
A clinically based review of patient and treatment characteristics in West Australian private orthodontic practices

Raymond Lam, Simone Mustac and Mithran S. Goonewardene

Department of Orthodontics, School of Dentistry, The University of Western Australia, Perth, Australia

Objective: To describe patient and treatment characteristics in West Australian private orthodontic practices.

Methods: A quantitative retrospective cross-sectional study of patient records from private practices in Western Australia was conducted. Permission was sought to access clinical records of 100 most recently-treated patients at each participating practice. A sample of 3,200 patients (response rate 84%) was collected, representing approximately one-third of practices in Western Australia, and simple descriptive statistics were applied to assess patient and treatment characteristics.

Results: The majority of patients were female (58.5%), adolescent and had private health insurance (75.6%). The most common patient complaint was crowding (37.6%) and aesthetics (21.3%). Data analysis indicated that 31% of patients were self-referred and a similar proportion did not have a specific complaint. Adult females had a higher interest in aesthetic options. Over half of the patients (56%) received first phase treatment, and non-extraction orthodontics accounted for 61.6% of cases. Full fixed appliances were the most commonly prescribed device (94%). The acceptance rate of orthognathic surgery, when offered, was approximately 30%.

Conclusion: Clinical data relating to actual patient presentations provide an invaluable insight into the realities of private practice. The eventual course of treatment is often determined by the patient's tolerances and expectations as much as a clinical recommendation.

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Raymond Lam: rraymondlam@gmail.com; Simone Mustac: simone.mustac@gmail.com;

Mithran S. Goonewardene: mithran.goonewardene@uwa.edu.au

Introduction

Numerous studies have reported variability in the worldwide prevalence of malocclusions and suggested figures ranging widely between 39 and 93%.¹⁻³ The differences are attributed to a complex interplay of factors including genetics,⁴⁻⁶ ethnicity,^{1,7,8} environment,⁹⁻¹² nutrition,^{13,14} self-perception^{15,16} and also the registration methods employed by researchers. At the population level, in order to prioritise malocclusions and estimate treatment need, various indices have been described. Despite this, no single index has gained universal acceptance nor provides an accurate predictor of the characteristics of patients presenting to clinics. In reality, orthodontic treatment

is sought by a diversity of patients for a variety of reasons. Not all patients, even those with severe deviations from normal, seek treatment.¹⁷ Conversely, patients may seek elective treatment to address minor imperfections. It is accepted that a malocclusion has a social and psychological impact on an individual's quality of life.¹⁸⁻²² Studies also suggest that a patient's perception of the severity of their malocclusion, rather than a clinical assessment, is a greater factor dictating their self-esteem.²³⁻²⁵ Clearly, the desire for seeking treatment is influenced by societal and cultural expectations which, in turn, impact the importance of addressing a malocclusion.

As a result, significant disagreement between the reporting of findings is found. For example, socio-economic status (SES) is often considered in population-based research in which a number of studies associate lower SES with diminished utilisation of orthodontic care.²⁶⁻²⁹ However, this finding was not universally reported, with several studies, including an Australian-based investigation, concluding that SES did not account for any substantial variability in those seeking treatment.^{30,31} In other aspects, differences in the prevalence and self-perception of a malocclusion have not been consistently identified between ethnic groups.^{15,32,33} Most studies report a gender bias favouring females, who are also reported to seek treatment for milder occlusal issues.³⁴⁻³⁶ In Australia, the results are mixed and highlighted by a study that focussed on 13-year-old adolescent children and reported that males were more likely to seek treatment.³⁰ However, research by Spencer et al. indicated that females were more likely to receive treatment in a cohort of similar age.³⁷ Specific studies related to the jurisdiction in question are therefore needed, as the applicability of research to the local profession is questionable.

An appreciation of the characteristics of patients who present to orthodontic clinics seeking care would appear worthwhile. Large data sets relating to the demand for different types of orthodontic treatments and the characteristics of those patients are rarely published. Available information has largely been sourced from population-based surveys or school/government-based studies.²⁹ There is a paucity of information related to private orthodontic practices, where the majority of treatment occurs. Estimating the need for treatment by various methods and indices does not necessarily correlate with the acceptance of care and so a clinically-based review of patient and treatment characteristics is essential. It is foreseen that relevant information could improve service delivery, ensuring appropriate funding and scheduling, appropriate workforce planning and tailored teaching. Governments would be able to develop targeted policies and programs from an informed position. Ultimately, this would enable the local profession to best serve their community and patients. Unfortunately, there is no meaningful study in Australia that explores this detail to the extent required.

