Orthodontic screening and referral practices of dental therapists in New Zealand

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Background: Timely referrals of appropriately screened cases are essential for the effective delivery of orthodontic treatment. Dental therapists are intimately involved with the orthodontic screening process in New Zealand, given that they are the primary oral health providers for child and adolescent patients.

Objectives: (1) To investigate New Zealand dental therapists’ orthodontic screening and referral practices; and, (2) to quantify the perceived need for supplementary orthodontic resources by New Zealand dental therapists.

Methods: An online questionnaire was distributed via email to 659 actively practising dental therapists in New Zealand. Participants answered questions related to their socio-demographic characteristics, orthodontic screening and referral practices, and further orthodontic education.

Results: All surveyed dental therapists viewed orthodontics as an important treatment priority. Most (64.6%, N = 148) agreed that the orthodontic screening process should be a joint undertaking between general dental practitioners and dental therapists. Most practitioners (63.3%, N = 145) had access to (and used) an orthodontic screening guideline. While almost all dental therapists (98.7%, N = 226) were confident in assessing cases that were suitable for orthodontic referral, 63.8% felt that they could gain from further education, and virtually all (99.6%, N = 228) believed that continuing professional development (CPD) courses in orthodontics would be beneficial. Over three-quarters were in favour of a standardised national guideline for orthodontic screening, while the remainder were either satisfied with their current guidelines (15.3%, N = 35) or believed that such guidelines were unnecessary (7.0%, N = 16). Several patterns were observed by therapist characteristics, particularly related to working sector (private or public) and length of professional experience.

Conclusions: There were differences in the orthodontic screening and referral practices of dental therapists in New Zealand. Dental therapists were receptive to the idea of standardised guidelines for orthodontic screening and there was a perceived need for CPD courses in orthodontics.

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Introduction

Malocclusion is a highly prevalent dental condition in New Zealand children, as approximately one-third have been determined to be in need of treatment. A malocclusion in the young is associated with a poorer oral health-related quality of life (OHRQOL), particularly in the domains of emotional and social wellbeing. Orthodontic treatment is not only efficacious in treating a malocclusion, it improves a patient’s OHRQOL. Appropriate screening and referral of children and adolescents can significantly reduce the complexity of future treatment needs through interceptive treatment.

In New Zealand, dental therapists are the primary oral healthcare providers for those under the age of 18. Included in their scope of practice is the recognition of orofacial abnormalities, along with referral as necessary to an appropriate practitioner. This scope
means that dental therapists are well placed to detect and refer malocclusions early. In fact, approximately one-quarter of patients who undergo orthodontic treatment in New Zealand are referred by a dental therapist. At the same time, it is fundamental that dental therapists are well versed in this task in order to prevent inappropriate referrals. The latter can create unnecessary financial burden and long consultation waitlists, which are detrimental to the parties involved including the patient, orthodontist and the referring practitioner. Overseas studies have demonstrated a high frequency of inappropriate orthodontic referrals which warrant the implementation of referral guidelines, but there are no national standardised guidelines established in New Zealand.

Several studies in New Zealand have investigated the role of the general dental practitioner in the provision of orthodontic treatment; however, there is a lack of information on the involvement of dental therapists. Current research suggests that dental therapists are actively involved in the orthodontic referral process and, while they are largely confident in screening appropriate cases, they are interested in further orthodontic education.

A recent qualitative study investigated the orthodontic screening and referral practices of dental therapists in New Zealand and found substantial variation between the practitioners interviewed. This variation occurred in a number of domains, including dental therapists’ orthodontic screening and referral process, the factors affecting this process, and their attitudes towards orthodontic treatment.

Therefore, the purpose of this study was to investigate New Zealand dental therapists’ orthodontic screening and referral practices. A secondary objective was to investigate their perceived need for continuing professional development (CPD) courses and a standardised screening guideline.

Materials and methods
An online national survey of actively practising dental therapists in New Zealand was conducted between June and September 2016. The participants were selected from the 2016 New Zealand Dental Register, obtained from the Dental Council of New Zealand (DCNZ). The sampling frame was limited to practitioners who had a current annual practising certificate (APC) in the scope of dental therapy. The study was approved by the University of Otago Ethics Committee (D15/158).

