ORIGINAL ARTICLE

Orthodontic treatment provided by general dentists who have achieved master's level in the Academy of General Dentistry

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Introduction: The purposes of this study were to document orthodontic treatment currently provided by general dentists for comparison with past and future studies and to ascertain variables that influence practitioners' orthodontic treatment patterns. **Methods:** A 21-item survey was mailed to 750 master's level members of the Academy of General Dentistry. Surveys returned within 8 weeks were included for statistical analysis. **Results:** The response rate was 62%. Most practitioners spent less than 10% of their practice time providing orthodontic treatment and reported that this would not change in the future. Many provided orthodontic treatment in the permanent dentition, and the most common conditions or malocclusions treated were space maintenance, anterior crossbite, rotation, habits, molar uprighting, and posterior crossbite. The most common orthodontic appliances used were removable Hawley appliances with finger springs, straight wire orthodontic therapy, rapid palatal expanders, and functional appliances. **Conclusions:** The number of general dentists providing comprehensive orthodontic treatment has not changed since previous surveys; practitioners also do not expect a change in the next 5 years. Factors that influenced the orthodontic treatment provided included the primary source of orthodontic training, the number of orthodontic continuing education hours earned per year, the practitioner's location, and the proximity to the nearest orthodontist. (Am J Orthod Dentofacial Orthop 2006;129:678-86)

Very little is known about orthodontic treatment provided by general dentists in the United States. Although orthodontic treatment provided by nonorthodontists has been evaluated in the past, previous investigators sampled only general practitioners from a few states, not from the nation as a whole.[1-6] One study reported that 17% of the responding general practitioners in Indiana provided comprehensive orthodontic treatment.[2] Respondents from a study in Massachusetts reported spending 2% of their time providing orthodontic treatment.[3] In contrast, studies about orthodontic treatment provided by pediatric dentists in the United States have been performed.[7,8]

The orthodontic training received in most predoctoral dental programs is typically limited. It has been postulated that, if the orthodontic training in dental schools were more thorough, general practitioners would better appreciate the expertise of orthodontic specialists and would make more referrals. This, however, has not proven true. In 1980, Manasse and Dooley[9] reported that those who treated orthodontic patients in their predoctorate education continued to treat orthodontic patients later in private practice.

Because of the lack of information about orthodontic treatment provided by general dentists and their orthodontic training in the United States, a nationwide study is warranted. Therefore, the purposes of this study were to document current orthodontic treatment provided by general dentists for comparison with past and future studies, to ascertain variables that influence practitioners' orthodontic treatment patterns, and to document the amount of orthodontic training general practitioners receive.

METHOD AND MATERIALS

A 21-item multiple-choice survey was mailed to 750 members of the Academy of General Dentistry who had attained the master's level. Appropriate institutional review board approval was obtained at the University of Louisville. The sample was randomly chosen and comprised 68% of current master's level

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1. Which of the following best describes your current involvement with general dentistry?
□ Private practice □ Academic □ Academic and Private Practice □ Government □ Retired
2. In which type of area is your practice located?
□ Urban □ Suburban □ Rural
3. In what state is your practice located?

_____

4. Where is the nearest orthodontist located?
□ In your office □ <1 mile □ 1-4 miles □ >4 miles
5. In what state did you receive your dental school education?

_____

6. How many years have you been a general dentist?
□ <10 □ 10-20 □ 21-30 □ 31-40 □ >40
7. What is your age?
□ 25-35 □ 36-45 □ 46-55 □ 56-65 □ >65
8. What is your gender?
□ Male □ Female
9. Where did you receive most of your orthodontic training?
□ Undergraduate dental training □ AEGD/GPR □ CE courses (1-2 day courses)
□ Continued weekend courses (1-5 years in duration) □ Other _____
10. Please rate the adequacy of the orthodontic training you received during your undergraduate dental education?

