Extractions prior to comprehensive orthodontic treatment in the mixed dentition

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Abstract

Studies concerning the prevalence of extractions prior to orthodontic treatment have been limited in scope. This quasiexperimental analysis from secondary data explores patient and provider variables as they relate to extractions prior to comprehensive orthodontic therapy in the mixed dentition. This national database contains 38,529 children who had at least one comprehensive orthodontic (mixed dentition) visit within a 27-month period (January 1987–March 1989). Because of the relatively small number of Class III malocclusion cases, an equal allocation, random sample method was used in choosing children from the three Angle malocclusion classifications and the seven NIDR regions. Of those selected 24.7% had one or more extractions prior to orthodontic treatment, with 56% occurring at either 11 or 12 years of age. There were slightly more extraction cases for the Class I malocclusion children (26.7%) than either Class II (23.1%) or Class III (24.1%). Those children who had an orthodontic extraction were slightly older ($P < 0.05$). There were no statistically significant differences relating to orthodontic extractions for the following patient and provider variables: gender, malocclusion classification, years since dental graduation, and type of dental practice. There were regional differences among extraction rates for pediatric dentists, with those from the NIDR Midwest region more likely to have children receiving one or more extractions. (Pediatr Dent 16:211–16, 1994)

Introduction

Since the turn of the century, there have been several philosophical shifts regarding extractions in conjunction with orthodontic treatment.[1] In recent years, the nonextraction approach has dominated much of clinical teaching and practice in this area of constantly varying treatment methods.[2] Several factors account for this swing toward nonextraction therapy. Research data based on postretention studies have not substantiated the efficacy of extraction over nonextraction therapy in crowded dentitions in ensuring long-term stability and good alignment.[3,4] Concurrently, there was more acceptance of dental protrusion, which translated to increased acceptance of protrusion in the circumoral area.[2]

Given this turn toward — or rediscovery of — a nonextraction philosophy and the acceptance of more protrusion, methods that facilitated or produced these results gained popularity. Functional appliances with active or passive arch-expanding mechanisms grew in favor,[5] as did the use of other arch-expanding appliances like lip bumpers.[6] The management of leeway space in conjunction with arch-expanding appliances, a method to reduce extractions, also gained more followers.[7]

These approaches simply supplemented two established nonextraction facilitating events: the introduction of bonding techniques that allowed for more space by not circumferentially banding all the teeth[8] and the general decline in caries over the past two decades.[9]

On the other hand, extractions are generally considered necessary in cases where modest skeletal discrepancies are to be resolved by camouflage treatment (i.e., making the teeth fit the skeletal malocclusion) in nongrowing, esthetically acceptable individuals; and when teeth must be removed due to dental pathology, compromised supporting tissue, poor morphology, or injury.

At least in some areas there appears to be a shift in the severity of cases treated by the orthodontist, pediatric dentist, or general dentist with an increasing number of patients seeking correction of relatively mild malocclusions.[10, 11] This may be a counter-balancing force that requires fewer extractions. Actually, there were not and are not presently established scientific criteria upon which to base extraction and nonextraction decision making.

The prevalence of extractions in orthodontic treatment in the past 15 years has been examined in few studies, each of which has very limited scope. Peck and Peck studied 537 patients from a single orthodontic practice in the northeastern United States.[10] Their findings include an overall extraction frequency of 42.1%, with a greater extraction rate for females (44.3%) than males (39.0%).

Investigations by Weintraub, et al. produced similar results.[12] In a survey of 238 of 264 licensed orthodontists in Michigan, the rate of extraction was estimated to be 39%, with a range of 5–87.5%. Because of this wide variance, the study concluded that a current trend in extraction frequency for orthodontic purposes was indeterminable. They found no correlation between extraction rate and either year of graduation or orthodontic training program.

