

ORIGINAL ARTICLE

Operator-related aspects in endodontic malpractice claims in Finland

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ABSTRACT

Objective: We analyzed operator-related differences in endodontic malpractice claims in Finland.

Materials and methods: Data comprised the endodontic malpractice claims handled at the Patient Insurance Centre (PIC) in 2002–2006 and 2011–2013. Two dental advisors at the PIC scrutinized the original documents of the cases ($n = 1271$). The case-related information included patient's age and gender, type of tooth, presence of radiographs, and methods of instrumentation and apex location. As injuries, we recorded broken instrument, perforation, injuries due to root canal irrigants/medicaments, and miscellaneous injuries. We categorized the injuries according to the PIC decisions as avoidable, unavoidable, or no injury. Operator-related information included dentist's age, gender, specialization, and service sector. We assessed level of patient documentation as adequate, moderate, or poor. Chi-squared tests, *t*-tests, and logistic regression modelling served in statistical analyses.

Results: Patients' mean age was 44.7 (range 8–85) years, and 71% were women. The private sector constituted 54% of claim cases. Younger patients, female dentists, and general practitioners predominated in the public sector. We found no sector differences in patients' gender, dentists' age, or type of injured tooth. PIC advisors confirmed no injury in 24% of claim cases; the advisors considered 65% of injury cases ($n = 970$) as avoidable and 35% as unavoidable. We found no operator-related differences in these figures. Working methods differed by operator's age and gender. Adequate patient documentation predominated in the public sector and among female, younger, or specialized dentists.

Conclusions: Operator-related factors had no impact on endodontic malpractice claims.

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Introduction

Endodontic injuries form a considerable proportion of malpractice claims in dentistry [1–7]. By following good clinical practice, dentists should, however, be able to avoid patient injuries in endodontic treatments. To help dentists with the challenges faced in endodontics, several guidelines are available [8–11], the most recent published in Finland in June 2016 [12].

Typical injuries in endodontic malpractice are perforation and a broken instrument [6]. A report from Denmark analyzed endodontic malpractice claims and found that perforations accounted for 10% of 'technical complications' [4], whereas an analysis on endodontic injuries in Israel reported errors in instrumentation for half of the cases and in opening canals for 37% [5]. In addition, root canal irrigants and medicaments can cause injuries when ending up outside the root canal [13].

To diminish failures in healthcare, Nordic countries have fairly similar systems that follow the 'No Blame/No Fault' rule. In Finland, the Patient Insurance Centre (PIC) handles patient healthcare claims according to The Patient Injury Act of 1987 and decides about the indemnity of a financial compensation for cases where the injury could have been avoided by following good clinical practice. Patients from both the private and public sector can submit a claim easily and free of

charge using forms available at service points and online. PIC receives on average about 7600 claims annually; in 2013–2015, endodontics was the most common clinical discipline on PIC's Top Ten list of all health care claims [14].

The PIC official statistics gives no detailed description of the injuries. A recent paper, based on the PIC data, reports the annual number of dentistry-related claims to be around 700, endodontics constituting 29% [15]. Another study from Finland analyzed health authority registers about the claims made against healthcare professionals and reported that around 7% of cases were related to endodontics and that male dentists or those who were general practitioners or older than 40 years were more subject to complaints regarding their clinical performance, but no differences existed between the two service sectors: private and public [16].

In this study, we analyzed the malpractice claims related to endodontics to determine whether differences exist according to the service sector and other operator-related characteristics.

Material and methods

Oral health services in Finland

In Finland, 57% of the dentists work in the public sector and 43% in the private sector; the mean age of employed

dentists ($n = 4400$) is 47.9 years, 71% are female, and 7% are of foreign origin [17]. The public sector has the responsibility of providing dental care for children below 18 years of age free of charge. In both sectors, services are open to the whole population; patients are free to decide where to go for dental care. The fees in the public sector are subsidized and notably smaller than those in the private sector, despite private sector patients receiving a partial reimbursement from the Social Insurance Institute for dental care, except for prosthodontic and orthodontic treatments.

Ethical consideration

Our study is based on decisions made by the PIC on endodontic malpractice claims in 2002–2006 and 2011–2013. The PIC, together with the Ministry of Social Affairs and Health, approved the study protocol. To further ensure fulfilment of ethics criteria, running numbers were the only identifiers for the cases in the database.

