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Original Research Article

Dental Malpractice in Oral Surgery, Endodontics, Prosthodontics, and Restorative Dentistry: The Prevalence in Saudi Arabia

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Abstract
Aim: *The aim of this study was to detect the prevalence of dental malpractice in the fields of oral surgery, endodontics, prosthodontics (crowns and bridges), and restorative dentistry in the Kingdom of Saudi Arabia.*
Materials and Methods: *378 patients aged ≥ 18 years were randomly selected and clinically examined for substandard dental treatments done in dental premises (hospitals, polyclinics, private clinics) in the Kingdom of Saudi Arabia. The study was conducted in the period July through September 2018. Each patient was clinically examined in the following fields: Prosthodontics (substandard crown and bridge placement in relation to tooth preparation and crown adaptation, PFM crown and bridge placement on feather edge finishing line, substandard post and core), endodontics (substandard root canal treatment), restorative dentistry (overhanging restorations: class II, III, IV, V), and oral surgery (dry socket due to traumatic prolonged tooth extraction and/or a fractured tooth part left in the socket. In addition to clinical examination, radiographs were also used. The results were documented in a patient examination form then statistically analyzed using Chi-Square Test.*
Results: *There was a significant difference in the percentages of dental malpractice (endodontics, restorative dentistry, prosthodontics, oral surgery) $p = 0.000 < 0.05$. Therefore, endodontics malpractice was the first 42.5%, restorative dentistry malpractice was the second 28.4%, prosthodontics malpractice was the third 26.4%, and oral surgery malpractice was the fourth 2.7%.*
Conclusion: *Dentists must consider ethical principles and acceptable standards and protocols of diagnosis and treatment. They also have an ethical responsibility to limit their extent and scope of practice to their level of professional experience in oral surgery. There is high need for improving the technical skills of practitioners in root canal treatments. Also, stressing on using wedges with matrices to avoid overhanging dental restorations is advised. Differences between societies might play a role in the lower percentages of prosthodontics malpractice in KSA.*
Keywords: *Malpractice, Oral Surgery, Prosthodontics, Endodontics, Restorative Dentistry.*

Introduction

Dental Malpractice

Dental malpractice is the failure of a dental professional to follow the accepted standards of practice of his or her profession, resulting in harm to the patient. Usually, proof of failure to comply with accepted standards of dental practice requires the testimony of someone with expertise in dentistry.[1]

Iatrogenic Damage to Periodontium by Restorative Treatment Procedures

Periodontal health and dental restorations are very intimately related. Periodontal health is important for correct functioning of all restorations while the functional stimulation due to dental restorations is necessary for guarding healthy periodontium.[2] The close relationship of iatrogenic factors with periodontal breakdown was originally recognized by Black 1912.[2,3] Afterward, many studies have focused their attention on different aspects of the periodontal – restorative interaction such as the location and position of the restoration with respect to the gingival margin, crown contours, presence of overhangs, presence of marginal leakage, roughness of the surfaces, and the type of restorative material.[2,4]

Substandard Root Canal Treatment

Literature indicates that substandard root canal treatments cause various kinds of periapical pathological conditions including granulomas, abscesses, or even cysts.[5] Bacteria were observed in 10 out of 12 (83.3%) cases in the most apical 2 mm of the root canals of periapically diseased roots.[6] Therefore, the point of termination where cleaning, shaping, and obturation should terminate should be 1.0 mm from the radiographic apex.[7]

Obturation has been accorded the most critical step and the cause of most treatment failures. Overfilling typically shows increased inflammation with delayed or impaired healing in addition to irritation from the material itself and an inadequate apical seal. Underfilling results when both preparation and obturation are short of the desired working length or when the obturation does not extend to the prepared length (failure to treat the canal). The optimal preparation/obturation length for a necrotic pulp is 0.5 to 1 mm short of the radiographic apex. For a vital pulp, the length is 0 to 2 mm short. Preparation or obturation shorter than the aforementioned lengths may leave existing or potential irritants in the apical canal. Periapical inflammation may develop over an extended period of time depending on the volume of irritants or the balance established between irritants and the immune system. Compared with overfilling, underfilling is less of a problem as indicated by prognosis and histologic studies. In addition, the obturation material should be of uniform density from coronal to apical aspects. The margins of gutta-percha should be sharp and distinct with no fuzziness indicating close adaptation. Also, radiolucencies and voids within the body of the obturating material and the dentin wall represent incomplete obturation.[8]

