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Risk factors for the appearance of cracks and fractures of teeth according to a survey of dentists

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ABSTRACT

BACKGROUND: Preventive treatment is essential in modern dentistry, resulting in increased attention to the causes and potential predictability of dental pathologies, including tooth cracks and fractures. Currently, there is a lack of comprehensive, detailed studies on this subject.

AIM: To assess the detectability of risk factors for tooth cracks and fractures (based on a survey of dentists).

MATERIALS AND METHODS: A survey of 52 dentists of various specialties was performed using a special questionnaire on the incidence and causes of tooth cracks and fractures.

RESULTS: According to the survey of dentists, the incidence of confirmed tooth cracks and fractures was 6.7% and 4.4% for extracted and treated teeth, respectively. Maxillary premolar roots were the most common site (59.1%), with longitudinal cracks/fractures predominating (68.2%). Of all reported cracks and fractures, 15.6% were only detected during an X-ray or CT examination. Overall, 87.7% of cracks and fractures were detected in devitalized teeth, 79.3% in patients with unreplaced missing teeth, dental cavities, or restoration of more than 50% of the occlusal surface (76.3% and 49.3%, respectively), and 30.6% in patients with root wall thinning. At least 65.0% of tooth destruction cases occurred within 5 years of devitalization, filling, or replacement.

CONCLUSION: The study found that the main risk factors for tooth cracks and fractures (more than 10% of extracted and treated teeth) are devitalization and excessive load caused by incomplete dental restoration, as well as significant destruction of the crown, root wall thinning, and a long period following devitalization, filling, or replacement. More than half of all tooth cracks are longitudinal. Maxillary premolars are more prone to cracks and fractures. These factors can be used to predict long-term complications such as tooth cracks and fractures after dental tissue treatment.

Keywords: tooth; cracks; fractures; detectability; survey.

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Факторы риска появления трещин и переломов зубов (по данным анкетирования врачей-стоматологов)

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АННОТАЦИЯ

Обоснование. Профилактическая направленность современной стоматологии обуславливает внимание к причинам и возможностям прогнозирования осложнений в состоянии зубов, в том числе трещин и переломов. В настоящее время комплексных детальных исследований по этой проблеме недостаточно.

Цель исследования — анализ выявляемости факторов риска появления трещин и переломов зубов (по данным анкетирования врачей-стоматологов).

Материалы и методы. Опрос 52 врачей-стоматологов разной специализации проводили с использованием разработанной анкеты, посвящённой частоте и причинам развития трещин и переломов зубов.

Результаты. По данным опроса врачей-стоматологов, частота диагностированных трещин и переломов зубов составляла соответственно 6,7 и 4,4% среди удалённых и леченых зубов. Преимущественная локализация — корни премоляров на верхней челюсти (59,1%), преимущественная топография продольная (68,2%). 15,6% трещин и переломов были обнаружены только при рентгеновском и КТ-обследовании. 87,7% трещин и переломов выявлялись в девитализированных зубах, 79,3% — у пациентов с незамещёнными дефектами зубного ряда, с наличием полости или реставрации более 50% окклюзионной поверхности (76,3 и 49,3% соответственно), 30,6% — на фоне истончённых стенок корня зуба. Не менее 65,0% разрушений зубов происходили в течении пяти лет после девитализации, пломбирования, протезирования.

Заключение. Установлено, что основными факторами, сопровождающими трещины и переломы зубов (свыше 10% от удалённых и леченых), являются девитализация зубов и их перегрузка из-за неполного замещения дефектов зубных рядов; значительное разрушение коронковой части зуба и истончение стенок корня зуба; длительные сроки после девитализации, пломбирования, протезирования. Более половины трещин характеризуются продольной топографией. Трещины и переломы чаще встречаются среди премоляров верхней челюсти. Указанные факторы являются базой для прогнозирования осложнений в виде трещин и переломов в отдалённые сроки после вмешательства в ткани зуба.

Ключевые слова: зуб; трещины; переломы; выявляемость; анкетирование.

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BACKGROUND

Cracked and fractured teeth are frequently encountered in clinical dental practice [1, 2]. In the majority cases, such teeth are non-restorable and require extraction. Exceptions include teeth with fractures confined to the coronal third of the root, where restoration using post-retained cores may be considered feasible [3–6].

The emphasis on preventive care in contemporary dentistry has heightened interest in identifying and predicting complications of dental hard tissues, including cracked and fractured teeth. However, comprehensive and detailed investigations into these conditions remain limited.

AIM: To assess the detectability of risk factors for cracked and fractured teeth based on a survey of practicing dentists.