An online questionnaire was developed and hosted on Qualtrics (www.qualtrics.com). From the initial source population of 918 dental therapists with a valid APC, those with an undisclosed email to either DCNZ or the New Zealand Dental and Oral Health Therapists Association (NZDOHTA) were excluded. Further exclusions applied to those who were currently practising overseas or were not practising within the scope of dental therapy (such as practitioners dual-registered in both dental therapy and dental hygiene but practising only the latter). A total of 659 dental therapists met all inclusion criteria, and they were emailed a link to the online questionnaire via two distribution channels: Qualtrics and a mass email to members of the NZDOHTA. Reminder emails were automatically sent to non-responders using the Qualtrics platform (thus preserving anonymity) at four and eight weekly intervals, with the study concluding in September 2016. Incentives for participation were offered in the form of five prize draws, sponsored by two dental supply companies. Prize-winners were randomly selected from participants who completed the survey and elected to enter the prize draw by providing a contact email address.

Building on the findings of a previous qualitative study, the survey comprised questions on a range of topics, primarily socio-demographic characteristics, orthodontic screening and referral practices, and views on supplementary orthodontic resources (Appendix 1). Questions regarding respondents’ orthodontic screening and referral practices were further grouped into the following subcategories: their views on orthodontic treatment; their screening and referral process; and the factors that might affect this process. For reporting purposes, respondents were grouped by gender, age, primary qualification, practising location (major city, provincial town, or other), and work sector (private, public, or both).

Data were analysed using the Statistical Package for the Social Sciences (version 22.0; SPSS Inc, IL, USA) with an alpha value of 0.05. All data were de-identified, and cases with incomplete or missing responses were excluded prior to data analysis. A bivariate analysis of categorical variables was conducted using the Chi-square test and Fisher’s exact test.
Results

Of the 659 dental therapists who were invited to participate, a total of 229 completed the questionnaire, giving a response rate of 34.7%. A comparison of gender and age data between respondents and the New Zealand dental therapy workforce (obtained from the DCNZ Workforce Analysis 2010) is presented in Table I. Responders were younger, but there was no gender difference between responders and the source population.

The socio-demographic characteristics of participants are summarised in Table II. Overall, most were female and worked in the public sector. The largest proportions of dental therapists were in the under-29 and over-50 age groups.

Views on orthodontic treatment

The data on dental therapists’ opinions regarding how the orthodontic screening process should be undertaken are presented in Table III. All dental therapists viewed orthodontic treatment as important, although the level of priority varied depending on patient factors. Approximately half of the respondents considered that orthodontic treatment was important for patients with severe malocclusions (53.3%) and mild-moderate malocclusions (55.0%). A greater proportion of participants (75.6%), and older dental therapists in particular, thought that it was a priority if elected by the patient. The majority of dental therapists believed that the orthodontic screening and referral process should be a joint task between general dentists and dental therapists, especially in the younger respondents and those with a Bachelor of Oral Health Degree.

Orthodontic screening

Some variation was noted in the orthodontic screening practices of dental therapists. The majority (86.9%) screened all patients for orthodontic consultation. The remaining practitioners screened only patients between a self-determined age range (10.0%) or those with a severe malocclusion (2.6%), or did not screen any patients (0.4%). More experienced practitioners and those working in the public sector were more likely to screen all patients, while younger dental therapists and those working in the private sector tended to only screen patients between certain ages.

Summary data on the orthodontic clinical characteristics assessed by dental therapists are presented in Table IV. Cross-bites, overjet, the presence of spacing or crowding, and overbite were the most commonly assessed. Deleterious habits were the least commonly assessed aspect. There were no significant differences according to dental therapists’ characteristics.

Approximately half of the dental therapists did not use any adjunctive diagnostic tools for orthodontic screening (52.0%). The most commonly used adjunct was intraoral radiography (45.4%). Few respondents reported the use of panoramic radiographs (15.7%) and study models (2.2%). A larger proportion of dental therapists working in the private sector used panoramic radiography compared with those working in the public sector.

Table I. Comparison of sex and age between study respondents and the NZ dental therapy workforce.

