

Orthodontists' perception and attitude toward accelerated orthodontic treatments in Australia

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Introduction: The purpose of this cross-sectional study was to survey the perception and attitude of Australian orthodontists toward accelerated orthodontic treatments.

Methods: An online questionnaire was distributed to 427 members of the Australian Society of Orthodontists. The questions related to: clinic demographics, familiarity with appliances/procedures to accelerate orthodontic treatment, the use of appliances/procedures to accelerate orthodontic treatment, and satisfaction with the outcomes when employing these appliances/procedures.

Results: The response rate was 42.38%. Of the respondents, 26.6% used customised fixed appliances which provided satisfactory outcomes. A small proportion of the respondents routinely used adjunctive procedures to accelerate treatment: 3.5% ($n=6$) corticotomies, 1.2% ($n=2$) piezocision, and 1.2% ($n=2$) intraoral vibrating devices.

Conclusion: Although a significant number of Australian orthodontists use customised fixed appliances to improve the efficiency of orthodontic treatment, the use of adjunctive procedures to accelerate tooth movement remains very low. Further research is needed to understand the possible limitations and restrictions surrounding this area of practice.

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Introduction

Orthodontic treatment has become increasingly popular, but the extended treatment time, often lasting more than two years, is considered a major deterrent.^{1,2} Extended orthodontic treatment is expensive, may contribute to poor patient compliance, and may increase the risk of adverse effects related to caries, gingival recession, and root resorption.^{3,4} Accelerated orthodontics comprises a group of invasive and non-invasive techniques purporting to reduce treatment time. These approaches may be categorised into:

- a) local delivery of biological compounds such as prostaglandin E (PGE) and cytokines. Cytokines, including interleukins (IL) and tumour necrosis

factor (TNF) alpha, exert an influence on bone remodelling and osteoclast function. Mechanical stress delivered during orthodontic treatment elevates the production of prostaglandin (PGE) and IL-1 beta within the periodontal ligament. Research has demonstrated that prostaglandins facilitate bone resorption, thereby expediting tooth movement.⁵ The injection of IL, TNF, and PGE has been demonstrated to increase tooth movement velocity, as evidenced by the increased staining of neurotransmitters substance P (SP) and vasoactive-intestinal peptide and cytokines IL-1 α and IL-1 β in parodontal tissues under orthodontic force, and the significant rise in cAMP and PGE2 levels in human periodontal ligament (PDL) fibroblasts treated with SP and IL-1 β .⁶

- b) device-assisted treatment including the use of vibratory force, customised orthodontic appliances, and low-energy laser therapy have shown promise in accelerating tooth movement. Nishimura et al. found that a vibrational stimulation of 60 Hz significantly enhanced RANKL expression in the periodontal ligament and increased osteoclast numbers in rats, resulting in significantly greater tooth movement compared to a control group, without causing additional root resorption.⁷ The use of low-energy laser therapy has been demonstrated to increase tooth movement velocity, as evidenced by Doshi-Mehta et al., who found that applying infrared radiation from an 810 nm aluminium-gallium-arsenide diode laser to a patient's teeth resulted in a 30% increase in the rate of tooth movement and significantly lower pain scores compared to a control group, which thereby reduced the overall duration of orthodontic treatment.⁸

These techniques originate from historic concepts that orthodontic forces induce bone bending and generate a bioelectrical potential.^{9–11} Experimentally, cyclic forces and vibration, particularly when applied intermittently, have been found to significantly accelerate tooth movements by 15% to 30%.⁵

- c) surgical facilitation such as piezocision and corticotomy. The piezocision technique, as a recent method for accelerating tooth movement, involves a primary gingival incision followed by piezo-surgical knife incisions delivered to the buccal bone cortex. The technique can be used in conjunction with Invisalign therapy, thereby offering aesthetic benefits and reduced treatment time. Corticotomy, a common surgical procedure, involves cutting and perforating cortical bone to decrease resistance, with the expectation of speeding up tooth movement.⁵

Few studies have investigated the perception of orthodontists on accelerated orthodontic techniques. A U.S. and Canadian survey of orthodontists showed that 70% were interested in less invasive and non-surgical accelerated techniques but struggled to remain updated regarding their relative efficacy. Moreover, most of the patients and parents were willing to pay up to 20% more to cover these advanced procedures.⁹ Similarly, an Iraqi study showed that most orthodontists were

interested in non-invasive accelerated orthodontic treatments and were willing to pay up to 40% more for accelerated appliances and the process of learning new techniques.¹²

To date, no studies have assessed the clinical practice and perception of orthodontists towards accelerated orthodontic procedures in Australia. The present study aims to evaluate the clinical practices, familiarity, and potential barriers of Australian orthodontists in adopting accelerated orthodontic procedures. It is expected that the findings will define knowledge gaps and contribute to the development of targeted policies and interventions.