A related study by the same group of investigators evaluated records from five practices with extreme self-reported extraction rates to examine a possible relationship between extraction treatment and the duration of active comprehensive therapy.[13] Analysis of 438 individual cases showed differences in treatment duration when extraction and nonextraction patients within each practice were compared, with treatment incorporating extractions taking longer. However, when these cases were pooled across practices there were no statistically significant differences between the groups for the length of treatment. There were no differences between the extraction and nonextraction groups based on sex of the patient, Angle classification, or number of arches involved in the treatment.

In Great Britain, Cousins, et al. studied 50 consecutive orthodontic cases at intervals over a 15-year period (1964–1978).[11] These investigators noted a substantial decline in the number of orthodontically related extractions and a decrease in treatment time within this period. Furthermore, there was an increase in the number of orthodontic cases to correct mild malocclusions.

An important issue in orthodontic extractions is the timing of this procedure. Serial extraction is one method in selectively choosing teeth for extraction in the developmental stages of growth.[14] When performed properly for carefully selected patients, this technique may reduce treatment time when compared with waiting until the child has a full complement of permanent teeth.[15]

Within the last few decades an increasing number of pediatric dentists and general practitioners have devoted at least some of their practice time to orthodontics. Their training and expertise may also dictate whether or not they perform orthodontics with or without extractions. For instance, in a survey of Indiana dentists, approximately 70% of the pediatric dentists and approximately 45% of the general dentists performed serial extractions.[16] More than 60% of the pediatric dentists and slightly less than 20% of the general dentists treated comprehensive orthodontic cases. Both groups had increased the amount of orthodontic care provided in the last decade, citing the attendance of continuing education courses in orthodontics as a major factor. Other studies of general practitioners demonstrate the increasing volume of orthodontic patients they treat.[17–19]

This study explores which patient and provider characteristics, if any, are related to whether or not a child has one or more extractions prior to comprehensive orthodontic therapy. Comparisons also are made within and between types of providers. This investigation also investigates whether or not secondary data analysis provides an indication of the type of mixed dentition patient who has any extractions associated with orthodontic treatment.

Methods

The original data set consists of fiscal records only for all children between the ages of 5 and 15 who were insured from January 1986 through March 1989 by a large national dental insurer. This database contains records for approximately 1,350,000 children. All children included within the database necessarily have dental insurance and have submitted at least one claim. Due to the nature of these claims data, neither surface- nor tooth-specific information was available.

A summary line was created for each individual, based on unique identifier variables (i.e., scrambled codes for family and claimant identification) from the first orthodontic treatment. Each line included: family and claimant identification codes, sex, age, zip code, state and NIDR region, scrambled provider identification code, and orthodontic category.

Each individual's zip code (the zip code of the employee covered by the insurance policy) was recoded to state and the seven NIDR regions within the contiguous United States (I — New England; II — Northeast; III — Midwest; IV — Southeast; V — Southwest; VI — Northwest; and VII — Pacific).[9] Because of a wide variation in the market share among states by this insurance carrier, only regional data are used in any subsequent analysis.

In this quasiexperimental design only those individuals with an American Dental Association orthodontic procedure code for "comprehensive orthodontic treatment — mixed (transitional) dentition" and who had at least one initial comprehensive orthodontic treatment on or after January 1, 1987, were eligible for analysis. This later starting date prevented a distorted and inflated figure of orthodontic services at the onset of the data collection period. Furthermore, it ensured an adequate time period prior to and immediately following initiation of orthodontic treatment during which an extraction could occur. Only simple exodontic procedures were tallied in these analyses (ADA procedure codes 7110 and 7120) with an unadjusted charge for each extraction also recorded. By limiting the study to record only simple extractions, the investigators expect that the preponderance of extractions to be primary canines, primary first molars, and permanent first premolars. The accuracy of the practitioner's coding using the ADA procedure codes for either dentition or angle classification cannot be determined.

A computer-generated, random sample, equal allocation method was used for further selection. One hundred individuals with a mixed dentition, comprehensive orthodontic treatment code, and who had their first orthodontic visit on or after January 1, 1987, were chosen for each combination of region and orthodontic classification. Thus, there were 21 separate cells (seven regions and three angle classifications) with a total of 2,100 individuals. Accordingly, the statistical calculations have been weighted to reflect the actual number of comprehensive orthodontic cases.

