

Orthodontic treatment provision and referral preferences among New Zealand general dental practitioners

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Background: General dental practitioners (GDPs) are key clinicians in the orthodontic referral chain as they complement (and may compete with) orthodontists in providing treatment for the public.

Objectives: To determine the nature and extent of GDPs' involvement in orthodontic treatment provision and to identify influences on GDPs' choice of orthodontist.

Methods: An email survey was conducted of actively-practising GDPs in May/June 2010. Two timelines of contact were followed, with non-responders to the first survey re-contacted three weeks later.

Results: Just under one-fifth (19.3 per cent) reported providing forms of orthodontic treatment. This proportion was higher among males, more experienced practitioners, and dentists in rural locations. The percentage involvement ranged from 22.3 per cent in Greater Auckland to 10.5 per cent in Greater Wellington and 11.9 per cent in Christchurch. In the remainder of New Zealand, percentages ranged from 11.5 per cent in urban areas to 37.1 per cent in rural areas. Of those providing treatment, almost half had 1-10 patients under management, and just over one-third had greater numbers. Sixty-one per cent of orthodontically-involved GDPs in Auckland had more than 10 orthodontic patients. The most commonly treated condition was a simple crossbite, while the least commonly treated condition was the severe Class III malocclusion.

Conclusions: The provision of orthodontic treatment by New Zealand GDPs has decreased in recent years to an average of about one in five, but this figure is considerably higher in rural areas and is a notable feature of the greater Auckland area. The findings suggest that the majority of the more complex cases are continuing to be referred to specialist orthodontists.

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Introduction

General dental practitioners (GDPs) are key clinicians in the orthodontic referral chain. They act as gatekeepers and referral conduits for patients requiring specialist treatment because they can be the first to detect malocclusions. GDPs are often the first consultation point for patients and parents who seek orthodontic advice, and the GDPs' degree of willingness to provide orthodontic treatment will naturally influence the amount of orthodontic treatment provided for the public by specialists. GDPs' orthodontic knowledge and practices should therefore be of interest to orthodontists and the public because they are the likely first contact.

Information on the delivery of orthodontic treatment in New Zealand is limited. Since Marriott et al. conducted their surveys of orthodontists and GDPs,^{1,2} there have been notable changes in the orthodontic care setting. For example, the ethnic composition of the adolescent population continues to change, with an ever-increasing proportion of non-Europeans.³ Māori are known to have a lower prevalence of malocclusion,⁴ and it is possible that this population change may influence the size of the pool of potential orthodontic patients. In addition, the Health Practitioners Competence Assurance Act (2003) has meant that dental therapists are now held

Table 1. Number of dentists providing orthodontic treatment, by dentist characteristics (brackets contain row percentages unless otherwise indicated).

	Number of respondents	Dentists providing orthodontic treatment
Sex		
Male	317 (62.3)	78 (24.6) ^a
Female	192 (37.7)	20 (10.4)
Number of years since graduation		
1-10	116 (22.8)	13 (11.2) ^a
11-20	119 (23.4)	23 (19.3)
21-30	140 (27.5)	27 (19.3)
31+	134 (26.3)	35 (26.1)
Practice location		
Rural	99 (19.4)	36 (36.4) ^a
Urban	410 (80.6)	62 (15.1)
All combined	509 (100.0)	98 (19.3)

^a $p < 0.05$

responsible for their own clinical practice. This has likely led to an increase in direct non-dentist referrals to orthodontists, further complicating the dentist-orthodontist nexus.

In 2001, Marriott et al. reported that 73 per cent of GDPs carried out orthodontic procedures.² Included in that estimate was the extraction of teeth on orthodontic instruction, and so the percentage is likely to be an over-estimate. Fifty-nine per cent of GDPs reported treating anterior crossbites, and 28 per cent were involved in the alignment of anterior teeth using comprehensive fixed-appliance treatment. These estimates may be a valid indication of the prevalence of GDPs' provision of orthodontic care at that time, but the current level of GDP involvement in providing orthodontic treatment is unknown.

