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Orthodontic Treatment Eligibility among New Patients Referred to National Dental Centre, Brunei Darussalam

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Authors' contributions

This work was carried out in collaboration among all authors. Author TT designed the study, wrote the protocol, performed the statistical analyses and authored the preliminary draft of the manuscript. Author UKU was involved in acquiring data, conceptual design of the manuscript and critical revision of the intellectual content of the manuscript. Author JSD assisted in the write-up and revision of the manuscript. Author HAR assisted the statistical analyses. All authors read and approved the final manuscript.

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ABSTRACT

Aims: To evaluate orthodontic treatment eligibility and appropriateness of new orthodontic referrals made by the general dental practitioners (GDPs) to the Specialist Orthodontic Unit, National Dental Centre (NDC) for orthodontic assessment from government dental clinics in Brunei-Muara district using Index of Orthodontic Treatment Need (IOTN) as an objective measure.
Material and Methods: Patients' data were collected from Brunei Health Information Management Systems (Bru-HIMS) for one-year period from 1st January 2018 to 31st December 2018. From this patient pool, a total of 147 patients who underwent orthodontic assessment were identified. The data collected were imported to RStudio to perform appropriate statistical analyses.
Results: Of 147 new patient referrals, 72.1% were female and 27.9% were male, with a mean age of 18.3 years (SD ± 5.8 years). Patients with age range of 9 to 39 years were evaluated. A total of

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87.8% of new patient referrals were eligible under IOTN. The predominant incisor relationship referred was class II division 1 (33.3%) and the prevalence of class III was high at 30.6%. The most common malocclusion trait referred was a severe dental contact point displacements >4 mm, grade 4d (53.1%).

Conclusion: A total of 87.8% of new patient referrals were deemed eligible by specialist orthodontists utilizing IOTN. A total of 83.7% of new patient referrals were in a definite need for orthodontic treatment. It is highly recommended for general dental practitioners to have training in utilizing IOTN and necessitate establishment of proper referral guidelines.

Keywords: Malocclusion; orthodontic treatment eligibility; waiting list; index of orthodontic treatment need; general dental practitioner.

1. INTRODUCTION

Malocclusion is neither a life-threatening condition, nor a pathologic entity; but rather, a deviation from normal development of the jaws and/or teeth [1]. A good proportion of these deviations however, are within range of what can be considered normal biologic variation. Nevertheless, some deviations may have a negative influence on dentoskeletal development, thus contributing to impaired orofacial aesthetics and function [2]. Apart from physical consequences, malocclusion could have a negative effect on the patients' psychological well-being, self-esteem and quality of life. People therefore, seek and value orthodontic treatment primarily as a way to overcome or minimize this social handicap. The strongest motivation to undergo orthodontic treatment appears to be the urge to conform to existing social norms for aesthetics. Orthodontic treatment places significant strain on dental health care resources especially within services that are subsidized by governments.

In Brunei Darussalam, there is an ever-increasing demand for orthodontic treatment within the Dental Services, as it is government-funded and subsidized. Against this backdrop, it is therefore crucial to evaluate orthodontic treatment eligibility in order to prioritize the limited resources and improve effectiveness of the service. For practical purposes, the dental services in Brunei have adopted Index of Orthodontic Treatment Need (IOTN) guidelines in 2010 in an attempt to evaluate orthodontic treatment eligibility objectively. These guidelines were first developed in the United Kingdom by Brook and Shaw (1989) and has two components; dental health component (DHC) and aesthetic component (AC) [3]. Orthodontic treatment need is primarily determined by the general dental practitioners (GDPs). When a patient at a primary dental clinic requests to have orthodontic treatment for his/her perceived malocclusion; the GDP, in his/her role as a gatekeeper to access to specialist dental care will evaluate two factors: first, general oral health and status; and secondly, eligibility for orthodontic treatment. The second factor plays a major role in determining the patient's referral in order to get registered on to the centrally maintained orthodontic waiting list. The GDPs often use the IOTN grading as an objective measure for evaluating orthodontic treatment eligibility. Every referred patient should be graded based on the DHC scale and AC (if required).