In a clinically-based study of patient and treatment characteristics, particular metrics provide useful insight

into the provision of orthodontic care. According to gender, there is a level of sexual dimorphism in craniofacial parameters related to malocclusions.³⁸⁻⁴⁰ Males with Class III characteristics present with significantly different dimensions in the maxilla, mandible and anterior facial heights when compared with females.³⁸ The age of the patient has important physical and psychological implications. Children and adolescents are most sensitive to a variety of social impacts such as acceptance and appearance, which affects their psychological development, social skills and possibly their education and life choices.^{41,42} Adult patients are self-motivated, more compliant, have the financial means to explore various treatments and place a higher emphasis on aesthetics and/or require comprehensive rehabilitation.⁴³⁻⁴⁶ However, adults respond differently to treatment due to limitations in growth and physiological changes in maturing tissues. SES of patients and the attainment of private health insurance (~55% of Australians) may impact on the affordability and acceptance of treatment plans.⁴⁷⁻⁴⁹ Patients may accept limitations in which cost, recovery or aesthetics during treatment may be a factor. In addition, patients are often reluctant and apprehensive to undergo orthognathic surgery for severe skeletal malocclusions. It is important for the orthodontic and oral/maxillofacial surgical profession to appreciate the demand for surgery as it impacts on scheduling and the emphasis of professional development. In other areas, there is limited data assessing referral patterns to orthodontic practices in Australia. Early interceptive or first phase treatment to address factors impeding arch development and jaw growth has been applied differentially by orthodontists.^{50,51} There are reported differences between jurisdiction and orthodontists' experience but these aspects have not been explored in the Australian setting.^{52,53} These typify relevant clinical considerations that can assist in assessing and appreciating the demand for orthodontic care and the types of patients seeking treatment.

The purpose of the present study is to describe patient and treatment characteristics in West Australian private orthodontic practices.

Methods

Ethics approval for the study was obtained from the Human Research Ethics Committee from The University of Western Australia.

The present quantitative study consisted of a retrospective cross-sectional analysis of private practice records from orthodontic practices throughout Western Australia. An invitation letter detailing the aim, method and contact details of the involved researchers was sent to a random sample of private practices throughout Western Australia. This was followed by email or phone contact seeking permission to access clinical records of the 100 most recent patients attending each practice.

A designated researcher visited each practice to view clinical records (treatment notes and management plan, radiographs, letters and photographs) and collected pertinent data relating to patient and treatment characteristics. Data included:

- Age, postcode, date of birth, ethnicity and gender of each patient
- The presence of private health insurance
- Presenting complaint and referral source
- The type of dental malocclusion and the degree of irregularity
- Multidisciplinary treatment with other specialists/dentists inclusive of orthognathic surgery or surgical exposure
- Whether early or first phase treatment was performed
- Type of removable or fixed appliance
- Extraction or non-extraction orthodontics

Other than being examined and having a treatment plan, no other exclusion criteria were considered. Patients of all ages and treatment modalities inclusive of interceptive, two phase, orthognathic, surveillance and no treatment were included in the clinical sample. A sample of 3,200 patients were therefore collected from the orthodontic practices in Western Australia. Specifically, 22 out of 26 practices agreed to partake in the study, representing a response rate of 84%. These practices were visited during the period 2015–2017

for data collection. The sample included patients from metropolitan, rural, interstate or overseas regions either for the continuation of treatment or a single repair/adjustment visit. Data were de-identified and numerically coded into a secured computer, which was kept in the Department of Orthodontics for the duration of the study. Each variable considered was recorded as indicated in the clinical notes without limiting each response. For example, it was not uncommon for a patient to have multiple presenting complaints that were recorded during data collation. Access to the data was restricted to the research team.

The data were managed under Microsoft Excel 2013 (Microsoft Corp, WA, USA) applying simple statistics using IBM SPSS version 23. Pearson's chi-square test was considered for some relationships with the level of significance set at 5% ($p < 0.05$).