In late 2009, the School of Dentistry was asked by the New Zealand Association of Orthodontists to undertake a survey of New Zealand dentists in order to determine their orthodontic referral practices and treatment provision. Accordingly, the aims of this study were: 1) to determine the nature and extent of GDPs' involvement in orthodontic treatment provision; and 2) to identify the influences on the choice of orthodontist by GDPs.

Material and methods

An email survey of actively-practising private general (non-specialist) dental practitioners (GDPs) was conducted in May 2010. The sampling frame was the Dental Register maintained by the Dental Council

of New Zealand and all GDPs with contactable email addresses were selected. Those without a current annual practicing certificate were excluded. A specifically-designed online questionnaire was designed and hosted on SurveyMonkey™ (www.surveymonkey.com). The questions were mainly of the closed-ended or 'forced choice' type with which respondents were asked to choose from a number of alternative responses. A number of the items required the respondent to rank response options in order of importance.

The questionnaire covered three main domains and included: 1) the GDP's socio-demographic and practice characteristics (including each respondent's classification of his/her practice as 'urban' or 'rural'); 2) the GDPs' usual orthodontic referral practices and decisions with respect to 30 different malocclusion types; and 3) the provision of orthodontic treatment, both in general and with respect to 30 different malocclusion types. This data was combined with information on their orthodontic patient load and their frequency of use of seven types of orthodontic appliance. Dentists' criteria for choosing a particular orthodontist were explored using items adapted from an earlier study.⁵ These covered the domains of communication and quality (8 items), reciprocation (5 items), patient preference (1 item) and orthodontist efficiency (2 items).

A cover letter explaining the purpose of the survey (along with a link to the online questionnaire) was emailed to all contactable GDPs in May 2010. To encourage participation, a reward was offered. Non-

respondents were re-contacted three weeks later with a new cover letter and the same questionnaire. Data collection ceased at the end of June 2010.

Data analysis

Chi-square analyses and ANOVA were used (as appropriate) to test differences between groups for statistical significance. A p value of < 0.05 was considered significant.

Confidentiality and ethical approval

Category B ethical approval was obtained from the Human Ethics Committee at the University of Otago prior to the distribution of the questionnaire. Informed consent was also obtained from the participating dentists.

Results

Of the 1174 dentists with contactable email addresses, 509 replied (response rate 43.3 per cent). Respondents and non-respondents did not differ significantly by age, but proportionally more females responded (34.5 per cent in the source population but 38.9 per cent of responders; $p < 0.05$).

The provision of orthodontic treatment

Almost two-thirds of the dentist respondents were male, and there was an approximately even distribution across age categories (Table I). Just under one-fifth of respondents reported that they provide orthodontic treatment. This proportion was higher among males, more experienced practitioners, and dentists in rural locations accounted for one-fifth of the respondents. Examined by large city area, the proportion providing orthodontic treatment was 22.3 per cent in greater Auckland, 10.5 per cent in Greater Wellington, and 11.9 per cent in Christchurch. In the remainder of New Zealand, the percentage varied from 11.5 per cent in the urban areas to 37.1 per cent in the rural areas.

Data on the number of patients under treatment by GDP orthodontic treatment providers (who numbered 95 dentists) are presented in Table II. Almost half of the respondents had between 1 and 10 as current orthodontic patients, and just over one-third had greater numbers. The number of patients undergoing treatment was higher in Auckland, where 61.3 per cent of involved GDPs had more than 10 current patients. A higher proportion of males (42.7 per cent) had more than 10 patients under treatment while most females usually treated between 1 and 10 patients. More urban dentists than rural dentists treated larger numbers of orthodontic patients.

Table II. Dentists with current active orthodontic patients and the number of patients, by dentist characteristics (brackets contain row percentages unless otherwise indicated).