DHC measures a number of malocclusion traits which are missing teeth, incisor overjet, incisor overbite, cross bites and displacement of the contact points. The DHC is categorized into 5 grades ranging from 'none' to 'definite need for orthodontic treatment' based on the malocclusion traits assessed. Grade 1 indicates no orthodontic treatment need; grade 2 indicates a little need of orthodontic treatment; grade 3 presents a borderline need for orthodontic treatment; lastly, grades 4 and 5 strongly imply a need for orthodontic treatment [3]. For instance, a patient having no missing teeth but presenting with reverse overjet of -4 mm; complaining of functional difficulties such as mastication and verbal communication, is categorized as grade 5 m. Obviously, this individual would suffer from a decreased Oral Health-Related Quality of Life (OHRQoL) [4]. Individuals categorized as DHC grade 3 will have to additionally have the AC applied in order to determine orthodontic treatment eligibility. Hence, AC measures the aesthetic defect as expressed by the malocclusion which can have a potential adverse impact on the patient psychologically [5,6]. AC has 10 scores which range from most aesthetically pleasing scored as 1 to least aesthetically pleasing scored as 10. To classify these scores according to orthodontic treatment need; scores 1 and 2 indicate no orthodontic treatment need; scores 3 and 4 indicate little

need for orthodontic treatment; scores 5, 6 and 7 indicate moderate need for orthodontic treatment; scores 8, 9 and 10 strongly imply a definite need for orthodontic treatment [6]. Therefore, only patients with a DHC grade 4 or 5, and those patients with a DHC grade 3 with an accompanying AC score 6 and above are deemed eligible for orthodontic treatment [7].

In primary dental clinics, GDPs utilize these guidelines to help identify patients who would benefit from orthodontic treatment and then, make appropriate referrals to the Specialist Orthodontic Unit. Within the Specialist Orthodontic Unit, the same benchmarks are applied for screening of all referrals from government dental clinics to filter new patients who are not eligible for undertaking orthodontic treatment. This serves to shorten waiting times for commencing treatment of new eligible patients and making the best use of limited orthodontic resources.

Currently, there is no published study evaluating eligibility of orthodontic referrals in Brunei-Muara district in Brunei Darussalam. Hence, the primary aim of this study was to evaluate orthodontic treatment eligibility and appropriateness of new orthodontic referrals made by the GDPs to the Specialist Orthodontic Unit, National Dental Centre (NDC) for orthodontic assessment from government dental clinics in Brunei-Muara district using IOTN as an objective measure. This study was designed to provide baseline data and to achieve the following additional objectives:

- To identify the prevalence of IOTN DHC malocclusion traits and British Standard Institute (BSI) [8] of incisor classification among new patient referrals
- To compare the prevalence of the IOTN, BSI of incisor classification, and orthodontic treatment eligibility with demographic factors

2. MATERIALS AND METHODS

This was a retrospective study of patients referred from government dental clinics in Brunei-Muara district to Specialist Orthodontic Unit, NDC for orthodontic assessment. The data of consecutively referred patients from 1st January 2018 to 31st December 2018 were accessed and pertinent patient details were extracted from Brunei Hospital Management System (Bru-HIMS).

The eligibility criteria of this study included all patients of both genders referred for fixed appliances treatment to the Specialist Orthodontic Unit, NDC within the stipulated time period in Brunei-Muara district. The study excluded patients who had undertaken orthodontic treatment in the past, patients with craniofacial anomalies, and patients presenting with general and/or systemic conditions which precluded orthodontic treatment.

A gatekeeper i.e. clinical supervisor helped identify eligible patients by searching through a centrally maintained prospective register for orthodontic referrals. Once access was granted, a self-designed data collection sheet was used to collect required data by accessing pertinent patient de-identified information utilizing the orthodontic referral register and Bru-HIMS. All data was collected by the primary investigator. The following information was recorded for all eligible consecutive new patients attending orthodontic assessment from 1st January 2018 to 31st December 2018:

- Gender;
- Age;
- Source of referral;
- Length of time since referral;
- BSI incisor classification [8];
- IOTN (DHC);
- IOTN (AC) [only if DHC grade 3 and below]; and,
- Eligibility for orthodontic treatment.