Poor		Average		Excellent
□ 1	□ 2	□ 3	□ 4	□ 5

11. How many <u>hours per year</u> do you spend in orthodontic continuing education courses?
□ <10 credit hours □ 10-20 credit hours □ 21-40 credit hours □ 41-60 credit hours □ >60 credit hours
12. What types of orthodontic services do you offer? (Check all that apply)
□ None □ Limited □ Comprehensive
13. Which of the following stages of dental development do you treat orthodontically?
(Check all that apply) □ No orthodontic treatment offered □ Primary dentition
□ Early mixed dentition □ Late mixed dentition □ Permanent dentition
14. What percentage of your orthodontic patients are over the age of 18 years?
□ N/A □ 1-20% □ 21-40% □ 41-60% □ 61-80% □ 81-99% □ 100%
15. Which of the following conditions would you typically treat? (Check all that apply)

□ No treatment provided	□ Space maintenance	□ Space regaining
□ Anterior cross-bite	□ Posterior cross-bite	□ Habits
□ Dental Class I malocclusion	□ Dental Class II malocclusion	□ Dental Class III malocclusion
□ Deep Bite	□ Skeletal Class II malocclusion	□ Skeletal Class III malocclusion
□ Open bite	□ Rotation/Minor malposition	□ Alignment of Impacted Teeth
□ Molar uprighting	□ Ectopic/ Eruption guidance	□ Serial extraction

16. Which types of orthodontic therapy do you use in your practice? (Check all that apply)

□ No treatment provided	□ Straight wire technique	□ Edgewise technique
□ Removable Hawley with auxiliary springs	□ Utility archwires (2x4, etc.)	□ Functional appliances
□ Fixed rapid palatal expander/RPE	□ Removable RPE	□ Invisalign
□ Intra-arch molar distalization appliances	□ Headgear/ Protraction HG	

17. Over the past year, how many <u>orthodontic appointments</u> do you average <u>per week</u>?
□ None □ <10 □ 10-20 □ 21-40 □ 41-60 □ >60
18. On average, how many <u>referrals</u> do you make to an orthodontic specialist <u>per month</u>?
□ None/ seldom refer □ <5 □ 5-10 □ >10 / refer all orthodontic treatment
19. What <u>percent of your office time</u> do you spend providing <u>orthodontic treatment</u>?
□ <10% □ 10-25% □ 26-50% □ 51-75% □ 76-90% □ 91-100%
How has this changed over the past 5 years?
□ It has increased. □ It has decreased. □ It has stayed the same.
What type of change (if any) do you anticipate over the next 5 years?
□ It will increase. □ It will decrease. □ It will stay the same.
20. If the percent of your office time spent providing orthodontic treatment has changed (or will change), what was (will be) the reason for the change?

_____

21. Comments:

Fig. Survey sent to master's level members of Academy of General Dentistry.

members. Exclusion criteria included practicing in a foreign country. Only responses received within 8 weeks of the mailing were included for statistical analysis. A sample of the survey is shown in the Figure.

Data collected from the surveys were entered into a Microsoft Excel (Micosoft, Seattle, Wash) database and verified for accuracy. The data files were then converted for use with the Statistical Package for the Social Sciences software (SPSS for Windows, 12.0 SPSS, Chicago, Ill) to conduct the analyses. Descriptive statistics were generated to describe the study sample in terms of provider and practice characteristics, orthodontic conditions treated, therapies used, and time spent in providing orthodontic care. Differences in treatment patterns and perceptions about treatment were assessed with chi-square techniques. Because multiple chi-square tests were run for each variable, the level of significance was determined to be $P < .01$.

RESULTS

Of the 750 surveys sent, 462 were completed and returned within 8 weeks, for a response rate of 62%.

Table I describes the practices and the practitioners surveyed. Most respondents practiced in suburban areas (53%) and within 1 mile of an orthodontist (62%). Most respondents were involved only in private practice (90%), were between the ages of 46 and 65 years (85%), had practiced more than 21 to 30 years (55%), and were male (95%). They practiced in 44 states.

