Submitted: 02 August, 2022 Accepted: 12 October, 2022 Published: 03 January, 2023 DOI:10.22514/jocpd.2022.034

ORIGINAL RESEARCH

Journal of Clinical Pediatric Dentistry

Frequency of missing data in clinical records in pediatric dentistry: a descriptive study

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Abstract

The aim of the present study was to investigate the frequency of missing data on routine dental care appointments and restorative procedures from the clinical records of children treated at a pediatric dental clinic. A descriptive retrospective study was conducted involving the clinical records of children three to 12 years of age treated only with restorations. The inclusion criteria were clinical records from the past 10 years of children with at least one restored tooth. Data collection was performed by a trained examiner who extracted information from the clinical records on appointments for routine dental care and restorative procedures. The frequency of missing data on clinical records was submitted to descriptive analysis. Among the 249 clinical records analyzed, boys accounted for little more than half (54.2%) and mean patient age was 6.9 $\pm$ 1.8 years. Ninety-four of the 249 clinical records were of appointments for routine dental care. Missing data were found for the gingival bleeding index (18.1%), visible plaque index (22.3%) and dietary logs (74.5%). Forty-seven children were submitted to a total of 618 restorative procedures. Information was missing on the type of restorative material (5%), brand of the material used (65.2%), the type of isolation (50.8%) and whether pulp capping was performed (75.9%). The percentage of missing data from clinical records was substantial, demonstrating that important information is not recorded during routine dental care or restorative procedures.

Keywords

Medical record; Data analysis; Dental caries; Dental restoration; Preventive dentistry

1. Introduction

A patient record is a set of documents consisting of the patient history (*e.g.*, medical condition, psychological/behavioral considerations, and oral health needs), radiographs, treatment plan, photographs, copies of prescriptions, follow-up with other practitioners, and other documents [1]. Also, it can help dentists in lawsuits, be helpful in cases of human identification and used legally by insurers, corporations, and policy makers to assist in the assessment of the balance between the outcomes and costs of care [2, 3].

According to the American Academy of Pediatric Dentistry (AAPD), the initial patient record includes a set of patient information, such as the patient's name, nickname, date of birth, sex assigned at birth, address, telephone number, name of referring party, medical history, psychological/behavioral considerations, chief complaint, availability of medical/dental records (including radiographs) of the patient's condition. The dental record is more specifically related to oral health and must include: medical history, dental history, clinical assessment, radiographs, diagnosis or differential diagnosis, treatment recommendations, parental consent, progress notes, and acknowledgment of the receipt of the health insurance plan [1].

Still, the AAPD advocates a comprehensive examination performed by a qualified dentist in sufficient detail to provide meaningful information to a dentist and/or public health officials. The information should include oral hygiene/soft tissue health, variations from a standard eruption/exfoliation level, dental dysplasia or discoloration, dental caries (including non-cavitated deficiencies), and existing restorations [4].

The complete patient record can also orient the clinician about planned treatment and appointment history (*e.g.*, help the clinician to understand the reasons for cancelations, failures, delays, and rescheduled visits) [1]. Moreover, to reduce the failure rate in clinical procedures, dentists should be aware of what has previously been done in clinical practice through sufficient information obtained from dental records. This study intends to identify the most common data missed in the patient record. Within this information, future action can be planned to avoid messiness in patient records. Hence, the aim was to evaluate the frequency of missing data from the patient records of children treated at a university dental school, particularly regarding appointments for routine care and restorative procedures.

2. Materials and Methods

2.1 Sample characteristics and study design

A descriptive, cross-sectional study was conducted involving the patient records of children treated at the UFMG Dental School in the city of Belo Horizonte, Brazil. Data were collected from May to August 2019. A single trained examiner analyzed all patient records. The study included a convenience sample of any patient with at least one restored tooth aging from 3 to 12 years old. The age range corresponded to all children eligible for dental treatment at the pediatric dental clinic of the Dental School. We also considered for inclusion only patient records from the past 10 years, which means patient records registered from the time range between 2009 to 2019. The exclusion criteria were patient records of children only submitted to oral screening (first visit to the dentist to decide whether the patient needs dental care). If patients need dental care, they are scheduled for the first routine dental appointment.