A total of 150 patients referred to Specialist Orthodontic Unit, NDC within stipulated time period. Only 147 patients underwent orthodontic assessment as the other 3 patients did not attend the assessment.

3. DATA ANALYSIS

All statistical analyses were carried out using RStudio Version 1.2.5019 software. Descriptive statistics were used to describe numerical data (mean and standard deviation) and categorical data (prevalence and percentage). Hypothesis test was also done to determine the relationship with the variable of interest and *P* value less than .05 ($P < .05$) was considered statistically different. Data cleansing was performed prior to commencing the actual analyses. This was aimed at minimizing inaccuracies by eliminating incomplete sets of data.

4. RESULTS

Table 1 demonstrates that, in total, 147 patients were assessed; 72.1% were female and only 27.9% of them were male, with the majority (82.3%) being of Malay ethnicity. The age of the study population ranged from 9 to 39 years, with more than half being less than 20 years old which constituted the greater proportion of referrals. Hence, the mean age of the study population was 18.3 years (SD ± 5.8 years).

The mean waiting time since referral was 71 days (10 weeks 1 day). Table 2 summarizes the number of referrals from 3 primary sources of referrals viz.; GDPs, Specialists (other than orthodontists) and Royal Brunei Armed Forces (RBAF) dental services; and malocclusion traits for the period from 1st January 2018 to 31st December 2018. Most of the patients (68.7%) referred to the Specialist Orthodontic Unit, NDC were referred by GDPs in peripheral clinics and NDC, followed by 21.8% referrals from specialists and 9.5% from RBAF. Of 147 referrals, 83.7% patients were in a definite need for orthodontic treatment (DHC grade 4 and 5) and there were two cases where IOTN grading was not applicable and stated just as spacing in lower jaw or upper jaw (Spacing is not represented on the IOTN scale). Furthermore, Table 3 shows further breakdown of the referrals pattern by each month in 2018. The highest referral in 2018 was in January (12.9%), whereas, the lowest referral was recorded in May (5.4%).

Fig. 1 presents the distribution of IOTN DHC grades among new patients referred to Specialist Orthodontic Unit, NDC in 2018. Out of 147 referrals, the highest recorded malocclusion diagnosed was 'severe dental contact point displacements >4 mm, grade 4d (53.1%). This was followed by dental overjet >6 mm but ≤9 mm, grade 4a (12.9%) and dental contact point displacements >2 mm but ≤4 mm, grade 3d (7.5%). Of referrals falling in the grade 3 category, 47.6% had to be assessed with the additional aesthetic component (AC) to confirm eligibility for orthodontic treatment.