Data collection

The target cases were all endodontic malpractice claims ($n = 1322$) handled at the PIC in 2002–2006 and 2011–2013. Two dental advisors at the PIC, both specialists in endodontics, scrutinized the official documents of the endodontic malpractice claims and recorded the raw data on a computerized platform created for this purpose. Later, we tested the data for logicality and possible errors and corrected any mistakes on the basis of original patient documents, re-scrutinized by one of the authors (OS). We excluded 51 incomplete cases due to missing identification of the tooth ($n = 37$), double claims for the same treatment ($n = 3$), and withdrawn cases ($n = 11$). A total of 1271 cases remained for analyses.

Data on the cases

The data included patients' gender and age, defined as years from birth to the time of the injury, and the service sector where the treatment took place. The teeth in question were categorized as anteriors (incisors and canines), premolars, or molars. Information gathered from the patient documents included the presence of radiographs, method of instrumentation (manual or engine-driven), and use of an electronic apex locator. The injuries recorded were perforation of the root canal or pulp chamber, a broken root canal instrument, injuries due to root canal irrigants and medicaments, and miscellaneous injuries such as under/overfilling, wrong diagnosis, and unnecessary treatment. In addition, the dental advisors assessed the level of the original patient documentation into three categories: adequate, moderate, and poor. Adequate documentation included dental and pulpal diagnosis, method of apex location and instrumentation, and data on working length, canal irrigants and medicaments, filling material and pre- and postoperative radiographs. Moderate documentation included pulpal diagnosis and information about apex location, canal irrigants and medicaments, and postoperative radiographs. Poor documentation included

medicaments, working length, or radiographs; missing documentation was included in this category as well. As part of the claim handling process the PIC advisors, all being experienced clinicians, assess each claim in detail and make a suggestion about whether or not the incident could have been avoided. We categorized the injuries according to the final PIC decisions about the claims as avoidable injury, unavoidable injury, and no injury. The first category refers to injuries that could have been avoided had the operator followed good clinical practice, whereas unavoidable injuries refer to the normal risks related to healthcare.

Data on the operators

The patient documents included only the operator's name and working sector. We used public sources to find additional background data on the operators. The yearbooks of the Finnish dentists gave reliable information, but not for those dentists who recently graduated or were only temporarily working in Finland. The inquiry system of the National Supervisory Authority for Welfare and Health (Valvira) reveals the name, year of birth, and professional details of all health-care workers holding a current license to practice. Unfortunately, the service does not provide the operator's gender. For Finnish dentists, their given name indicated their gender clearly enough, but not so for all dentists of foreign background. Age and gender remained unknown for short-term operators who had returned to their country of origin and for those who had otherwise lost their license to practice as a dentist. In total, data on operator's gender were missing for 6 cases and on age for 51 cases.

Statistical methods

To evaluate differences between the groups, we used Chi-squared tests for frequencies and *t*-tests for mean values. Further, we analyzed the role of operator-related factors in the occurrence of avoidable injuries. We applied logistic regression modelling and calculated odds ratios (ORs) and their 95% confidence intervals (95% CIs). Analyses were performed with the software Survo MM version 3.4.1 (<http://www.survo.fi/mm/english.html>).

Results

Patients' age ranged from 8 to 85 years, and the vast majority were women. The private sector accounted for 54% of the malpractice claims, 56% in 2002–2006 and 51% in 2011–2013 ($p = 0.061$). Table 1 shows a comparison between the sectors with regard to patients, dentists, and the teeth in question. Younger patients, female dentists, and general practitioners predominated in the public sector. We found no sector differences in patients' gender, dentists' age, or type of tooth.

Table 2 shows various aspects of the treatment process in endodontic malpractice claims according to operators' characteristics. Root canal instrumentation had been manual in 61% of the cases; engine-driven instrumentation had been used more frequently by male than female dentists (34%

versus 28%; $p = 0.026$) and by younger dentists. A preoperative radiograph was available for 62% of cases, and no operator-related differences emerged. The method for apex location was working length radiograph in 43% of cases. For 37% of cases, the method had gone undocumented, more frequently by male (43%) or older (45%) dentists.

Patient documentation was adequate in 50%, moderate in 32%, and poor in 18% of cases (Table 2). The operator-related differences were statistically highly significant; adequate documentation was more frequent in the public sector, by female dentists, and by the youngest dentists. Figure 1 shows that 77% of dentists under 30 years of age had provided adequate patient documentation, around 40%

of 50- to 59-year-olds, and 25% of those aged 60 years and older.