During access opening all canals should be located,[7] and mishaps related to root canal treatment failure such as perforations (lateral root perforation and furcation perforation) should be avoided by following the anatomy and morphology of each individual tooth.[9] Finally, vertical root fracture can happen due the overzealous application of condensation force to obturate an underprepared or overprepared canal also after post cementation.[9]

Preparations for Full Coverage Crowns

Literature makes it clear that a shoulder preparation is the correct finishing line for full coverage metal-ceramic crowns also called porcelain-fused-to-metal restoration (PFM) in addition to full ceramic crowns for the purpose of achieving correct adaptation, avoiding marginal gap and plaque accumulation.[10]

Post and Core

The length of the dowel should equal the crown length or two-thirds the length of the root. The length of the remaining apical fill should be at least 4.0 mm.[11]

Wedging for Proper Proximal Contact

Literature clarifies the importance of using a wedge during preparation of interproximal areas. The benefits of using the wedge are summarized in serving as a guide to help prevent overextension of the gingival floor and helping in achieving sufficient teeth separation which is critical to establishing proper proximal contact subsequently by compensating for the thickness of the matrix band (the matrix band must be in absolute contact with (touching) the adjacent contact area).[12]

It is clear that not abiding with the instructions of using a wedge with a matrix when preparing restorations in interproximal or interdental areas ends up with the creation of overhanging restorations that cause plaque accumulation as there isn't accessibility for the patient to clean properly thus periodontal irritation and inflammation.

Dry Socket (Alveolar Osteitis)

Dry socket, also called fibrinolytic osteitis, is a major complication that follows extraction of teeth in oral surgery. It's an acute inflammation of the alveolar bone around the extracted tooth, and it is characterized by severe pain with breakdown of the blood clot within the socket making the socket empty and often filled with food debris. There is mild swelling and redness of the gingiva, halitosis, bone exposure, and severe tenderness on examination. There are many predisposing factors, some of which are related to the patient including smoking, failure to comply with postoperative instructions which may cause infection after extraction, and systemic illness such as diabetes mellitus and clotting problems, whereas other factors are caused by the dentist including traumatic, difficult, and prolonged tooth extraction, infection during extraction (the use of infected instruments and disposable materials), and infiltration anesthesia (vasoconstrictor).[13,14,15]

Fractured Root Tips

Studies showed that under certain circumstances root fragments (3.0 mm) could successfully remain in situ with normal healing. However, retained roots also have the propensity to cause pain and discomfort to patients and can be a cause of infection especially if fractured during the extraction of non-vital teeth and associated with apical infection. Fragments presenting with a clinical abnormality such as pain, a sinus tract, or an abscess, have non- vital pulps or areas of infection around them require their removal through transalveolar approach. Therefore, a risk-benefit analysis should be considered by the clinician when considering removal of retained roots. If it is decided to leave a retained root fragment, the dentist is obliged to advise the patient and to ensure clinical and radiographic follow-up while taking into account safe radiation exposure guidelines.[15,16]

Materials and Methods

Ethical approval

The study was registered with the research center of Riyadh Elm University (FRP/2018/203) and received ethical approval from the institutional review board of the same institution (RC/IRB/2018/1070).

Selection of the content for analysis and statistical analysis

378 patients aged ≥18 years were randomly selected and clinically examined for substandard dental treatments done in dental premises (hospitals, polyclinics, private clinics, etc…) in the Kingdom of Saudi Arabia. The study was conducted in the period July through September 2018. After taking the patient consent on an informed consent statement form for clinical studies, each patient was clinically examined in the following fields: Prosthodontics (substandard crown and bridge placement in relation to tooth preparation and crown adaptation, porcelain fused to metal (PFM) crown and bridge placement on feather edge finishing line, substandard post and core), endodontics (substandard root canal treatment e.g. underfilling, overfilling, incomplete obturation, poor condensation of obturation, perforations, separated instruments, vertical root fracture), restorative dentistry (overhanging restorations: class II, III, IV, V), and oral surgery (delayed wound healing "dry socket" due to traumatic prolonged tooth extraction and/or a fractured tooth part left in the socket "remnant of a root fragment" e.g. apical third of a tooth. In addition to clinical examination, panoramic, periapical, and bitewing radiographs were used too. The data obtained were documented in a patient examination form then statistically analyzed using Chi-Square Test (nonparametric statistics) to test the contingency of the variables. All statistical analyses were performed using the IBM SPSS Statistics 20 data processing software. The significance level was set at $p < 0.05$.

