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Original research

Turkish adaptation and implementation of the modified infection control questionnaire in intraoral digital imaging

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Purpose

There are very few studies evaluating the knowledge of dentists about infection precautions in oral radiology. The aim of this study was to assess the psychometric properties of the Turkish version of the modified form of a developed questionnaire and to apply this questionnaire to Turkish dentists.

Materials and Methods

The questionnaire was applied to a sample of 250 dentists for the scale development [200 for confirmatory factor analysis (CFA) and 50 for control] and 173 dentists for the implementation of the scale. The scale was applied to 200 dentists and construct validity was examined with CFA. For model fit; chi square to df ratio, RMSEA (Root Mean Square Error of Approximation), TLI (Tucker-Lewis Index), CFI (Comparative Fit Index), GFI (goodness of fit index), AGFI (adjusted goodness of fit index) and NFI (normed fit index) were obtained. Also, reliability analysis was applied and item-total correlations and Cronbach's alpha values were given. Adapted scale scores using a different sample of 173 dentists were compared according to demographic characteristics.

Results

CFA showed good fit statistics (X^2/df=1.511, RMSEA=0.057, TLI=0.942, CFI=0.953, GFI=0.926, AGFI=0.900, NFI=0.928) for the scale. Item-total correlations were over 0.30 and Cronbach's alpha was calculated as 0.877. In addition, experienced dentists had higher scores in the dimension of personal hygiene ($p<0.05$).

Conclusion

The Turkish version of the modified infection control questionnaire in oral radiology showed adequate psychometric properties. This indicated that it could be a valid and reliable tool for the assessment of infection control in oral radiology among Turkish dentists.

Keywords: *Infection control, Cross infection, Dentistry, Radiology, Questionnaires*

Introduction

The passage of infectious agents from person to person is referred to as 'cross-infection'. Dentists, dental assistants, and patients are faced with various microorganisms in their dental practice, among them hepatitis B virus, hepatitis C virus, *herpes simplex* type 1 and type 2 viruses, human immunodeficiency virus, *streptococcus, cytomegalovirus, mycobacterium tuberculosis* are some of these microorganisms (1-3).

Cross-infection may occur during all dental procedures (4). One of these procedures is intraoral digital imaging (5,6). As radiology clinics see many patients in a short period, infection control precautions must be taken in a strict manner (2). It is emphasized that each patient should be considered to be infected and infection control precautions should be performed for all patients during radiography (2,7).

Due to saliva contamination, dental staff and patients are at high risk for cross-infection in intraoral radiography (2,5). Since saliva is difficult to

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discriminate, the risk of infection in intraoral radiography procedures is ever-present (8).

Dental personnel and patients are at high risk of developing tuberculosis, herpes viruses, upper respiratory tract infections, and hepatitis viruses. To prevent cross-infection between dental staff and patients, infection control procedures are performed. During dental radiographic procedures, the performer's hands, the patient's mouth, sensors, tube, exposure button, keyboard, and mouse may be contaminated with saliva. The risk of cross-infection is high in dental radiology. Thus, radiographic infection control precautions must be applied to all patients (3).

To the best of our knowledge, there are very few studies (9,10) in the literature evaluating the knowledge of dentists about infection precautions in oral radiology through the use of a dedicated questionnaire.

The first aim of this study was to assess the psychometric properties (internal consistency and structural validity) of the Turkish version of the modified form of a questionnaire developed by da Costa et al. (9); the second was to apply this questionnaire to Turkish dentists.

Materials and Methods

Before beginning the study, ethical approval was obtained from Pamukkale University Medical Ethics Committee (Research Code No: 60116787-020/77263, Date of approval: 20/11/2017). This work was done in accordance with the principles defined in the Declaration of Helsinki, including all revisions.

A questionnaire developed by Da Costa et al. (9) was used in our study. In the questionnaire of that study, 31 items in nine domains were created. The domains were handwashing, gloves, clothing, accessories, radiographic sensors, protection of radiography equipment, overgloves, overgloves (in digital imaging) and cleaning.

For our study, initially, the questionnaire used in the study of Da Costa et al. (9) was translated from English to Turkish and then re-translated into English by a native Turkish and fluent English speaking dentist who did not participate in the other parts of the study. The infection control questionnaire, consisting of 18 items, was formed according to this revision (Table 1). Thus, the validity was obtained, and the adapted questionnaire was finalized.

The dentists who used digital intraoral imaging were invited to answer the translated Turkish version of the modified infection control questionnaire by e-mail. Also, members of the Turkish Dental Association were invited to do so by their e-mail group.