Results

Patient characteristics

Data were available for 3,200 patients and a summary of their personal details is outlined in Table I. The majority of patients were female, Caucasian, adolescent and had private health insurance. Few Indigenous Australians received orthodontic treatment. As shown in Figure 1, the majority of treatment was skewed towards the pre-adolescent and adolescent age group. However, adults comprised almost a third of the patients who presented.

As demonstrated in Figure 2, the most common presenting complaint from patients was crowding (37.6%), followed by a desire for improved aesthetics (21.3%) and obvious spacing (3.6%). Approximately a third (31.4%) of patients did not have a specific complaint noted in their clinical documentation. This may be related to recommendations made by the treating clinician to seek orthodontic care either as part of general dentistry or when it was considered that orthodontic consultation/intervention may be

Table I. Patient demographic characteristics. Outlining age, insurance and ethnicity of patients presenting for treatment.

Age	Minimum 4	Median 14	Maximum 73	Average 18	>18 Years 913 (28.5%)	<= 18 Years 2287 (71.5%)			
Private health Insurance	Yes 75.6%	No 24.4%							
Ethnicity	Caucasian 72.4%	Asian 11.5%	Indian 5.9%	Mediterranean 7.5%	Middle Eastern 1.1%	African 0.7%	Aboriginal 0.3%	Spanish 0.5%	

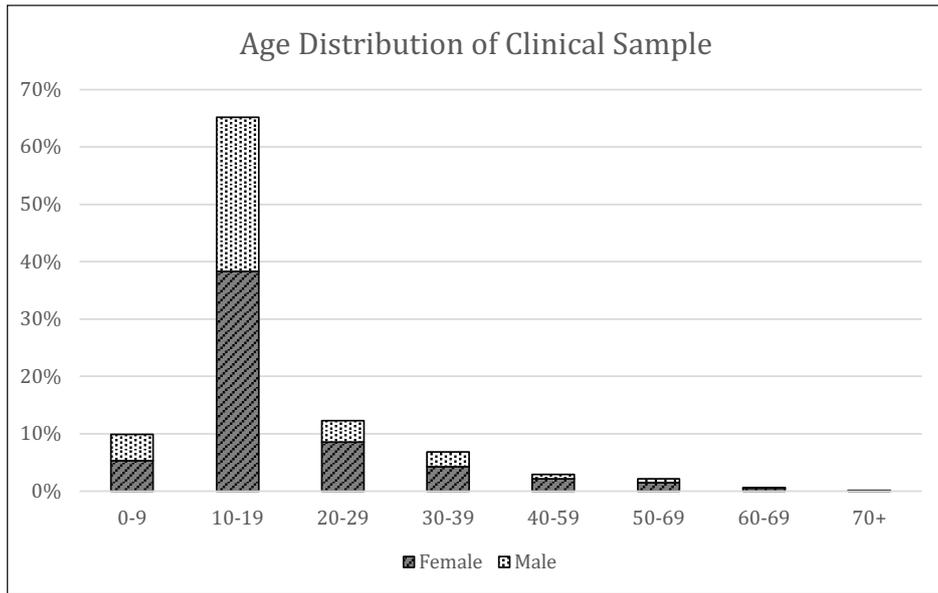


Figure 1. Age distribution showing the proportion of each gender within an arbitrary selected age range.