Results

For the purpose of the study, the null hypothesis H_0 which stated that the percentages of dental malpractice (prosthodontics, endodontics, restorative dentistry, oral surgery) were equal at a confidence level 95% was tested. The results of the 378 patients were as the following:

Table 1 shows that the Mean of observed endodontics malpractice was 0.75, restorative dentistry malpractice 0.50, prosthodontics malpractice 0.46, and oral surgery malpractice 0.05. In addition, the standard deviation was 0.436, 0.501, 0.499, 0.213 for the aforementioned four types of dental malpractice, respectively. Furthermore, Mode = 0 for prosthodontics, restorative dentistry, and oral surgery which indicated that the nonexistence of dental malpractice was more than the existence of dental malpractice for all of the three types (prosthodontics, restorative dentistry, oral surgery). However, Mode =1 for endodontics which indicated that the existence of dental malpractice was more than the nonexistence of dental malpractice with respect to endodontics according to this study encoding 0 = no malpractice 1= malpractice.

Table 1: Descriptive Statistics

Dental Malpractice	N	Sum	Mean	Std. Deviation	Mode
Prosthdontics	378	175	.46	.499	0
Endodontics	378	282	.75	.436	1
Restorative Dentistry	378	188	.50	.501	0
Oral Surgery	378	18	.05	.213	0
Valid N (listwise)	378				

Table 2 shows that endodontics was the first with 282 observations (42.5%), restorative dentistry was the second with 188 observations (28.4%), prosthodontics was the third with 175 observations (26.4%), and oral surgery was the fourth with 18 observations (2.7%). The question of this study was: Were dental malpractice observations distributed in equal proportions? In another word: Was the difference in the percentages of dental malpractice significant or insignificant? at a confidence level 95%. To answer this question, the null hypothesis H_0 was tested versus the alternative hypothesis H_1 which stated that there was a significant difference in the percentages (number of observations) of dental malpractice (prosthodontics, endodontics, restorative dentistry, oral surgery).

Hypotheses:

H_0: $p_{\text{Restorative Dentistry}} = p_{\text{Endodontics}} = p_{\text{Prosthodontics}} = p_{\text{Oral Surgery}} = ¼$

H_1: $p_{\text{Restorative Dentistry}} \neq p_{\text{Endodontics}} \neq p_{\text{Prosthodontics}} \neq p_{\text{Oral Surgery}} \neq 0$

Table 2: Observed Malpractice Frequency and Percentages

Dental Malpractice		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Prosthodontics	175	26.4	26.4	26.4
	Endodontics	282	42.5	42.5	68.9
	Restorative Dentistry	188	28.4	28.4	97.3
	Oral Surgery	18	2.7	2.7	100.0
	Total	663	100.0	100.0	

Table 3 shows the observed and the expected number of dental malpractice (prosthodontics, endodontics, restorative dentistry, oral surgery). Chi-Square Test was used to test the contingency of the observed and the expected number of dental malpractice. The expected number was equal for each of the four types of dental malpractice (165.8),

and this what the null hypothesis stated. So, was the hypothesis accepted or not?