In the first routine dental appointment, the clinician fills out the patient record. The patient record includes the name of the patient, date of birth, sex, address, phone number, sociodemographic data, medical history, parental history, allergies, medications used for systemic health, prescriptions, consent forms, and the dental record. The dental record is part of the patient record. It includes oral health examination (caries, periodontal and malocclusion assessment, trauma injury history), oral hygiene habits (use of fluoride toothpaste and dental floss), dietary log, routine dental care appointments, consultation referrals, radiographs, treatment plan, treatment history, post-treatment plan, and prescriptions. Routine dental care is performed at every appointment in an intervals greater than six months. Thus, a dental record can have more than one routine dental care appointment. During the routine care appointment, the clinician collects information on the patient's oral condition on the day of the appointment, comprising the dental caries assessment (total number of teeth and number of decayed, exfoliated or extracted and restored teeth), the gingival bleeding index (GBI) [5], visible plaque index (VPI) [6], and dietary log [7]. We excluded routine dental care appointments completed in intervals $\leq$6 months.

The dietary log comprises the information on the child's diet for three weekdays. The parents are requested to fill out the dietary log, informing all solids and liquids ingested by the child during these days. Weekdays represent the daily routine of the child. First, we consider the consistency of the sugared food (solid and liquids), scoring them as follows: (1) sugared liquids; (2) sugared solid. Also, we score the time of food ingestion: (1) if food is ingested during the main meals (breakfast, lunch, and dinner); (2) if the food is ingested between the main meals. Then we multiply the consistency of the sugared food by the time of food ingestion. *e.g.*, if the child ingested candy (2) between breakfast and lunch (2), the score for the meal is 4: ($2 \times 2 = 4$). After all sugared food is scored, we sum the scores per day and calculate a mean for the three days. The higher the score, the more cariogenic the diet is.

Undergraduate dental students are responsible for providing oral health care, filling out the patient records of this clinic, planning the treatment, and executing them. All the steps are closely supervised by a clinical professor (dentist).

2.2 Calibration process and pilot study

Prior to the main study, an experienced pediatric dentist (CCM) and the main investigator (ACSO) evaluated five patient records to test the data collection method (spreadsheet created in the Excel™ software). The data were cross-checked by the researchers to standardize the data collection process. After the creation of the first spreadsheet, additional five patient records were analyzed until no more changes were deemed necessary.

2.3 Data collection

The following data were collected in the patient records: sociodemographic information (date of birth and sex), and the dental records (routine dental care appointments and restorative procedures). We considered any routine dental care appointment completed in intervals >6 months and comprised the following information: number of decayed, exfoliated or extracted and restored teeth, the gingival bleeding index (GBI) [5], visible plaque index (VPI) [6], and dietary log.

The following information was collected regarding restorative procedures in the dental record: type of restored tooth, position of the tooth in the mouth, type and brand of the restorative material, Black's classification [8], number of surfaces restored, type of isolation, whether pulp capping was performed and the child's behavior on the day of restoration according to the Frankl scale [9].