Many practitioners (29%) reported that they received most of their orthodontic training during predoctoral education, and 22% in 1- to 2-day continuing education (CE) courses. Of those who stated that they received most of their education by other means (23%), many commented that this was through neighboring orthodontists, study groups, Invisalign certification, and Advanced Education in General Dentistry programs (AEGD). When asked to evaluate the adequacy of the orthodontic training they received during their predoctoral education, 55% answered "poor," 17% "average," and only 4% "excellent" (the rest of the responses included more than 1 number). Eighty percent of all practitioners received fewer than 10 orthodontic CE hours annually.

As listed in Table II, the respondents reported diverse treatment timing. Many practitioners provided orthodontic treatment for patients in the permanent dentition (38%), late mixed dentition (29%), and early mixed dentition (34%). The most common orthodontic conditions or malocclusions they reported treating included space maintenance (57%), anterior crossbite (37%), minor rotations (36%), habits (33%), and molar uprighting (33%). Many provided limited orthodontic treatment (32%), and the most commonly used orthodontic appliances (therapies) were removable Hawley appliances with finger springs (36%), straight archwires (24%), fixed rapid palatal expanders (22%), and functional appliances (22%). When asked about the timing of treatment provided, the complexity of treatment provided, and the orthodontic therapies used, the percentages of practitioners who responded that they provided no orthodontic treatment were fairly consistent (43%, 49%, and 47%, respectively). However, when asked about the conditions or malocclusions treated, fewer reported no treatment (36%).

As shown in Table III, the highest percentage of respondents had fewer than 10 orthodontic appointments per week (46%), referred less than 5 patients per

Table I. Practitioner and practice characteristics (%)

Location (n = 456)	
Urban	27.4
Suburban	52.6
Rural	20.0
Nearest orthodontist (n = 457)	
In office	9.4
<1 mile	53.0
1-4 miles	25.8
>4 miles	11.8
Years in practice (n = 460)	
10-20 y	10.9
21-30 y	54.6
31-40 y	26.5
>40 y	8.0
Sex (n = 460)	
Male	95.2
Female	4.8
Age (n = 459)	
25-45	7.0
46-65	84.7
>65	8.3
Orthodontic patients over 18 (n = 441)	
N/A	42.0
1%-40%	38.3
41%-80%	8.4
81%-100%	11.3
Orthodontic education (n = 453)	
Predoctoral training	28.9
AEGD/GPR	10.4
CE 1- or 2-day courses	21.6
Continued weekend courses (1-5 year courses)	15.7
Other	23.4
Adequacy of predoctoral orthodontic training (n = 453)	
1 (Poor)	55.2
2	20.3
3 (Average)	17.0
4	3.1
5 (Excellent)	4.4
Orthodontic CE hours per year (n = 450)	
<10 h	79.8
10-20 h	11.8
>20 h	8.4

Table II. Treatment timing, orthodontic conditions treated, and therapies used (%)

Treatment timing (n = 460)	
No orthodontic treatment	43.0
Primary dentition	21.1
Early mixed dentition	33.9
Late mixed dentition	29.3
Permanent dentition	37.9
Complexity of orthodontic treatment (n = 458)	
None	48.9
Limited	31.7
Comprehensive	19.4
Conditions/malocclusions treated (n = 459)	
Space maintenance	56.9
Anterior crossbite	36.8
No treatment	36.4
Rotation	36.2
Habits	33.1
Molar uprighting	32.9
Posterior crossbite	29.6
Space regaining	29.4
Dental Class I	26.6
Ectopic eruption	25.7
Serial extraction	25.7
Deepbite	21.4
Dental Class II	21.1
Open bite	16.6
Skeletal Class II	15.3
Dental Class III	12.9
Impaction	12.6
Skeletal Class III	7.6
Orthodontic therapies used (n = 459)	
No orthodontic therapies	47.1
Removable Hawley	35.7
Straight wire	23.7
Fixed rapid palatal expander	21.8
Functional appliances	21.6
Intra-arch molar distalization	18.5
Utility archwires	15.7
Invisalign	14.4
Removable rapid palatal expander	13.3
Edgewise	5.2
Headgear/protraction headgear	4.6