Table 3: Chi-Square Test Malpractice Frequencies

Dental Malpractice	Observed N	Expected N	Residual
Prosthodontics	175	165.8	9.3
Endodontics	282	165.8	116.3
Restorative Dentistry	188	165.8	22.3
Oral Surgery	18	165.8	-147.8
Total	663		

The answer came in Table 4 which contains the results of the study test. For degree of freedom df = 3 and a significance level of this study set at a=5% (one side test, right) with referring to Chi-Square statistical tables, the value of $\chi 2$ tab=7.815. When comparing $\chi 2$ tab with the actual value in Table 4 $\chi 2$ cal=216.741, it was found that $\chi 2$ tab $<\chi 2$ cal with p-value (sig)=0.000 < 0.05. This result was the acceptance of H_1 and the rejection of H_0. Chi-Square Test showed that there was a significant difference in the percentages (number of observations) of dental malpractice (prosthodontics, endodontics, restorative dentistry, oral surgery) p= 0.000 < 0.05. Therefore, endodontics malpractice was the first 42.5%, restorative dentistry malpractice was the second 28.4%, prosthodontics malpractice was the third 26.4%, and oral surgery malpractice was the fourth 2.7% (Table 2, Chart 1, Chart 2).

Table 4: Chi-Square Test Statistics

	Dental Malpractice
Chi-Square	216.741[a]
df	3
Asymp. Sig.	.000

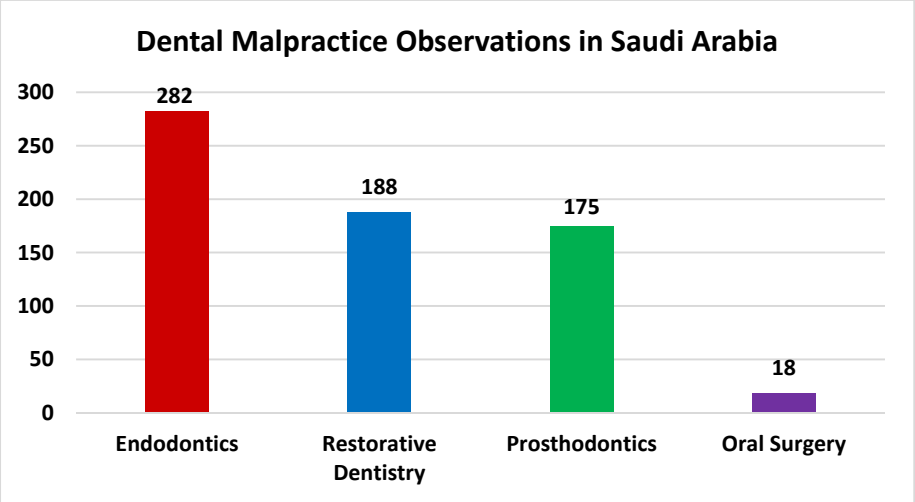

Chart 1: Dental Malpractice Observations in Saudi Arabia 2018

Discussion

According to literature, endodontics and prosthodontics have been present in all reports and have been among the three most frequently listed complaint areas during the past decade (Table 5).[17] Also, as detailed in Hapcook study done in the United States of America and published in The Journal of The American Dental Association 2006, prosthodontics, endodontics, and restorative dentistry malpractice were considerably more common in the dental field than others (Table 5).[21] Oral surgery seems to be lesser involved within recent years while implant placements are a new growing area of malpractice complaints.[17]

1. Comparison with literature

When comparing prosthodontics with endodontics, it was found that in literature the percentages of prosthodontics malpractice were higher than the percentages of endodontics malpractice (Table 5). However, the percentages of endodontics malpractice were higher than the percentages of prosthodontics malpractice in this study (KSA).

Table 5: The top three most frequent areas of malpractice cases/complaint cases as described in actual references.[17]

René and Öwall[18]	Prosthodontics (36.8%)	Formalities (13.6%)	Endodontics (12.4%)
Milgrom et al.[19]	Oral surgery (21.9%)	Prosthodontics (19.5%)	Endodontics (18.1%)
Ozdemir et al.[20]	Oral surgery (45.6%)	Prosthodontics (36.4%)	Endodontics (18.2%)
Hapcook[21]	Prosthodontics (28%)	Endodontics (17%)	Restorative (16%)
Bjørndal and Reit[22*]	Prosthodontics (35.65%)	Endodontics (13.8%)	Diagnostics (12.3%)
Kiani and Sheikhazadi[23]	Prosthodontics (27.8%)	Oral surgery (23.5%)	Endodontics (16.6%)
Givol et al.[24]	Prosthodontics (28.0%)	Oral surgery (16.0%)	Endodontics (13.8%)
Pinchi et al.[25]	Implant (25%)	Prosthodontics (24%)	Endodontics (19.3%)