<table>
<thead>
<tr>
<th>Age group</th>
<th>Respondents</th>
<th>NZ dental therapy workforce</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N (%)</td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>219 (95.6)</td>
<td>715 (96.6)</td>
</tr>
<tr>
<td>Male</td>
<td>10 (4.4)</td>
<td>25 (3.4)</td>
</tr>
<tr>
<td>Age group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>29 years or younger</td>
<td>57 (25.0)</td>
<td>114 (15.4)</td>
</tr>
<tr>
<td>30–39 years</td>
<td>30 (13.2)</td>
<td>91 (12.3)</td>
</tr>
<tr>
<td>40–49 years</td>
<td>30 (13.2)</td>
<td>133 (18.0)</td>
</tr>
<tr>
<td>50–59 years</td>
<td>67 (29.4)</td>
<td>265 (35.8)</td>
</tr>
<tr>
<td>60 years or older</td>
<td>44 (19.3)</td>
<td>137 (18.5)</td>
</tr>
<tr>
<td>Total</td>
<td>229 (100.0)</td>
<td>740 (100.0)</td>
</tr>
</tbody>
</table>

*a Data obtained from DCNZ Workforce Analysis 2010; b age data not available for one respondent; c *p < 0.01.
Most dental therapists had access to, and utilised, an orthodontic screening guideline (63.3%) while approximately one-quarter did not have a guideline but desired access to one (24.0%). The remainder did not use the guideline available to them (3.9%), did not want a guideline (0.4%), or preferred the input of a dentist or orthodontist (2.2% and 6.1%, respectively). A larger proportion of more experienced practitioners and those working in the public sector had access to screening guidelines compared with those in other groups. Before referring patients for orthodontic consultation, 45.9% of practitioners offered brief information about treatment options.

Orthodontic referral practices

The majority of practitioners referred patients using a referral form (34.5%), a referral letter template (44.5%), or both (14.4%). Only 6.6% did not use a specific form when referring patients for an orthodontic assessment. Most respondents referred patients to a list of orthodontists in the area (82.1%). This was followed in frequency by referral to a specific orthodontist (15.3%) and a general dentist practising orthodontics (2.2%). A greater proportion of dental therapists who practised outside a major city or in the private sector referred patients to a specific orthodontist than did other groups.

The participants were asked to self-assess the overall appropriateness of their orthodontic referrals. The majority (87.3%) considered their referral methods were effective while the remainder believed their referral method was inappropriate, despite having not received any complaints (12.2%). The self-perception that referrals were inappropriate was more prevalent in younger groups. A similar pattern was observed when participants were asked to rate their confidence in assessing cases that were appropriate for orthodontic

<table>
<thead>
<tr>
<th>Table II. Socio-demographic and educational characteristics of respondents.</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>219 (95.6)</td>
</tr>
<tr>
<td>Male</td>
<td>10 (4.4)</td>
</tr>
<tr>
<td><strong>Age group</strong>&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>29 years or younger</td>
<td>57 (25.0)</td>
</tr>
<tr>
<td>30–39 years</td>
<td>30 (13.2)</td>
</tr>
<tr>
<td>40–49 years</td>
<td>30 (13.2)</td>
</tr>
<tr>
<td>50–59 years</td>
<td>67 (29.4)</td>
</tr>
<tr>
<td>60 years or older</td>
<td>44 (19.3)</td>
</tr>
<tr>
<td><strong>Qualification</strong></td>
<td></td>
</tr>
<tr>
<td>Bachelor of Oral Health (Otago or AUT)</td>
<td>89 (38.9)</td>
</tr>
<tr>
<td>Diploma in Dental Therapy</td>
<td>22 (9.6)</td>
</tr>
<tr>
<td>Certificate in Dental Therapy</td>
<td>27 (11.8)</td>
</tr>
<tr>
<td>Certificate in Dental Nursing</td>
<td>74 (32.3)</td>
</tr>
<tr>
<td>Other</td>
<td>17 (7.4)</td>
</tr>
<tr>
<td><strong>Location</strong></td>
<td></td>
</tr>
<tr>
<td>Major city</td>
<td>127 (55.5)</td>
</tr>
<tr>
<td>Provincial town</td>
<td>82 (35.8)</td>
</tr>
<tr>
<td>Other</td>
<td>20 (8.7)</td>
</tr>
<tr>
<td><strong>Work sector</strong></td>
<td></td>
</tr>
<tr>
<td>Private</td>
<td>32 (14.0)</td>
</tr>
<tr>
<td>Public</td>
<td>170 (74.2)</td>
</tr>
<tr>
<td>Both</td>
<td>27 (11.8)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>229 (100.0)</td>
</tr>
</tbody>
</table>

<sup>a</sup> Age data not available for one respondent
Table III. Opinion of oral health practitioners responsible for orthodontic screening by demographic characteristics.