2.4 Statistical analysis

The data were analyzed with the aid of the Statistical Package for the Social Sciences (SPSS for Windows, version 20.0, IBM Corp, Armonk, NY, USA). The descriptive analysis involved the calculation of absolute and relative frequencies for categorical variables as well as mean and standard deviation values for continuous variables. Three types of data analysis were performed relative to the aim of the study:

(1) First, a descriptive analysis of data, including the number of patient records, number of children and sociodemographic information (sex and age). The child's age was calculated using the birth date until the date of the dental restoration;

(2) Then, it was analyzed data regarding routine care appointments. Dental records were categorized as "complete" when information was found on all teeth, "partially complete" when some information was missing and "no data" when the dental record on the day of the routine dental care was blank;

(3) Finally, data regarding the restorative procedures was done. Restorative materials were categorized as "glass ionomer cement" (GIC), "resin-modified glass ionomer cement" (RMGIC) or "composite resin" (CR). The brand of the restorative material was collected from the dental records and categorized as "identified" or "missing" (when no information was found on the brand). The dental arch was categorized as "upper" or "lower". The type of isolation was categorized into "rubber dam" or "cotton rolls"; and dental pulp capping was categorized as "yes" or "no". Children

classified as having positive behavior (+ and ++) were grouped into a "good behavior" category, and those classified as having negative behavior (− and −−) were grouped into a "poor behavior" category [9]. Missing information was recorded for all variables.

3. Results

The final sample comprised 249 patient records. Patient age ranged from three to 12 years, with a mean of 6.9 ± 1.8 years, and 54.2% were boys. Mean GBI, VPI, and dietary log scores were 14.6 ± 16%, 14.5 ± 13.8%, and 11.4 ± 4.5 points, respectively.

The 249 patient records involved 618 routine dental care appointments. Among the total number of routine dental care appointments, 524 were conducted in less than six months and were excluded from the analysis. Thus, 94 routine dental care appointments were considered for the present analysis. Missing data from routine dental care appointments constituted incomplete dental records (1.1%), partially complete records (27.7%), missing GBI (18.1%), missing VPI (22.3%), and missing dietary logs (74.5%) (Table 1).

A total of 618 restorative procedures were performed on the 249 children. Fourteen records (2.3%) did not inform the day that the restoration was performed. Two records (0.32%) did not inform the restored tooth; consequently, the dental arch and tooth position were also missing. Regarding restored cavities, 73.6% were Black's Class I and II, and this information was missing from 52 (8.4%) records. The largest portion of records reported one restored surface (47.6%), and 56 (9.1%) records did not inform the number of restored surfaces. RMGIC was the predominant material (40.9%), followed by conventional GIC (37.1%) and CR (16.5%). Thirty-one dental records (5%) did not inform the type of restorative material. Cotton rolls were the predominant type of isolation (38.8%), and 50.8% of records failed to report the type of isolation. Most children exhibited good behavior (90.1%), and 1.6% of dental records failed to report this information. The highest frequencies of missing information were related to pulp capping (75.9%) and the brand of the restorative material (65.2%) (Table 2).

TABLE 1. Frequency of missing information from routine dental care appointments with an interval of ≥ 6 months.

Routine dental Care*	N = 94 (100%)
Dental Records	
Complete	67 (71.3%)
Partially Complete	26 (27.6%)
No data	1 (1.1%)
Gingival bleeding index (GBI)	
Valid	77 (81.9%)
Missing	17 (18.1%)
Visible plaque index (VPI)	
Valid	73 (77.7%)
Missing	21 (22.3%)
Dietary log	
Valid	24 (25.5%)
Missing	70 (74.5%)

**Children should be screened for oral health status every six months (e.g., dental records with number of decayed, filled or extracted/exfoliated teeth, Gingival Bleeding Index (GBI), Visible Plaque Index (VPI) and dietary log). "Missing" corresponds to absent exam.*

4. Discussion

As expected, the present study demonstrated a high frequency of missing data from patient records. The most frequent missing information was related to the GBI, VPI, dietary log, brand of material used, type of isolation, and pulp capping.

