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Burden of Dental Anomalies at a University Pediatric Dental Clinic

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**Abstract**

Burden of Dental Anomalies at a University Pediatric Dental Clinic

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**Purpose:** Investigate the burden of dental treatment for children and adolescents with dental anomalies.

**Methods:** Electronic health records (axiUm) of patients seen at the University of Washington Center for Pediatric Dentistry (2010-2019) were used for this cohort study. Children and adolescents with dental anomalies were identified using word recognition from Info Manager in axiUm followed by comprehensive assessment to confirm dental anomaly case status (amelogenesis imperfecta, dentinogenesis imperfecta, hypodontia, hyperdontia, dentin dysplasia). For controls, 3 charts were matched for each case based on first visit date (+/- 1 month). Sociodemographic variables, medical history information, stage of dentition, insurance status and claims, appointments, cost, and restorative treatment were obtained. Data was analyzed using descriptive statistics, chi squared, and t-test ( $P < .05$ ).

**Results:** Of the 2,097 new patients, dental anomalies were identified in 699 patients (33%). For 5 out of the 10 years of follow up, we found controls to have more dental claims than children with dental anomalies ( $P < .05$ ). However, there were no significant differences in either number of

appointments or mean costs between groups. The dental anomaly group had more zirconia crowns, orthodontic and surgical treatment over all ( $P<.0141$ ) and ( $P<.001$ ), compared to more restorative treatment overall in the control group ( $P<.001$ ).

Conclusion: Compared to a pediatric population with high-carries risk, children with dental anomalies did not have more dental claims, appointments, or overall cost for dental care. Further investigation of definitive dental treatment among young adults is needed to expand the current assessment of the burden of dental anomalies.

## **BACKGROUND**

Dental anomalies, often diagnosed in the early years of child development, are classified depending on their abnormalities in number, shape, color, structure, texture, eruption, exfoliation and position (Jahanimoghadam 2016). The most common are oligodontia, hypodontia, hyperdontia, and mesiodens. Amelogenesis imperfecta (AI), dentinogenesis imperfecta (DI), and dentin dysplasia (DD), AI, DI, and DD are the utmost complex requiring more dental treatment, appointments and time in the dental office, increased risk of long-term psychological distress, significant financial burden, as well as having the potential for lifelong monitoring and continued dental care. (Barron et al. 2008; Ng and Messer 2009; Bozkurt et al. 2014)

Children diagnosed with complex dental anomalies will present with clinical problems including poor esthetics, tooth sensitivity, and extensive tooth wear.(Barron et al. 2008; Ng and Messer 2009) Management for cases in childhood and adolescence are often aimed at improving esthetics, reducing sensitivity, correcting or maintaining vertical dimension and restoring masticatory function.(Ng and Messer 2009) Treatment for developmental dental anomalies varies upon complexity and phenotype. (Ng and Messer 2009; Gadhia et al. 2012; Sabandal and Schäfer 2016) Evidence has shown that early diagnosis followed by appropriate preventive and restorative care with a multidisciplinary approach typically performed over several treatment phases, is essential to optimize the final outcome.(Ayers et al. 2004; Ng and Messer 2009; Sabandal and Schäfer 2016) Challenges for a successful overall treatment include but are not limited to irregularities in the eruption process, morphology of the crown, pulp-dentine organ, and in the number of teeth.(Poulsen et al. 2008) An additional burden to dental rehabilitation includes the negative effect that treatment has on patients' oral health-related quality of life and psychosocial health. Children diagnosed with complex dental anomalies can develop psychosocial effects in

terms of self-esteem, self-image, social interaction, and display social avoidance, fear, and anxiety.(Coffield et al. 2005) Therefore, timely and effective dental treatment that maximizes function and esthetics not only treats the underlying dental defect, but can make a substantial difference in the psychosocial functioning of children and adolescences with dental anomalies.(Coffield et al. 2005) There is a gap in knowledge on financial burden, time commitment, additional appointments required, and restorative challenges on the road to dental rehabilitation into adulthood dental care.

Current published literature provides no information on the economic impact for treatment of developmental dental anomalies for children diagnosed and treated within the United States at a large scale. Limited dental insurance coverage, high out-of-pocket costs, and limited participating dental providers which are commonly cited reasons for not accessing dental care (Meyerhoefer et al. 2014) are additional hurdles in obtaining and maintaining oral health among children and adolescents with complex dental anomalies. The cost analysis of prosthodontic rehabilitation of young patients with dental anomalies is a gap in the dental and medical research that remains to be assessed. While only one study (in Sweden) attempted to assess the financial burden it only assessed children with AI concluding that early treatment is associated with lower costs and a lower number of dental visits.(Pousette Lundgren et al. 2021)

While the Global Burden of Disease (GBD) has spotlighted the financial impact of oral diseases at country level it fails in providing the actual financial burden of oral conditions and more specifically, the financial burden for dental developmental disorders or anomalies. Although the GBD found that together, the direct and indirect costs led to an annual economic impact of \$442B for 2010 alone, it consolidates available economic data relating only to the direct and

indirect cost of common dental conditions. Listl et al. found that high-income countries like the United States, attributed to 83% of the direct treatment cost, yet, authors concluded that “there is an urgent need to increase the availability of internationally comparable data on dental treatment costs,” and “data relevant to comprehensively assess the full magnitude of direct and indirect costs of dental and oral diseases still seem very sparse.”(Listl et al. 2015)

The purpose of this study is to determine the financial burden of simple and complex dental anomalies in children and adolescents in a large university pediatric dental clinic database (2010-2019), and to identify sociodemographic factors associated with fulfilling dental visits and completing restorative care. We hypothesize that children with dental anomalies will have significantly higher appointment requirements, time in the dental office, and a higher financial burden for restorative dental care. Results from this study will expand the body of knowledge concerning factors that influence the diagnosis, treatment timeline, and family financial expectations of dental anomalies in children and adolescents seeking dental care at a university pediatric dental clinic.