Study sample

In scale development studies, it is mentioned that the sample size should not be less than 100 and should be at least five times the number of items (11-13). Thus, the questionnaire was applied to 250 dentists for the scale development [200 for confirmatory factor analysis (CFA) and 50 for control] and 173 dentists for the implementation of the scale. 200 dentists completed the survey for CFA. Fifty others completed the questionnaire to provide a control group.

For the second part of the study, the adapted questionnaire was filled in by 173 dentists. The demographic features of the dentists were documented. The dimensions of the

Table 1. *Modified infection control questionnaire*

Questions	1: Never	2: Rarely	3: Sometimes	4: Mostly	5: Always
1: I wear a mask during radiography.					
2: I wash my hands before wearing gloves.					
3: I wash my hands after removing my gloves.					
4: I cover the sensor with a disposable barrier.					
5: I use the disposable barrier (stretch film, aluminum foil, etc.) of the patient's seat used during radiography after each patient.					
6: I cover the x-ray tube head with a disposable barrier.					
7: I cover the exposure button with a disposable barrier.					
8: I cover the computer keyboard with a disposable barrier.					
9: I cover the computer mouse with a disposable barrier.					
10: I use gloves when placing the sensor to the mouth.					
11: I use gloves when dressing the patient lead aprons and thyroid protectors.					
12: I use gloves when setting the x-ray tube head.					
13: I use gloves when pushing the exposure button.					
14: After every patient I disinfect the patient's chair.					
15: After every patient I disinfect the exposure button.					
16: After every patient I disinfect the x-ray tube head.					
17: I regularly disinfect the contact surfaces of the radiographic process.					
18: I disinfect the contact surfaces in the radiography process after individuals with infectious diseases, like hepatitis.					

questionnaire were compared with age, gender, education level (general dentist or specialist dentist) and experience in dentistry (1–5 years, 5–10 years, 10 years and above) with multi-comparison tests. Figure 1 is a flowchart outlining the steps of the method used.

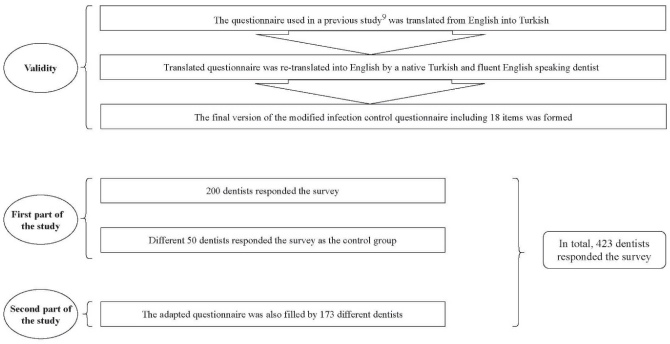

Figure 1. *Flow-process diagram for the preparation and implementation of the survey.*

Data analysis

For construct validity, CFA was used. For model fit; X^2/df ratio, RMSEA (Root Mean Square Error of Approximation), TLI (Tucker-Lewis Index), CFI (Comparative Fit Index), GFI (goodness of fit index), AGFI (adjusted goodness of fit index) and NFI (normed fit index) were obtained. For reliability analysis, item-total correlations and Cronbach's alpha values were given. Adapted scale scores using a different sample of 173 dentists were compared according to demographic characteristics. The normality assumption of the data was examined by the Kolmogorov-Smirnov test before comparing according to demographic characteristics and it was seen that the normal distribution assumption was provided ($p>0.05$). Therefore, t-test was used to compare the two groups and one-way ANOVA was used to compare more than two groups. Tukey test was used for pairwise comparisons after ANOVA. The upper limit of the significance level was accepted as 0.05 for all analyzes. The LISREL 10.2 (Scientific Software International; Lincolnwood, IL, USA) and SPSS 22 package programs (SPSS, Inc.; Chicago, IL, USA) were used to analyze the data.

Results

In total, 423 dentists responded to the survey; 250 for the first part and 173 for the second part of the study.

Validity and reliability analysis

A questionnaire consisting of three dimensions was applied to a group consisting of 200 dentists and its validity examined by CFA. As can be seen in Figure 2, the standardized loads were 0.33 and above.