METHODS

A total of 52 dentists representing various dental specialties were surveyed using a structured, custom-designed questionnaire. The participants had a mean clinical experience of 12.4 ± 3.4 years. The questionnaire consisted of 24 items grouped into 7 sections with multiple-choice formats (Table 1). It addressed the prevalence and characteristics of cracked and fractured teeth, biomechanical loading conditions, and time intervals following restoration and prosthetic treatment. Among the respondents were 19 general dentists, 18 oral surgeons, and 15 prosthodontists.

RESULTS

Statistical analysis of the survey revealed that tooth fractures and cracks were identified in 12.1% of treated teeth and 10.2% of extracted teeth, averaging 11.1% (1,329 teeth). Cracks accounted for the majority of damage (60.4%, 803 teeth), whereas fractures comprised 39.6% (526 teeth).

Among affected teeth, incisors, cuspids, bicuspid, and molars accounted for 206 (15.5%), 22 (1.7%), 701 (52.7%), and 400 (30.1%) teeth, respectively, with bicuspid being the most frequently involved (Fig. 1). Maxillary teeth were affected more frequently than mandibular ones (62.5% [830 teeth] vs. 37.5% [499 teeth]). Root involvement was more common than crown involvement (59.1% [785 roots] vs 40.9% [544 crowns]). Longitudinal cracks and fractures were more common (68.2%, 906 teeth) than transverse ones (31.8%, 423 teeth).

Cracks and fractures were detected solely by radiography in 5.9% of cases (78 teeth) and by computed tomography in 9.7% of cases (129 teeth).

The majority of affected teeth (87.7%, 1,166 teeth) were previously devitalized (Fig. 2). Only 5.3% of cracked or fractured teeth (71 teeth) were mobile. The majority of affected teeth were under excessive occlusal load due to unreplaced missing teeth (79.2%, 1,052 teeth). Bruxism and temporomandibular dysfunction contributed to 29.2%

of cases (388 teeth), and occlusal interferences to 12.7% of cases (169 teeth). Jawbone resorption near cervical line exceeding 30% of root length was found in 30.1% (400 teeth), whereas periapical bone resorption was present in only 9.3% (124 teeth).

Extensive loss of coronal tooth structure (more than 50% of the occlusal surface) was reported in 76.3% (1,014 teeth). In 20.5% (208 teeth), cavities extended to the dental cervix. Teeth restored with composite fillings showed a lower fracture rate (49.3%, 655 teeth). Teeth with core buildup using metal or glass fiber posts were affected in 21.9% (291), 21.1% (280), and 10.3% (137) of cases, respectively. Root wall thinning was detected in 30.6% of fractured or cracked teeth (406 teeth). Artificial crowns were present in 8.1% (108 teeth), and 23.6% (313 teeth) served as abutments for bridge restorations. Another 15.1% (200 teeth) were abutments for partial removable dentures.

The time elapsed since devitalization in teeth with fractures or cracks was distributed as follows: ≤ 3 years in 3.8% (359 of 1,156 devitalized teeth), ≤ 5 years in 52.0% (606 teeth), ≤ 10 years in 15.6% (182 teeth), and > 10 years in 1.6% (19 teeth) (see Fig. 2). For teeth with composite restorations, fractures and cracks occurred ≤ 3 years in 19.2% (126 of 655 teeth), ≤ 5 years in 46.4% (304 teeth), ≤ 10 years in 22.9% (150 teeth), and > 10 years in 11.5% (75 teeth). In teeth restored with artificial crowns (including abutments for bridge restorations), fractures and cracks developed ≤ 3 years after placement in 29.2% of cases (123 of 421 teeth), ≤ 5 years in 49.2% (207 teeth), ≤ 10 years in 8.1% (34 teeth), and > 10 years in 13.5% (57 teeth). Fractures and cracks in abutment teeth engaged by clasps or attachments of removable partial dentures occurred ≤ 3 years after prosthesis placement in 39.0% of cases (78 of 200 abutment teeth), ≤ 5 years in 49.5% (99 teeth), ≤ 10 years in 6.5% (13 teeth), and > 10 years in 5.0% (10 teeth).

DISCUSSION

According to the surveyed dentists, cracks and fractures were detected in more than 10% of extracted and treated teeth, indicating a relatively high frequency. The primary contributing factors included prior devitalization and excessive occlusal load due to unreplaced missing teeth, extensive coronal destruction, root wall thinning, and long intervals following devitalization, restoration, or prosthetic treatment. More than half of the cracks were longitudinal. Cracks and fractures occurred more commonly in maxillary bicuspid.