## **METHODS**

### **Study design and population**

The project was approved by the University of Washington (UW) Institutional Review Board (STUDY00012045). This cross-sectional study utilized data from electronic charts of patients (0-18 years of age) seeking care at the UW Center for Pediatric Dentistry (CPD) from 2010-2019.

### **Variables**

Electronic health record software (axiUm) is utilized at UW CPD for storing patient medical and dental information as well as coordinating and demonstrating patient treatment needs. The axiUm software is commonly used at dental education institutions and is used to gather and store pertinent patient information in an electronic record. Based on information available from patient electronic health records (EHR), we defined the following variables:

Sociodemographic variables, it included subject's age in months at their first visit; date of birth in the day, month, year format; sex assigned at birth, male or female; and the subject's insurance status identified as, Medicaid insurance, Other (private insurance or private insurance and Medicaid insurance), and Self-Pay (no insurance). Subjects with a Developmental Disabilities Association (DDA) benefit, an expanded insurance benefit available to patients with special healthcare needs (SHCN), were excluded from this study population due to the large prevalence of dental anomalies among patients with complex medical histories. The CPD sees many patients with SHCN and is a known referral destination for patients with SHCN on Medicaid insurance. This study focused on the otherwise healthy population at the CPD.

Medical history, it included information on general health history grouped by systems as well as presence of syndromes. Data were categorized into the following categories: otherwise healthy, cardiovascular, endocrine, neurologic, respiratory, and other, which included hematology/oncology diseases, psychiatric disorders, gastrointestinal disease, and ectodermal disease.

Dental variables, it included diagnosis of AI, abnormal changes to the enamel structures of the primary and/or permanent dentition; DI and DD, abnormal changes to the dentin structures of the primary and/or permanent dentition; oligodontia, absence of more than 6 teeth in the primary and/or permanent dentition; hypodontia, absence of 1 to 6 teeth in the primary and/or permanent dentition; and hyperdontia, the presence of supernumerary teeth in the primary and/or permanent dentition.

Treatment variables, it included forms of definitive treatment comprised of sealant placement, silver diamine fluoride application, amalgam and composite restorations, crowns, full coverage restorations, indirect pulp cap, direct pulp cap, pulpotomy, pulpectomy, extractions, orthodontics, and means of anxiolysis and sedation in the form of nitrous oxide, oral conscious sedation, and general anesthesia.

Financial variables, it included payment from patient insurance company, patient out of pocket expense, and number of insurance claims.

### **Data collection**

We collected data from the CPD in a comprehensive search of EHR for all patients from 2010-2019. Each subject was counted once at the first date of entry of the dental anomaly within the axiUm EHR. Info Manager, a report builder module in axiUm using word recognition, was utilized to identify and obtain the dental anomalies cases. The following phrases were used in word recognition: amelogenesis imperfecta, dentinogenesis imperfecta, dentin dysplasia, oligodontia, hypodontia, congenitally missing tooth, supernumerary tooth, mesiodens, dental anomaly, and

dental anomalies. Each identified case was further investigated by a research team member to verify accuracy and later grouped based on type of dental anomaly. An inter and intra Kappa test was conducted to verify reliability of data extraction. The inter and intra Kappa test scores were 0.76 and 0.76 respectively (95% CI; SD [0.44, 1.00]). To further analyze differences and association in the distribution of the variables collected, we randomly matched each case to three non-dental anomaly individuals based on the date of first visit to the clinic (+/- 1 month of first visit).

## **Data analysis**

Password protected data from axiUm EHR was sent to the research team in Excel version 16.0 (Microsoft Corp., Redmond, Wash.). Individuals were assigned a study number for identification and the link to the original data was kept secure and password protected. De-identified data was later entered into and managed using Research Electronic Data Capture (REDCap) tools hosted by the UW. REDCap is a secure, web-based application designed to support data capture for research studies.(Harris et al. 2009) Differences in demographics characteristics were analyzed using descriptive statistics. Through the decade of data collected, we assessed the presence of trends of dental cost and financial burden using yearly financial totals. The year 2019 was used as a cutoff because it was the latest one non-impacted by COVID-19 pandemic. Critical value was set at 5%.