The fact that the chi square to df value is less than 2 in the model fit coefficients indicates a good fit, and that it is between 2 and 3 indicates an acceptable fit. According to Brown (14), TLI and CFI values being 0.90 or above indicate model fit. GFI values between 0.90 and 0.95 are acceptable,

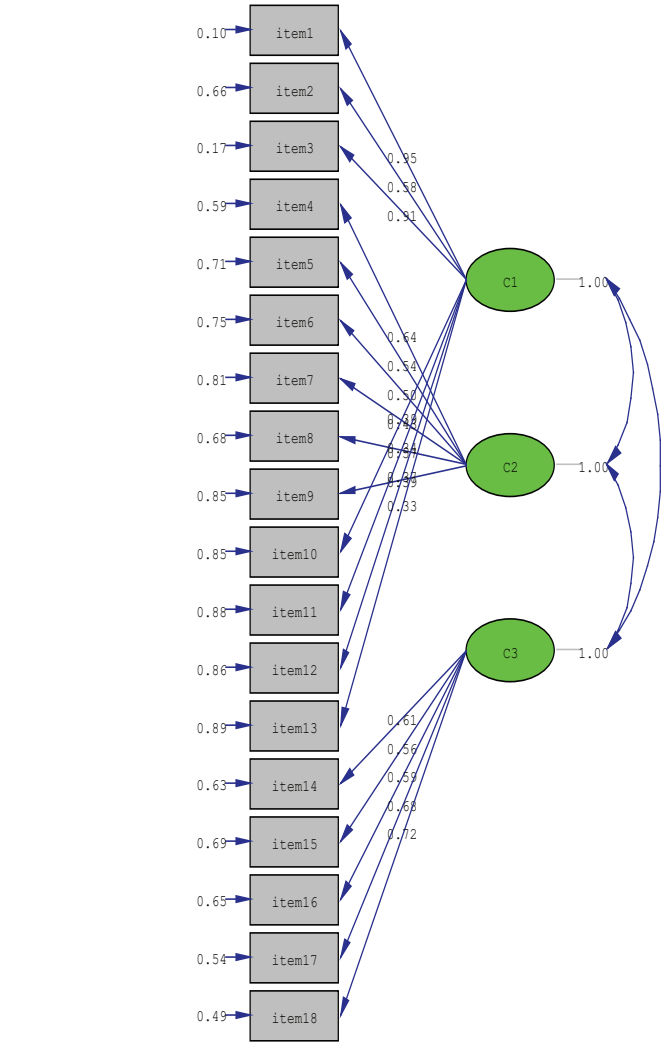

Figure 2. *Confirmatory factor analysis graphic.*

and greater than 0.95 indicates a good fit. (15,16). Values greater than 0.85 are acceptable for AGFI values (17-19). Similar ranges are applicable for NFI (20). According to Browne and Cudeck (21), RMSEA value below 0.08 is another indicator for model fit. In our study, model fit indexes were calculated as: X^2/df=1.511, RMSEA=0.057, TLI=0.942, CFI=0.953, GFI=0.926, AGFI=0.900 and NFI=0.928.

Item-total statistics belonging to the items are given in Table 2. Total correlations of the items were over 0.30. The reliability coefficient for the complete questionnaire was X^2/df = 0.877.

Comparison of the scales in the questionnaire

For the second part of the study, 173 dentists (86 females and 87 males) with a mean age of 36.4 responded to the survey. Table 3 shows the details of the demographic features and comparison of three dimensions. There was no statistically significant difference according to age, gender and education level in the 95% confidence level ($p>0.05$). On the other hand, it was observed that the mean averages were not the same according to professional experience ($p<0.05$). Multi-comparison test results showed that the mean for the first dimension of the individuals with more experience was significantly higher than the others. Besides, it can be said

that the averages of the second and third dimensions did not show a significant difference according to age, gender, education level, and experience, at 95% confidence level (p>0.05).

Table 2. *Item-total statistics of the 18 items*

Dimension	Items	Mean	SD	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Dimension 1 (personal hygiene) (α=0.824)	M1	3,29	,973	,595	,867
	M2	3,73	1,401	,411	,874
	M3	3,53	,834	,400	,874
	M10	2,33	1,474	,525	,869
	M11	1,88	1,344	,556	,863
	M12	2,27	1,543	,581	,860
	M13	1,99	1,404	,559	,868
Dimension 2 (precautions during radiographic procedures) (α=0.876)	M4	3,55	1,548	,521	,865
	M5	1,92	1,497	,504	,870
	M6	3,90	,450	,519	,864
	M7	3,35	1,534	,501	,865
	M8	3,25	1,384	,494	,871
	M9	3,93	1,599	,481	,872
Dimension 3 (precautions after radiographic procedures) (α= 0.859)	M14	3,33	1,503	,572	,861
	M15	3,28	1,507	,688	,854
	M16	3,16	1,541	,625	,857
	M17	3,91	1,361	,522	,869
	M18	3,69	,911	,464	,872