	Number of dentists	Total number of patients currently undergoing orthodontic treatment		
		None	1 to 10	More than 10
Sex				
Male	75 (78.9)	12 (16.0)	31 (41.3)	32 (42.7) ^a
Female	20 (21.1)	1 (5.0)	14 (70.0)	5 (25.0)
Number of years since graduation				
1-10	12 (12.6)	1 (8.3)	7 (58.3)	4 (33.3)
11-20	22 (23.2)	2 (9.1)	9 (40.9)	11 (50.0)
21-30	27 (28.4)	2 (7.4)	16 (59.3)	9 (33.3)
31+	34 (35.8)	8 (23.5)	13 (38.2)	13 (38.2)
Practice location				
Rural	33 (34.7)	5 (15.2)	19 (57.6)	9 (27.3)
Urban	62 (65.3)	8 (12.9)	26 (41.9)	28 (45.2)
All combined	95 (100.0) ^b	13 (13.7)	45 (47.4)	37 (38.9)

^a $p < 0.05$

^b Data on patients under treatments missing for 3 respondents who claimed to provide treatment

Table IIIa. Provision of orthodontic treatment ('usually' or 'always') for specific malocclusion types, by dentist characteristics (brackets contain row percentages unless otherwise indicated).

	All combined	Male	Female	1-10	11-20	21-30	31+	Rural	Urban
Condition									
Midline shift	50 (52.6)	41 (54.7)	9 (45.0)	7 (58.3)	13 (59.1)	15 (55.6)	15 (44.1)	15 (45.5)	35 (56.5)
Crowding	64 (67.4)	52 (69.3)	12 (60.0)	8 (66.7)	14 (63.6)	18 (66.7)	24 (70.6)	22 (66.7)	42 (67.7)
Simple crossbite	91 (95.8)	73 (97.3)	18 (90.0)	11 (91.7)	20 (90.9)	26 (96.3)	34 (100)	32 (97.0)	59 (95.2)
Complex crossbite	42 (44.2)	35 (46.7)	7 (35.0)	5 (41.7)	12 (54.5)	10 (37.0)	15 (45.1)	16 (48.5)	26 (41.9)
Unilateral crossbite	65 (64.4)	55 (73.3)	10 (50.0) ^a	9 (75.0)	15 (68.2)	17 (63.0)	24 (70.6)	23 (69.7)	42 (67.7)
Bilateral cross bite	55 (57.9)	42 (56.0)	13 (65.0)	7 (58.3)	13 (59.1)	18 (66.7)	17 (50.0)	18 (54.5)	37 (59.7)
Hypodontia	50 (52.6)	43 (57.3)	7 (35.0)	4 (33.3)	12 (54.5)	15 (55.6)	19 (55.9)	19 (57.6)	31 (50.0)
Infraoccluded primary molar	51 (53.7)	44 (58.7)	7 (35.0)	4 (33.3)	12 (54.5)	15 (55.6)	20 (58.8)	22 (66.7)	29 (46.8)
Impacted molars	57 (60.0)	49 (65.3)	8 (40.0) ^a	4 (33.3)	13 (59.1)	18 (66.7)	22 (64.7)	20 (60.6)	37 (59.7)
Posterior crossbite with mandibular displacement	36 (37.9)	29 (38.7)	7 (35.0)	5 (41.7)	8 (36.4)	9 (33.3)	14 (41.2)	14 (42.4)	22 (35.5)
First permanent molar with poor long term prognosis	60 (63.2)	51 (68.0)	9 (45.0)	7 (58.3)	13 (59.1)	15 (55.6)	25 (73.5)	23 (69.7)	37 (59.7)
Upper midline diastema	62 (65.3)	51 (68.0)	11 (55.0)	8 (66.7)	13 (59.1)	16 (59.3)	25 (73.5)	19 (57.6)	43 (69.4)
Traumatic loss of central incisors	63 (66.3)	51 (68.0)	12 (60.0)	8 (66.7)	14 (63.6)	16 (59.3)	25 (73.5)	22 (66.7)	41 (66.1)
Retained primary incisors	66 (69.5)	57 (76.0)	9 (45.0) ^a	4 (33.3)	14 (63.6)	18 (66.7)	30 (88.2) ^a	26 (78.8)	40 (64.5) ^a
Anterior crossbite	86 (90.5)	70 (93.3)	16 (80.0)	10 (83.3)	18 (81.8)	25 (92.6)	33 (97.1)	30 (90.9)	56 (90.3)
Finger/thumb sucking habits	72 (75.8)	58 (77.3)	14 (70.0)	8 (66.7)	14 (63.6)	23 (85.2)	27 (79.4)	22 (66.7)	50 (80.6)
Ectopic maxillary canines	52 (54.7)	45 (60.0)	7 (35.0) ^a	4 (33.3)	10 (45.5)	17 (63.0)	21 (61.8)	18 (54.5)	34 (54.8)
Anterior openbite	41 (43.2)	36 (48.0)	5 (25.0)	5 (41.7)	11 (50.0)	10 (37.0)	50 (44.1)	13 (39.4)	28 (45.2)