## **RESULTS**

### **Cross-Sectional Characteristics**

From the 2010-2019 period, dental anomalies were identified in 699 subjects representing 2.21% of all new patients seeking care at the pediatric university clinic. The majority were males

(61.9%), in primary dentition (37.1%) and with Medicaid insurance (79.1%). The mean age of subjects with dental anomalies was 8.6 years (SD: 3.7). Most subjects with dental anomalies were otherwise healthy (65.4%). Compared to individuals without dental anomalies (controls), subjects were significantly more likely to be male (61.9% vs. 51.4%;  $p < 0.0001$ ) to have Medicaid insurance (79.1% vs. 69.6%;  $p < 0.0001$ ), and to be otherwise healthy (65.4% vs. 61.0%;  $p < 0.0001$ ). Our control group was significantly more likely to be in primary dentition (40.9% vs. 37.1%,  $p = 0.0012$ ), and of age 0-5y (38.5% vs. 19.6%,  $p < 0.0001$ ) at time of first visit. In addition, there was no difference in age (8.6 vs. 8.5 years;  $p = 0.4750$ ) or in the prevalence of syndromic diagnoses (1.2% vs. 2.3%;  $p = 0.0557$ ) (Table 1).

### **Number of Claims, Appointments, and Types of Restorative Treatment**

On average, children with dental anomalies had fewer insurance claims, and a similar number of appointments compared to children without dental anomalies (Table 2 and Figure 1a and 1b). The average number of appointments for both groups was found not to be statistically significant and was 2.2 per year ( $p < 0.8026$ ). The dental anomaly group had significantly fewer dental insurance claims (6.3 vs 7.6,  $p < 0.0001$ ). Specifically for 5 out of the 10 years of follow-up (2013-2017), we found controls to have significantly more dental claims than children with dental anomalies ( $p < 0.05$ ). When dental claims were analyzed by type of services, we found that the dental anomaly group had more zirconia crowns, orthodontic treatment, and surgical treatment over all ( $p < 0.0141$ ,  $p < 0.0002$  and  $p < 0.0001$ ), compared to more restorative treatment overall in the control group ( $p < 0.0001$ ). On the contrary, the control group had more sealants ( $p < 0.0001$ ), silver diamine fluoride applications ( $p < 0.0001$ ), one and two surface posterior composites ( $p < 0.0002$ ), indirect pulp caps ( $p < 0.0005$ ), and pulpotomies ( $p < 0.0001$ ). Significant differences

were also found with the number of one surface anterior composites ( $p < 0.0047$ ), two surface anterior composites ( $p < 0.0381$ ), three or more surface posterior composites ( $p < 0.0025$ ) and stainless-steel crowns ( $p < 0.0018$ ). Behavior management including nitrous oxide, oral conscious sedation, and general anesthesia were similar between both the anomaly and control groups.

### **Cost of Treatment**

On average, children attending a University Pediatric Dental Clinic with dental anomalies incur less overall dental cost than children without dental anomalies (Table 2 and Figure 3). From 2010-2019, children with dental anomalies averaged \$794.47 in dental treatment costs, compared to \$806.35 average cost by children (controls) without dental anomalies. This was found not to be statistically significant with  $p = 0.7117$  (Table 2). While there is an overall trend for costs to increase within the 10 years of data, we did not find significant differences between the groups.

### **DISCUSSION**

The purpose of this study is to determine the financial burden of simple and complex dental anomalies in children and adolescents in a large university pediatric dental clinic. We hypothesized that families with children with dental anomalies will incur in a greater financial burden, as measured by increased insurance claims, appointments and overall cost as compared to children without dental anomalies. The results from this study will expand on the limited body of knowledge concerning the burden that dental anomalies in children and adolescents experience when seeking dental care at a university pediatric dental clinic. Results of this study rejected our hypothesis and failed to confirm that children and adolescents with dental anomalies require significantly higher appointment requirements, time in the dental office, and experience a

higher financial burden for restorative dental care. Although the types of dental restorative treatment were different in both groups with the anomaly group requiring more surgical and orthodontic treatment compared to restorative treatment in the control group, no statistically significant financial burden was found.

To provide relevant information for decision making and public policy addressing oral disease, describing and highlighting the magnitude of the financial burden of families and economic impact of dental diseases in our society needs to be investigated. (Listl et al. 2015b) While the Global Burden of Disease (GBD) highlighted the financial impact of oral diseases, it has been unable to provide the actual financial burden of dental developmental disorders or anomalies. Although the GBD found that together, the direct and indirect costs led to an annual economic impact of \$442B for 2010, the treatment reviewed was for common dental conditions such as caries and periodontal conditions. Authors concluded that comprehensive and comparable data is an urgent need in order to understand the extent of dental treatment costs, and data related to the direct and indirect costs of dental and oral diseases still seem very scarce. (Listl et al. 2015)

For children with public insurance coverage, untreated tooth decay continues to be a significant problem. (Brickhouse et al. 2008) The comparison of untreated dental caries of children enrolled in public insurance programs to children of the same age who were not enrolled is important because Medicaid is required per federal guidelines to provide access to dental care for children enrolled in Medicaid equal to that of other children in their communities. (Brickhouse et al. 2008) Our study population, as well as the population at our dental clinic, are families seeking dental treatment who often have public insurance coverage. When evaluating the access to dental