Discussion

Digital imaging in dentistry is rapidly spreading (6). Despite the advantages of lower radiation doses by comparison with conventional film-based radiography – the elimination of chemical processing and the need for storage, for instance – traditional methods remain the norm, and infection control has become a substantial problem (22). According to a Centers for Disease Control and Prevention (CDC) report, digital imaging sensors are categorized as semi-critical devices (5). These devices come into contact with the oral mucosa and should be covered with a barrier and cleaned after each x-ray exposure, in order to reduce cross-contamination.

Few studies (9,10) have been carried out into infection control in oral radiology. In Da Costa et al.'s first study (9), the researchers aimed to create a valid questionnaire for the assessment of infection control in oral radiology. The final version of the questionnaire of Da Costa et al (9), consisting of 31 items in 9 domains, showed good psychometric properties for determining infection control. There were 18 items in our modified version of the Turkish questionnaire. There were three dimensions in our study, compared to nine in the other (9). In our study, item-total correlations were found to be greater than 0.30 and Cronbach's alpha was calculated as 0.877, as in the other study. In construct validity, all the questions in our study had good agreement, while in the other study, most of the questions had a good agreement. The reason for achieving better agreement in our study may be the lower number of questions, compared to Da Costa et al.'s study (9).

After Da Costa et al.'s study (9) of the development and validation of the infection control questionnaire in oral radiology, the researchers applied that questionnaire to 1,006 dentists and 1,203 dental students (10). According to the results of that study, there was no significant association

Table 3. *Demographic features and comparison of the dimensions in terms of the demographic characteristics of the 173 dentists who participated in the second part of the study.*

				Dimension 1				Dimension 2				Dimension 3			
Variable	Category	f	%	Mean	SD	Test	p	Mean	SD	Test	p	Mean	SD	Test	p
Age	20-29	61	35,3	4,17	,69	1.69^{F}	0.17	2,08	,96	1.87^{F}	0.32	3,72	,81	0.01^{F}	0.99
	30-39	56	32,4	4,09	,66			2,07	1,14			3,70	1,00		
	40-49	27	15,6	4,28	,76			2,07	1,31			3,70	,96		
	50 and above	29	16,8	4,35	,68			1,67	,82			3,69	,97		
Gender	Female	87	50,3	4,20	,65	0.77^{t}	0.44	2,00	1,06	-0.10^{t}	0.92	3,79	,94	1.25^{t}	0.21
	Male	86	49,7	4,12	,68			2,02	1,07			3,62	,89		
Education level	General dentist	140	80,9	4,17	,64	0.72^{t}	0.47	1,94	1,05	-1.78^{t}	0.08	3,69	,87	-0.44^{t}	0.66
	Specialist	33	19,1	4,08	,75			2,30	1,09			3,77	1,10		
Experience	1–5 years	56	32,4	4,06^{a}	,58	3.06^{F}	0.04*	1,97	,90	0.62^{F}	0.54	3,66	,76	0.11^{F}	0.90
	5–10 years	39	22,5	4,02^{a}	,69			2,17	1,09			3,74	,97		
	10 years and above	78	45,1	4,29^{b}	,68			1,95	1,16			3,72	1,00		

*p<0.05; ^{F}F value; ^{t}t value; Different letters at mean indicate statistical significance at p<0.05.

with respect to experience in the profession, age, specialty, or working institution, although male dentists had lower scores in infection control than females (10). In the present study, experienced dentists had higher scores regarding personal hygiene. However, no differences were detected according to age, gender and education level. In Da Costa et al.'s study, infection control of the keyboard and mouse was found to be poor (10). Controversially, the results of our survey showed that the barrier protection of the keyboard and mouse had high scores. Also, the protection of the patient chair and radiographic equipment had higher scores in our study. The number of our respondents was lower than in Da Costa et al.'s study (10). This may be explained by the inclusion criteria of our study: we only invited the dentists who took intraoral x-rays themselves.

Gamoh et al. (8) published a survey study about the infection control awareness of dentists and dental hygienists in a university hospital in Japan. According to the results of that study, nearly half of the dentists stated that they washed their hands before putting on gloves. One in four said that they washed their hands sometimes, and one in four that they did not wash them at all. In Gamoh et al.'s study (8), hand hygiene before donning gloves was found to be better in males than in females. Our results were different in this respect, with no significant difference between the genders being found for the personal hygiene dimension.