*The percentage is the average of 1995-1999 and 2000-2004. Prosthodontics (crown & bridge plus dentures)

In 2017, Safadi et al. found that in Saudi Arabia endodontics malpractice had the highest percentage and was the first most frequent 40% followed by restorative dentistry malpractice that was the second most frequent 33% then prosthodontics (crowns and bridges) malpractice was the third and last 27%.[26]

2. Comparison with Bjørndal and Reit - Int Endod J, Denmark 1995-2004

For the purpose of comparison with literature in details, we chose Bjørndal and Reit - International Endodontic Journal, Denmark from 1995 to 2004.[22]

The malpractice cases percentages as described in the original reference of Bjørndal and Reit were as the following:

Denmark 1995-1999

Prosthodontics (crowns and bridges) malpractice 23.0%, endodontics malpractice 14.5%, restorative dentistry (caries) malpractice 9.7%, oral surgery malpractice 4.4%.[22]

Denmark 2000-2004

Prosthodontics (crowns and bridges) malpractice 22.8%, endodontics malpractice 13.1%, restorative dentistry malpractice (caries) 12.8%, oral surgery malpractice 4.0%.[22]

For the purpose of comparison, the aforementioned types of dental malpractice were considered as one comparative group. Through the following calculation the percentages became:

Denmark 1995-1999:

Endodontics + Prosthodontics + Restorative Dentistry + Oral Surgery =100% (Equation 1)

With couple of operations:

Prosthodontics = 5.227 Oral Surgery

Restorative Dentistry = 2.204 Oral Surgery

Endodontics = 3.295 Oral Surgery

After compensating in equation 1, the percentages became:

Prosthodontics malpractice 44.6%, endodontics malpractice 28.1%, restorative dentistry malpractice 18.8 %, oral surgery malpractice 8.5 %

Denmark 2000-2004

Endodontics + Prosthodontics + Restorative Dentistry + Oral Surgery =100% (Equation 1)

With couple of operations:

Prosthodontics = 5.7 Oral Surgery

Restorative Dentistry = 3.2 Oral Surgery

Endodontics = 3.275 Oral Surgery

After compensating in equation 1, the percentages became:

Prosthodontics malpractice 43.3%, endodontics malpractice 24.8%, restorative dentistry malpractice 24.3%, oral surgery malpractice 7.6%

The comparison results were (Table 6, Chart 2, Chart 3):

Endodontics malpractice was the first 42.5% in this study (KSA). However, it was the second in Bjørndal and Reit study (Denmark) 28.1% (1995-1999) and 24.8% (2000-2004).

Restorative dentistry malpractice was the second 28.4% in this study (KSA). However, it was the third in Bjørndal and Reit study (Denmark) 18.8% (1995-1999) and 24.3% (2000-2004).

Prosthodontics (crowns and bridges) malpractice was the third 26.4 % in this study (KSA). However, it was the first in Bjørndal and Reit study (Denmark) 44.6% (1995-1999) and 43.3% (2000-2004).

In both studies, oral surgery malpractice was the fourth and last 2.7% in this study (KSA) and in Bjørndal and Reit study (Denmark) 8.5% (1995-1999) and 7.6% (2000-2004).

Table 6: Comparison of dental malpractice between KSA and Denmark (according to percentages prevalence)

Type of Dental Malpractice	KSA 2018		Denmark 1995-1999		Denmark 2000-2004	
	Percentage	Rank	Percentage	Rank	Percentage	Rank
Endodontics	42.5%	1	28.1%	2	24.8%	2
Restorative Dentistry	28.4%	2	18.8%	3	24.3%	3
Prosthodontics (Crowns and Bridges)	26.4%	3	44.6%	1	43.3%	1
Oral Surgery	2.7%	4	8.5%	4	7.6%	4
Total	100%	-	100%	-	100%	-