Table III. Orthodontic appointments, time spent, referrals, and changes (%)

Orthodontic appointments per week (n = 450)	
0	49.6
<10	46.2
>10	4.2
Orthodontic referrals per month (n = 452)	
0	9.1
<5	37.6
5-10	32.7
>10	20.6
Time spent providing orthodontic treatment (n = 436)	
<10%	88.3
>10%	11.7
Change in time spent over past 5 years (n = 429)	
Increased	12.8
Decreased	17.2
Same	69.9
Change in time spent over next 5 years (n = 433)	
Increased	15.0
Decreased	12.0
Same	73.0

month to an orthodontist (47%), and spent less than 10% of their time providing orthodontic treatment (88%). Over the past 5 years, most practitioners had not changed the amount of orthodontic treatment they provided (70%) and did not plan to change in the next 5 years (73%).

The respondents described several factors that influenced their orthodontic-treatment patterns. Variables compared with the number of weekly orthodontic visits and amount of time spent are listed in Table IV. Practitioners whose involvement in general dentistry included government service or retirement referred fewer patients per month ($P < .001$). Those who were older were less likely to expect increases in the orthodontic treatment they provided in the next 5 years ($P < .01$) and were more likely to expect a decrease ($P < .01$). Those who reported that most of their orthodontic training was through CE or other modalities (other than dental school or AEGD/General Practice Residency [GPR] programs) and those who received more orthodontic CE annually had more orthodontic appointments per week ($P < .001$), referred fewer orthodontic patients per month ($P < .01$ and $P < .001$, respectively), spent more than 10% of their time providing orthodontic treatment ($P < .001$), were more likely to have increased the amount of orthodontic treatment they provided in the past 5 years ($P < .001$), and were more likely to expect an increase in the next 5 years ($P < .001$). Those who perceived the adequacy of their predoctoral orthodontic training to be poor were more likely to have fewer or no orthodontic appointments per week ($P < .001$).

Table V compares practitioner characteristics with the conditions (malocclusions) treated and the complexity of the treatment provided. Practitioners in rural areas treated more patients with anterior crossbite ($P < .001$) than those in suburban or urban areas. Also, those who practiced over 4 miles from the nearest orthodontist treated more dental Class II ($P < .01$), dental Class III ($P < .01$), deepbite ($P < .01$), skeletal Class II ($P < .001$), and serial extraction patients ($P < .01$).

Regarding education, practitioners who received more annual hours of orthodontic CE were more likely to treat all conditions ($P < .001$) except serial extraction. (Those who received 10 to 20 hours of orthodontic

Table IV. Variables affecting orthodontic appointments per week, orthodontic referrals, and time spent (%)