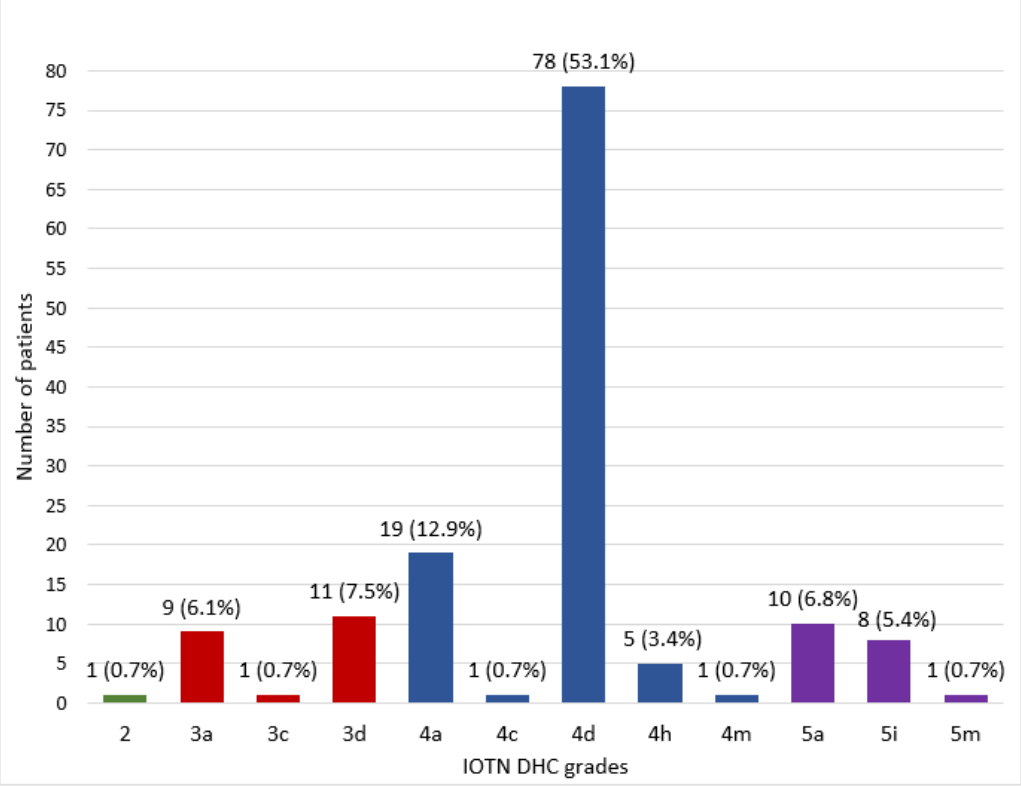

Fig. 1. Distribution of IOTN DHC grades among new patients referred to Specialist Orthodontic Unit, NDC in 2018

[n = 145 (2 cases were excluded in this Fig. 1 as it is not part of IOTN)]

Table 1. Sociodemographic characteristic of patients

Sociodemographic characteristics	n	(%)
Gender		
Male	41	(27.9)
Female	106	(72.1)
Age in categories		
<20	97	(66.0)
≥20	50	(34.0)
Ethnicity		
Malay	121	(82.3)
Chinese	26	(17.7)

n = Frequency; % = Percentage

Table 2. Referral pattern to NDC

Period	Total referrals n (%)	Source of referral n (%)			Malocclusion trait				
					IOTN grades n (%)				Spacing n (%)
		GDP	Specialist	RBAF	2	3	4	5	
01/01/18-31/12/18	147 (100)	101(68.7)	32 (21.8)	14 (9.5)	1 (0.7)	21(14.3)	104(70.7)	19(12.9)	2 (1.4)

n = Frequency; % = Percentage; GDP = General dental practitioner; Specialist = Specialist other than orthodontist; RBAF = Royal Brunei Armed Forces dental services

Table 3. Referral pattern to NDC by month

Period	Source of referral n (%)			Malocclusion trait				
				IOTN grades n (%)				Spacing n (%)
	GDP	Specialist	RBAF	2	3	4	5	
January	13 (8.8)	5 (3.4)	1 (0.7)	0	2 (1.4)	14 (9.5)	3 (2.0)	0
February	2 (1.4)	7 (4.8)	0	0	2 (1.4)	6 (4.1)	1 (0.7)	0
March	15 (10.2)	0	0	1 (0.7)	1 (0.7)	9 (6.1)	4 (2.7)	0
April	8 (5.4)	1 (0.7)	1 (0.7)	0	1 (0.7)	9 (6.1)	0	0
May	7 (4.8)	1 (0.7)	0	0	1 (0.7)	5 (3.4)	1 (0.7)	1 (0.7)
June	8 (5.4)	1 (0.7)	1 (0.7)	0	1 (0.7)	8 (5.4)	1 (0.7)	0
July	5 (3.4)	1 (0.7)	4 (2.7)	0	1 (0.7)	7 (4.8)	2 (1.4)	0
August	8 (5.4)	6 (4.1)	2 (1.4)	0	5 (3.4)	9 (6.1)	1 (0.7)	1 (0.7)
September	11 (7.5)	1 (0.7)	2 (1.4)	0	4 (2.7)	10 (6.8)	0	0
October	9 (6.1)	2 (1.4)	2 (1.4)	0	1 (0.6)	10 (6.8)	2 (1.4)	0
November	7 (4.8)	5 (3.4)	1 (0.7)	0	2 (1.4)	8 (5.4)	3 (2.0)	0
December	8 (5.4)	2 (1.3)	0	0	0	9 (6.1)	1 (0.7)	0

n = Frequency; % = Percentage; IOTN = Index of Orthodontic Treatment Need; GDP = General dental practitioner: Specialist = Specialist other than orthodontist; RBAF = Royal Brunei Armed Forces dental services; Note: total percentages may not be 100 due to rounding

The distribution of new patient orthodontic referrals by incisor relationship is illustrated in Fig. 2. The most prevalent incisor relationship among new patient referrals was Class II division 1, comprising a total of 33.3%. This was followed by Class III (30.6%), followed by Class I (28.6%) as the third highest among those referred. The least frequently observed incisor relationship was Class II division 2 (7.5%).