CONCLUSION

Based on the survey findings, cracks and fractures were detected in 6.7% and 4.4% of extracted and treated teeth, respectively. The roots of maxillary bicuspid were the most

Table 1. Key findings of the dentist survey on tooth cracks and fractures

Question	Answer	
	No.	%
1. Indicate the number of teeth with fractures and the number of teeth with cracks observed in your clinical practice	526 803	39,6 60,4
2. What percentage of treated and extracted teeth were fractured or cracked?	1331 1326	12,1 10,2
3. How frequently did the following tooth characteristics and functional conditions occur among fractured or cracked teeth (%)?		
Incisors	206	15,5
Cuspids	22	1,7
Bicuspid	701	52,7
Molars	400	30,1
Maxilla	830	62,5
Mandible	499	37,5
Crack or fracture site:		
crown	544	40,9
root	785	59,1
Crack or fracture type:		
longitudinal	906	68,2
transverse	423	31,8
Detected on:		
X-ray only	78	5,9
CT only	129	9,7
Devitalized teeth	1166	87,7
Mobile teeth	71	5,3
Excessive occlusal load:		
unreplaced missing teeth	1052	79,2
bruxism	388	29,2
Occlusal interference	169	12,7
Jawbone resorption > 1/3 root near cervical line	400	30,1
Periapical bone resorption	124	9,3
Cavity > 50% of the occlusal surface	1014	76,3
Presence of:		
composite restoration > 50% of the occlusal surface	655	49,3
cast post-and-core	291	21,9
metal post	280	21,1
glass fiber post	137	10,3
Artificial crown	108	8,1
Thinning of root canal walls	406	30,6
Abutment for bridge restoration	313	23,6
Abutment for removable denture	200	15,1
4. Time elapsed since devitalization, years:		
≤ 3 years	359	30,8
≤ 5 years	606	52,0
≤ 10 years	182	15,6
> 10 years	19	1,6
5. Time elapsed since restoration, years:		
≤ 3 years	126	19,2
≤ 5 years	304	46,4
≤ 10 years	150	22,9
> 10 years	75	11,5
6. Time elapsed since crown or bridge restoration placement, years:		
≤ 3 years	123	29,2
≤ 5 years	207	49,2
≤ 10 years	34	8,1
> 10 years	57	13,5
7. Time elapsed since removable denture placement, years:		
≤ 3 years	78	39,0
≤ 5 years	99	49,5
≤ 10 years	13	6,5
> 10 years	10	5,0