Material and methods

An online survey was developed and distributed via the SurveyMonkey online platform to 427 members of the Australian Society of Orthodontists (ASO). The survey was approved by the Human Research Ethics Committee of The University of Western Australia (2022/ET000572).

The survey consisted of 25 questions. Questions 1 to 5 covered participant demographics. Questions 6 to 25 assessed each participant's: (1) familiarity with appliances/procedures to accelerate orthodontic treatment (including customised fixed appliances, intraoral vibrating devices, corticotomies, piezocision, and intraorally injected drugs); (2) the use of contemporary appliances/procedures to accelerate orthodontic treatment in practice; and, if the participant did use these appliances/procedures, their satisfaction with the treatment outcomes. The responses on satisfaction of the outcomes and perceived efficacy were measured on a 5-point Likert scale, for which: '1' meant very satisfied and '5' meant very dissatisfied. The responses related to enthusiasm were graded on a 4-point Likert scale (1=enthusiastic, 2=willing, 3=neutral, 4=reluctant).

All of the data handling and statistical analyses were performed using the IBM Statistical Package for the Social Science (SPSS) for Windows, Version 21.0. (SPSS Inc, Chicago, Illinois). Data from the online survey platform was directly imported into SPSS-compatible files. The collected data were checked for errors and only responses from participants with complete data sets were used for the analysis. A reliability analysis was conducted on the items comprising different scales assessing the response

of orthodontists, which tested internal consistency by computing the relevant Cronbach Alpha (α) level. Accordingly, the collected data variables were continuous and categorical and were summarised in mean and standard deviation (SD) or proportion.

Results

Of the 427 orthodontists registered with the Australian Society of Orthodontists, 180 responded to the survey (a response rate of 42.38%). Of the 180 participants, 171 respondents (95%) answered all applicable questions. The response rate related to individual questions varied from 95% to 98%. Most participants were male (71.59%; $n=126$) and between 40 and 49 years of age (27.43%; $n=48$).

Demographic

Most of the orthodontists practiced in the state of Victoria (34.7%; $n=60$) and had been practicing for 11 to 20 years (25.9%; $n=45$). Table I summarises the demographics of the participants.

Customised fixed appliances

Table II reveals that most of the orthodontists who incorporate customised fixed appliances into their clinical practice were enthusiastic about appliance use and felt satisfied with the efficacy and outcomes.

The percentage of orthodontists using customised fixed orthodontic appliances was 26.6% ($n=46$; 95% CI 21.5–31.7). A significant proportion were enthusiastic (45.7%; $n=21$) or willing (28.3%; $n=13$) in the use these appliances. Similarly, the majority of the orthodontists using fixed appliances were either very satisfied (37.6%; $n=17$) or satisfied (37.6%; $n=17$) with the outcome of treatment. When asked about the efficacy, the majority of respondents were either very satisfied 35.6%; $n=16$) or satisfied (46.7%; $n=21$) with the results. The reliability analysis of the three items revealed high internal consistency between enthusiasm, satisfaction regarding the outcome, and efficiency (Cronbach alpha value 0.854).

Adjuncts

Table III reveals the current practice and perception of Australian orthodontists regarding the different

