Quality of communicating design features for cobalt chromium removable partial dentures in Riyadh, Saudi Arabia

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Introduction

Although tooth/implant-supported fixed dental restorations are usually more preferred for the restoration of edentulous spaces, the removable partial denture (RPD) remains a viable treatment option for the replacement of missing teeth in partially edentulous mouths (1). This is mainly related to economic and technical factors (2). The RPD is, relatively, a conservative, simple and inexpensive type of treatment. It does not require high clinical or technical skills nor advanced technologies compared to implant-supported prostheses (3). Moreover, it is a reversible treatment option so in case of denture failure or patient’s dissatisfaction a dentist in agreement with the patient can switch to tooth/implant-supported fixed dental restorations to restore the dental spaces. In addition, the RPD can be the single restoration option when various contraindications preclude the use of tooth/implant-supported fixed dental restorations (4). Furthermore, the findings of epidemiolog-
Materials and Methods

Twelve commercial dental laboratories located in Riyadh city, the capital of Saudi Arabia, were contacted and invited to take part in this survey. Two laboratories declined participation; one laboratory apologized due to lack of facility to construct cobalt chromium RPDs and 9 laboratories approved to participate. The geographical location of participating laboratories comprised the different sectors of Riyadh. Five laboratories were in the northern sector and one in each of the remaining sectors of Riyadh, i.e., east, west, middle and south. Five laboratories provide work for both private and governmental dental centers/hospitals and 4 laboratories provide work for only the private dental sector.

The nine participating commercial dental laboratories were surveyed over a period of more than 6 months. The aim of the survey was to target partially edentulous cases that were sent from dentists working in Riyadh for the fabrication of clasp-retained cobalt chromium RPDs. Arrangements were made with the designated laboratories to keep records for the all constructed RPDs and frequent visits were made by the second author to examine the collected cases. During each visit dentists’ prescriptions were scrutinized, targeted casts were examined and a special data collection form was completed. The data collection form was a modified version of the one that was used in a previous investigation (30). Before the outset of the survey, the developed form was also distributed among 6 dental technicians to provide feedback about the clarity and feasibility of the contents. The noted remarks were considered in the final draft of the research form.

The study form sought information relating to:

- Laboratory address and location in Riyadh.
- Dental center address and location in Riyadh.
- Type of practice (governmental or private).
- Type of the examined cast (maxillary or mandibular).
- Kennedy classification (Class I, Class II, Class III and Class IV).
- Number of standing teeth.
- Number of dental spaces.
- Who made the RPD design? (the dentist alone, the technician alone, both the dentist and the technician).
- Methods of communicating the RPD design (verbal instructions, written instructions, diagram, drawing on the cast, none).
- Whether the design features of each component of the RPD was provided by the dentist (i.e. major connectors, direct retainers and rests)?
- Type of the major connector as provided by the dentist.
- Evidence of preparation of rest seats.

Prescriptions were examined following the fabrication of the metal framework. This is to ensure that no further design instructions could be provided by the dentist and one could be certain that no relevant information was missed. Photographs and digital records were made for the examined cases. When needed, dental technicians at the designated laboratories were consulted to clarify any confusing points upon scrutinizing dentists’ prescriptions and associated casts. Both authors discussed and agreed the collected data.

Statistical analysis

Survey data were analyzed using the SPSS statistical package (IBM SPSS Statistics for Windows, Version 20.0, Released 2011, IBM Corp, Armonk, New York, USA). Descriptive statistics presented the characteristics of the examined cases and frequency tables were generated to illustrate the used methods for communicating design features of the prescribed RPDs as provided by the dentists. Also, a frequency table was made to demonstrate the quality of rest seat preparation among the surveyed cases.

In order to quantify the quality of instructions for the RPD design as provided by the dentist to the dental technician, a quality score was developed. The quality score was calculated according to the number of prescribed design elements as shown in Table 1.
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The quality scores were presented according to type of cast and Kennedy classification. T-test for independent samples and the one-way ANOVA were utilized to examine the association between mean score of the quality of the provided instructions and type of cast/Kennedy classification. The significance level was set at \( p < 0.05 \).

**Results**

Over the period of this survey, a total of 162 dentists’ prescriptions for RPDs and associated casts were examined. The collected cases came from a variety of dental centers that were located in the different geographical areas of Riyadh city. The vast majority of the surveyed cases came from the private sector (92.6%). Number of mandibular casts slightly exceeded that of maxillary ones (52.5% compared to 47.5%). Kennedy Class I cases were the most frequent (53.7%) and Kennedy Class IV cases were the least frequent (3%). Characteristics of the examined cases are presented in Table 2.