<table>
<thead>
<tr>
<th>Perceived practitioners responsible, N(%)</th>
<th>Both general dentists and dental therapists</th>
<th>Primarily general dentists</th>
<th>Primarily dental therapists</th>
<th>Primarily specialist orthodontists</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>140 (63.9)</td>
<td>2 (0.9)</td>
<td>52 (23.7)</td>
<td>25 (11.4)</td>
</tr>
<tr>
<td>Male</td>
<td>8 (80.0)</td>
<td>0 (0.0)</td>
<td>1 (10.0)</td>
<td>1 (10.0)</td>
</tr>
<tr>
<td>Age group</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>29 years or younger</td>
<td>51 (89.5)</td>
<td>0 (0.0)</td>
<td>5 (8.8)</td>
<td>1 (1.8)</td>
</tr>
<tr>
<td>30–39 years</td>
<td>23 (76.7)</td>
<td>0 (0.0)</td>
<td>3 (10.0)</td>
<td>4 (13.3)</td>
</tr>
<tr>
<td>40–49 years</td>
<td>18 (60.0)</td>
<td>0 (0.0)</td>
<td>7 (23.3)</td>
<td>5 (16.7)</td>
</tr>
<tr>
<td>50–59 years</td>
<td>34 (50.7)</td>
<td>2 (3.0)</td>
<td>25 (37.3)</td>
<td>6 (9.0)</td>
</tr>
<tr>
<td>60 years or older</td>
<td>22 (50.0)</td>
<td>0 (0.0)</td>
<td>13 (29.5)</td>
<td>9 (20.5)</td>
</tr>
<tr>
<td>Qualification</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bachelor of Oral Health (Otago or AUT)</td>
<td>7 (78.7)</td>
<td>2 (2.2)</td>
<td>12 (13.5)</td>
<td>5 (5.6)</td>
</tr>
<tr>
<td>Diploma in Dental Therapy</td>
<td>11 (50.0)</td>
<td>0 (0.0)</td>
<td>7 (31.8)</td>
<td>4 (18.2)</td>
</tr>
<tr>
<td>Certificate in Dental Therapy</td>
<td>14 (51.9)</td>
<td>0 (0.0)</td>
<td>7 (25.9)</td>
<td>6 (22.2)</td>
</tr>
<tr>
<td>Certificate in Dental Nursing</td>
<td>39 (52.7)</td>
<td>0 (0.0)</td>
<td>24 (32.4)</td>
<td>11 (14.9)</td>
</tr>
<tr>
<td>Other</td>
<td>14 (82.4)</td>
<td>0 (0.0)</td>
<td>3 (17.6)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Location</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Major city</td>
<td>81 (63.8)</td>
<td>2 (1.6)</td>
<td>31 (24.4)</td>
<td>13 (10.2)</td>
</tr>
<tr>
<td>Provincial town</td>
<td>53 (64.6)</td>
<td>0 (0.0)</td>
<td>19 (23.2)</td>
<td>10 (12.2)</td>
</tr>
<tr>
<td>Other</td>
<td>14 (70.0)</td>
<td>0 (0.0)</td>
<td>3 (15.0)</td>
<td>3 (15.0)</td>
</tr>
<tr>
<td>Work setting</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private</td>
<td>24 (75.0)</td>
<td>2 (6.3)</td>
<td>5 (15.6)</td>
<td>1 (3.1)</td>
</tr>
<tr>
<td>Public</td>
<td>105 (61.8)</td>
<td>0 (0.0)</td>
<td>42 (24.7)</td>
<td>23 (13.5)</td>
</tr>
<tr>
<td>Both</td>
<td>19 (70.4)</td>
<td>0 (0.0)</td>
<td>6 (22.2)</td>
<td>2 (7.4)</td>
</tr>
<tr>
<td>Total</td>
<td>148 (64.6)</td>
<td>2 (0.9)</td>
<td>53 (23.1)</td>
<td>26 (11.4)</td>
</tr>
</tbody>
</table>

*p < 0.05; p < 0.01; p < 0.001

referral. While a large number of dental therapists felt very confident (34.9%), a greater proportion reported that they were moderately confident and would benefit from further education (63.8%). The proportion of dental therapists who reported feeling very confident was higher in the older age groups. Only 1.3% reported feeling not confident. When participants were instead asked whether they were confident in delaying referrals and monitoring patients (if appropriate), an overall greater proportion reported being not confident (16.2%).