Table 4 illustrates the association of sociodemographic factors towards several malocclusion traits and orthodontic treatment eligibility. Statistical test showed a significant association between age groups and IOTN. It was observed that subjects aged less than 20 years old were significantly higher than those more than 20 years old in IOTN DHC grades 2, 4 and 5 (P = .01). Furthermore, there was also significant association detected between age groups and eligibility. It was observed that subjects aged more than 20 years old (30.2%) were significantly lower as compared with those less than 20 years old (69.8%) (P = .01).

Table 4. Association of sociodemographic factors towards prevalence of IOTN DHC malocclusion traits, BSI of incisor classification, and orthodontic treatment eligibility

Socio-demographic characteristics	IOTN grades				*P* value	BSI				*P* value	Eligibility		*P* value
	2 n = 1	3 n = 21	4 n = 104	5 n = 19		I n = 42	II division 1 n = 49	II division 2 n = 11	III n = 45		Eligible n = 129	Not eligible n = 18	
Gender													
Male	0.0%	4.8%	31.7%	36.8%	.06	26.2%	26.5%	36.4%	28.9%	.91	27.9%	27.8%	.99
Female	100.0%	95.2%	68.3%	63.2%		73.8%	73.5%	63.6%	71.1%		72.1%	72.2%	
Age in categories													
<20	100.0%	38.1%	69.2%	84.2%	.01	64.3%	71.4%	45.5%	66.7%	.43	69.8%	38.9%	.01
≥20	0.0%	61.9%	30.8%	15.8%		35.7%	28.6%	54.6%	33.3%		30.2%	61.1%	
Ethnicity													
Malay	0.0%	85.7%	79.8%	94.7%	.07	85.7%	81.6%	81.8%	80.0%	.92	83.0%	77.8%	.59
Others	100.0%	14.3%	20.2%	5.3%		14.3%	18.4%	18.2%	20.0%		17.0%	22.2%	

n = Frequency; % = Percentage; IOTN = Index of Orthodontic Treatment Need; BSI = British Standard Institute of incisor classification
Note: 2 cases excluded from IOTN due to inapplicable

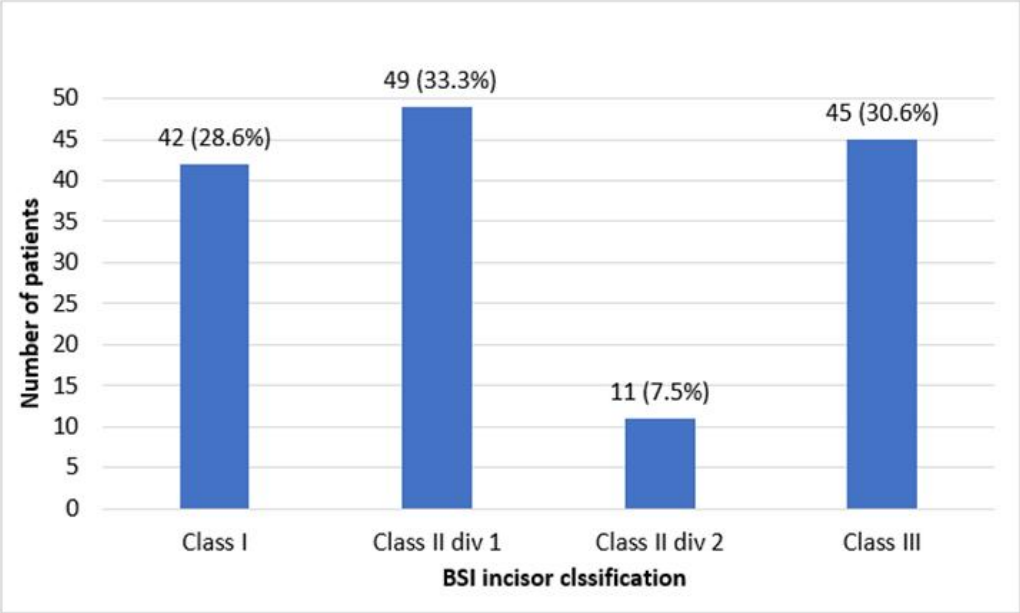

Fig. 2. Distribution of incisor relationship among new patients referred to Specialist Orthodontic Unit, NDC in 2018