care for families with public insurance coverage, low reimbursement rates, broken appointments and patient noncompliance, and burdensome paperwork associated with Medicaid, were the major reasons consistently provided by dentists for their lack of participation in the Medicaid program. (Mofidi et al. 2002). Given this limitation, and that dental anomalies are sex- and age-independent, timeliness of care and access for all families is vital for adequate and appropriate dental care for all children. (Sella Tunis et al. 2021) In our study, we found that children with dental anomalies had fewer insurance claims, and a similar number of appointments compared to children without dental anomalies. This finding emphasizes that dental anomalies in children and adolescents may require a similar amount of dental treatment compared to a high caries risk and predominantly Medicaid university dental clinic patient population. Brickhouse et al. investigated the effects of Medicaid enrollment on children with untreated dental caries and discovered that children enrolled in Medicaid 1.7 times more likely to have untreated dental caries than were non-enrolled children. (Brickhouse et al. 2008) Due to access of services and/or complexity of treatment needs, many patients are referred to the CPD for comprehensive dental treatment from private dental clinics and are on Medicaid insurance. Due to the multidisciplinary resources available at the University of Washington, referrals not only occur from local private offices, but also dental offices which are multiple hour commutes away from the University. Due to the location of referrals, especially for our high caries risk population on Medicaid insurance, our findings that the non-anomaly group had more restorative treatment needs is validated. This is emphasized by most of the dental anomalies over our decade of data being hyperdontia, and not AI, DI, or DD which require more extensive restorative dental treatment needs.

Wang et al. evaluated the effects of State health insurance programs on access to dental care and found that 6-17-years-old low-income children use more dental services, have more

unmet dental care need, and are less likely to have public coverage compared to low-income children aged 2-5. (Wang et al. 2007) This age group, when the permanent dentition is erupting and developing, is a critical timeframe for ideal care for complex dental anomalies like AI, DI, and DD. The common clinical problems for these complex anomalies include extensive tooth wear, poor esthetics, and tooth sensitivity, which not only can have psychosocial effects, but create dental rehabilitation challenges. (Ng and Messer 2009) The financial burden of prosthetic dental treatment for complex dental anomalies like AI has been evaluated by Pousette Lundgren et al. and found that the mean total costs were 8.5 times higher for patients with AI. (Pousette Lundgren et al. 2021) Our study was not limited to only one complex dental anomaly and found the mean total cost for treatment to be \$794.47 (SD: 1,028.28) for patients with dental anomalies, compared to \$806.35 (SD: 1,013.93) for our non-anomaly group.

The number of claims was utilized to aid in assessment of financial burden of dental anomalies. The dental anomaly group had significantly fewer dental insurance claims (6.3 vs 7.6,  $p < 0.0001$ ). Specifically for 5 out of the 10 years (2013-2017) we found that the non-anomaly group had significantly more dental claims than children with dental anomalies. Further analysis of finances revealed that during this five-year period, the amount of funding from the University of Washington's Peter Domoto Fund for Children was \$243,098.18. For 2010-2012, 2018, and 2019 the total combined contribution from the Domoto Fund was \$53,841.93. The Peter Domoto Fund for Children was established for Dr. Peter Domoto, who served as department chair at the University of Washington Center for Pediatric Dentistry for 25 years. He is known nationally for his work on behalf of children who lack access to dental care and are at high risk of oral diseases. Upon retirement in 2002, he was honored by establishing the fund which ensures access to oral

health care at UW Pediatric Dentistry for economically disadvantaged, at-risk children. This large financial contribution during 2013-2017 explains how our high caries risk control group had significantly more claims. The CPD was able to provide more care to high-risk children with Medicaid in need, and were able to provide more restorative treatment.

Our study had several limitations. Our study analyzed the claims, number of appointments, and finances of children diagnosed with dental anomalies that presented to a university pediatric dental clinic. These children were then randomly matched each to three non-dental anomaly individuals based on the date of first visit to the clinic (+/- 1 month of first visit). Therefore, these patients were not specifically matched by age, gender, or any other variable. This allowed for age and stage of dentition to be evaluated, give a realistic clinical view of the variation of patients that present to a dental clinic for first visits, more specifically permit a vast amount of data to be evaluated over a decade worth of dental care allowing us to include more children in our study and give a more well-rounded perspective of the population seeking care at our clinic, which is also a strength of this comprehensive study completed over 10 years.

The second limitation to our study was discrepancies noted after matching our dental anomaly subject to three non-anomaly patients. Our matching was done randomly within 1 month of first visit. Each subject was counted once at the first date of entry of the dental anomaly within the axiUm EHR. Our search was constricted by the type of data that the EHR captures. Dental anomalies cases were obtained through Info Manager in axiUm using word recognition. We aimed to keep the randomization of our matches, but this led to finding some anomalies in dental charts after the matching process. These patients are ones that were later identified as

having an anomaly noted in their chart but were not originally assigned to our dental anomaly group. Sensitivity testing was completed after obtaining our data to determine the significance of these patients. It was determined these 81 patients did not affect our results and these patients were excluded from the study. The implementation of software, axiUm Info Manager, used in this study presents a novel way of completing comprehensive chart reviews. This large database sets up a line of research that investigates other relevant variables such as the time and resources spent by families of patients with dental anomalies and inter-professional collaborations. The CPD is a multi-provider facility with charting variability between providers, however, more recently note templates have been implemented which aid in the reduction of variance, which can be helpful in structuring further analyses.