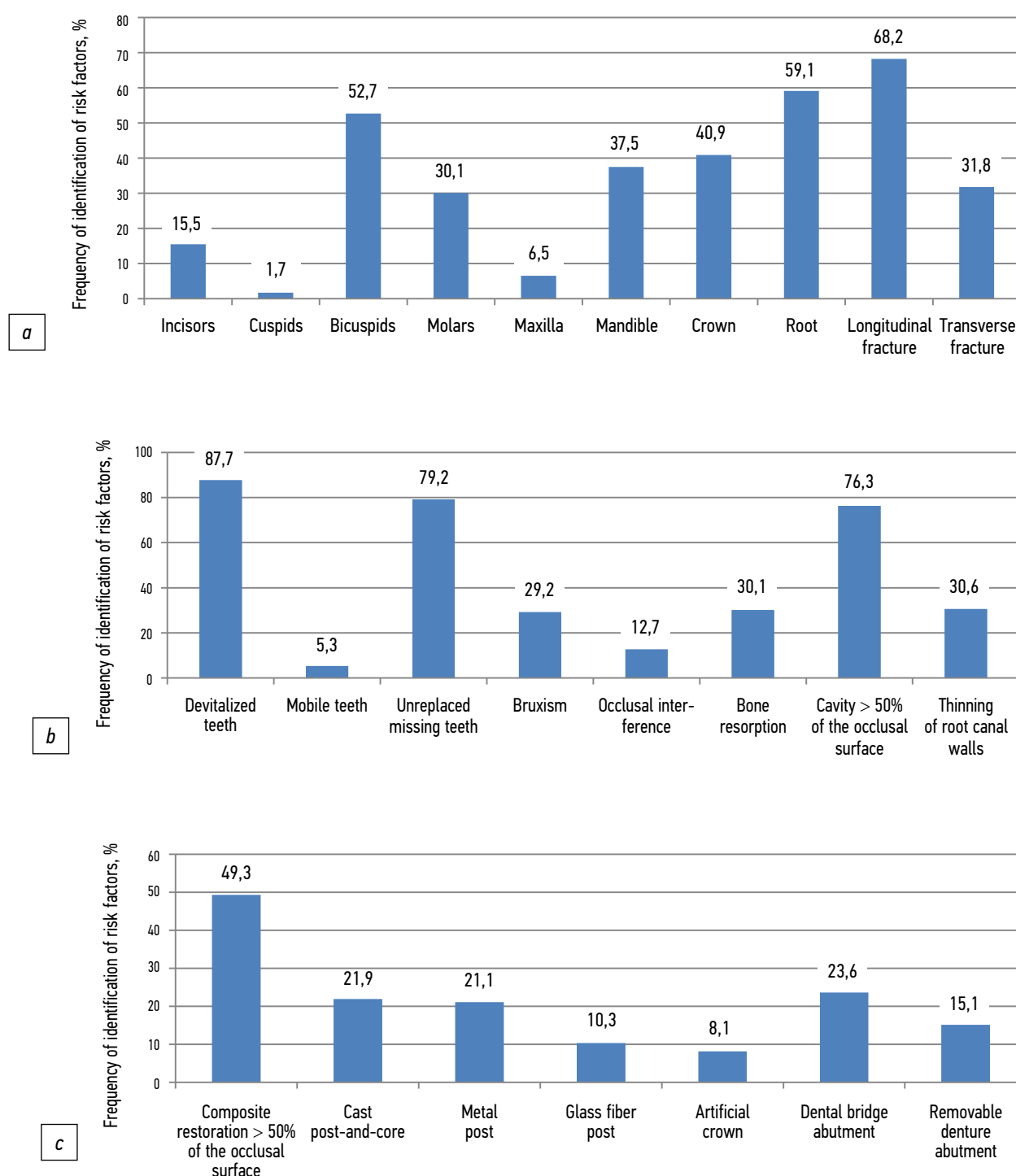


Fig. 1. The frequency of identification of risk factors among teeth with cracks and fractures: *a* — topographical factors; *b* — factors of functioning; *c* — the presence of restoration structures.

common site (59.1%), with longitudinal cracks accounting for 68.2%. In 15.6% of cases, cracks and fractures were only identified by radiography or CT imaging.

A total of 87.7% of cracks and fractures were observed in devitalized teeth; 79.3% occurred in patients with unreplaced missing teeth, cavities, or restorations involving more than 50% of the occlusal surface (76.3%

and 49.3%, respectively); 30.6% were found in teeth with root wall thinning. At least 65.0% of structural failures occurred within five years after devitalization, restoration, or prosthetic treatment.

These findings may serve as a basis for predicting the long-term risk of cracks and fractures following dental tissue treatment.

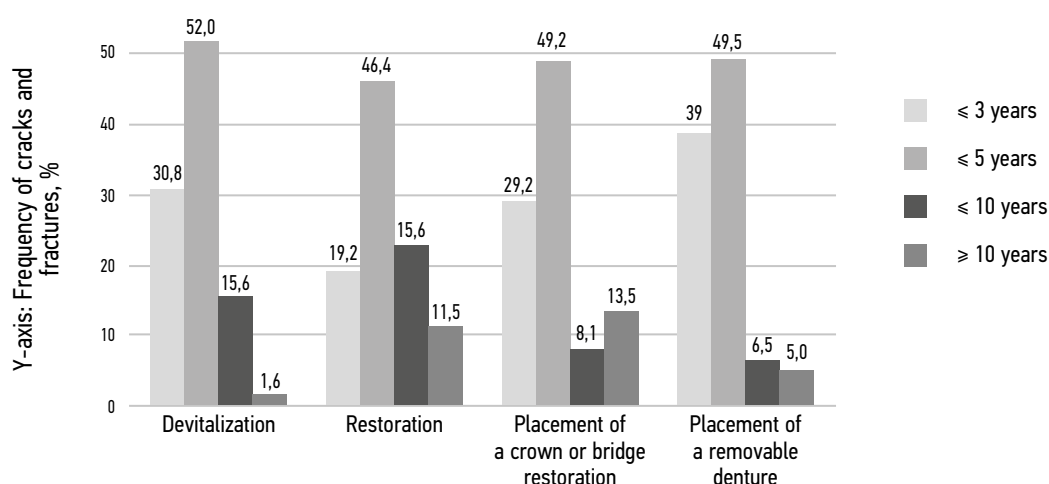


Fig. 2. The frequency of fractures and cracks depending on the service life from the moment of tooth devitalization, tooth restoration, fixation of the crown or bridge prosthesis, application of a removable prosthesis.

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