^a $p < 0.05$

Data on orthodontic conditions which were treated are presented in Tables IIIa and IIIb. The most commonly treated condition was a simple crossbite (treated by almost all responders) and the least commonly treated condition was the severe Class III malocclusion. More males than females treated unilateral crossbites, retained primary teeth, impacted molars, retained primary incisors or ectopic maxillary canines. A consistent experience gradient was evident in the treatment of retained primary incisors. A higher proportion of experienced practitioners was involved in treating primary tooth retention; this was also more common among rural respondents. There were no other significant urban-rural treatment differences of significance. There were no statistically significant differences by dentist characteristics in the proportion treating any of the Angle Class I to III malocclusion types. However, there were notable differences in

the treatment of: Class II division 1 (more males); Class II division 2 with mild skeletal II pattern (more experienced practitioners); Class II division 2 with more marked skeletal discrepancy (more males); and severe Class III skeletal patterns (more experienced practitioners).

Simple removable appliances were used frequently or always by just over half of those providing orthodontic treatment, whereas functional appliances were used frequently or always by about one in six (Table IV). Fixed appliances were never used by half of those providing orthodontic treatment.

Referral practices of GDPs

Referral data were derived from all respondents (including those who reported providing orthodontic treatment). Data are first presented based on factors

Table IIIb. Provision of orthodontic treatment ('usually' or 'always') for Angle Class I to III malocclusion types, by dentist characteristics (brackets contain row percentages unless otherwise indicated).

	Sex			Years since graduation				Practice location	
	All combined	Male	Female	1-10	11-20	21-30	31+	Rural	Urban
Condition									
Class I malocclusion									
Crowding	59 (62.1)	48 (64.0)	11 (55.0)	7 (58.3)	14 (63.6)	15 (55.6)	23 (67.6)	19 (57.6)	40 (64.5)
Bimaxillary proclination	51 (53.7)	41 (54.7)	10 (50.0)	7 (58.3)	13 (59.1)	13 (48.1)	18 (52.9)	16 (48.5)	35 (56.5)
Spacing	54 (56.8)	45 (60.0)	9 (45.0)	8 (66.7)	14 (63.6)	14 (51.9)	18 (52.9)	18 (54.5)	36 (58.1)
Class II malocclusion									
div. 1: CI I/mild CI II skeletal pattern	56 (58.9)	47 (62.7)	9 (45.0)	8 (67.7)	13 (59.1)	14 (51.9)	21 (61.8)	17 (51.5)	39 (62.9)
div. 1: moderate CI II skeletal pattern	45 (47.4)	39 (52.0)	6 (30.0)	7 (58.3)	11 (50.0)	11 (40.7)	16 (47.1)	16 (47.1)	16 (47.1)
div. 2: CI I/mild CI II skeletal pattern	49 (51.6)	40 (53.3)	9 (45.0)	8 (66.7)	13 (59.1)	13 (48.1)	15 (44.1)	16 (48.5)	33 (53.2)
div. 2: more marked CI II skeletal discrepancy	30 (31.6)	27 (36.0)	3 (15.0)	3 (25.0)	8 (36.4)	8 (29.6)	11 (32.4)	11 (33.3)	19 (30.6)
Class III malocclusion									
Normal or mild CI III skeletal pattern	44 (46.3)	35 (46.7)	9 (45.0)	7 (58.3)	10 (45.5)	14 (51.9)	13 (38.2)	16 (48.5)	28 (45.2)
Mild to moderate CI III skeletal pattern	27 (28.4)	22 (29.3)	5 (25.0)	5 (41.7)	8 (36.4)	6 (22.2)	8 (23.5)	8 (23.5)	8 (23.5)
Severe CI III skeletal pattern	15 (15.8)	13 (17.3)	2 (10.0)	1 (8.3)	2 (9.1)	5 (18.5)	7 (20.7)	7 (20.7)	7 (20.7)

Table IV. Frequency of use of various treatment options by dentists who provide orthodontic treatment (brackets contain row percentages).