Factors affecting the referral process

The exposure to orthodontic theory during participants’ primary dental therapy education was classified into three categories: substantial (a dedicated paper or module; 27.9%); minimal (1–2 lectures; 69.9%); or none (2.2%). A greater proportion of younger dental therapists and those who held a Bachelor of Oral Health qualification reported having substantial exposure.

A similar classification was used when assessing exposure to orthodontic practice during primary dental therapy education. The overall level of exposure to practical experience was less than the theoretical component, with the following proportions reported: substantial (full semester/year of clinical sessions; 9.2%); minimal (1–2 clinical sessions; 70.7%); or none (20.1%). No statistically significant difference was observed between the different sub-groups.
Orthodontic screening practices of NZ dental therapists

Most dental therapists had a support clinician available with whom to discuss cases. This included another dental therapist (34.9%), a general dentist (42.4%) or an orthodontist (17.0%). A small proportion (5.7%) had no support clinician available.

**Supplementary resources**

Dental therapists held a very positive view towards orthodontic CPD courses and almost all believed they would be beneficial. A large proportion believed that CPD courses were not only beneficial but should be made mandatory (61.6%). The remainder also regarded CPD courses as valuable but thought that they should remain optional (38.0%). There was a preference for a ‘face-to-face’ format for CPD courses (62.9%) over an online format (14.0%). The remainder had no preference for a particular format. Despite the interest in these programs, only two-thirds of dental therapists had previously completed an orthodontic CPD course (66.4%). Of the 33.6% who had not undertaken an orthodontic CPD course, the main reasons given for non-attendance were limited availability (57.1%) and cost (28.6%).
Data on the perceived need for a standardised national guideline for orthodontic screening (as well as a standardised orthodontic referral form) are presented in Table V. Over three-quarters of the respondents stated that they would like a standardised guideline, while slightly fewer wanted a standardised referral form.

Aspects that dental therapists wished to be incorporated into the proposed guidelines included (in order of preference): signs to observe at landmark ages (70.3%), situations requiring early referral (62.0%), normal parameters (61.6%), and a step-by-step screening form (60.3%).

Discussion

The present survey found that dental therapists generally held a positive view of their role in the orthodontic referral chain, with most screening all of their patients. Nearly all dental therapists supported continuing education in orthodontics and the development of a standardised screening guideline. Despite this uniformity of opinion, several differences

Table V. Perceived need for a standardised orthodontic guideline and standardised orthodontic referral form by demographic characteristics.

<table>
<thead>
<tr>
<th></th>
<th>Perceived need for standardised guideline, N (%)</th>
<th>Perceived need for standardised referral form, N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No – Happy with own guideline</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>170 (77.6)</td>
<td>35 (16.0)</td>
</tr>
<tr>
<td>Male</td>
<td>8 (80.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td><strong>Age group</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>29 years or younger</td>
<td>49 (86.0)</td>
<td>5 (8.8)</td>
</tr>
<tr>
<td>30–39 years</td>
<td>25 (83.3)</td>
<td>1 (3.3)</td>
</tr>
<tr>
<td>40–49 years</td>
<td>24 (80.0)</td>
<td>4 (13.3)</td>
</tr>
<tr>
<td>50–59 years</td>
<td>49 (73.1)</td>
<td>13 (19.4)</td>
</tr>
<tr>
<td>60 years or older</td>
<td>30 (68.2)</td>
<td>12 (27.3)</td>
</tr>
<tr>
<td><strong>Qualification</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bachelor of Oral Health [Otago or AUT]</td>
<td>73 (82.0)</td>
<td>7 (7.9)</td>
</tr>
<tr>
<td>Diploma in Dental Therapy</td>
<td>18 (81.8)</td>
<td>3 (13.6)</td>
</tr>
<tr>
<td>Certificate in Dental Therapy</td>
<td>20 (74.1)</td>
<td>5 (18.5)</td>
</tr>
<tr>
<td>Certificate in Dental Nursing</td>
<td>51 (68.9)</td>
<td>19 (25.7)</td>
</tr>
<tr>
<td>Other</td>
<td>16 (94.1)</td>
<td>1 (5.9)</td>
</tr>
<tr>
<td><strong>Location</strong></td>
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<td></td>
</tr>
<tr>
<td>Major city</td>
<td>103 (81.1)</td>
<td>14 (11.0)</td>
</tr>
<tr>
<td>Provincial town</td>
<td>59 (72.0)</td>
<td>18 (22.0)</td>
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<td>Other</td>
<td>16 (80.0)</td>
<td>3 (15.0)</td>
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<tr>
<td><strong>Work setting</strong></td>
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<td></td>
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<td>Private</td>
<td>24 (75.0)</td>
<td>3 (9.4)</td>
</tr>
<tr>
<td>Public</td>
<td>136 (80.0)</td>
<td>26 (15.3)</td>
</tr>
<tr>
<td>Both</td>
<td>18 (66.7)</td>
<td>6 (22.2)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>178 (77.7)</td>
<td>35 (15.3)</td>
</tr>
</tbody>
</table>
were observed in dental therapists’ screening and referral practices, particularly their confidence in orthodontic assessment and their current use of a screening guideline.