The dental advisors found one injury in 73% and 2–3 injuries in 3% of cases; 24% of the claims had no injury. The advisors confirmed a broken instrument in 24% and perforation in 22% of submitted claims; in 5% of cases the injury was related to root canal irrigants/medicaments; 27% were miscellaneous injuries (Table 3). We found no operator-related differences in occurrence of injury types.

The advisors verified injuries in a total of 970 claims, deeming 65% of these as avoidable and 35% as unavoidable. We analyzed the role of operator-related factors in the occurrence of avoidable injuries by means of a logistic regression model (Table 4). Dentist's age was the only operator-related factor reaching statistical significance ($OR = 1.02$; $p = 0.007$). Service sector and dentists' gender and specialization remained insignificant terms in the model after controlling for patient's age. Dentist's age was missing in 51 cases; to enrol all cases in the analyses, we fitted a model without this factor and this model (not shown) produced virtually the same estimates and odds ratios seen in Table 4.

Discussion

We found no operator-related differences in scrutinized endodontic malpractice claims or verified injuries. This indicates that adverse events occur in the entire profession, not only in a narrow and skewed segment of it. The majority (65%) of verified injuries were judged avoidable had the operator followed good clinical practice. Our finding is in line with a study based on the Finnish health authority claim registers reporting 65% of patient safety incidents in dental and oral treatments as being 'possibly preventable' [16]. The cases assessed to be avoidable injuries may reflect dentists'

Table 1. Characteristics of the endodontic malpractice cases claimed to the patient insurance centre in Finland, according to the service sector.

Characteristics of cases	All cases (n = 1271)	Private sector (n = 680)	Public sector (n = 591)	p Value
Patients' age (years)				
Mean (SD)	44.7 (14.4)	46.1 (13.6)	43.2 (15.0)	<0.001
Range; median	8–85; 44.5	16–82; 46.4	8–85; 42.6	
Patients' gender				
Women (%)	71	70	73	0.258
Men (%)	29	30	27	
Dentists' age (years)				
Mean (SD)	45.4 (10.2)	45.9 (10.0)	44.9 (10.5)	0.103
Range; median	24–75; 45.5	24–75; 45.7	24–71; 45.4	
Data missing	n = 51	n = 13	n = 38	
Dentists' gender				
Women (%)	62	52	73	<0.001
Men (%)	38	48	27	
Data missing	n = 6	n = 1	n = 5	
Dentists' professional level				
General practitioner (%)	93	91	96	<0.001
Specialist (%)	7	9	4	
Type of tooth				
Anterior (%)	12	11	13	0.090
Premolar (%)	23	21	25	
Molar (%)	65	68	62	

Table 2. Process-related aspects in endodontic malpractice cases claimed to the patient insurance centre in Finland, according to operators' background information.

Aspects of process, based on the information in the patient documents	All claims made (n = 1271) %	Service sector		Dentist's gender		Dentist's age (years)			Dentist is specialized	
		Private (n = 680) %	Public (n = 591) %	Female (n = 781) %	Male (n = 484) %	24–39 (n = 373) %	40–49 (n = 402) %	50–75 (n = 445) %	No (n = 1188) %	Yes (n = 83) %
Instrumentation										
Manual	61	60	63	61	57	57	66	64	62	51
Engine-driven	31	31	30	28	34	34	30	26	30	41
Undocumented	8	9	7	11	9	9	4	10	8	8
		$p = 0.306$		$p = 0.026$		$p = 0.002$			$p = 0.086$	
Preoperative radiograph										
Taken	62	63	61	63	61	64	58	63	62	65
Undocumented	38	37	39	37	39	36	42	37	38	35
		$p = 0.460$		$p = 0.604$		$p = 0.218$			$p = 0.562$	
Apex location by										
Working length radiograph	43	40	46	45	39	45	46	39	44	37
Electronic device	20	21	20	22	18	21	23	16	19	35
Undocumented	37	39	34	33	43	34	31	45	37	28
		$p = 0.107$		$p = 0.003$		$p < 0.001$			$p = 0.002$	
Documentation										
Adequate	50	43	59	56	40	62	55	35	49	61
Moderate	32	32	31	32	32	28	32	35	33	21
Poor	18	25	11	12	28	10	13	30	18	18
		$p < 0.001$		$p < 0.001$		$p < 0.001$			$p = 0.053$	