Appliance type	Frequency of use				Missing
	Never	Sometimes	Frequently	Always	
Simple removable appliance	11 (11.6)	33 (34.7)	37 (38.9)	14 (14.7)	3
Limited fixed appliance	35 (38.0)	32 (34.8)	23 (25.0)	2 (2.2)	6
Functional appliances	47 (50.5)	30 (32.3)	15 (16.1)	1 (1.1)	5
Full fixed appliances without extraction	44 (48.4)	14 (15.4)	26 (28.6)	7 (7.7)	7
Full fixed appliances with extraction	49 (52.7)	20 (21.5)	21 (22.6)	3 (3.2)	5
Combination of fixed appliances with functional appliances	54 (59.3)	18 (19.8)	16 (17.6)	3 (3.3)	7
Invisalign	73 (77.7)	15 (16.0)	3 (3.2)	3 (3.2)	4

considered of importance and which influence GDP referral to a particular orthodontist. This is followed by GDP referral practices for particular types of malocclusion.

What factors are important in the GDPs' choice of orthodontist?

The factors influencing GDPs' referral to particular orthodontists are presented in descending order of influence in Table V. The factor with the highest importance score was patient satisfaction, while the least important factor was the ability to finish

cases quickly. Factors were combined into the four categories of *communication and quality* (comprising the 8 items ranked 1, 2, 3, 4, 6, 8, 9 and 13 in Table II), *reciprocation* (the 5 items ranked 5, 10, 12, 15, 16), *patient preference* (the single item ranked 7) and *the efficiency of the orthodontist's treatment* (the 2 items ranked 14 and 17) in order to determine whether there were referral differences related to GDP characteristics. The ranks for those categories were: *communication and quality*, mean score 3.8; *reciprocation*, mean score 3.7; *patient preference*, mean score 3.2; and *the efficiency of the orthodontist's treatment*, mean score 2.9.

Table V. Relative importance of various characteristics of orthodontist, by dentist characteristics (a higher score means that the characteristic is rated as more important).

Orthodontist characteristics	Mean score (SD)	Rank
Patients are satisfied	4.6 (0.7)	1
Is approachable	4.5 (0.8)	2
Pays attention to oral hygiene	4.1 (0.9)	3
Superior professional reputation	4.1 (0.9)	4
Refers patients back for check-up	4.0 (1.0)	5
Gives information about treatment plans very quickly	4.0 (0.9)	6
Favourable experience with the orthodontist in the past	3.9 (1.0)	7
Patient prefers the orthodontist	3.7 (1.0)	8
Orthodontist is known to you personally	3.6 (1.2)	9
Orthodontist helps you with your orthodontic patients	3.6 (1.2)	10
Involves you in patients' treatment plans	3.5 (1.1)	11
Expresses thanks for referrals	3.3 (1.2)	12
Easy to reach by telephone	3.2 (1.2)	13
No lengthy waiting lists	3.2 (1.1)	14
Refers patients to you	3.1 (1.1)	15
Gives your patients priority	2.8 (1.1)	16
Finishes cases quickly	2.6 (1.0)	17

There were no differences in rank order by gender, years of experience or practice location.

Which conditions do GDPs refer?

Data on dentists' referral practices are presented by malocclusion type in Table VI. Generally, conditions requiring more complex management were usually referred by all GDPs. The condition with the highest proportion of GDP referral (90.5 per cent) was the severe skeletal Class III patient and the least referred condition was the upper midline diastema. There were minor significant differences in referral patterns between orthodontic treatment providers and non-providers. A higher proportion of non-providers chose to refer given orthodontic conditions. The greatest relative referral differences between orthodontic treatment providers and non-providers were observed with simple crossbites and anterior crossbites.