At the outset, it is pertinent to examine the weaknesses and strengths of the current study. The validity of the findings is largely dependent on how representative the responding sample is of the source population (the New Zealand dental therapy workforce). Systematic age differences were observed, with over-representation of respondents in the youngest age group (younger than 29 years). Owing to the online format of the survey, it is possible that a larger proportion of younger dental therapists (who may be more likely to have an active email address) were included in the sample, which might have introduced a selection bias. It is also possible that a demographic shift towards a greater proportion of younger dental therapists has occurred since 2010 (when the most recent workforce analysis was conducted). Furthermore, the relatively low response rate of 34.7% may have contributed a degree of error. Therefore, caution should be exercised in generalising the findings of the current study to the entire New Zealand dental therapy workforce. Future studies may improve the response rate by administering surveys at professional association meetings, where attendance rates are typically high. Despite the subjective measurement of dental therapists’ opinion as the aim of the current study, an additional limitation is that certain topics may have been better investigated using objective measures (such as the appropriateness of orthodontic referrals). Accordingly, the observations reported by this study may not reflect the perspectives held by patients and orthodontists. Only one other quantitative study has been conducted on a similar topic and, while a higher response rate was obtained, the number of aspects investigated was more limited. A particular strength of the current study is that it was able to quantitatively evaluate, and build upon, a broad range of topics that were shown to be of importance in a recently-published qualitative study. Reassuringly, the findings generally supported those of Sarfarazi et al. (2010) and Tan et al. (2016).

The key factors that influenced dental therapists’ responses were age and qualification held. These variables may be linked to one another since they were usually found to have an association with the same topics. Dental therapists with a Bachelor of Oral Health qualification are also likely to be younger, because the two institutions offering this degree (the Auckland University of Technology and the University of Otago) introduced the programs in 2006 and 2007, respectively. A larger proportion of older practitioners were more confident, felt that their referrals were appropriate and screened all of their patients. Overall, dental therapists in the older age groups received less exposure to orthodontic theory during their education but a larger proportion had subsequently completed further courses in orthodontics. Correspondingly, it is logical that continuing education and experience are the key contributory factors to these aspects. Older dental therapists also tended to view orthodontics as a high treatment priority only if it was desired by the patient, rather than if the therapist believed that there was a need for treatment. This may stem from a greater exposure to the realities of orthodontic treatment in New Zealand. One such example is cost, where fewer patients of lower socio-economic status have been shown to seek orthodontic care, and their threshold for seeking treatment is higher.

Differences between practitioners working in the public and private sectors were also apparent. Overall, those who worked in the public sector tended to screen all of their patients, referred a higher number of patients, and referred to a list of orthodontists. A larger proportion of dental therapists who worked in the public sector also had access to screening guidelines, indicating that some district health boards (DHBs) have taken the initiative of developing their own screening guidelines to cope with this greater throughput. The Auckland DHB and Southern DHB are among those who provided screening guidelines to their dental therapists.

Overall, most dental therapists reported that their orthodontic referrals were appropriate, and almost none received complaints. While this is promising, it is unclear whether these opinions would be concordant with those of patients and orthodontists. It is possible that inappropriate referrals have gone undetected by dental therapists since orthodontists may receive criticism on their behalf from patients, and this is then not passed back to the referring clinician. Furthermore, orthodontists may not inform dental therapists of cases that they believe have been inappropriately referred. This observation also contradicted previous research, conducted on general dentists overseas, which indicated that a significant
**Appendix 1. Survey questionnaire**