Table I. Demographics of the survey respondents

	Percentage (%)	Count (n)
What is your gender identity?		
Male	71.6%	126
Female	26.7%	47
Other/Rather not say	1.7%	3
What is your age?		
<30	2.9%	5
30-39	25.1%	44
40-49	27.4%	48
50-59	17.7%	31
>60	26.9%	47
Where did you complete your orthodontic training?		
University of Adelaide	15.8%	28
University of Melbourne	22.6%	40
University of Otago	4.5%	8
University of Queensland	10.2%	18
University of Sydney	11.3%	20
University of Western Australia	12.4%	22
Other	23.2%	41
What is your primary state/territory of practice?		
ACT	1.7%	3
NSW	17.9%	31
NT	0.6%	1
Qld	20.8%	36
SA	9.2%	16
Tas	1.7%	3
Vic	34.7%	60
WA	13.3%	23
How many years have you been practicing orthodontics (post-completion of specialist training)?		
<6	21.3%	37
6-10	14.9%	26
11-20	25.9%	45
21-30	19.5%	34
>30	18.4%	32

accelerated orthodontic procedures. The present survey revealed that Australian orthodontists do not routinely use different accelerated orthodontic modalities, involving intraoral vibrating devices, corticotomies, piezocision, or intraorally injected drugs.

Figure 1 summarises the positive response rates when asked if the orthodontists utilised accelerated orthodontic techniques. The responses were 1.2% ($n=2$) for intraoral vibrating devices, 3.5% ($n=6$) for corticotomies, 1.2% ($n=2$) for piezocision, and 0% for intraorally injected drugs.

The assessment of enthusiasm for different modalities revealed that 100% of the respondents were neutral about using intraoral vibrating devices. However, 16.7% of the respondents who used corticotomies ($N=6$) were enthusiastic, 33.3% were willing, 16.7% neutral and 33.3% were reluctant. When asked about piezocision ($n=2$), one participant was neutral and the other was reluctant to use this treatment modality. When questioned about the rates of satisfaction, using intraoral vibrating devices ($n=2$), one participant was neutral and the other was very dissatisfied. However, even with the limited number of respondents utilising corticotomies ($n=2$), the satisfaction rates for corticotomies and piezocision were equally satisfied or neutral, respectively. When asked about satisfaction regarding the efficiency of the techniques/treatments, most of the respondents who used accelerated techniques were satisfied.

Discussion

The present study is the first Australian national survey that investigated orthodontist's perceptions and attitudes toward appliances and procedures that

Table II. Orthodontist's perception of using customised fixed orthodontic appliances

	Percentage (%)	Count (n)
Do you incorporate customised fixed appliances (for example, Insignia/Sure Smile) in your clinical practice?		
No	73.4%	127
Yes	26.6%	46
How enthusiastic are you about these appliances?		
Enthusiastic	45.7%	21
Willing	28.3%	13
Neutral	17.4%	8
Reluctant	8.7%	4
How satisfied are you with the outcome after using customised fixed appliances?		
Very satisfied	37.8%	17
Satisfied	37.8%	17
Neutral	11.1%	5
Dissatisfied	8.9%	4
Very dissatisfied	4.4%	2
How satisfied are you with the efficiency of your treatment after using customised fixed appliances?		
Very satisfied	35.6%	16
Satisfied	46.7%	21
Neutral	13.3%	6
Dissatisfied	4.4%	2
Very dissatisfied	0.0%	0

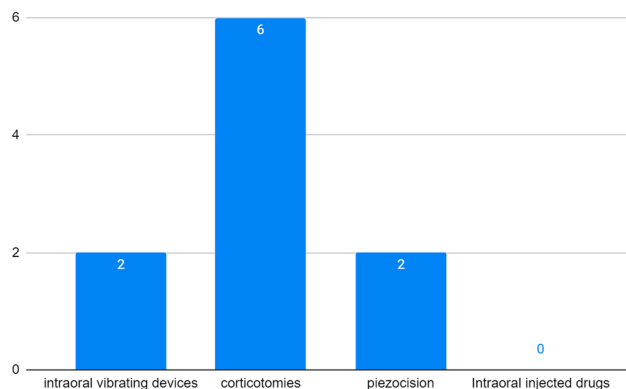


Figure 1. The number of orthodontists using accelerated orthodontics in their practice.

may accelerate orthodontic treatment. The survey was prompted by the increasing interest in procedures and their potential to accelerate orthodontic treatment.^{13,14}