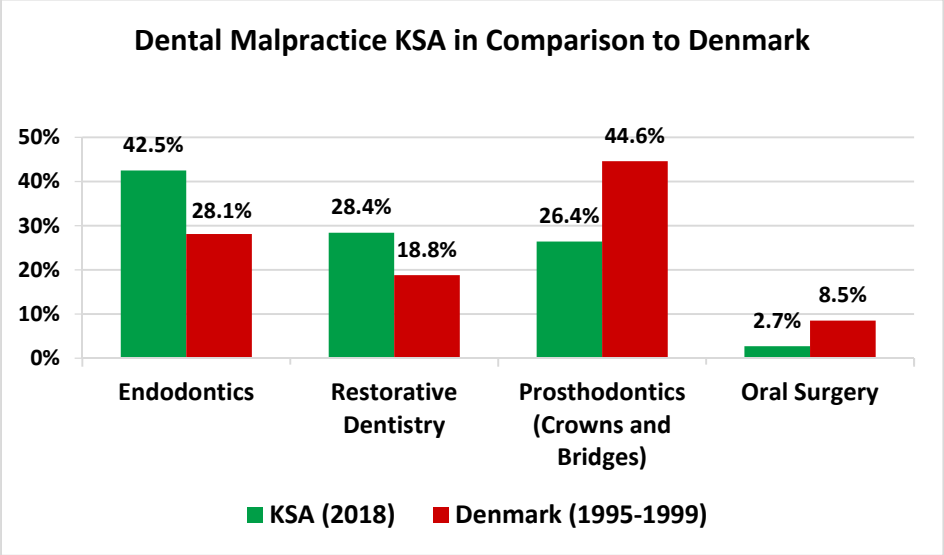

Chart 2: Dental Malpractice KSA (2018) in Comparison to Denmark (1995-1999)

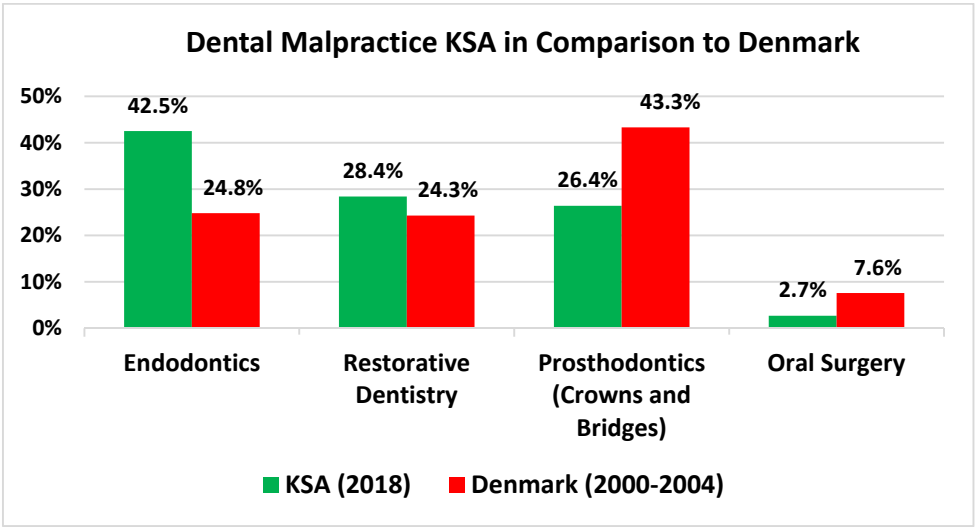

Chart 3: Dental Malpractice KSA (2018) in Comparison to Denmark (2000-2004)

Conclusion

Dentists must consider ethical principles and acceptable standards and protocols of diagnosis and treatment. Also, dental practitioners have an ethical responsibility to limit their extent and scope of practice to their level of professional experience in the field of oral surgery. A risk-benefit analysis should be considered by the clinician when considering removal of retained roots. If it is decided to leave a retained root fragment, the dentist is obliged to advise the patient and to ensure clinical and radiographic follow-up while taking into account safe radiation exposure guidelines.[16] The approach "non nocere" (do no harm) is recommended. The results of this study can alert the official authorities that there is high need for

improving the technical skills of dental practitioners in performing root canal treatments through improving teaching curriculums and training methods at universities, continuing dental education, and benefiting from other countries experiments that have lower percentages in dental malpractice in endodontics. In addition, it's advised to stress on using wedges with matrices to avoid overhanging dental restorations in restorative dentistry. Concerning prosthodontics malpractice, differences between the Saudi and the Danish societies might play a role in the higher percentages of prosthodontics malpractice in Denmark in comparison to KSA.

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