After the 2,100 were selected, the investigators received a list from the insurer of the names and addresses for each of these providers. For all the known providers, the year of graduation from dental school and type of practice (pediatric dentist, orthodontist, or general practice) were determined. Since the investigators anticipated the majority of providers to be orthodontists, The Orthodontic Directory of the World[20] was the initial resource that was consulted for specific facts concerning postgraduate training location and dates of attendance for each provider. If the practitioner was an orthodontist, this directory also provided information on the preferential orthodontic technique (e.g., Begg, edgewise) used. If the provider was not listed in the Orthodontic Directory of the World, then another provider directory — Directory of Pediatric Dentists or American Dental Directory[21] — was consulted to determine the provider's specialty, if any. In all cases the American Dental Directory served as the resource for year of dental school graduation.

The provider variables then were merged to the existing data summary files. It is from this finalized format that all exploratory statistical analyses were performed. Bivariate comparisons were performed using either chi-square or Fisher's exact test (for nominal data) and Student's t-test (for continuous data) in SAS computer software (SAS Institute, Inc., Cary, NC). Statistical significance was set at the $P < 0.05$ level.

Results

Of the 38,529 children who had comprehensive orthodontic treatment for the mixed dentition the percent of Class I, Class II, and Class III malocclusion cases who received treatment was 41.1, 54.0, and 4.9, respectively (Table 1). Of the 2,100 randomly selected cases 24.7% had one or more extractions during or just prior to comprehensive orthodontic treatment. There were

Table 1: Number of mixed dentation, comprehensive orthodontic cases (N = 38,529)

NIDR Region	*Angle* *I*	*II*	*III*
I (New England)	1099	1720	127
II (Northeast)	1931	3021	250
III (Midwest)	4076	5207	465
IV (Southeast)	3573	4608	514
V (Southwest)	1738	1890	190
VI (Northwest)	1142	1344	123
VII (Pacific)	2275	3010	226
Percent (%)	41.1	54.0	4.9

Table 2: Percentage of children with one or more extractions (N = 2100)

NIDR Region	*Angle* *I*	*II*	*III*
I (New England)	34	18	22
II (Northeast)	26	14	25
III (Midwest)	28	23	20
IV (Southeast)	20	24	22
V (Southwest)	24	30	23
VI (Northwest)	31	28	26
VII (Pacific)	24	25	31

Table 3: Number of comprehensive orthodontic cases, by age and sex (N = 2100)

Age	*Sex*		*Percentage with extraction (%)*	
	Male	*Female*	*Male*	*Female*
5	1	1	0	0
6	5	10	20.0	10.0
7	25	36	16.0	11.1
8	75	110	12.0	20.9
9	121	146	21.5	24.7
10	154	194	20.8	21.1
11	232	252	27.2	29.0
12	204	292	30.4	32.5
13	79	116	22.8	19.0
14	16	17	6.2	29.4
15	7	7	28.6	0

slightly more extraction cases for the Class I malocclusion children (26.7%) than either Class II (23.1%) or Class III (24.1%). Regional differences by malocclusion type varied from a low of 14% (Region II — Class II) to a high of 34% (Region I — Class I) for extractions (Table 2). There were more females than males regardless of whether they had any extractions. Each of the contiguous United States, including the District of Columbia, was represented. In this sample there were specialty providers educated at 60 different institutions.

The mean number of extractions per individual with one or more extractions is 3.29 (SD 2.28), median of 3, mode of 2, and a maximum of 18. Twenty-two percent of those with extractions had four teeth removed, whereas 30% of those with extractions had two teeth removed. The percentage of children with extractions peaks at age 12 (Table 3). Fifty-six percent of those with any extractions were either 11 or 12 years old. The unadjusted extraction cost per child for those who had at least one extracted tooth during this time frame was $37.85 (SD 31.95; median 30). No regional comparisons were made for this cost.