	Appointments/wk			*Referrals/mo*				*Time spent*	
Variable	*0*	*<10*	*>10*	*0*	*<5*	*5-10*	*>10*	*<10%*	*>10%*
Status (n = 450)				†	†	†	†		
Private practice	48.8	46.8	4.5	7.4	37.0	34.1	21.5	88.8	11.2
Private practice, academics	58.6	37.9	3.4	13.8	37.9	31.0	17.2	89.8	10.2
Government/retired/other	52.9	47.1	0.2	38.9	50.0	5.6	5.6	84.3	15.7
Orthodontic training (n = 444)	†	†	†	*	*	*	*	†	†
Predoctoral	80.6	18.6	0.8	3.1	38.5	30.8	27.7	100.0	0.0
AEGD/GPR	63.0	37.0	0.0	12.8	44.7	23.4	19.1	100.0	0.0
CE (1-2 d courses)	46.4	51.5	2.1	5.2	31.3	35.4	28.1	95.7	4.3
Extended courses (1-5 year courses)	17.6	69.1	13.2	18.6	37.1	34.3	10.0	64.8	35.2
Other	26.9	66.3	6.7	12.6	38.8	36.9	11.7	78.0	22.0
Adequacy of predoctoral orthodontic training (n = 444)	†	†	†						
1 (Poor)	50.4	45.5	4.1	9.4	38.0	33.1	19.6	87.7	12.3
2	43.3	53.3	3.3	10.9	33.7	35.9	19.6	88.4	11.6
3 (Average)	60.5	38.2	1.3	6.6	46.1	27.6	19.7	94.6	5.4
4	33.3	66.7	0.0	7.7	23.1	38.5	30.8	81.8	18.2
5 (Excellent)	40.0	40.0	20.0	5.0	30.0	35.0	30.0	73.7	26.3
Orthodontic CE/y (n = 441)	†	†	†	†	†	†	†	†	†
<10 hours	59.9	38.6	1.4	4.8	36.0	35.1	24.1	98.8	1.2
10-20 hours	3.8	86.5	9.6	23.1	36.5	28.8	11.5	58.5	41.5
>20 hours	8.1	67.6	24.3	28.9	50.0	21.1	0.0	34.2	65.8

*$P < .01$; †$P < .001$.

CE per year were more likely to treat patients with serial extraction [$P < .01$].) With respect to malocclusions treated, those who received most of their training in predoctoral education or AEGD/GPR were more likely to state that they provided no orthodontic treatment ($P < .001$). Those who received most of their orthodontic training through extended CE courses (1-5 year weekend courses) or other modalities were more likely to treat all malocclusions ($P < .001$).

Practitioners with fewer years of experience treated more comprehensive orthodontic cases ($P < .01$) than those who received more annual orthodontic CE hours and those who received most of their orthodontic training after completing all formal dental training (after dental school or AEGD/GPR) ($P < .001$).

Table VI lists the orthodontic therapies and the variables affecting them. Respondents who practiced in rural areas treated more patients with straightwire appliances, utility arches, and molar distalization appliances ($P < .01$) than those in urban or suburban areas. Practitioners with more than 10 annual orthodontic CE hours used more of the therapies evaluated ($P < .001$) than those who received most of their orthodontic training through extended CE courses or other modalities ($P < .001$; straightwire, $P < .01$). The only appliances that significantly increased in use by those who participated in 1- or 2-day orthodontic CE courses were removable Hawley appliances with finger springs and Invisalign ($P < .001$). Those who received most of their orthodontic training in dental school or in AEGD/GPR or those who received fewer than 10 orthodontic CE hours per year were more likely to provide no orthodontic treatment ($P < .001$).

DISCUSSION

This study's response rate was comparable with the expected response rate of a mailed survey; this suggests an interest in orthodontic treatment by these general dentists.[10,11] However, 38% of those surveyed did not respond, possibly contributing some response bias. To control for random associations seen with multiple chi-square tests, the significance level was set at $P < .01$. Closed-ended questions were used to limit ambiguity and facilitate analysis; however, no definitions were included in the survey to avoid increasing its length. The reproducibility of practitioners' responses was confirmed when they were questioned about the stages of dental development treated, the timing of treatment, and the number of orthodontic appointments per week. Consistently, 43% to 50% responded that they provided no orthodontic treatment.