The study identified that 26.6% of orthodontist respondents reported using customised fixed appliances. Interestingly, this differs from a recent Australian study in which it was noted that 33.4% of Australian orthodontists used these appliances in practice.¹⁵ The figures appear to be less than in Europe (49.4%) (Lithuania)¹¹ and in India (44.5%).¹⁴ The percentage discrepancy is perhaps due to the lack of consensus between orthodontists about the need, type, and length of use of fixed appliances. Weber et al. compared the clinical effectiveness and efficiency of a customised orthodontic bracket system with a conventional appliance. The clinicians had significant experience with the CAD/CAM Insignia™ system and the findings indicated that the Insignia™ system, provided greater efficiency, as evidenced by a reduced total treatment time and

fewer appointments.¹⁶ In a separate investigation by Penning et al., it was concluded that the duration and quality of treatment were significantly influenced by the experience of the orthodontist and the severity of the malocclusion at the beginning of treatment, rather than by the specific orthodontic appliance system employed.¹⁷ However, the findings of Penning et al. have to be carefully considered as the clinicians were not universally familiar with the technical processes associated with the system and its clinical application, prior to undertaking the study.

The present research suggests that orthodontists who incorporate customised fixed appliances into their practices are satisfied with the efficacy and treatment outcomes and are enthusiastic about their use. Although clear aligners are becoming increasingly popular, only 33.3% of orthodontists considered

Table III. Orthodontist's perception of using accelerated orthodontic treatments

	Intraoral vibrating devices		Corticotomies		Piezocision		Intraoral injected drugs	
	(%)	Count (n)	(%)	Count (n)	(%)	Count (n)	(%)	Count (n)
Do you incorporate accelerated orthodontic techniques?								
No	98.8%	170	96.5%	166	98.8%	170	100.0%	171
Yes	1.2%	2	3.5%	6	1.2%	2	0.0%	0
How enthusiastic are you about these techniques?								
Enthusiastic	0.0%	0	16.7%	1	0.0%	0	0.0%	0
Willing	0.0%	0	33.3%	2	50.0%	1	0.0%	0
Neutral	100.0%	2	16.7%	1	0.0%	0	0.0%	0
Reluctant	0.0%	0	33.3%	2	50.0%	1	0.0%	0
How satisfied are you with the outcome?								
Very satisfied	0.0%	0	0.0%	0	0.0%	0	0.0%	0
Satisfied	0.0%	0	50.0%	1	50.0%	1	0.0%	0
Neutral	50.0%	1	50.0%	1	50.0%	1	0.0%	0
Dissatisfied	50.0%	1	0.0%	0	0.0%	0	0.0%	0
Very dissatisfied	0.0%	0	0.0%	0	0.0%	0	0.0%	0
How satisfied are you with the efficiency of your treatment?								
Very satisfied	0.0%	0	0.0%	0	0.0%	0	0.0%	0
Satisfied	50.0%	1	50.0%	1	100.0%	2	0.0%	0
Neutral	0.0%	0	50.0%	1	0.0%	0	0.0%	0
Dissatisfied	50.0%	1	0.0%	0	0.0%	0	0.0%	0
Very dissatisfied	0.0%	0	0.0%	0	0.0%	0	0.0%	0

them to be a suitable alternative to fixed appliances.¹⁸ Moreover, research assessing the effectiveness of fixed appliances indicates that fixed appliance success rates are as high as 87.5%.¹⁹

When asked about incorporating adjunctive procedures to accelerate orthodontic treatment into their clinical practice, 96.5% of orthodontists reported the avoidance of these procedures. This matches the results of a 2020 survey in which 96% of Australian orthodontists did not use any adjunctive procedures to accelerate orthodontic treatment.²⁰ In contrast, a 2020 Journal of Clinical Orthodontics study reported that up to 62% of American orthodontists used at least one of the adjunctive accelerative procedures.²¹ The percentage of orthodontists incorporating at least one accelerative procedure into their practice is as high as 66.8% in Iraq,²² 53.5% in India,²³ and 12% in Brazil.²⁴

The discrepancy in the adoption of accelerating procedures and appliances between Australia and other regions may arise due to various factors. Notably, the proficiency of Australian operators appears to outweigh the benefits of appliance customisation. Consequently, the absence of clinical skills of orthodontists may be a deterrent in utilising accelerative procedures.²⁵ The absence of a consensus on the efficacy and a lack of standardisation of accelerative procedures makes obtaining valid consent from the patients challenging.²⁶ Moreover, the high level of heterogeneity and lack of objectivity in measuring orthodontic tooth movement (OTM) as a result of these procedures makes measuring their efficacy difficult.²⁷ Several practical limitations might explain the low uptake of accelerated orthodontics in Australia along with the vast heterogeneity of practice in this area throughout the world.^{24–26}