The other limitation to our study is the age at which patient's graduate to our university clinic, a private clinic, or are referred to another specialty for comprehensive treatment which effects the types of treatment we can identify in axium. Pousette Lundgren et al. evaluated the timing of crown placement as part of their overall cost analysis of children with amelogenesis imperfecta. In their study, crown placement timing was analyzed with age at the start of ceramic crown therapy ranging from 10 to 22 years (mean:  $15.6 \pm 2.8$ ). The average age of crown placement in this study is around the age that patients from the CPD would graduate from our pediatric clinic and either be referred to our university dental clinic or a private dental clinic for dental care. Due to potential loss of follow-up and further analysis of these complex dental anomaly cases requiring extensive treatment, our study results are more reflective of the comparison of children and young adolescents with dental anomalies compared to a high caries risk population. However, as our study exhibited, families with children with dental anomalies

may not acquire a more significant financial burden than those families with children that are high caries risk. This information is not only valuable for future financial planning for children with dental anomalies, but also helpful in recognizing the financial need for and importance of early intervention dental care for high caries risk children.

## **CONCLUSION**

This study demonstrates that children with dental anomalies had fewer insurance claims, and a similar number of appointments compared to children without dental anomalies. This finding emphasizes that dental anomalies in children and adolescents may require a similar amount of dental treatment compared to a high caries risk and predominantly Medicaid university dental clinic patient population. Results of this study did not confirm that children and adolescents with dental anomalies require significantly higher appointment requirements, time in the dental office, and experience a higher financial burden for restorative dental care. It is possible that a greater financial burden may be significant in young adult patients when seeking definitive care. This study demonstrated that children with dental anomalies require more esthetic crowns, surgical treatment and orthodontic treatment compared to more restorative treatment in the control group. This study will provide comparable data to aid in the continued assessment of financial burden of dental anomalies. More research is needed to investigate the burden of dental anomalies in young adults after graduating from a university pediatric dental clinic.

Table 1: Demographics

	Dental Anomalies N (%)	No Dental Anomalies N (%)	p-value*
<b>Sex</b>			<0.0001
Male	433 (61.9%)	1034 (51.4%)	
Female	266 (38.1%)	976 (48.6%)	
<b>Dentition</b>			0.0012
Missing information	3 (0.4%)	7 (0.3%)	
Primary Dentition	259 (37.1%)	823 (40.9%)	
Mixed Dentition	215 (30.8%)	467 ( 3.2%)	
Permanent Dentition	222 (31.8%)	713 (35.5%)	
<b>Insurance Status</b>			<0.0001
Other**	104 (14.9%)	524 (26.1%)	
Medicaid	553 (79.1%)	1399 (69.6%)	
Self-Pay	31 (4.4%)	2 (0.1%)	
Missing Information	11 (1.6%)	85 (4.2%)	
<b>Medical Diagnosis</b>			<0.0001
Healthy	457 (65.4%)	1227 (61.0%)	
Respiratory Disease	43 (6.2%)	78 (3.9%)	
Neurologic Disorders	6 (0.9%)	97 (4.8%)	
Other***	193 (27.6%)	608 (30.2%)	
<b>Syndrome</b>			0.0557
No	687 (98.8%)	1962 (97.7%)	
Yes	8 (1.2%)	47 (2.3%)	
<b>Type of Dental Anomaly</b>			N/A
Amelogenesis Imperfecta (AI)	26 (3.7%)		
Dentinogenesis Imperfecta (DI)	17 (2.4%)		
Dentin Dysplasia (DD)	1 (0.1%)		
Hyperdontia	570 (81.8%)	N/A	
Hypodontia	34 (4.9%)		
Oligodontia	13 (1.9%)		
Other	36 (5.1%)		
<b>Age</b>			<0.0001
0-5y	137 (19.6%)	773 (38.5%)	
6-11y	406 (58.1%)	590 (29.4%)	
12y+	156 (22.3%)	647 (32.2%)	
<b>Mean Age (SD)</b>	8.6 (3.7)	8.5 (5.5)	0.4750
<b>Median Age (IQR)</b>	8 (6.0-11.0)	8 (4.0-13.0)	
*Significant at p< 0.05. Chi squared test completed for goodness of fit of categorical variable, t-test performed for continuous variables. ** Private insurance or private insurance + Medicaid *** Common Disease including: Cardiovascular Disease, Endocrine Disorders, Hematology/Oncology, Psychiatric Disorders, Gastrointestinal Disease, Ectodermal (hair, nails, skin) disease			