Members who had attained the master's level in the Academy of General Dentistry were chosen to represent the general dentistry community because of their involvement in the field of dentistry. Unfortunately, involvement with the Academy of General Dentistry might also cause a bias in the results. That is, practitioners who have sought this status might be more

Table V. Variables affecting conditions or malocclusions treated and complexity of treatment (%)

	Orthodontic conditions treated						
Variable	*None*	*Anterior crossbite*	*Posterior crossbite*	*Dental Class I*	*Dental Class II*	*Dental Class III*	*Deepbite*
Location (n = 453)		†					
Urban	47.2	34.1	27.6	22.0	17.1	12.2	17.9
Suburban	33.9	30.1	26.4	24.7	19.7	11.3	19.2
Rural	29.7	57.1	41.8	37.4	29.7	16.5	31.9
Nearest orthodontist (n = 454)					*	*	*
In office	47.6	35.7	19.0	14.3	11.9	4.8	11.9
<1 mile	32.4	33.2	29.9	27.4	20.3	12.4	20.7
1-4 miles	41.0	37.6	27.4	22.2	17.1	9.4	17.9
>4 miles	35.2	51.9	42.6	40.7	38.9	25.9	38.9
Orthodontic training (n = 452)	†	†	†	†	†	†	†
Predoctoral	56.2	14.6	4.6	0.8	0.8	0.8	0.8
AEGD/GPR	55.3	27.7	14.9	8.5	2.1	2.1	0.0
CE (1-2 d)	32.7	28.6	18.4	21.4	11.2	7.1	11.2
Extended (1-5 y)	8.5	78.9	77.5	71.8	67.6	31.0	66.2
Other	22.6	49.1	46.2	41.5	34.0	26.4	35.8
Orthodontic CE h/y (n = 449)	†	†	†	†	†	†	†
<10 h	43.3	26.8	18.2	12.8	8.1	4.5	8.4
10-20 h	5.7	71.7	66.0	73.6	64.2	35.8	66.0
>20 h	7.9	86.8	92.1	92.1	86.8	60.5	86.8

*$P < .01$; †$P < .001$.

inclined to seek further orthodontic education and to provide more orthodontic treatment than other general dentists. In addition, the respondents appeared to be in the later stages of their careers (90% had practiced more than 20 years), and many stated that, as they neared retirement, they were providing less orthodontic treatment than in the past.

Similar to this study, Koroluk et al[2] and Wolsky and McNamara[4] reported that 18% and 19% of responding general dentists (in Indiana and Michigan, respectively) provided comprehensive orthodontic treatment. In our study, however, fewer respondents stated that they provided limited orthodontic treatment than previously reported (32% and 57%, respectively).[4]

The exact definition of "comprehensive treatment" was not given in the survey, but a similar proportion of practitioners reported treating such advanced malocclusions as serial extractions, deepbite, and dental Class II. Wolsky and McNamara[4] considered treatment to be comprehensive if it involved multibanded/bonded techniques for Class I, Class II, or Class III malocclusions, and *Glossary of Orthodontic Terms* (with McNamara on its editorial board) stated that, at the completion of comprehensive treatment, "each tooth is in its ideal position, and the achievable optimum in occlusion has been attained."[12] If this definition had been given in the survey, more respondents who provide interceptive treatment (phase I) might have stated that they provide comprehensive treatment, although it might not be treatment in the full permanent dentition (phase II treatment).

Interestingly, when asked about the conditions or malocclusions they treated, fewer practitioners stated they provided no orthodontic treatment than when asked about treatment timing, the number of orthodontic appointments per week, and the stages of dental development treated. Possibly, those who provided space maintenance did not consider this to be part of orthodontic therapy in the previous questions.

Many practitioners provided space maintenance and orthodontic treatment for anterior crossbites, rotation, habits, and molar uprighting, but the breadth of treatment that general dentists provided varied from previous studies. Our results were consistently higher for all conditions than reported by Gorczyca et al[3] in 1989 (Massachusetts), but were lower than reported by Jacobs et al[5] in 1991 (Iowa). In comparison with the survey by Gorczyca et al,[3] treatment for anterior crossbite appeared to increase from 20% (1989) to 37% (2004), minor tooth rotations from 14% (1989) to 36% (2004), posterior crossbite from 12% (1989) to 30% (2004), space regaining from 15% (1989) to 29% (2004), dental Class I from 9% (1989) to 27% (2004), ectopic eruption from 6% (1989) to 26% (2004), dental Class II from 18% (1989) to 21% (2004), skeletal Class II from 6% (1989) to 15% (2004), and dental Class III from 2% (1989) to 13% (2004). Surprisingly, Jacobs et al[5] reported much