Two-thirds of respondents reported referring between 1 and 3 patients to an orthodontist in a typical month while 52 (10.7 per cent) reported referring no patients.

Almost all (91.6 per cent) had at least one orthodontist geographically located within 10 km to whom they could potentially refer patients; 8.4 per cent had none, and 7.8 per cent had more than 10. When asked about the actual number of orthodontists (and dentists with orthodontic interests) to whom patient referrals could be made, 20.9 per cent reported 1 specialist, 39.5 per cent reported 2 and approximately 30 per cent reported 3 or more.

CPD courses

Over half of the respondents (57.6 per cent) expressed interest in attending CPD courses run by the New Zealand Association of Orthodontists (NZAO). This was significantly higher among females than males (65.1 per cent and 53.0 per cent respectively), younger practitioners (70.0 per cent, 61.2 per cent, 59.0 per cent and 42.2 per cent in the four time groups since graduation respectively) and those who provided orthodontic treatment (of whom 75.0 per cent were interested).

Table VI. Orthodontic referral practices of dentists by condition and whether they provide orthodontic treatment (brackets contain row percentages unless otherwise indicated).

	Usually refer this condition (all dentists – providers and nonproviders)	Orthodontic treatment providers who usually refer it	Non-providers who usually refer it	Number of missing responses
Midline shift	230 (47.6)	37 (42.0)	193 (48.9)	26
Crowding	346 (72.1)	35 (40.2) ^a	311 (79.1)	29
Simple crossbite	245 (50.7)	11 (12.5) ^a	234 (59.2)	26
Complex crossbite	410 (84.5)	49 (55.7) ^a	361 (90.9)	24
Unilateral crossbite	327 (67.3)	31 (35.2) ^a	296 (74.4)	23
Bilateral cross bite	342 (70.4)	42 (47.7) ^a	300 (75.4)	23
Hypodontia	304 (63.2)	42 (47.7) ^a	262 (66.7)	28
Retained primary teeth	159 (33.2)	20 (23.0)	139 (35.5)	30
Infraoccluded primary molar	227 (47.1)	34 (38.6)	193 (49.0)	27
Impacted molars	260 (54.1)	34 (39.1) ^a	226 (57.4)	28
Posterior crossbite with mandibular displacement	380 (78.7)	45 (51.1) ^a	335 (84.8)	26
First permanent molar with poor long term prognosis	241 (50.1)	35 (39.8)	206 (52.4)	28
Upper midline diastema	149 (30.7)	25 (28.4)	124 (31.2)	24
Dilacerations	196 (41.7)	39 (44.8)	157 (41.0)	39
Traumatic loss of central incisors	191 (39.6)	31 (36.0)	160 (40.4)	27
Retained primary incisors	205 (42.7)	25 (28.7) ^a	180 (45.8)	29
Anterior crossbite	315 (64.9)	16 (18.4) ^a	299 (75.1)	24
Finger/thumb sucking habits	208 (42.9)	21 (24.1) ^a	187 (47.0)	24
Ectopic maxillary canines	390 (80.7)	47 (54.0) ^a	343 (86.6)	26
Anterior openbite	377 (78.4)	46 (52.9) ^a	331 (84.0)	28
Class I malocclusion				
Crowding	333 (68.9)	35 (40.2) ^a	298 (75.3)	26
Bimaxillary proclination	357 (74.1)	45 (51.7) ^a	312 (79.0)	27
Spacing	252 (52.1)	33 (38.4) ^a	219 (55.0)	25
Class II malocclusion				
CI II div. 1: CI I / mild CI II skeletal pattern	325 (67.1)	37 (42.5) ^a	288 (72.5)	25
CI II div. 1: moderate CI II skeletal pattern	370 (76.8)	46 (52.9) ^a	324 (82.0)	27
CI II div. 2: CI I / mild CI II skeletal pattern	361 (74.6)	43 (49.4) ^a	318 (80.1)	25
CI II div. 2: more marked CI II skeletal discrepancy	409 (85.0)	57 (66.3) ^a	352 (89.1)	28
Class III malocclusion				
Normal or mild CI III skeletal pattern	334 (69.6)	49 (56.3) ^a	285 (72.5)	29
Mild to moderate CI III skeletal pattern	406 (83.9)	58 (67.4) ^a	348 (87.4)	25
Severe CI III skeletal pattern	436 (90.5)	70 (80.5) ^a	366 (92.7)	27