Table 2: Claims, Appointments, and Cost by Year 2010-2019

Year	Claims Mean (SD)			Appointments Mean (SD)			Cost (\$) Mean (SD)		
	Anomalies	Control	p-value	Anomalies	Control	p-value	Anomalies	Control	p-value
2010	6.9 (8.3)	5.8 (5.1)	0.3894	1.9 (1.4)	1.8 (1.5)	0.7678	615.00 (1,038.55)	484.97 (655.04)	0.4521
2011	5.4 (5.1)	6.5 (5.4)	0.0731	1.8 (1.1)	2.0 (1.5)	0.3336	546.77 (627.89)	638.31 (1,074.65)	0.2751
2012	5.8 (5.6)	6.8 (5.6)	0.0782	1.9 (1.3)	2.0 (1.4)	0.7240	834.34 (957.97)	770.94 (991.33)	0.5144
2013	5.2 (5.2)	6.6 (5.3)	0.0052	2.1 (1.8)	2.1 (2.1)	0.8499	659.72 (716.14)	708.20 (870.47)	0.4773
2014	6.5 (6.0)	7.9 (6.3)	0.0179	2.2 (1.8)	2.4 (2.2)	0.3502	832.53 (896.57)	893.37 (1,055.70)	0.4585
2015	6.3 (6.4)	7.8 (6.4)	0.0081	2.3 (2.5)	2.3 (2.0)	0.8234	746.57 (956.21)	802.35 (1,025.79)	0.5119
2016	6.1 (5.7)	8.3 (6.5)	0.0000	2.3 (2.3)	2.3 (1.9)	0.8498	720.93 (879.13)	803.79 (998.51)	0.2852
2017	6.6 (5.8)	8.1 (5.9)	0.0123	2.2 (1.7)	2.3 (1.6)	0.5828	901.84 (1,010.65)	809.82 (1,021.15)	0.3539
2018	7.9 (6.0)	8.1 (5.5)	0.8427	2.7 (2.2)	2.3 (1.6)	0.0595	960.43 (1,194.66)	844.01 (959.18)	0.3891
2019	7.6 (6.0)	8.8 (5.6)	0.1101	2.4 (2.2)	2.3 (1.4)	0.7842	1,235.72 (1,991.80)	1042.51 (1,175.62)	0.3944
2010-19	6.3 (5.9)	7.6 (6.0)	0.0000	2.2 (1.9)	2.2 (1.8)	0.8026	794.47 (1,028.28)	806.35 (1,013.93)	0.7117