To the best of our knowledge, our questionnaire-based study is the first systematic attempt to investigate the infection control of Turkish dentists in oral radiology. However, the perceptions and attitudes of 135 Turkish dentists about cross-infection in general dental procedures had previously been studied by Yuzbasioglu et al. (23). According to the results of that study, almost all participants reported that all patients should be considered infectious, and precautions taken in every patient (23). However, they found that only 18.5% of the participants favored barrier protection or cleaning of the dental radiographic equipment. In that study, it was not reported whether the radiographic systems were conventional or digital, intraoral or extraoral imaging systems (23).

Conclusion

The results of the present study showed that the Turkish version of the modified infection control questionnaire in oral radiology showed adequate psychometric properties. This indicated that it could be a valid and reliable tool for the assessment of infection control in oral radiology among Turkish dentists. The study also showed that experienced dentists had higher scores in the dimension of personal hygiene.

Türkçe Özet: *İntraoral Dijital Görüntülemede Modifiye Enfeksiyon Kontrol Anketinin Türkçe'ye Uyarlanması ve Uygulanması. Amaç: Oral radyolojinde enfeksiyon kontrol önlemleri konusunda diş hekimlerinin bilgilerini değerlendiren çok az çalışma vardır. Bu çalışmanın amacı, geliştirilmiş bir anket formunun Türkçe versiyonunun psikometrik özelliklerini değerlendirmek ve bu anketi Türk diş hekimlerine uygulamaktır. Gereç ve Yöntem: Anket, ölçek geliştirme için 250 diş hekimine [doğrulayıcı faktör analizi (CFA) için 200, kontrol grubu için 50 hekim], ölçeğin uygulanması için ise 173 diş hekimine uygulanmıştır. Ölçek, 200 diş hekiminden oluşan örnekleme uygulanmış ve yapı geçerliği CFA ile incelenmiştir. Model uyumu için, x^2/df oranı, RMSEA (ortalama karesel yaklaşım hatası), TLI (Tucker-Lewis indeksi), CFI (karşılaştırmalı uyum indeksi), GFI (uyum iyiliği indeksi), AGFI (ayarlanmış uyum indeksi) ve NFI (normlu uyum indeksi) ölçüleri elde edilmiştir. Ayrıca güvenirlik analizi uygulanmış ve madde-toplam korelasyonları ve Cronbach alfa değerleri verilmiştir. Daha sonra, 173 diş hekiminden oluşan farklı bir örneklem kullanılarak uyarlanmış ölçek puanları demografik özelliklere göre karşılaştırılmıştır. Bulgular: CFA, ölçek için model uyum iyilikleri (x^2/df=1.511, RMSEA=0.057, TLI=0.942, CFI=0.953, GFI=0.926, AGFI=0.900, NFI=0.928) göstermiştir. Madde-toplam korelasyonları 0.30'un üzerindedir ve Cronbach alfa 0.877 olarak hesaplanmıştır. Ayrıca, kişisel hijyen boyutunda tecrübeli diş hekimleri daha yüksek puanlara sahipti ($p<0.05$). Sonuç: Oral radyolojide modifiye edilmiş enfeksiyon kontrol anketinin Türkçe versiyonu yeterli psikometrik özellikler göstermiştir. Bu sonuçlar, anketin Türk diş hekimleri arasında oral radyolojide enfeksiyon kontrolünün değerlendirilmesi için geçerli ve güvenilir bir araç olabileceğini göstermiştir. Anahtar Kelimeler: Enfeksiyon kontrolü, Çapraz enfeksiyon, Diş hekimliği, Radyoloji, Anketler*

Ethics Committee Approval: Ethical approval was obtained from Pamukkale University Medical Ethics Committee (Research Code No: 60116787-020/77263, Date of approval: 20/11/2017). This work was done in accordance with the principles defined in the Declaration of Helsinki, including all revisions.

Informed Consent: The informed consents were provided by the participants.

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Author contributions: MO, ZA, BA, and IP participated in design of the study. MO and IP participated in generating the data for the study. MO and IP participated in gathering the data for the study. BA participated in the analysis of the data. MO and IP wrote the majority of the original draft of the paper. MO, ZA, BA, and IP participated in writing the paper. All authors approved the final version of this paper.

Conflict of Interest: The authors had no conflict of interest to declare.

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