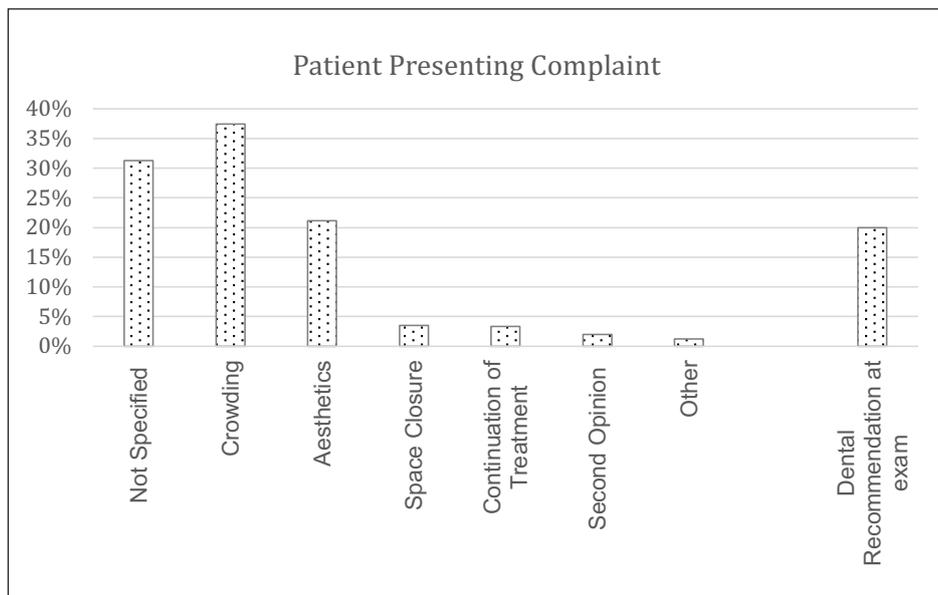


Figure 2. Tally of patient complaint(s), which also considers more than one complaint from a particular patient if indicated in their clinical records. *Dental recommendation at exam* relates to referrals to orthodontists when a malocclusion was identified by the examining clinician.

warranted. This was most obvious in the publically funded School Dental Service, in which approximately half of the referrals were made without a specific complaint from the patient. A continuation of cases represented about 5% of patient complaints and, where documentation allowed such a determination, approximately two-thirds of continuation cases were due to locality (interstate/overseas/convenience) and the remainder represented patients seeking further treatment due to relapse. Approximately 18% of

adult patients had a course of previous orthodontic treatment. Other complaints not specifically categorised in the table included difficulty with oral hygiene, airway related issues and function.

Clinician referral characteristics

As expected, a majority of orthodontic referrals were made by general dentists (42.5%). However, approximately 31% of patients (including walk-in)

presented to the orthodontist without a referral or having been seen by a dental clinician. Of these, less than 1% of requests were inappropriate or outside the scope of orthodontic treatment.

As shown in Figure 3, the most common reason for referral was crowding (44%), a Class II malocclusion (30%), a malocclusion specifically relating to an increased overjet (17%) and cross-bite (14%). Approximately 8% requested an orthodontic consultation without a specific reason. Many referrals had more than one specific complaint.

Characteristics of presenting malocclusions

Summaries of the occlusal characteristics of the sample are shown in Tables II and III. An Angle Class II Division 1 malocclusion was most frequently observed. At presentation, 26.8% of patients had one or more missing teeth. The most common were third molars (23%) followed by the second premolar (4.2%), lateral incisors (3.9%) and the first premolar (3.2%). This includes teeth lost through previous dental history either through prophylactic removal of wisdom teeth, caries, hopeless prognosis or earlier orthodontic treatment. Supernumerary teeth were present in 2.2% of patients.

The most commonly impacted teeth were the third molars (42.4%) followed by the canines (8.2%) and the second premolars 4.5%. The proportion of impacted mandibular third molars was significantly higher than impacted maxillary third molars ($p < 0.05$). The prevalence of maxillary canine impaction (7.5%) was significantly higher than lower canine (0.6%) impaction ($p < 0.05$).

Other discrepancies involved cross-bites, which were present in 31.5% of the sample, with anterior cross-bite the most common. Approximately 4% of patients exhibited a combination of cross-bites. Open bite malocclusions were seen in 6.5% of the sample, with an anterior open bite the most frequent. Mild to moderate crowding in both the maxilla and mandible represented over two-thirds of presenting patients. When crowding was considered with spacing, approximately 85% of presenting patients had an arch length discrepancy.

A skeletal component associated with the presenting malocclusion based on lateral cephalometric radiographs was randomly analysed in half the sample population. A normal relationship was observed in 35% of cases whilst a retrognathic mandible was identified in 49% of cases but fewer prognathic mandibles at 8%. Therefore, a high proportion of

Table II. Summary of orthodontic discrepancies and patient characteristics by gender.