Table 4: Bivariate analysis between extraction and nonextraction groups

	No Extraction	*Extraction*	*Percentage Extraction*	*x^2 Stat*	*P Value*
Age					
Mean	10.6	10.9			
SD	1.8	1.5			0.0006
Sex					
Male	701	218	23.7		
Female	881	300	25.4	0.8	0.362
Region					
I	226	74	24.7		
II	235	65	21.7		
III	229	71	23.7		
IV	234	66	22.0		
V	223	77	25.7		
VI	215	85	28.3		
VII	220	80	26.7	8.2	0.223
Angle					
I	513	187	26.7		
II	538	162	23.1		
III	531	169	24.1	2.2	0.339
Years since graduation					
Mean	22.2	22.2			
SD	8.6	8.5			0.914
Type of practice					
General	171	46	21.2	2.9	0.235
Orthodontist	920	313	25.4		
Pediatric dentist	80	20	20.0		

Table 4 shows the differences for extraction rates by both patient (age, sex, region of the country, and Angle classification) and provider characteristics (years since dental school graduation, type of practice). Those children with one or more extractions are slightly older at onset of orthodontic treatment than those children without extractions ($P < 0.05$). Table 5 displays the percentage of children who had an extraction, by malocclusion classification and type of practice. For instance, 14.8% of the children who were Class II and received their comprehensive orthodontic treatment by a pediatric dentist had at least one extraction. The highest extraction rate was for Class I children who were treated by an orthodontist (28.6%).

Approximately 24% of the selected children had incomplete information about their providers (i.e., no assignment of benefits; billed as a group practice). For the 1,550 providers who could be determined via one of the three directories, the percentages of orthodontists, general practitioners, and pediatric dentists were 79.5, 14.0, and 6.5, respectively.

For each of the provider categories the mean age for children with extractions is slightly older than those without extractions, although the age is statistically significant ($P < 0.05$) only for those treated by general practitioners (Table 6). For pediatric dentists there are regional differences for extraction rates ($P = 0.020$). Although less than half of the patients of Midwest pediatric dentists had one or more extractions, the ratio of extraction to nonextraction cases was much higher than any other region of the country. All other patient variables and the years since dental school graduation showed no statistically significant differences within each provider category for extraction rates.

Discussion

Orthodontic extraction rates in our study were substantially lower when compared with previous studies.[10, 12] While our study is limited to the mixed dentition, consideration also should be given to the increase in the number of children who are covered by dental insurance. Concomitantly, the decrease in dental car-

Table 5: Extraction rates for practitioners

	Angle					
	I		*II*		*III*	
Provider Type	N	*Extraction (%)*	N	*Extraction (%)*	N	*Extraction (%)*
Orthodontist	384	28.6	418	23.9	431	23.9
General Practice	87	23.0	63	17.5	67	22.4
Pediatric Dentist	42	21.4	27	14.8	31	22.6
Unknown	187	25.7	192	24.5	171	25.7

Table 6: Bivariate analysis between extraction and nonextraction groups

		Orthodontist			*General Dentist*			*Pediatric Dentist*		
Variable	*df*	*Extractions (%)*	*x^2 Stat*	*Prob•*	*Extractions (%)*	*x^2 Stat*	*Prob•*	*Extractions (%)*	*x^2 Stat*	*Prob•*
Patient										
Sex										
Female	1	27.2	0.02	0.901	19.1	0.7	0.413	14.3	3.7	0.054
Male		23.2			24.7			25.5		
Region										
I	6	24.7	5.1	0.533	18.2	4.0	0.676	25.0	15.1	0.020
II		27.1			14.8			26.7		
III		22.9			19.0			42.9		
IV		22.2			17.4			20.0		
V		29.3			19.4			11.8		
VI		26.7			28.6			8.3		
VII		25.1			24.1			0.0		
Angle										
I	2	28.6	1.8	0.410	23.0	1.2	0.539	21.4	1.2	0.547
II		23.9			17.5			14.8		
III		23.9			22.4			22.6		
		Extraction	Mean ± SD			Mean ± SD			Mean ± SD	
Age		No	10.7 ± 1.7	0.074		10.1 ± 1.7	0.0001		10.0 ± 1.8	0.572
		Yes	10.9 ± 1.5			11.1 ± 1.2			10.2 ± 1.8	
Provider										
Years since graduation		No	22.8 ± 8.6	0.689		19.2 ± 9.2	0.363		22.0 ± 6.5	0.522
		Yes	23.0 ± 8.4			17.9 ± 8.4			21.1 ± 5.4	

• Significance determined by chi-square analysis, Student's *t*-test, or Fisher's Exact Test, as appropriate.

ies over the past couple of decades also may be associated with fewer complex dentitions because of fewer extractions due to dental caries.