Table V. Continued

Orthodontic conditions treated						*Complexity*		
Skeletal Class II	*Skeletal Class III*	*Open bite*	*Rotation*	*Impaction*	*Serial extraction*	*None*	*Limited*	*Complex*
14.6	6.5	13.8	31.7	11.4	19.5	55.6	28.2	16.1
12.6	7.1	16.3	34.3	11.3	24.7	48.3	34.9	16.8
23.1 †	11.0	20.9	45.1	18.7	35.2 *	42.2 †	27.8 †	30.0 †
7.1	4.8	9.5	28.6	7.1	19.0	59.5	23.8	16.7
14.9	8.3	17.4	36.1	12.0	29.5	48.1	33.9	18.0
10.3	2.6	12.0	35.0	10.3	15.4	49.2	37.3	13.6
33.3 †	16.7 †	27.8 †	44.4 †	24.1 †	35.2	44.4 †	16.7 †	38.9 †
0.8	0.8	0.8	10.0	0.8	21.5	77.1	22.1	0.8
0.0	0.0	4.3	14.9	2.1	14.9	66.0	31.9	2.1
7.1	5.1	9.2	36.7	9.2	24.5	45.9	46.9	7.1
43.7	14.1	46.5	74.6	33.8	39.4	17.1	22.9	60.0
29.2 †	17.9 †	28.3 †	52.8 †	21.7 †	28.3 *	28.3 †	35.8 †	35.8 †
5.3	3.4	6.4	24.6	4.7	21.8	59.2	33.5	7.3
49.1	22.6	50.9	77.4	39.6	47.2	3.8	35.8	60.4
65.8	28.9	68.4	92.1	52.6	36.8	7.9	13.2	78.9

*$P < .01$; †$P < .001$.

higher percentages of general dentists who treated crossbite (54%), serial extraction (72%), dental Class II (20%), and dental Class III (20%). Koroluk et al[2] reported findings similar to our study.

The most commonly used orthodontic appliances were removable Hawley appliances with finger springs and straight archwires. Orthodontic appliance use appears to have increased in comparison with that reported by Gorczyca et al.[3] For example, the use of removable Hawley appliances with finger springs increased from 26% (1989) to 36% (2004), straight archwires from 8% (1989) to 24% (2004), fixed rapid palatal expanders from 7% (1989) to 22% (2004), functional appliances from 12% (1989) to 22% (2004), utility archwires from 6% (1989) to 16% (2004), and removable palatal expanders from 8% (1989) to 13%

Table VI. Variables affecting orthodontic therapies used (%)

Variable	*None*	*Straight wire*	*Edgewise*	*Utility arches*	*Functionnal appliance*	*Fixed RPE*	*Invisalign*	*Molar distalization*	*Headgear/ protraction headgear*
Location (n = 459)		*		*				*	
Urban	52.8	21.1	6.5	9.8	15.4	18.7	13.8	14.6	3.3
Suburban	46.9	19.7	4.6	14.6	20.9	20.5	13.0	16.3	4.6
Rural	40.7	36.3	4.4	26.4	30.8	28.6	16.5	29.7	5.5
Orthodontic training (n = 452)	†	*	†	†	†	†	†	†	†
Predoctoral	76.9	0.0	0.8	0.8	2.3	1.5	0.8	1.5	0.0
AEGD/GPR	63.8	4.3	4.3	0.0	4.3	12.8	2.1	4.3	0.0
CE (1-2 d courses)	43.9	13.3	1.0	6.1	15.3	11.2	21.4	13.3	1.0
Extended courses (1-5 year courses)	12.7	71.8	7.0	45.1	56.3	63.4	26.8	43.7	14.1
Other	26.4	40.6	14.2	30.2	35.8	33.0	22.6	34.0	9.4
Orthodontic CE h/y (n = 449)	†	†	†	†	†	†	†	†	†
<10 h	56.7	11.7	3.4	7.0	10.3	10.1	8.1	9.2	0.8
10-20 h	5.7	67.9	17.0	49.1	62.3	66.0	37.7	49.1	15.1
>20 h	7.9	78.9	5.3	55.3	73.7	73.7	39.5	68.4	26.3

*$P < .01$; †$P < .001$.