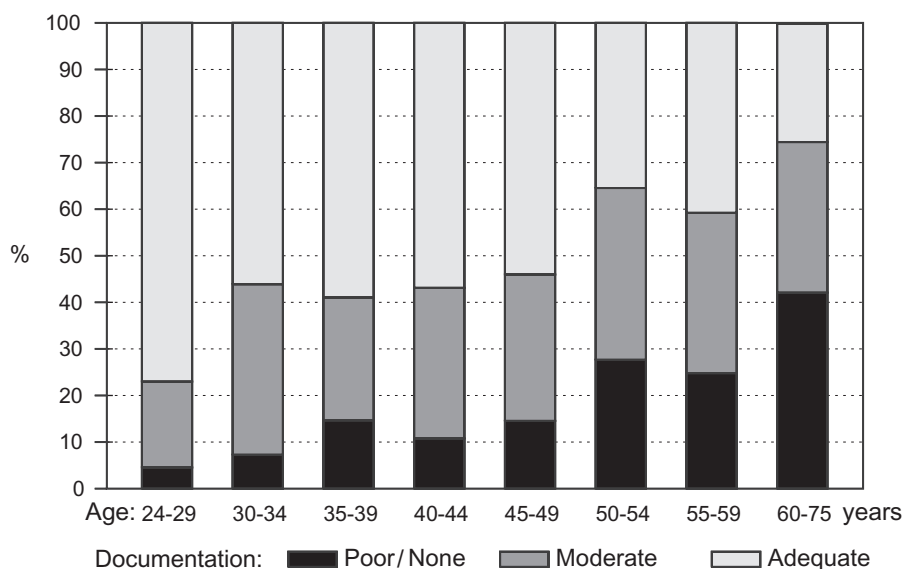


Figure 1. Quality of patient documentation in endodontic malpractice claims in Finland according to dentists' age.

Table 3. Types of the injuries verified in endodontic malpractice cases claimed to the patient insurance centre (PIC) in Finland, according to the operators' background information.

Types of the injuries verified when scrutinized by the PIC dental advisors	All claims made (n = 1271)	Service sector		Dentist's gender		Dentist's age (years)			Dentist is specialized	
		Private (n = 680)	Public (n = 591)	Female (n = 781)	Male (n = 484)	24-39 (n = 373)	40-49 (n = 402)	50-75 (n = 445)	No (n = 1188)	Yes (n = 83)
	%	%	%	%	%	%	%	%	%	%
Broken instrument										
No	76	74	77	75	76	73	74	79	75	84
Yes	24	26	24	25	24	27	26	21	25	16
		<i>p</i> = 0.231		<i>p</i> = 0.764			<i>p</i> = 0.106		<i>p</i> = 0.056	
Perforation										
No	78	80	76	78	77	76	79	78	78	78
Yes	22	20	24	22	23	24	21	22	22	22
		<i>p</i> = 0.095		<i>p</i> = 0.729			<i>p</i> = 0.607		<i>p</i> = 0.924	
Irrigant/Medicament										
No	95	96	93	95	94	95	96	93	95	94
Yes	5	4	7	5	6	5	4	7	5	6
		<i>p</i> = 0.066		<i>p</i> = 0.359			<i>p</i> = 0.180		<i>p</i> = 0.831	
Miscellaneous										
No	73	71	75	73	73	75	71	72	73	76
Yes	27	29	25	27	27	25	29	28	27	24
		<i>p</i> = 0.060		<i>p</i> = 0.872			<i>p</i> = 0.387		<i>p</i> = 0.508	

Table 4. The role of operator-related factors in the occurrence of avoidable injuries in the endodontic malpractice cases (n = 970), by means of logistic regression modelling.

Parameter	Estimate	SE	OR	95%CI	<i>p</i> Value
Service sector: Public (ref.), Private	-0.025	0.144	0.98	0.74, 1.29	0.863
Dentist's age (years)	0.018	0.007	1.02	1.01, 1.03	0.007
Dentist's gender: Female (ref.), Male	0.202	0.146	1.22	0.92, 1.63	0.168
Specialized: No (ref.), Yes	0.014	0.304	1.01	0.56, 1.84	0.963
Patient's age (years)	-0.014	0.005	0.99	0.98, 1.00	0.005
Constant term	0.144	0.467			

Fitting results: deviance = 1191.0; df = 928

SE: standard error; OR: odds ratio; 95%CI: OR's 95% confidence interval; ref.: reference category.

deficient knowledge of the normal variety in root canal anatomy and their inadequate training in the use of a new technique. Therefore, ways to ensure dentists' know-how in endodontics should be sought after graduation and over the entire clinical career.