Of the different accelerated orthodontic treatments, the most commonly used was corticotomy surgery, as 3.5% of participants in the present study employed the procedure. This percentage is higher compared to the 2020 ASO survey in which no Australian orthodontist reported using surgical corticotomy.²⁰ In comparison, less than 10% of U.S. orthodontists use this treatment modality.²⁸ However, 14% of orthodontists use corticotomy in India,²³ and 4% in Iraq.²²

When asked about their enthusiasm regarding the use of corticotomy and clinical satisfaction with the outcome and efficacy, the respondents who applied this procedure listed a positive response. There are several

studies that have explored the patient's acceptance of orthodontic procedures.^{24–29} However, no study has assessed the level of acceptance and enthusiasm regarding this procedure from an orthodontist's perspective. The positive response regarding corticotomies is likely due to the research suggesting that corticotomies can accelerate treatment by 2.2–3 times and are generally well-accepted by patients.³⁰ However, the literature covered in this systematic review generally reflected a lower level of evidence. Moreover, there are significant questions related to the risks of these invasive procedures, identified as damage to the tooth roots,³¹ and questions related to the duration of the regional acceleratory phenomenon (RAP) effect on the overall treatment duration.

Related to the remaining procedures, including intraoral vibrating devices, piezocision, and intraorally injected drugs, the majority of the respondents reported that they did not incorporate these modalities into their routine practice. This is consistent with the data from the 2020 ASO survey, in which less than 1% of orthodontists reported using piezocision and only 3% reported using intraoral vibrating devices.²⁰ The use of intraoral vibrating devices, however, varies greatly across the world as noted by 62% of orthodontists in the U.S. employing vibration,²⁰ but only 4.7% in India,²³ and 0% in Brazil.²¹

Several factors may explain the vast discrepancy between the utilisation of non-invasive modalities for orthodontic acceleration throughout the world. Modalities like intraoral vibration devices, while non-invasive, have a lack of clear evidence from multiple randomised control trials regarding their effectiveness which limits their utility.^{32–35} The use of vibratory interventions might also lead to additional costs for patients and revenue cuts for orthodontists which is a factor worthy of consideration.³⁶

There is a lack of randomised control trials (RCTs) which have assessed the efficacy of acceleratory procedures in a large cohort of patients. The data on the potential benefits of these treatment adjuncts mainly comes from animal models. Most clinicians might not find these procedures useful due to the lack of evidence from human studies and the absence of a positive effect size; that is, the potential positive outcomes of accelerated orthodontics when compared to other procedures.

A limitation of the present study is the potential for selection bias, as the study sample was exclusively

drawn from members of the Australian Society of Orthodontists, which possibly limited the representation of all orthodontists practicing in Australia. Furthermore, the utilisation of an online survey platform may have excluded orthodontists who are less technologically aware, potentially biasing the sample towards those more comfortable in the digital world. Additionally, given the study's exclusive focus on Australian registered orthodontists rather than those specifically trained in Australia, variations in training backgrounds and experiences within different healthcare systems may have influenced the response rate.

Conclusion

The survey achieved a notable response rate of 42.38%. Despite a substantial portion of Australian orthodontists employing customised fixed appliances to enhance the efficiency of orthodontic treatment, the adoption of adjunctive procedures for accelerating orthodontic treatment remains markedly low. In summary:

- A reasonable proportion of Australian orthodontists use customised fixed appliances in their daily practice.
- Most of the orthodontists using customised appliances are satisfied with the outcomes and efficiency of the appliances.
- The uptake of accelerated orthodontic treatments by Australian orthodontists is low.
- Operator-related skills, a lack of consensus regarding the efficacy of treatment, and the high level of heterogeneity in these practices might explain the low uptake of accelerative treatments by Australian orthodontists.
- Further research is needed to highlight the challenges orthodontists face and to explain the low uptake of accelerative treatment modalities.

Conflict of interest

The authors declare that there is no conflict of interest.

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AH, MG, SN, RL and MR Conceptualisation, methodology, supervision, collecting data, writing original draft, reviewing and editing the manuscript; AH, MG, SN, RL: Methodology, collecting data, writing original draft; AH, SN, RL: Collecting data, writing original draft; AH, MG, SN, RL and MR: Data analysis, reviewing and editing the manuscript. All authors read and approved the final version of the manuscript

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