The visible plaque index (VPI) offers a very important information on tooth brushing habits. A study showed that 84% of 12-year-old children who reported frequent tooth brushing had no caries experience in the primary dentition and had no occlusal dental plaque [10]. A previous study suggested that a gingival bleeding index (GBI) of 15% can be used as a criterion to define gingivitis [11]. Moreover, several systematic health problems are correlated with periodontal disease, such as cardiovascular disease, diabetes mellitus, overweight and obesity [12–14]. It is accepted that periodontal disease can originate from gingivitis and that dental plaque is a key etiological concern [15]. This data is quite important to guide clinicians in choosing the proper restorative material due to its mechanical and remineralization properties (*e.g.*, fluoride release) and planning the treatment accordingly. For example, a clinician may choose to use CIV for the restoration of teeth in children with high scores of dental plaque.

Collecting information from a dietary log is important to the analysis of sugar intake. Several studies point out the association between sugar intake and the prevalence of dental caries [16–18]. One study showed that children with dental caries had greater soda intake than those without dental caries [19]. As healthcare provider, dentists must be aware of their patients' diet not only from the cariogenic standpoint but also to identify imbalances in the diet that may be related to systemic health problems. For instance, there is evidence of higher proportions of energy intake from soft drinks by overweight children [20]. The lack of information on the child's diet makes it difficult to identify possible factors affecting systematic and oral health. The causal effect of fermentable carbohydrates on dental caries is well known in the literature [21], and information related to the diet can help the clinician identify the major imbalances in diet associated with dental caries.

The highest percentages of missing information were related to the brand of the restorative material employed, the type of isolation and whether pulp capping was performed. This information can assist clinicians in determining the reasons why a restoration failed. In a study conducted by Pinto *et al.* [22] (2014), the annual failure rate was higher when GIC (12.9%) and RMGIC (12.2%) were used compared to CR (9.5%). Moreover, class I restorations had a signifi-

TABLE 2. Frequency of missing information from dental records regarding restoration procedures.

Information regarding restoration	N = 618 (%)
Date of restoration	
Valid	604 (97.7%)
Missing	14 (2.3%)
Position of tooth in arch	
Anterior	117 (18.9%)
Posterior	499 (80.8%)
Missing	2 (0.3%)
Black Classification	
Class I	192 (31.1%)
Class II	263 (42.5%)
Class III	39 (6.3%)
Class IV	14 (2.3%)
Class V	31 (5.0%)
Class VI	27 (4.4%)
Missing	52 (8.4%)
Number of restored surfaces	
1 surface	294 (47.6%)
≥2 surfaces	268 (43.3%)
Missing	56 (9.1%)
Restorative material	
GIC	229 (37.1%)
RMGIC	253 (40.9%)
CR	102 (16.5%)
CR + GIC	3 (0.5%)
Missing	31 (5.0%)
Brand of restorative material	
3M	6 (1.0%)
Filtek 3M	11 (1.8%)
Ketac	25 (4.0%)
Ketac Molar	10 (1.6%)
Riva	14 (2.3%)
Vitremer	130 (21.0%)
Outros	19 (3.1%)
Missing	403 (65.2%)
Dental arch	
Upper	314 (50.8%)
Lower	302 (48.9%)
Missing	2 (0.3%)
Type of isolation	
Rubber dam	64 (10.4%)
Cotton rolls	240 (38.8%)
Missing	314 (50.8%)
Dental pulp capping	
Valid	149 (24.1%)
Missing	469 (75.9%)
Frankl behavioral rating scale	
Good behavior	557 (90.1%)
Poor behavior	51 (8.3%)
Missing	10 (1.6%)

"Missing" corresponds to absent information. GIC: glass ionomer cement; RMGIC: resin-modified glass ionomer cement; CR: composite resin.

cantly longer survival rate compared to class II restorations (p = 0.016), and restorations involving more surfaces had a 44% greater risk of failure (95% CI: 1.03–2.00) compared to restorations involving only the occlusal surface [22]. As the survival of restorations can be affected by several factors, it is important to register variables in the dental record that can potentially explain a possible failure in order to determine other treatment options in case of restoration failure. That being said, if information regarding the brand of the material, the type of the material, and the type of isolation had been registered in the dental record, the clinician could plan a different restorative strategy for future restorations. However, this is speculation as we did not collect data of retreatment.