(2004). Headgear use was unchanged (5% in both studies); this might reflect decreased use of the appliance.

However, when compared with the studies of Koroluk et al[2] and Jacobs et al,[5] orthodontic appliance use appears to have decreased. For example, both studies reported that 60% of the respondents used removable Hawley appliances with finger springs,[2,5] 30% used functional appliances,[2,5] and 23% used utility archwires and straight archwires.[2]

Most respondents (88%) spent less than 10% of their time providing orthodontic treatment. In comparison, Wolsky and McNamara[4] reported that 96% spent less than 25% of their time providing such treatment. Gorczyca et al[3] reported that the mean amount of time spent was less than 2%; similar to this study, 12% expected this to increase in the next 5 years. Interestingly, Huang and del Aguila[6] found that 7% of orthodontic insurance claims through a large dental benefits carrier in Washington were made by general dentists. Ninety percent of the general dentists who submitted claims were for 5 patients or fewer.

Although 20% received more than 10 orthodontic CE hours per year, and 16% attended extended weekend courses for further orthodontic training, only 12% spent more than 10% of their time providing orthodontic treatment. Surprisingly, although most (90%) respondents practiced general dentistry for more then 20 years, 29% stated that most of their orthodontic education was from their predoctoral training. This was previously reported as only 9% by Gorczyca et al.[3]

Several factors influenced the complexity of treatment provided, the types of conditions treated, the therapies rendered, and the amount of time spent providing treatment. Practicing in a rural location influenced practitioners to treat anterior crossbite and other types of interceptive orthodontic treatment such as space maintenance and ectopic eruption. These findings could be related to the lack of patient access to such care. Similarly, Huang et al[1] found that the number of orthodontic claims submitted by general dentists in Washington increased in areas with fewer orthodontists per capita income (rural).

Differences were seen in the orthodontic treatment patterns of practitioners who received more education, either through CE or other modalities. Those who received more orthodontic CE hours per year were more likely to provide comprehensive orthodontic treatment, to spend more time providing treatment, to expect a future increase in the time spent, to treat all malocclusions evaluated, and to use all orthodontic therapies (except edgewise). Similarly, those who stated that their orthodontic education was only from dental school were more likely to provide no orthodontic treatment. This was a relevant finding, because most dental schools provide only limited orthodontic education to their predoctoral students, and most practitioners had completed dental school over 20 years ago.

Because many respondents were nearing retirement, older ones were more likely to expect decreases in the time spent providing orthodontic treatment. This finding might also be related to practitioner training in the past, practice maturation, comfort level, economics, or the marketing of orthodontic treatment.

Further studies are warranted regarding the rationale for current referral patterns to orthodontic specialists and the factors influencing which patients are not referred. In addition, diagnostic methods used to assess patients and the changes in these methods should be evaluated.

CONCLUSIONS

1. The percentage of general dentists who provide comprehensive orthodontic treatment is unchanged since previous studies, but the breadth of treatment provided appears to have increased.
2. Practitioners who received more orthodontic CE hours per year were more likely to treat all malocclusions evaluated, to use all orthodontic therapies evaluated, to spend more time providing treatment, and to expect the time spent to increase in the future.
3. Older practitioners were more likely to expect decreases in the time spent providing orthodontic treatment.
4. Although many practitioners provided comprehensive orthodontic treatment, most provided only limited treatment or no orthodontic treatment at all.

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