Examination of dentists’ prescriptions and related casts showed that most of the RPD cases were designed by the dental technician alone (64.2%). In these cases, the dentists did not send any instructions about the design of the requested RPD. Only 16% of the RPDs were designed by the dentist alone. The dentist and dental technician shared the design of the partial denture in almost 20% of the examined cases. Methods of communicating the design of RPD varied between dentists. Almost 12% of the dentists provided verbal instructions, a minority sent written instructions (8.6%) and 5.6% provided a diagram about the proposed design of the RPD. The design of the denture was drawn on the cast in 10% of the cases. Shape of the major connector was indicated by the dentist in 58 cases (35.8%). Type and position of the direct retainers were determined in about 20% of the cases and denture rests were prescribed by the dentist in 21% of the examined casts and prescriptions. The former results are illustrated in Table 3.

The mean quality score of dentists’ instructions was approximately 1. Only 18% of the provided instructions achieved quality score equal to 4. The quality score was 0 among the majority of the examined cases (64.2%) and in 18% of the cases the quality score ranged between 1 and 3 indicating insufficient instructions for the design of RPD. No association was identified between type of cast, i.e. maxillary or mandibular, and quality scores of the instructions (\( p>0.05 \)). On the contrary, an association was found between Kennedy classification of the restored dentition and quality
scores of the provided instructions as Kennedy Class III cases achieved significantly higher mean quality score compared to Kennedy Class II cases (p<0.05) (Table 4).

When a major connector was prescribed by the dentist, the horseshoe design followed by the palatal plate design, were the most prescribed connectors for the maxillary RPDs. On the other hand, the lingual bar and lingual plate designs were the dominant connectors for the mandibular RPDs (Table 5).

The working casts of the RPDs were examined for an evidence of rest seats preparation. The results indicated that rest seat preparation was unpopular practice as only 16.7% of the evaluated casts had clearly defined rest seat preparation (Table 6).

**Discussion**

Research to investigate quality of current dental practice on an international level is still limited (17). Extensive research to underline the status of today’s dental practice and development of guidelines for quality dental care is highly recommended. In Saudi Arabia, over the last three decades there has been wide expansion in dental education and growing number of dental graduates (31). This was coupled with rapid growth in the delivery of oral health services (32-33). Despite these facts, information about quality of present dental care in Saudi Arabia is quite scarce. So far, only few attempts have been made to address this important issue (34-35). While this study evaluates the quality of communicating design features for RPDs, it can be considered a starting point and call for researcher to investigate the standard of current dental services in Saudi Arabia on all levels. This is in order to achieve a national goal of standard dental care for all people.

The RPD is one of the prosthodontic treatment options for the replacement of missing teeth. Although RPDs have their limitations and contraindications, the RPDs have also certain advantages and indications (4, 36). General dental practitioners worldwide are still expected to possess the required clinical skills to offer their patients such simple treatment option. The superiority and attractiveness of tooth/implant-supported
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fixed partial dentures do not justify low interest in learning the topic of RPDs or poor management of this treatment modality. Principles of construction RPDs should be respected to maximize the chance of success and any negligence on this part is, professionally and ethically, not accepted.

In a survey of commercial dental labs in Athens, Greece (37), the constructed RPDs were mostly for Kennedy Class I dentitions. In a recent Saudi study for the prevalence of missing teeth and type of provided prosthetic treatment (16), most of the patients with Kennedy class I or class II were treated with RPDs. In this survey, characteristics of the examined cases reveal clear predominance for Kennedy Class I and Class II in the study sample (Table 2). It appears that the higher need/demand for treatment with RPDs is associated with the presence of free-end saddles or missing posterior support.

Overall, the results indicate poor quality of communicating design features for RPDs among dentists in Riyadh, Saudi Arabia. This is consistent with the findings of previous international studies (24, 27, 28, 38-40). The quality scores of the provided instructions for RPD design were very low among the majority of the examined cases (Table 4). The reliance on dental technicians to perform the design of the RPD seems huge. This means a production of RPDs with no account to the clinical and biological findings. The final likely outcome, could be, a provision of faulty dentures with damaging effect and poor prognosis. This is clearly a mark of malpractice (17).