Figure 1a: Claims by Year 2010-2019

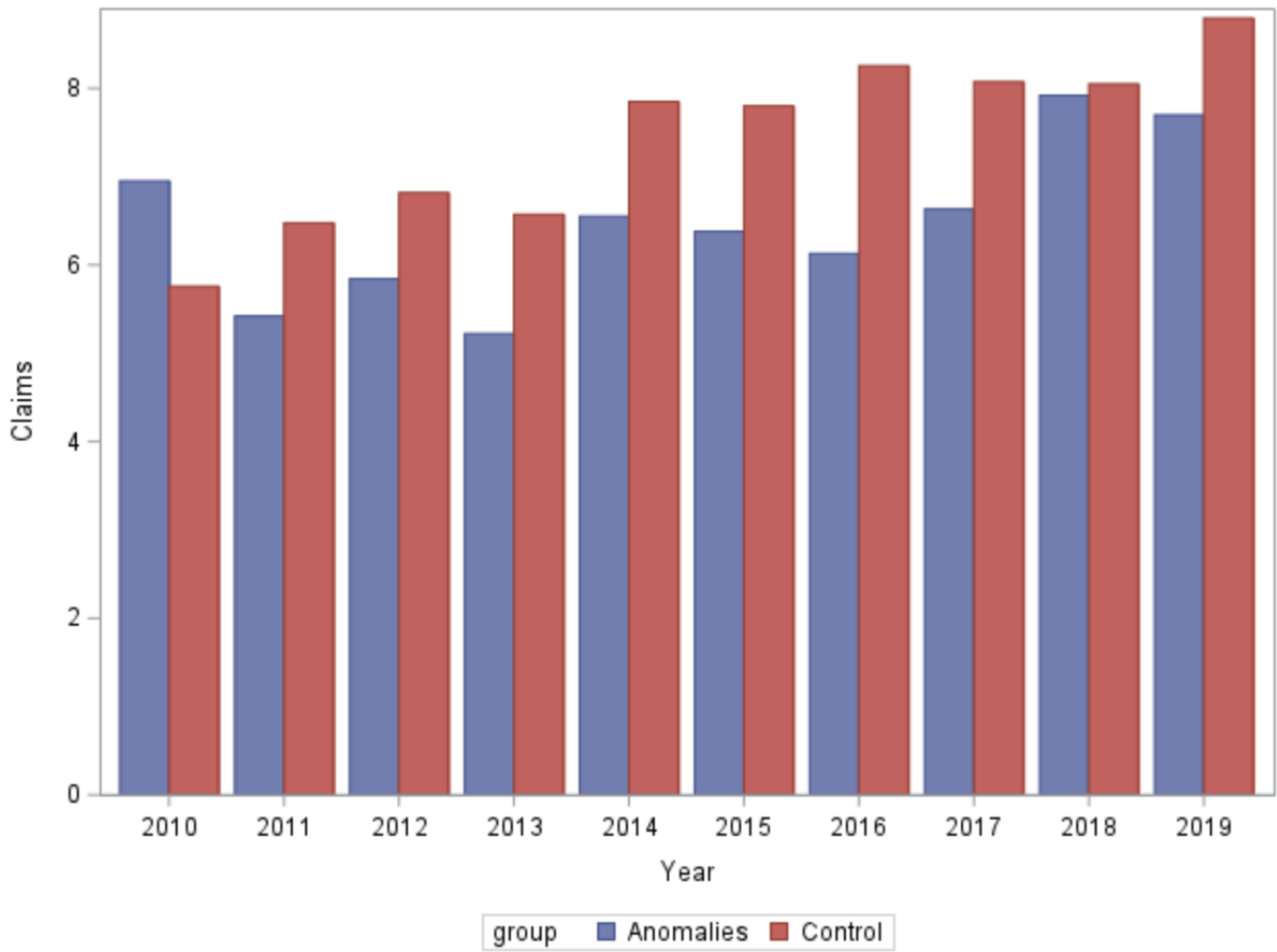


Figure 1b: Appointments by Year 2010-2019

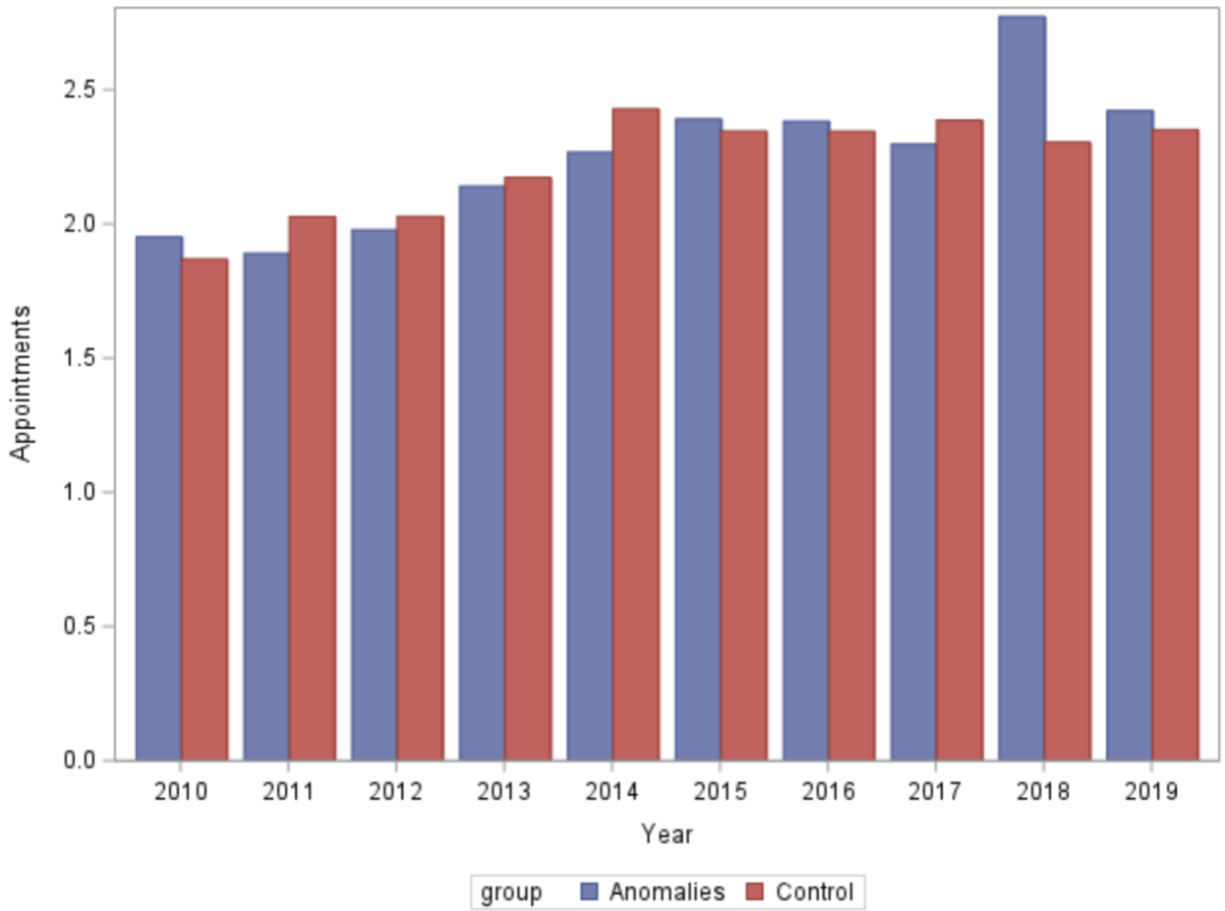


Figure 2: Cost of Treatment in US Dollars 2010-2019

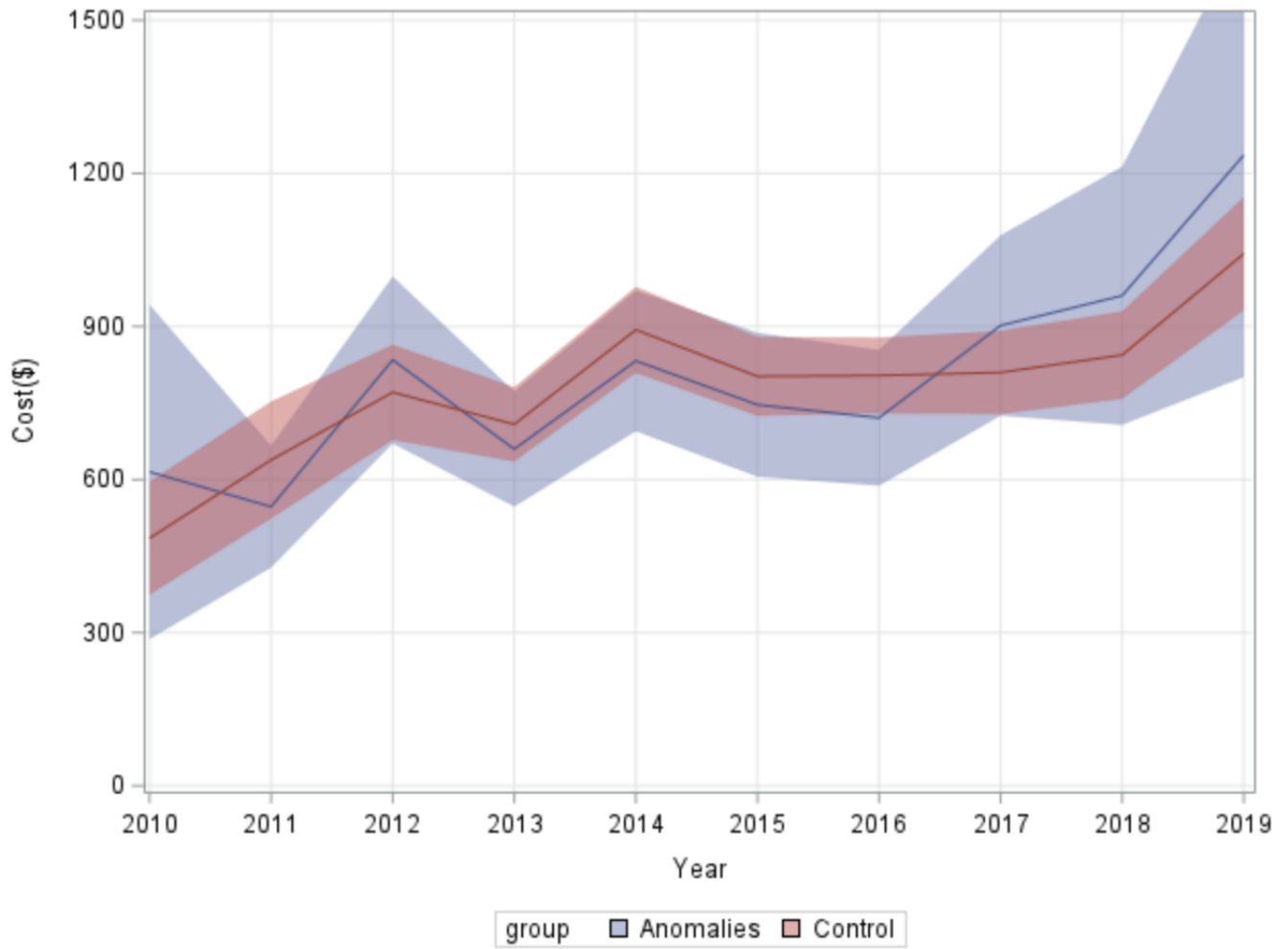


Table 3: Restorative Treatment from 2010-2019

Treatment	Anomalies	Control	p-value
	N(%)	N(%)	
<b>Restorative</b>			
Any Restorative	787 (9.93%)	4904 (12.65%)	<0.0001
Sealant	399 (5.03%)	2411 (6.22%)	<0.0001
Silver Diamine Fluoride	7 (0.09%)	168 (0.43%)	<0.0001
1 Surface Composite Ant	29 (0.37%)	245 (0.63%)	0.0047
2 Surface Composite Ant	29 (0.37%)	213 (0.55%)	0.0381
3+ Surface Composite Ant	29 (0.37%)	129 (0.33%)	0.6436
1 Surface Composite Pos	152 (1.92%)	1023 (2.64%)	0.0002
2 Surface Composite Pos	187 (2.36%)	1220 (3.15%)	0.0002
3+ Surface Composite Pos	17 (0.21%)	176 (0.45%)	0.0025