The curriculum in dentistry gives basic level of skills and guides referring to specialists when needed. However,

frequent referrals of endodontic cases can be an unrealistic option in Finland since only about 1.3% of dentists are specialized in endodontics. In the UK, where the corresponding proportion is only 0.67%, new concepts have been piloted for developing dentists with enhanced skills via training and support at the primary care units [18]. Analogous attempts may be applicable in larger clinics, public or private, to create

a chain of support for general practitioners in the form of guided working, easy consultation, and referral as needed. Such support would be of great value to dentists, who often feel like they are 'working in the dark' because of the complexity of root canal treatment [19].

Both administration and operators in oral healthcare services have recently become more aware of the importance of identifying situations leading to adverse events. Consequently, new tools are available to avoid or diminish such events. The conceptual framework for proper discussions on patient safety has been developed by the World Health Organization [20], but also locally, e.g. in Finland [21]. A recent review concludes that 'the only interventions in dentistry that reduce or minimize adverse events are surgical safety checklists' [22]. Other papers suggest monitoring patient records to identify triggers for adverse events [23], but also patient complaints are relatively reliable safety risk indicators [24]. Regular debriefing of and discussion about adverse events at clinics could lead to improvements in patient safety. Recently, a paper from the UK gave practical suggestions on such attempts to be applied in oral healthcare services [25].

Patients' increasing awareness about the possibility of submitting a malpractice claim has been seen as a continuous increase in the numbers of claims handled by the PIC and in compensation paid for injuries [14]. In one of the three endodontic claims, the PIC advisors found no injury; such cases nevertheless reflect the patient's dissatisfaction with treatment. In addition, patient complaints serve as an indicator of a lack of quality or safety [16,24] and should thus be discussed seriously by the operator and the whole team.

With regard to the process of root canal treatment, an interesting finding was the notable differences in methods of instrumentation and apex location according to the dentist's gender, age, and specialization. Manual instrumentation and radiograph-based apex location predominated among female dentists or among unspecialized or older dentists; almost half of the male dentists and older dentists left the method undocumented. The most prominent operator-related differences occurred, however, in patient documentation, which was adequate mostly in cases treated in the public sector or by female, younger, or specialized dentists.

A few reports have shown that female dentists may emphasize preventive and conservative treatments and be slower to adopt new technical equipment in day-to-day practice. In Denmark, female dentists used electronic devices less frequently and performed fewer root canal treatments than their male colleagues [26]. Regarding instrumentation, our results confirm their finding of a gender difference. Finland has a long history of women serving as the majority in the dental profession and in the public sector. Two earlier reports from Finland have shown that the quality of root canal treatment is better for younger dentists than for their older peers [27] and that female dentists and younger dentists tend to record more information in patient documents [28]. Our findings confirm these results.

Our large material includes all endodontic malpractice claims handled by the PIC in altogether eight years, thus

reliably describing the situation in Finland in the 2000s. Indemnity of the 2002–2006 claims had been partly analyzed earlier [29]. Since the role of public sector in serving adult patients has slightly expanded [30], we updated our data by adding all endodontic claims handled in 2011–2013. However, we found no difference between the data sets in numbers of claims by sector ($p = 0.061$). Comparison with the official data of the dental workforce in Finland reveals that the private dentists here formed a larger proportion than they are in actuality (54% versus 43%); this is, however, understandable because the private sector provides services mainly to adults. A similar comparison of dentists' gender shows an underrepresentation of female dentists in our study (62% versus 71%), most likely due to the predominance of cases from the private sector, where more dentists are male.

The experienced PIC advisors assessed the claims, but the scrutiny relied on the patient documents and related information required from the operator. Since our results revealed a large variety in the quality of documentation, the amount of data available differed from case to case. This can be seen as a limitation of the study.

Conclusions

Operator-related factors had no impact on endodontic malpractice claims. Two of three verified patient injuries could have been avoided by following good clinical practice.

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Disclosure statement

The authors report no conflicts of interest.

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