In the UK and Ireland, the quality of written instructions for the design of cobalt chromium RPDs was attributed to educational factors (41). Major problems in teaching the design and construction of cobalt chromium RPDs during the vocational training of dental graduates were identified (41). Dental educators in Saudi Arabia should take the results of this survey into account when planning dental curricula and prosthodontic courses of continuing professional development. Further research, perhaps of qualitative nature, is warranted to understand the reasons behind such inappropriate professional behavior among practicing dentists in Riyadh, Saudi Arabia.

In an Irish survey (39), the authors used very similar criteria to that used in our survey to quantify the level of prescription for cobalt chromium RPDs. Four design variables were scrutinized in dentists’ written instructions (39). These include: configuration of denture base, retention (design of clasps, material and position), support (position and distribution of rests), and design of the major connector. The four design variables were found in 10% of the examined written instructions. In 7% of the prescriptions there were three design variables, in 13% two design variables were found, in 17% one design variable was identified and 53% of the prescriptions were lacking any design variables (39). In the current survey the aforementioned figures are compared to 17.9%, 1.9%, 2.5%, 13.6% and 64.2% respectively (Table 4).

While no relation was established between quality of the provided instructions and type of dental cast for the treated case, an association was determined between Kennedy classification and quality of prescription (Table 4). The reliance of the surveyed dentists on the technicians to design cases with Kennedy Class II appears to be greater than the other Kennedy Classes. An explanation for this finding cannot be provided and it is recommended to search this point in future studies.

In this investigation, the design of cobalt chromium RPDs was delegated entirely to the dental technician in 64.2% of the examined cases. This number is compared to 57% in the neighboring Kingdom of Bahrain (23) and 89.5% in the United Arab Emirates (26). However, this comparison cannot be claimed to be accurate as the examined samples for cobalt chromium RPDs in Bahrain and UAE were very small (n =14 and 19 respectively). In an earlier study in Saudi Arabia, a self-administered questionnaire was used to collect information about quality of written instructions in the work authorization form and the level of communication between dentists and dental technicians for fixed and removable prosthodontics (34). Data was obtained from dental technicians working in the Dental College at King Saud University. The results indicated that 49.6% of the examined written instructions were judged as clear and in 34% of the fixed and removable cases the dental technician had to communicate with the dentist to obtain more clarification regarding certain written instructions. With RPDs, the author reported that the design was made by the dentist in 95% of the evaluated work authorization. However, all these cases were made in a University environment by a specialist, a demonstrator, a postgraduate student, an intern or a dental student. As the design of that survey was different from the design of our survey, no valid comparison can be made between their findings.

Using a diagram or a drawing on the cast to communicate the design of the RPD seems to be uncommon method of communication among dentists in Riyadh, Saudi Arabia (Table 3). This also was the case in Ireland as only 7% of the dentists provided a diagram in their prescriptions for cobalt chromium RPDs (39). In the Kingdom of Bahrain, the proportion of dentists who provided a diagram in their prescriptions for the cobalt chromium RPDs was 43% (23). This is compared to 5.6% in the current survey. In the UAE, 36.85% of the dentists sometimes use a drawing for the RPD design and 63.2% never/rarely do that (26). In this survey, 10% of the dentists communicated the design of the RPD through a drawing on the cast. It should be remembered again that the number of the examined cases in Bahrain and UAE was very small and the validity of any comparison with the results of this survey can be questioned.

Table 3 illustrates that when instructions were provided, the shape of the major connector was the most frequent element to be prescribed by the surveyed dentists (35.8%). This is similar to the outcome of a UK survey where the design of the major connector was the most common component in dentists’ prescriptions (59%) (30). The reason why dentists in this survey give more attention to the design of the major connector in comparison with the other elements of the cobalt chromium RPDs is not clear.

Despite the shortcomings of the horseshoe connector in terms of flexibility and wide coverage of dental and gingival tissues, this design of a major connector was the most prescribed for the maxillary RPDs (Table 5). This is in agreement with the results of a Greek survey (37). Unfortunately, the design of this study does not allow us to identify the reasons behind such practice. In the mandible, only two types of major connectors were noted in dentists’ prescriptions. These comprise the lingual bar and lingual plate. Similarly, these types of mandibular major connectors were found to be popular among dentists in the UK (30, 38, 42). The biological and hygienic merits of the lingual bar are well-known.
to practitioners (38). Although the lingual plate is the most rigid mandibular connector, it may encourage plaque accumulation and risk the health of the supporting dental and gingival tissues (43). However, the lingual plate is well tolerated by a majority of patients and may contribute to indirect retention of the RPD (38, 44).