1. I have read and understood the information and aims of the research study, and agree to take part in it. I understand that any information I provide may be used in academic or professional journals/conferences. However, no personal identifiers will be used in the preparation of this material.
   a. Yes, I agree to take part
   b. No, I would prefer not to participate

2. Are you:
   a. Male
   b. Female

3. What is your age?
   a. (OPEN RESPONSE)

4. Where did you complete your primary dental therapy qualification?
   a. New Zealand
   b. Australia
   c. Other (please specify)

5. What qualification do you hold?
   a. Bachelor of Oral Health (Otago)
   b. Bachelor of Health Science in Oral Health (AUT)
   c. Certificate in Dental Therapy (issued by the Department of Health or other NZ educational institution)
   d. Certificate in Dental Nursing (issued by the Department of Health or other NZ educational institution)
   e. Diploma in Dental Therapy (issued by a NZ educational institution)
   f. Bachelor of Health Sciences (Endorsement in Dental Therapy)(Otago)
   g. Other (please specify qualification and institution)

6. In which year did you obtain your primary dental therapy qualification?
   a. (OPEN RESPONSE)

7. Have you obtained any further qualifications following your primary dental therapy qualification?
   a. No
   b. Yes (please specify qualification, institution and year obtained)

8. How long have you been practising as a dental therapist for?
   a. Less than 2 years
   b. 2 to 5 years
   c. 5 to 10 years
   d. Over 10 years

9. Which region are you currently practising in?
   a. Northland
   b. Auckland
   c. Waikato-Bay of Plenty
   d. Gisborne
   e. Hawke’s Bay
   f. Central Districts
   g. Taranaki
   h. Wellington
   i. Nelson-Marlborough
   j. West Coast
   k. Canterbury
   l. Otago
   m. Southland

10. Where do you currently practise?
    a. Major city
    b. Provincial town
    c. Other (please specify)

11. Which sector are you working in?
    a. Private
    b. Public
    c. Both

11A. (If answered “Both” to Q11) Approximately what percentage of time do you spend working in the private sector?
    a. (OPEN RESPONSE)

12. Have you worked in an orthodontic practice before?
    a. Yes
    b. No

13. How do you view orthodontics as a treatment priority? (Select all that apply)
    a. Important for those with severe malocclusions only
    b. Important for those with mild to moderate malocclusions
    c. Important for those who wish to receive orthodontic treatment
    d. Not very important

14. How do you think the orthodontic screening/referral process should be handled?
    a. It should be a joint task between general dentists and dental therapists
    b. It should primarily be done by general dentists
    c. It should primarily be done by dental therapists
    d. Patients should go directly to a specialist orthodontist

15. Which statement best describes the patients you screen for orthodontic treatment?
    a. I routinely screen all of my patients
    b. I routinely screen all of my patients that are between a certain age
    c. I take notice only if there is an obvious malocclusion
    d. I do not screen any patients

16. How many patients do you refer for orthodontic consultation/treatment every month (on average)?
    a. None
    b. Fewer than 5 patients
    c. Between 5 and 10 patients
    d. Between 10 and 20 patients
    e. More than 20 patients

17. Do you follow a fixed set of guidelines or protocols for referring patients for orthodontic treatment?
    a. I have access to, and use, a guideline
    b. I have access to, but do not use, a guideline
    c. I do not have access to a guideline but believe it would be beneficial
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18. Which document do you use for referring patients for orthodontic treatment?
   a. A specific referral form
   b. A template referral letter
   c. A specific referral form and a template referral letter
   d. No specific document

19. To whom would you refer patients requiring an orthodontic consultation?
   a. A specific specialist orthodontist
   b. A list of specialist orthodontists
   c. A specific general dentist who practises orthodontics
   d. A general dentist

20. Which of the following do you carry out when deciding whether to refer a patient? (Select all applicable)
   a. Assess occlusal and skeletal relationships
   b. Assess presence of spacing or crowding
   c. Assess dental development
   d. Assess presence of ectopic teeth
   e. Assess presence of cross-bites
   f. Assess overjet
   g. Assess overbite
   h. Assess presence of deleterious habits
   i. Other (please specify)

21. In your opinion, which age is the best for orthodontic referral?
   a. (OPEN RESPONSE)

22. Do you offer the patient brief information on what treatment options are available?
   a. Yes
   b. No

23. Which additional diagnostic tools do you use in the orthodontic screening process? (select all applicable)
   a. No additional diagnostic tools
   b. Panoramic radiograph
   c. Intraoral radiographs
   d. Study models