^a $p < 0.05$

Table VII. Comparison of conditions treated 'usually' or 'always' by Auckland GDP providers of orthodontic treatment (N = 31) with those from elsewhere in New Zealand (N = 64; data in table are percentages).

	Auckland	Elsewhere
Midline shift	74.2	42.2 ^a
Crowding	80.6	60.9
Simple crossbite	93.5	96.9
Complex crossbite	58.1	37.5
Unilateral crossbite	77.4	64.1
Bilateral cross bite	74.2	50.0 ^a
Hypodontia	58.1	50.0
Retained primary teeth	74.2	76.6
Infraoccluded primary molar	54.8	53.1
Impacted molars	64.5	57.8
Posterior crossbite with mandibular displacement	51.6	31.3
First permanent molar with poor long term prognosis	64.5	62.5
Upper midline diastema	77.4	59.4
Dilacerations	48.4	35.9
Traumatic loss of central incisors	67.7	65.6
Retained primary incisors	61.3	73.4
Anterior crossbite	87.1	92.2
Finger/thumb sucking habits	83.9	71.9
Ectopic maxillary canines	67.7	48.4
Anterior openbite	61.0	34.4 ^a
Class I malocclusion		
Crowding	80.6	53.1 ^a
Bimaxillary proclination	77.4	42.2 ^a
Spacing	74.2	48.4
Class II malocclusion		
div. 1: CI I / mild CI II skeletal pattern	77.4	50.0 ^a
div. 1: moderate CI II skeletal pattern	71.0	35.9 ^a
div. 2: CI I / mild CI II skeletal pattern	67.7	43.8 ^a
div. 2: more marked CI II skeletal discrepancy	41.9	26.6
Class III malocclusion		
Normal or mild CI III skeletal pattern	61.3	39.1 ^a
Mild to moderate CI III skeletal pattern	38.7	23.4
Severe CI III skeletal pattern	19.4	14.1

^ap < 0.05

Discussion

This study aimed to describe the involvement of GDPs in orthodontic treatment provision and to identify the factors that influence the GDPs' choice of orthodontist. It was found that approximately one in five GDPs provides orthodontic treatment. This

proportion was highest in rural areas and also among urban GDPs in Auckland. The most commonly treated conditions were considered minor (simple crossbites), but there was a proportion of GDPs treating more complex malocclusions using a range of orthodontic techniques. In selecting an orthodontist for referrals,

GDPs valued patient satisfaction, the orthodontist's approachability and professional reputation, his/her attention to patients' oral hygiene, and the quality of the dentist-orthodontist relationship. Reciprocation was seen as being important. Generally, more complex cases were usually referred and, not surprisingly, the malocclusion severity threshold for referral appeared to be higher among GDPs who provided orthodontic treatment themselves.

Of concern was the questionnaire response rate, which was a relatively low 43.3 per cent of New Zealand dentists. This suggests the possibility of bias in the responders. The proportion of female respondents was slightly higher than that in the source population (GDPs), but the age distribution was broadly similar. It may have been that the current study over-estimated the proportion providing orthodontic treatment because those who replied were more likely to have found the survey topic of interest. The relationship of the New Zealand Association of Orthodontists with the study was not disclosed to the potential participants. Notwithstanding these considerations, it was difficult to determine the extent of any associated bias.