The dependence of the surveyed dentists on the dental technician to design the direct retainers of the RPD is alarming. Prescription of the type and position of the denture clasps was recorded in almost 20% of the cases (Table 3). This is compared to 47.7% in an Iranian survey (28).

Preparation of rest seats is an essential part of mouth rehabilitation to receive a metal RPD. Adequate rest seat preparation is important for denture support and effective indirect retention. Nonetheless, the results of this survey underline poor practice with respect to rest seat preparation. Evidence of rest seat preparation was missing in the majority of the examined master casts (Table 6). In the UAE survey (26), rest seat preparation was identified in 13 out of the 19 assessed cast RPD cases (68.4%). However, such small sample may not reflect the current practice among UAE dentists in this respect. In the UK, Nassani et al., (30) reported that preparation of rest seats was encountered in 23% of the studied RPD cases and Rice et al., (45) recognized rest seat preparation in 30% of the assessed casts for cobalt chromium RPDs.

A limitation for this survey is related to the surveyed dental laboratories. The choice of the laboratories was on the basis of practicality and availability of facilities for the fabrication of cobalt chromium RPDs. However, an account was made for the participation of laboratories from the different sectors of Riyadh.

It can be noted that the surveyed cases present a random sample of the constructed RPDs in Riyadh city and were included in the study due to their presence in the participating laboratory at the time of the study. Moreover, the examined cases in this survey came from the different geographical areas of Riyadh and probably present the current practice of general dental practitioners working in Riyadh with regard to communicating design features of cobalt chromium RPDs. However, the results cannot necessarily be generalized to the whole Kingdom of Saudi Arabia. Nevertheless, Riyadh city is the capital of the Kingdom. It hosts the largest turnover of medical and dental services across the country (32). Hence, one could argue that the outcome of this survey provide considerable insight on the current status of prescription for the construction of metal RPDs among dentists working in Saudi Arabia. A future national survey is recommended to confirm the findings.

**Conclusion**

The final outcome of this survey indicates poor quality of communicating the design features of cobalt chromium RPDs among practicing dentists in Riyadh, Saudi Arabia. The reliance on the dental technician to perform the design of the cast RPDs seems to be high. This finding is a sign of malpractice with ethical, legal and clinical implications. Further research, perhaps of qualitative nature, is recommended to understand the reasons behind such inappropriate professional behavior.

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**Türkçe Özet:** Suudi Arabistan Riyad’da kobalt krom hareketli parsiyel protezlerin dizayn özelliklerinin yaylaşılması.AMAÇ: Bu araştırma, kobalt krom hareketli parsiyel protezlerin (HP) dizayn özelliklerinin Suudi Arabistan Riyad’ındaki diş heşpleri arasında paylaşılanmasının incelenmesi amaçlanmıştır. Gerçek ve Yöntem: Riyad’da dokuz ticari dental laboratuvar artırılmıştır. Her ziyarete, kobalt krom HPP için hazırlanmış ana modeler ve diş heşplerinin yönergeleri incelenmiştir. Belirlenen yönergelerin kalitesi skoru 0-4 arasında notlanmıştır. Sıfır skor diş hekiminde laboratuvarında hiçbir yönerge gelmediği anlamına gelmektedir. Skor 4 ise ana bağlayıcının çekili, direkt tutucuların pozisyonu ve tırnakların yerini gibi HPP’nin ana elemanlarının dizaynı için talimatlar verilmediği anlamına gelmektedir. Bulgular: 162 diş hekimli talimatlı ve ilgili modeller incelenmiştir. Vakaların büyük çoğunluğunun hiç teşvik edilmemiş (%64,2). Diz heşplerinin talimatlarında en sık olarak ana bağlayıcının çekili (%35,8), Diz heşplerinin kalırate oratılama %0,96'dır (SS=1,54). Talimatların %18’inde 4 skoru belirlenmiştir. Kennedy Sinifı III vakalarda, Kennedy Sinifı II vakalara oranla daha yüksek kalite skorlarına rastlanmıştır (p<0,05). İncelenen modellerin %16,7’i açıkça tırnak yerini hazırlamayı beklentirmekte. Sonuç: Bu araştırmanın bulguları Suudi Arabistan Riyad’da kobalt krom HPP dizayn özelliklerinin paylaşılması durumunda yetersiz bir kalite göstermektedir. Diz teşviklerinin HPP modeller üzerinde yaptıkları planlamaları olan güven büyütür. Anıhatır kelimer: Kalite, dizayn, kobalt krom, hareketli, parsiyel protезler, Suudi Arabistan

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