Our findings corroborate those of previous investigators showing that there were no statistical differences for the patient's sex, the malocclusion classification, or the practitioner's number of years since graduation from dental school.[12, 13] Unlike previous findings, which were limited to orthodontists, our research finds similar results for general and pediatric dentists. The sole exception is for regional differences among pediatric dentists. The relatively small number of pediatric dentists in this population, however, tempers these findings. Further investigation concerning the training (i.e., residency as well as continuing education) of these pediatric dentists is warranted.

The reliability of provider coding for malocclusion and dentition (mixed, permanent) classifications is of concern. Additionally, the use of the three Angle malocclusion classifications for insurance claims is limiting for research purposes, especially since subclassifications are overlooked. In order to minimize the number of children who possibly are neither in the mixed dentition phase of development nor have extractions for other reasons besides an orthodontic condition, the bivariate analysis was recalculated deleting those children who were younger than 8 or older than 13 years of age. Except for one instance, which converted a borderline probability to a *P*- value of 0.022 for the differences between the sexes for the extraction rate by pediatric dentists (Table 6), all other probabilities closely maintained their original values.

A linchpin of the research design is that the preponderance of the extractions were for orthodontic reasons. Certainly, there is no guarantee that this is the case. However, the latest national school childrens' dental survey demonstrated that their mean DMFS was 3.07, with only 4.3% of the DMFS due to the missing component.[9] Therefore, only a very small proportion of the school-aged population has had any extractions of the permanent dentition because of carious lesions. Moreover, since this studied population includes only those whose families are covered by dental insurance, they are more likely to be regular dental utilizers and benefit from early preventive and restorative dental care.

Undoubtedly, the major shortcoming of this research effort is the lack of a clinical component. While secondary data analysis may be extremely useful for explaining some health care issues (e.g., cost of relative services), it appears that some clinical decision analysis must supplement this information before a clearer picture is established concerning predictor variables for orthodontic extractions. This issue is particularly important because general and pediatric dentists have more selectivity in choosing the patients they treat orthodontically.

The absence of a substantial portion of the provider information presented an unanticipated problem. Less than 10% of missing practitioner information was because of either group practice billings or because the provider couldn't be located in one of the directories. The preponderance of missing practitioner information, however, was because providers didn't accept assignment of benefits. While this national insurance carrier records all transactions, regardless of any payment and to whom, there are gaps within the database. Other health services researchers are cautioned about these shortcomings.

A potentially confounding problem is the possibility of an increase in the number of orthodontic procedures for less deviant malocclusion in an insured population. With orthodontic riders to the basic dental insurance benefit package becoming more available within the past decade, many families may take this opportunity to seek comprehensive orthodontic care for their children. Whether or not this has affected the percentage of children who have extractions prior to comprehensive orthodontic treatment is beyond the scope of this investigation.

Conclusion

For this dentally insured population:

1. Children who had an orthodontic extraction were slightly older. This finding is more predominant among general practitioners.
2. These findings corroborate those of others in which there were no statistical differences for orthodontic extractions regardless of the patient's sex, malocclusion classification, or number of years since the dentist's graduation from dental school.
3. Although less than half of the orthodontic patients of pediatric dentists in the Midwest region had one or more extractions, this was much higher than any other region of the country. This finding, however, is from a limited number of pediatric dentists and caution should be taken in its interpretation.

The authors wish to thank the American Academy of Pediatric Dentistry for providing a directory of pediatric dentists.

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