24. Do you think that your referral method is effective? (Select all that apply)
   a. Yes
   b. No, I have received repeated criticism from patients
   c. No, I have received repeated criticism from the parents of patients
   d. No, I have received repeated criticism from specialist orthodontists
   e. No, I have received repeated criticism from general dentists
   f. No, but I have not received any criticism

24A. (If answered “b, c, d, e” to Question 25) Please provide details of the criticism that you have received:
   a. Wrong timing for referral (too early / too late)

25. How much exposure have you had to orthodontic diagnosis in your career?
   a. A substantial amount (i.e. regularly see patients requiring orthodontic screening)
   b. Minimal (i.e. occasionally see patients requiring orthodontic screening)
   c. None

26. How confident do you feel in assessing cases that require orthodontic referral?
   a. Very confident
   b. Fairly confident, but could benefit from further education
   c. Not confident

27. How confident are you at holding off referrals and monitoring a patient (if appropriate)?
   a. Very confident
   b. Fairly confident, but could benefit from further education
   c. Not confident

28. Do you have somebody to discuss complex cases with?
   a. Yes – another dental therapist
   b. Yes – a general dentist
   c. Yes – a specialist orthodontist
   d. No

29. How much exposure have you had to orthodontic theory during your primary dental therapy education?
   a. A substantial amount (i.e. a dedicated paper/module etc)
   b. Minimal (i.e. 1-2 lectures)
   c. None

30. How much exposure have you had to orthodontic clinic/practice during your primary dental therapy education?
   a. A substantial amount (i.e.full semester/year)
   b. Minimal (i.e. 1-2 clinics/practicals)
   c. None

31. Have you undertaken any further studies/CPD courses in the area of orthodontics?
   a. Yes – a comprehensive course in orthodontics for dental therapists
   b. Yes – a CPD course/seminar
   c. No – But I would like to
   d. No – I would prefer not to

31A. (If answered “No” to Q32) For what reasons have you not attended any recent CPD events in orthodontics? (select all that apply)
   a. Cost of CPD events
number of patients were inappropriately referred to orthodontists.\textsuperscript{11,12} Although no detailed information on the type of feedback system employed by orthodontists was collected, it is clear that they should play an active role in conveying constructive feedback to dental therapists as part of the latter's professional development.

There appeared to be a lack of exposure to orthodontics (particularly practical aspects) in current and previous dental therapy programs. This shortfall in the curriculum may have contributed to the perceived need for CPD courses in orthodontics, since many dental therapists felt that further education was necessary. These observations were also concordant with themes identified in previous studies.\textsuperscript{15,16} A review of the dental therapy curriculum to address this issue may be worthwhile. Despite a high expression of interest, the primary barrier to completing a CPD course was reported to be the lack of availability of such courses. Therefore, an implication for the orthodontic community is the need to facilitate these requests through the provision of more CPD courses, possibly using online formats aimed at reaching dental therapists in more remote regions.

Dental therapists were highly in favour of a standardised national guideline for orthodontic screening. Ideally, guidelines should adhere to strict quality control standards and be appropriately evidence-based in order to be effective clinical tools.\textsuperscript{19} Several guidelines in dentistry have already been developed that meet these criteria. An example is the national guideline in England for managing palatally-placed maxillary canines, which is endorsed by the Scottish Intercollegiate Guidelines Network.\textsuperscript{20} Research conducted on general dentists overseas suggests that the use of an orthodontic screening guideline does not improve referral patterns, despite conforming to the aforementioned criteria.\textsuperscript{21} Despite this, the implementation of a standardised orthodontic screening guideline in New Zealand may still be worthwhile, since the findings of O’Brien et al.\textsuperscript{21} may not be applicable to the target population. Furthermore, the present study assumes that the majority of referrals are already appropriate (as reported by dental therapists) and so the main function of this guideline would be to increase practitioner confidence.
Conclusions
There was considerable variation between dental therapists in New Zealand in their orthodontic screening and referral practices. Age, qualification and work sector appeared to have the most influence. While the current study offers substantial insight into the dental therapy-orthodontic interface, the effectiveness of the referral system from the perspective of patients and orthodontists remains largely unknown. Further research is required to investigate patients’ and orthodontists’ experiences of referrals made by dental therapists. The development, implementation and evaluation of a national orthodontic screening guideline would be the next logical step in providing dental therapists with the resources they want and need to confidently manage this referral process.

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