		Gender					
		Females		Males		Total	
		N	%	N	%	N	%
Patient factors	Number and dental maturity	1873	58.5%	1327		3200	41.5%
	Habits	72	2.3%	54	1.7%	126	4.0%
Sagittal	Class I	701	21.9%	495	15.5%	1196	37.4%
	Class II division 1	808	25.3%	549	17.2%	1357	42.4%
	Class II division 2	253	7.9%	172	5.4%	425	13.3%
	Class III	111	3.5%	111	3.5%	222	6.9%
	Overjet	998	31.4%	737	23.2%	1735	54.6%
Vertical	Presence overbite	1270	39.9%	957	30.1%	2227	70.0%
	Presence open bite	137	4.3%	68	2.1%	205	6.4%
Transverse	Crossbite	532	16.6%	475	14.8%	1007	31.5%
	Maxillary midline discrepancy	419	13.1%	341	10.7%	760	23.8%
	Mandibular midline discrepancy	857	26.8%	611	19.1%	1468	45.9%
Arch length discrepancy	Maxilla	1622	50.7%	1156	36.1%	2778	86.8%
	Mandible	1605	50.2%	1125	35.2%	2730	85.3%

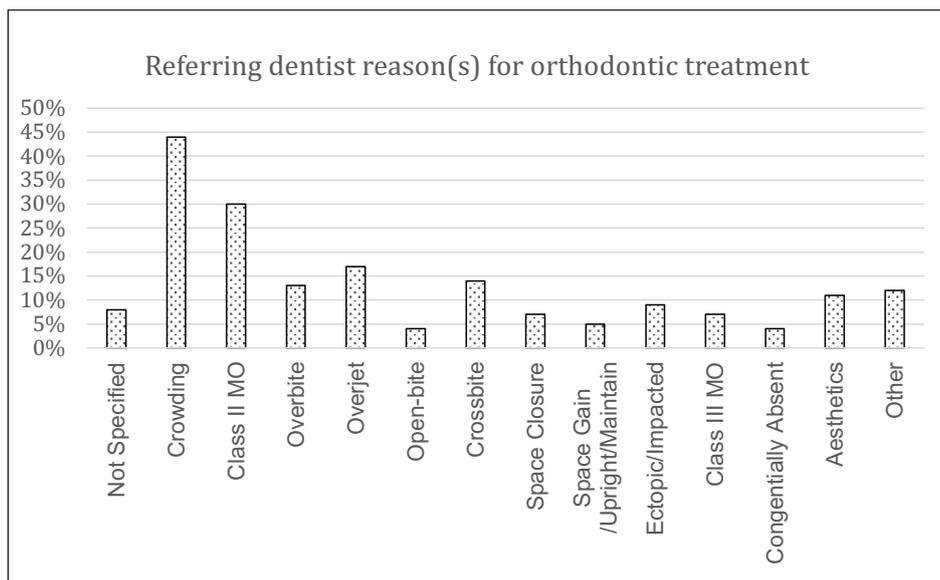


Figure 3. Summation of clinical reasons for referring to orthodontist. This figure included multiple reasons when evident on the clinical records/referring letter if applicable for a particular patient. *Not specified* related to referrals to orthodontists with the request to address the patient's orthodontic needs without exact specification of the condition(s).

presenting patients exhibited a skeletal discrepancy associated with their malocclusion.

Treatment characteristics

Approximately 56% of the patients received first phase orthodontic treatment with no significant differences in the proportion of patients between the classes of malocclusion. An upper removable appliance (URA) was commonly prescribed for patients with an anterior cross-bite (7%). Patients exhibiting a posterior cross-bite, either unilaterally or bilaterally, commonly received an expansion appliance. A rapid maxillary expansion device (RME) (36%) was favoured more often than slow maxillary expansion using a Quad Helix appliance (5%) or a slow expansion plate (7.4%). An anti-habit device was recommended in 6.3% of cases in which patients exhibited an open bite.

Functional appliances were prescribed in 8.8% of the adolescent population. These devices featured most commonly for the treatment of Class II Division 1 malocclusions (13.3%) when a Bionator (4.3%), Herbst (3.8%) or a Twin Block (3.7%) appliance were generally prescribed. Headgear was prescribed in 2.1% of cases. For Class II Division 2 malocclusions, functional appliances were considered in 3.6% of cases, during which the Herbst appliance (2%) was

the most recommended and headgear accounted for 0.6% of cases. A two-stage approach in treating Class II malocclusions was not considered a priority. A reverse headgear/facemask was used in 13.5% of Class III malocclusions. Only two cases of chin-cup therapy were noted during the study (<0.06%).