The American Academy of Pediatric Dentistry (AAPD) recognizes that the patient record is an essential component of health care and serves as a source of information for the dentist as well as any other professional [1]. The patient record is also an important legal document in relationships with third parties. Poor or inadequate documentation of patient health care has been consistently reported as a major contributing factor in unfavorable legal judgments against dentists [23]. The high rate of missing data can have negative consequences for dentists, especially in the legal realm. The Regional Council of Brazilian Dentistry reported that 5% of cases of lawsuits against dentists could have been avoided if the clinical records had been filled out correctly [24]. Moreover, the AAPD recognizes that patients have the right to review records regarding their treatment and have the information explained or interpreted as necessary, except as restricted by law. In addition, patients have the right to request a transfer of their medical records [1, 25].

The missing information in patient records does not mean that the data does not exist. However, the data was not registered by the clinician. Also, having data documented in the patient record does not necessarily solve problems of the dental practice. The clinician has to know what to do with the data collected during the patient examination; and how to implement recommendations of the clinical practice using the information collected. Otherwise, much data collected in patient records might be useless.

The study has limitations. The amount of missing data found can point out a shortcoming of this clinic's operation. It means that this cross-sectional study has some selection bias [26] as dental students filled out the patient records of this study. Thus, the results of this study have limited applicability to other dental schools and epidemiological settings. The results of this study do not represent patient records filled out by licensed dentists working in private or public settings.

This is a convenience sample focused on specific topics of the clinical record. The data presented in this study was restricted to some dental procedures. Therefore, to overcome this, future studies should be conducted on a larger sample of patient records and cover other data, such as insurance status, the protocol of oral hygiene, and others.

The strength of this study was the demonstration of how the restoration executed was poorly registered. To try to overcome the missing data in this clinical setting, the clinical supervisor should be more attentive when mentoring their dental students. Also, the patient record could be reviewed in such a way as to

keep only the important information for the patient's treatment plan and prognosis.

5. Conclusion

The most frequent missing data were related to the GBI, VBI, dietary log, brand of material used, the type of isolation, and whether pulp capping had been performed. The substantial frequency of missing data shows that important data on restorative procedures and routine exams are not being registered.

AUTHOR CONTRIBUTIONS

ACSO and CCM—conceived the idea for the project and revised the manuscript. ACSO—collected the data, and led the writing. CCM, MABP and RAB—analyzed and interpreted the data. All authors read and approved the final version of the manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The protocol for this study received approval from the Human Research Ethics Committee of the Dental School of the Federal University of Minas Gerais (UFMG) (Human Research Ethics Committee approval: 12457519.5.0000.5149). Informed consent was obtained from all subjects' parents involved in the study.

ACKNOWLEDGMENT

Not applicable.

FUNDING

This study was supported by Dean's Office of Research of the Federal University of Minas Gerais (Pró-Reitoria de Pesquisa, PRPq/UFMG), National Council for Scientific and Technological Development (PIBIC/CNPq, Ministry of Education, Brazil, process #146797/2020-5) and Coordination for the Advancement of Higher Education Personnel (CAPES, Ministry of Education, Brazil), Fundação de Amparo à Pesquisa do Estado de Minas Gerais (FAPEMIG, APQ00323-17). The funding agencies had no role in the conception of the study, data collection, data analysis or interpretation of the results.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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How to cite this article: Ana Clara SOUZA-OLIVEIRA, Marco Aurélio Benini PASCHOAL, Rachel ALVARENGA-BRANT, Carolina Castro MARTINS. Frequency of missing data in clinical records in pediatric dentistry: a descriptive study. Journal of Clinical Pediatric Dentistry. 2023; 47(1): 44-49. doi: 10.22514/jocpd.2022.034.