Table 5. Orthodontic referrals outcome

Period	Total referrals n (%)	Eligibility		Patients placed on orthodontic waiting list for fixed appliances n (%)	Patients placed on re-assessment n (%)	Patients with treatment plan and/or discharged n (%)
		Eligible n (%)	Not eligible n (%)			
01/01/18-31/12/18	147 (100)	129 (87.8)	18 (12.2)	105 (71.4)	18 (12.2)	24 (16.4)

n = Frequency; % = Percentage

Table 4 illustrates the association of sociodemographic factors towards several malocclusion traits and orthodontic treatment eligibility. Statistical test showed a significant association between age groups and IOTN. It was observed that subjects aged less than 20 years old were significantly higher than those more than 20 years old in IOTN DHC grades 2, 4 and 5 (P = .01). Furthermore, there was also significant association detected between age groups and eligibility. It was observed that subjects aged more than 20 years old (30.2%) were significantly lower as compared with those less than 20 years old (69.8%) (P = .01).

Table 5 summarizes the outcome of the referrals, where out of 147 patients, 87.8% patients were deemed eligible for orthodontic treatment and the remaining 12.2% patients were not eligible as their dental status did not indicate need for orthodontic treatment. Of these eligible referrals, only 71.4% were accepted for orthodontic treatment and placed on the orthodontic waiting list; whereas 12.2% were appointed for reassessment; and the remaining 16.4% were referred back to the referring GDPs.

5. DISCUSSION

This study evaluated orthodontic treatment eligibility among new patients referred using IOTN as an objective measure. The use of IOTN is an impartial and effective method to evaluate new patient referrals. In this way, eligibility of the patients in need of treatment can be determined objectively. It helps in proper referrals to avoid unnecessary treatment [9]. As assessed using IOTN, a total of 147 new patient referrals to the Specialist Orthodontic Unit for fixed appliances were evaluated. From IOTN DHC grades

distribution in this study, it is apparent that most patients were in need of treatment. From collated data, the mean age of the patients was 18.3 years, which was higher than 11.6-14.8 years mean age range reported previously in similar studies [9,10]. This difference could be contributed by a large population in the age group 15-19 years than in 10-14 years age range in Brunei Darussalam [11].

Previous studies have reported that the demand for orthodontic treatment was significantly higher among females, and studies have revealed that females were more likely to be dissatisfied with the aesthetics of their dentition as compared to male [9,12]. The current study corroborates a similar trend with females being more predominant (72.1%) in seeking orthodontic treatment. The gender ratio among the general population in Brunei Darussalam was reported to be almost evenly balanced with males comprising 51.4% of the total population; thereby validating the fact that a pre-existing population by gender ratio bias was not a reason for this trend [11]. This could possibly be attributed to male and female patients having different expectations of outcomes from orthodontic treatment. That female patients perceive a greater need for orthodontic treatment in order to improve the appearance of their dentition and self-confidence; while fewer male patients seek orthodontic treatment to improve their social well-being has been pointed out in a previous study [13].

The most commonly observed incisor relationship in the referred sample was Class II division 1 (33.3%), although the prevalence of this malocclusion type in the present study was lower as compared with 38% to 40% reported in previous studies. However, the present study followed a similar trend, with a majority of Class II division 1 [10,14]. The increased incidence of this malocclusion type may be attributed to the associated negative social perception and the concern of patients and parents which could have contributed to patients' motivation to seek orthodontic treatment. This finding in the present study affirmed that the predominant antero-posterior relationship of the dental arches among new patient referrals in Brunei-Muara district was Class II division 1.