Fixed appliances were the most common device used in orthodontic practice, accounting for 94% of patients. This figure included patients waiting for further development with a view to fixed appliances. Full fixed appliances were the most common, accounting for 85% of cases with 10.5% of cases being single arch. Clear Aligner (eg. Invisalign - Align Technology, Inc., CA, USA) accounted for approximately 4% of cases. Of note, the cohort of patients receiving this form of treatment were generally adult females of average age 33 years (age range 17–69, median age 30, 79% female). Incognito[®] (3M Oral Care, CA, USA) fixed lingual appliances accounted for 0.5% of cases.

If wisdom teeth were disregarded, the majority of treatment plans involved non-extraction orthodontics (61.6%). This figure included modified treatment plans in which patients declined the extraction of teeth. Approximately 3% of patients required surgical exposure of unerupted teeth, with the most common being impacted/unerupted maxillary canines. The majority of these teeth were surgically exposed by oral surgeons (79%), with periodontists accounting

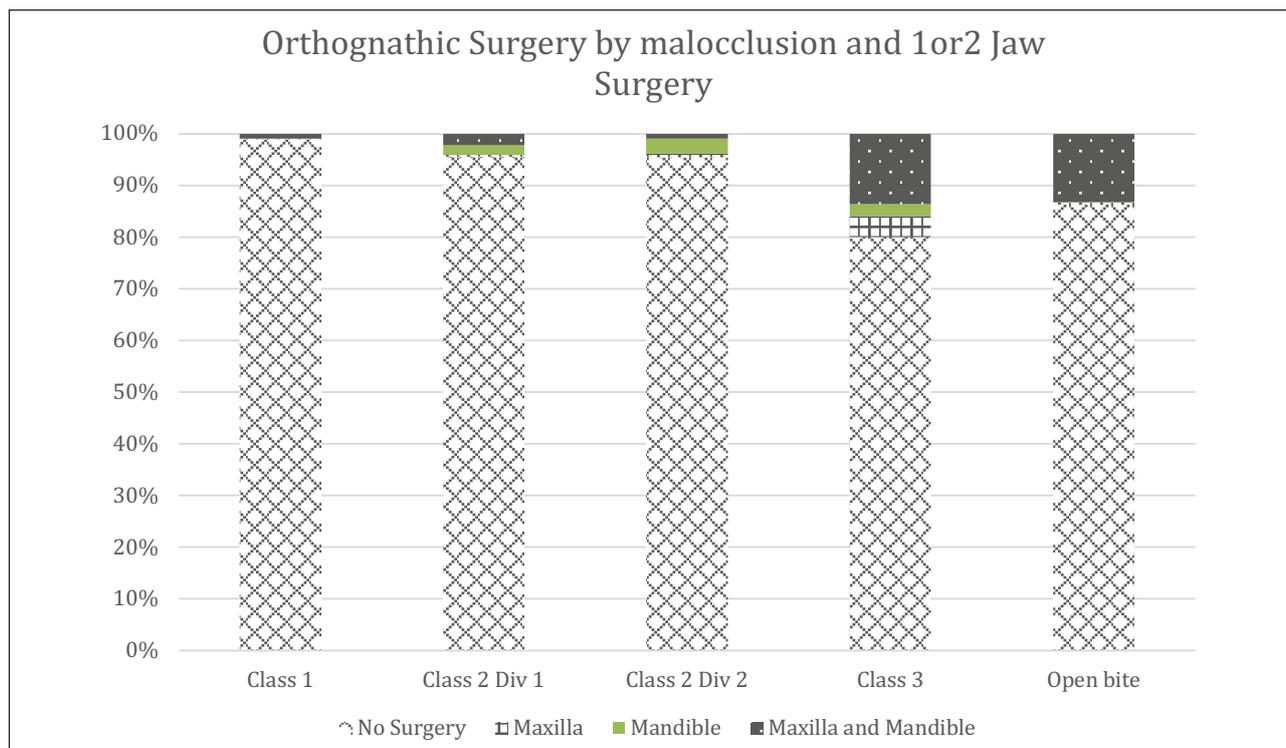


Figure 4. Summation of surgical and non-surgical cases in clinical sample. It is important to appreciate that there were instances where surgery was recommended but patients had opted for a non-surgical approach.

for 21% of cases. Surgically-assisted rapid maxillary expansion occurred in 4.2% of cases. Orthognathic surgery was most common in Class III malocclusions with 20.1% of this group undergoing surgery. In this cohort, two jaw surgery was the most frequent and accounted for 13.6%. In comparison, 4.3% of Class II Division 1 and 4.5% of Class II Division 2 patients received surgery. The majority of Class II Division 2 patients involved surgery in the mandible only (2.8%). For patients presenting with open bite malocclusions, 13.2% received surgery, with the majority of the procedures involving both jaws. Figure 4 depicts the type of jaw surgery by malocclusion. The present study demonstrated an acceptance rate of approximately 30% in which patients were willing to undergo orthognathic surgery as part of their planned orthodontic treatment. In the majority of instances, patients who declined surgery were willing to accept the limitations in outcomes.