1 Surface Amalgam	8 (0.1%)	25 (0.06%)	0.2659
2 Surface Amalgam	11 (0.14%)	34 (0.09%)	0.1818
3+ Surface Amalgam	3 (0.04%)	14 (0.04%)	0.9411
Composite Crown	35 (0.44%)	204 (0.53%)	0.3359
Stainless Steel Crown	242 (3.05%)	1463 (3.77%)	0.0018
Zirconia Crown	15 (0.19%)	35 (0.09%)	0.0141
<b>Miscellaneous</b>			
Orthodontics	88 (1.11%)	273 (0.7%)	0.0002
Surgery	906 (11.43%)	2292 (5.91%)	<0.0001
<b>Pulp Therapy</b>			
Indirect pulp cap	7 (0.09%)	121 (0.31%)	0.0005
Direct pulp cap	4 (0.05%)	8 (0.02%)	0.1311
Pulpotomy	20 (0.25%)	239 (0.62%)	<0.0001
Pulpectomy	2 (0.03%)	30 (0.08%)	0.1060
Root Canal Therapy	18 (0.23%)	52 (0.13%)	0.0513
<b>Behavior Management</b>			
N2O	216 (2.72%)	1158 (2.99%)	0.2087
OCS	20 (0.25%)	144 (0.37%)	0.1024
GA	27 (0.34%)	108 (0.28%)	0.3484
<b>Total</b>	<b>7929 (100%)</b>	<b>38781 (100%)</b>	<b>0.8325</b>

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