collection of data from one institution are considered a limitation of the study. Further longitudinal studies are required, and those from different areas of the Eastern Province of Saudi Arabia with larger sample size will result in a better representation of the population in this area.

5. Conclusions

1. The mean age of the patients seeking RPD treatment or with partial edentulism was 49.18 years, with higher prevalence of male patients.
2. The most frequently encountered partial edentulism was Kennedy class I, with higher prevalence in the mandible.
3. The major connectors frequently encountered were the A-P palatal strap in the maxilla and lingual plate in the mandible.
4. The RPI clasp has high frequency with tooth-tissue supported RPDs, whereas Aker clasp is common with tooth-supported RPDs.
5. Continuous education, good communication, and familiarity with RPD basic principles are mandatory to attain proper and effective RPD prosthesis.

Ethical statement

We wish to confirm that there are no known conflicts of interest associated with this publication and there has been no significant financial support not mentioned within the manuscript for this work that could have influenced its outcome.

Declaration of Competing Interest

The authors declare no conflict of interest.

Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.sdentj.2019.07.002.

References

Al-Dwairi, Z.N., 2006. Partial edentulism and removable denture construction: a frequency study in Jordanians. Eur. J. Prosthodont. Restor. Dent. 14, 13–17.
Al-Quaran, F.A., Al-Ghalayini, R.F., Al-Zu'bi, B.N., 2011. Single tooth replacement: Factors affecting different prosthetic treatment modalities. BMC Oral Health 11, 34.
Bassey, I.E., 1985. The prosthetic requirements of partially edentulous patients as seen in Lagos University Teaching Hospital. Nig. Q. J. Hosp. Med. 3, 49–51.
Carr, A.B., Brown, D.T., 2011. McCracken's Removable Partial Prosthodontics (ed 12). Elsevier, St. Louis, pp. 95–128.
Curtis, D.A., Curtis, T.A., Wagnild, G.W., et al, 1992. Incidence of various classes of removable partial dentures. J. Prosthet. Dent. 67, 664–667.
Davenport, J.C., Basker, R.M., Heath, J.R., et al, 2000a. A system of design. Br. Dent. J. 189, 586–590.
Davenport, J.C., Basker, R.M., Heath, J.R., et al, 2001a. Clasp design. Br. Dent. J. 190, 71–81.
Davenport, J.C., Basker, R.M., Heath, J.R., et al, 2000b. Communication between the dentist and the dental technician. Br. Dent. J. 189, 471–474.
Davenport, J.C., Basker, R.M., Heath, J.R., et al, 2001b. Connectors. Br. Dent. J. 190, 184–191.
Davenport, J.C., Basker, R.M., Heath, J.R., et al, 2001c. Indirect retention. Br. Dent. J. 190, 128–132.
Davenport, J.C., Basker, R.M., Heath, J.R., et al, 2000c. Surveying. Br. Dent. J. 189, 532–542.
Ettinger, R.L., Beck, J.D., Jakobsen, J., 1984. Removable prosthodontic treatment needs: a survey. J. Prosthet. Dent. 51, 419–427.
Fej'erdy, P., Borb'ely, J., Schmidt, J., et al, 2008. Removable partial denture design and its effect on remaining teeth, based on Hungarian national survey. Fogorv. Sz. 101, 3–11.

Fouda, S.M., Al-Harbi, F.A., Khan, S.Q., et al, 2017. Missing teeth and prosthetic treatment in patients treated at College of Dentistry, University of Dammam. Inter. J. Dentistry 7593540, 6.

Gad, M.M., 2017. Removable partial denture designing: variation of hard and soft tissue anatomy and maxillary major connector selection. Int. J. Dentistry Oral Sci. 4, 457–463.

Graqham, R., Mihaylov, S., Jepson, N., et al, 2006. Determining need for a removable partial denture: A quantitative study of factors that influence dentist provision and patient use. Br. Dent. J. 200, 155–158.

Henderson, D., McGivney, G.P., Castleberry, D.J., 1985. McCracken's Removable Partial Prosthodontics. CV Mosby. St. Louis, Toronto, Princeton, pp. 21–126.

Johnson, A., Wildgoose, D.G., 2010. Partial denture design comparisons between inexperienced and experienced undergraduate students and the teaching staff of a UK dental school. Br. Dent. J. 209, 287–292.

Keyf, F., 2001. Frequency of the various classes of removable partial dentures and selection of major connectors and direct/indirect retainers. Turk. J. Med. Sci. 31, 445–449.

LaVere, A.M., Krol, A.J., 1973. Selection of a major connector for the extension-base removable partial denture. J. Prosthet. Dent. 30, 102–105.

Lechne, S.K., Thomas, G.A., Bradshaw, M., 1998. An interactive multimedia solution to learning removable partial denture design. J. Prosthodont. 7, 177–182.

Lynch, C.D., Allen, P.F., 2007. The teaching of removable partial dentures in Ireland and the United Kingdom. Br. Dent. J. 203, E17.

Manski, R.J., Moeller, J.F., Maas, W.R., 2001. Dental services. An analysis of utilization over 20 years. J. Am. Dent. Assoc. 132, 655–664.

Neto, A.F., Duarte, A.R.C., Shiratori, F.K., et al, 2010. Evaluation of senior Brazilian dental students about mouth preparation and removable partial denture design. J. Dent. Educ. 74, 1255–1260.

Neto, A.F., Silva, R.S.G., Diniz, A.C., et al, 2011. Ethics in the provision of removable partial dentures. Braz. J. Oral Sci. 11, 19–24.

Olusile, A.O., Esan, T.A., 2002. Pattern of demand of removable partial dentures in Ile-ife. Niger J. Health Sci. 2, 6–8.

Osborne, J., Lammine, G.A., 1974. Partial Denture. Blackwell Scientific Publishers, Oxford London, Edinburgh, Melbourne, pp. 3–5.

Öwall, B.E., Bieniek, K.W., Spiekermann, H., 1995. Removable partial denture production in western Germany. Quintessence Int. 26, 621–627.

Öwall, B.E., Taylor, R.L., 1989. A survey of dentitions and removable partial dentures constructed for patients in North America. J. Prosthet. Dent. 61, 465–470.

Pellizzer, E.P., Almeida, D.A., Falcón-Antenucci, R.M., et al, 2012. Prevalence of removable partial dentures users treated at the Aracatuba Dental School-UNESP. Gerodontology 29, 140–144.

Phoenix, R.D., Cagna, D.R., DeFreest, C.F., 2008. Stewart's Clinical Removable Partial Prosthodontics. Quintessence, Hanover Park, pp. 8–17.

Pun, D.K., Waliszewski, M.P., Waliszewski, K.J., et al, 2011. Survey of partial removable dental prosthesis (partial RDP) types in a distinct patient population. J. Prosthet. Dent. 106, 48–56.

Radhi, A., Lynch, C.D., Hannigan, A., 2007. Quality of written communication and master impressions for fabrication of removable partial prostheses in the Kingdom of Bahrain. J. Oral Rehabil. 34, 153–157.

Schwarz, W.D., Barsby, M.J., 1980. A survey of the practice of partial denture prosthetics in the United Kingdom. J. Dent. 8, 95–101.

Toremalm, H., Öwall, B., 1988. Partial edentulism treated with cast framework removable partial dentures. Quintessence Int. 19, 493–499.

Torres, E.M., Rocha, S.S., Carvalho, M.A., et al, 2011. Evaluation of planning for removable partial denture and quality of casts and prescriptions sent to the dental laboratories. Rev. Odontol. Bras Central 20, 25–30.