Discussion

Nature of data

The present study investigated the socio-demographic, personal and orthodontic characteristics of patients

and their management modalities in private practices. All clinicians were based in Western Australia, which represented approximately 10% of registered specialist orthodontists in the country.⁵⁴ A qualitative analysis of clinical samples may be of greater relevance to orthodontic planning and practice compared with studies based on screening or surveys. For example, the reported prevalence of impacted maxillary canines in the present study was 7.5% and higher than previously reported figures of 1–2.5%.⁵⁵⁻⁶⁰ As data represented actual presentations, it may be a better indicator of orthodontic demand and professional workload. The present study applied no exclusion criteria and therefore represented the full range of treatments encountered in practice. Any observable differences between population-based investigations and clinical sampling may therefore be attributed to expectations regarding treatment or stated differently. What each patient observes as significant and whether they are willing to seek care becomes relevant. Clinical data also provides an insight into more elective procedures that cannot be fully quantified by population indices based on need.

It should be appreciated that data representing each patient's eventual course of management are influenced

Table III. Breakdown of orthodontic discrepancy by subtype.

Patient Factors	Dentition Type	Deciduous 0.1%	Mixed 33.5%	Permanent 66.4%		
	Habits	Thumbsucking 52.30%	Bruxism 13.50%	Tongue thrust 34.10%	Other 0.10%	
	Referred by	Nil (walk in) 31.1%	General dentist 42.5%	School dentist 18.7%	Dental specialist 7.6%	Medical colleague 0.1%
Sagittal	Overjet	Normal (2-3mm) 44.4%	Reduced 3.3%	Increased 48.0%	Edge to edge (0mm) 4.3%	
Vertical	Presence overbite	Normal (1-2mm) 29.0%	Reduced 14.0%	Increased 54.6%	Negative 2.4%	
	Presence open bite	Anterior 90.7%	Unilateral posterior 6.2%	Bilateral posterior 3.1%		
Transverse	Crossbite	Anterior 45.8%	Unilateral posterior 38.8%	Bilateral posterior 15.4%		
	Maxillary midline discrepancy	Midsagittal (<2mm) 76.2%	Right deviation 14.0%	Left deviation 9.8%		
	Mandibular midline discrepancy	Midsagittal (<2mm) 54.1%	Right deviation 26.1%	Left deviation 19.8%		
Arch length discrepancy	Maxilla	Normal 13.2%	Mild (1-3mm) 35.3%	Moderate (4-5mm) 29.7%	Severe (>6mm) 10.2%	Spacing 11.6%
	Mandible	Normal 14.7%	Mild (1-3mm) 43.5%	Moderate (4-5mm) 28.5%	Severe (>6mm) 7.0%	Spacing 6.3%

by their personal circumstances. In many instances, the ideal or preferred treatment plan may not have been adopted. This includes instances in which patients declined the extraction of teeth, orthognathic surgery or wearing unaesthetic appliances, or in which they opted for a less costly alternative. Data also included instances in which no treatment was performed when the decision was related to the patient's age or requests that were inappropriate and/or outside the scope of orthodontics.