The use of an internet-based survey (Survey Monkey™) rather than a conventional postal survey was a new experience. Errors in the DCNZ's Dental Register, out-of-date email addresses, and a common practice email address serving several dentists, were minor problems encountered. A strength of the study was the generation of important information on orthodontists' referrals which was the first examination of orthodontic treatment by New Zealand GDPs since the survey of Marriott et al.²

The percentage of GDPs providing orthodontic treatment was lower than that found in the study of Marriott et al.,² in which nearly three-quarters of dentists provided at least one item of orthodontic treatment. While this might signal a reduction in orthodontic care by GDPs, the Marriott report included orthodontist-directed extraction of teeth as part of orthodontic treatment. It is possible that this inclusion inflated treatment percentage and has likely over-estimated GDP involvement. In the Marriott survey, 59 per cent of GDP respondents reported treating anterior crossbites and 28 per cent aligned anterior teeth using comprehensive fixed-appliance treatment. Those estimates may be a valid indication of the prevalence of dentist involvement in orthodontics at that time.

Male dentists, older more experienced GDPs and those located in smaller centres and rural areas more commonly provided orthodontic treatment. These findings were consistent with those of the earlier survey. The most striking finding was that the provision of orthodontic treatment by GDPs in the greater Auckland area was twice that seen elsewhere in the country (excluding rural areas). Although the number of patients under treatment was generally low, it appeared to be higher than reported a decade earlier.² The proportion of GDPs with 10 or more orthodontic patients under treatment had risen from 12.5 per cent to 39 per cent in the current study, and it was as high as 61 per cent in Auckland. A direct comparison of the conditions treated by Auckland GDP providers of orthodontic treatment with those treated by GDPs elsewhere in the country is presented in Table VII. For most orthodontic conditions, the treatment rates were higher among the Auckland GDPs and were especially evident for more severe conditions. A comparison of the use of the various treatment options (Table VIII) reveals that, with the exception of simple removable appliances and Invisalign, Auckland GDP providers of orthodontic treatment were more frequent users of fixed and functional appliances.

These findings suggest that the 'orthodontist' exists and is largely an Auckland phenomenon. A more systematic examination of this situation is warranted to determine the ultimate effect on specialist orthodontics. It is envisaged that this would involve data collection and estimates of the adolescent population in the area, the full-time equivalent number of orthodontists and the proportion of the adolescent population in need of treatment. Such an analysis was beyond the scope of the current survey, but it is suggested that it would be a worthwhile future project.

GDPs' referral patterns are a key influence governing the need for specialist orthodontists. It is estimated that 63 per cent of referrals to Australasian orthodontic practices come from GDPs.⁶ GDPs' perceptions and referral practices are therefore of considerable importance, particularly in the interpersonal relationship categories of *communication and quality* and *reciprocation*. This is consistent with the findings of previous studies.^{5,7,8} In the context of the current study, the term 'reciprocation' refers to the 'give and take' between orthodontist and referring dentist: the dentist refers patients to the orthodontist, and the orthodontist responds by providing information on

Table VIII. Comparison of frequency of use of various treatment options 'frequently' or 'always' by Auckland GDP providers of orthodontic treatment (N = 31) with those from elsewhere in New Zealand (N = 64; data in Table are percentages).

Appliance type	Auckland	Elsewhere
Simple removable appliance	48.4	56.3
Limited fixed appliance	46.7	17.7 ^a
Functional appliances	26.7	12.7
Full fixed appliances without extraction	65.5	22.6 ^a
Full fixed appliances with extraction	40.0	19.0 ^a
Combination of fixed appliances with functional appliances	37.9	12.9 ^a
Invisalign	6.5	6.3

^a $p < 0.05$

the patient's management to the dentist and advice and assistance with minor orthodontic matters. The data in Table V suggest that it is important for the orthodontist to be approachable, receptive and reputable, and to provide timely and relevant information to the referring practitioner. It is equally as important for referring dentists to feel included and in partnership with the orthodontic care of the patient.

Conclusions

The findings of this study suggest that the proportion of New Zealand GDPs providing orthodontic treatment has decreased in the last decade to about one in five overall.

GDP delivery of orthodontic treatment is considerably higher in rural areas and in the greater Auckland area.

The findings suggest that the majority of the more complex cases are continuing to be referred to specialist orthodontists.

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