Comparison of results with published literature

The present study was consistent with recent investigations reporting a higher proportion of females seeking orthodontic treatment.^{34-36,45} It was noteworthy that almost a third of patients seeking treatment in this sample were adults. However, given the cross-sectional nature of the data and the paucity of local research, the present study was unable to report whether there was an increase in the number of adults seeking care. Despite this, it was a significant observation that, in the adult population, 75% of

clear aligner cases consisted of females. This supports research suggesting that females place a greater emphasis on aesthetics,^{34,35,61} not only in their decision to proceed with treatment but also in choosing the mechanism to fulfil their expectations. Clinical data from this study provide an invaluable insight into existing research focused on long-term orthodontic outcomes.⁶²⁻⁶⁵

The utilisation of orthodontic services matches the main ethnic groups in Australia (Caucasian, Asian and Indian).⁶⁶ However, it was notable that Indigenous Australians did not feature proportionally within the demographic range. This is consistent with research identifying disparities in this group in accessing general dental care.⁶⁷⁻⁶⁹ As orthodontics is primarily referral based, it is unsurprising that this translated to lower presentations. During the present study, approximately 55% of the Australian population had private health insurance, with the vast majority having dental cover.^{48,70} A higher proportion of patients in the study had private health insurance (75%), which may reflect socio-economic privilege.

In certain occlusal metrics such as crowding,^{3,71} impacted upper canines,⁵⁵⁻⁶⁰ Angle Class II and III malocclusions,^{3,17,71} the reported values were higher than previous published research. However, this was not as consistently reported, as cross-bites,⁷²⁻⁷⁴ open bites^{3,75,76} and habits⁷⁷⁻⁷⁹ were within or less than reported frequencies. Although these metrics may be affected by the biased nature of the dataset, there were other confounding factors that were difficult to quantify. One factor was the registration method employed in the study. This was most evident in the lower frequencies of habits compared with other studies that were based in public screening clinics or large teaching institutions. When presented with an occlusion modified by a habit, the referring clinician may resort to conservative/watchful measures or the parent may not consider it necessary at that time to seek specialist referral. An additional important factor was the impact of self-assessment towards seeking treatment. It is well known that certain individuals perceive clinically milder issues to be of greater importance and will actively seek treatment. This is not uncommon as the present study reported that almost a third of patients were self-referred (walk-in) without having seen a primary clinician. This finding also provides confidence to the profession that the public is aware of the orthodontic profession and the types of services provided.

In severe malocclusions requiring multi-disciplinary care, it is curious that patients will often accept limitations. This was demonstrated in the low acceptance rate of patients willing to undergo orthognathic surgery. A proportion of patients were also willing to accept compromises in treatment in requesting non-extraction treatment plans. This provides an invaluable insight into the realities of orthodontic treatment and how each case is customised and personal.

Limitations

This dataset was skewed and consisted of patients with either a perceived or clinically diagnosed malocclusion who were willing to seek treatment in private practices. Therefore, it is not possible to accurately calculate the incidence or prevalence rates of malocclusion within the population. The accuracy of the study was also dependent on the clinical diagnosis and subsequent treatment plans offered by each orthodontist. It is well known that there are often different approaches

to treating various orthodontic problems.⁸⁰ Although this cannot be quantified, the present study assumed that all treatment modalities offered were clinically acceptable. As this was a retrospective study, only the eventual treatment approach was recorded and may not necessarily be the ideal or clinically-preferred approach. Consistent with general dental practice in Australia, the majority of clinicians practice within the jurisdiction in which they obtained their qualification.^{81,82} The majority of orthodontists in this study graduated in the state of Western Australia. Since the study occurred over a two-year period and for logistic reasons, the sampling date differed between practices. Data collection for a particular practice occurred when it was practical and feasible for the researchers.

Conclusion

By exploring clinical data relating to patient and treatment characteristics in West Australian private orthodontic practices, it was observed that the majority of patients were Caucasian, female, had private health insurance and were adolescent. Despite this, a large proportion of adults also sought treatment and presented with a main complaint of crowded teeth and the desire to improve aesthetics. These expectations have often resulted in patients actively seeking orthodontic treatment without a prior referral. Although most patients were prescribed fixed appliances, other forms of treatment to address their concerns were not uncommon in particular demographic groups. The use of clear aligners in the female adult population was common but the eventual course of treatment was often determined by the patient's preferences and tolerances as much as the clinical assessment and recommendation. This was demonstrated by the low acceptance rate of orthognathic surgery in extreme skeletal discrepancies. The present study provided an invaluable insight into the realities of private orthodontic practice and the types of problems encountered.

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Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this article.

Corresponding author

Mithran S. Goonewardene
 BDS, MMedSc, CertOrth
 Program Director, Orthodontics
 School of Dentistry
 The University of Western Australia
 17 Monash Avenue, Nedlands WA 6009
 Email: mithran.goonewardene@uwa.edu.au

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