In this study, utilizing IOTN DHC grades, 83.7% of new patient referrals fell into category of definite need for orthodontic treatment (grade 4 and 5) on dental health grounds, which compared favourably to 55% among new patient referrals in the Ireland [10]. However, the prevalence of this category in the present study is lower than 88.3% reported from Malaysia in a recent study [15]. The reason for this low in this category may have been due to the longer wait to be taken off waiting list in government dental clinics in Brunei Darussalam; and that more private dental clinics have recently begun offering orthodontic treatment [16]. However, the present study only looked at only one of a number of aspects that determined treatment eligibility. It may therefore be pertinent to comprehend that the decision to provide fixed appliances is not solely based on the outcome of evaluation using indices of orthodontic treatment. Additional factors which contribute in decision making progress includes status of caries, oral hygiene, Basic Periodontal Examination (BPE) status and patient motivation for treatment.

Furthermore, the most prevalent malocclusion trait in the sample as evaluated by IOTN grading was DHC grade 4d category; with at least one region of crowding with 4mm contact point displacement or more was high at 53.1% and this far exceeded 16.5% and 18.1% as reported previously in Ireland and United Kingdom respectively [10,17]. The prevalence of DHC grade 3 category was 14.3% of the new patient referrals. Of this percentage, 47.6% patients had their AC scored. With a long waiting list in Brunei Darussalam and the need for effective prioritization of resources, AC should be used in the assessment of treatment eligibility of all subjects deemed in DHC grade 3 category. This in turn, results in lowering the need for orthodontic treatment. In the United Kingdom National Health Service, orthodontic treatment is restricted to patients having DHC grade 5, 4, and AC score 6 or more for grade 3 category [7]. With the minimum limit, AC score of 6 will reduce a sizeable number of referrals in the DHC grade 3 as they would not be eligible for orthodontic treatment under NHS. This may translate as shorter waiting times for assessment of new patients being taken of the waiting list in order to commence orthodontic treatment. However, this should be implemented strictly by the primary care provider viz. GDPs, which suggests that primary care dentists would benefit from further training in the proper use of AC photographs for making appropriate orthodontic referrals to orthodontists when evaluating new patient assessments.

There was a significant association between age groups and eligibility in this study (P = .01). It

was identified that most patients deemed eligible for orthodontic treatment were in the age category of less than 20 years old (69.8%). This could be attributed to adolescents with malocclusion being more vulnerable to being bullied than adults, which in turn may have led to more adolescents seeking orthodontic treatment. Thus, the adolescent population were predominant in the present study. A previously published study in the United Kingdom revealed that there was a significant association between malocclusion and bullying. It was also found that individuals with malocclusion are less likely to get bullied with increasing age [17]. These inferences are in line with the findings from the present study, indicating lower prevalence in adult patients seeking for orthodontic treatment.

Although significant number of referrals was appropriate, there were still a considerable proportion of referrals that were deemed ineligible for treatment in Brunei government orthodontic clinic and it accounted for 12.2% of the total referrals. This is suggestive of a possible shortcoming in the referral process. This may be due to the GDPs having limited knowledge and training on orthodontic treatment need assessment and consequently may benefit from specialist orthodontic training in techniques for proper assessment to determine treatment eligibility [18]. According to Fleming et al. [19] orthodontic referral instigated by parents came in second only after the dental practitioner. This may also suggest that, parental concern and pressure on GDPs may have influenced their decision to refer borderline cases to the specialists to avoid complaints.

This study provides baseline data for Brunei-Muara district only using IOTN as an objective measure to determine orthodontic treatment need in primary and secondary dental care settings. Further research is indicated to identify ideal methods for disseminating and enforcing orthodontic referral guidelines in order to promote appropriate utilization of the referral service. Meanwhile, in order to minimize the new patient referrals with no/little need of orthodontic treatment (or ineligible for treatment), it is recommended that referring GDPs and specialist orthodontists should work collaboratively. This could potentially result in shortened waiting times for new patients' assessment and commencing treatment of new eligible patients, thus, it should result in optimizing limited orthodontic resources and improving effectiveness of the service.

6. LIMITATIONS AND RECOMMENDATION

There were several limitations encountered during the study. Firstly, several patients' case notes had some missing information, hence had to be excluded from data analyses. Secondly, the findings in the present study were based solely on data of new patient referrals from government primary dental clinics in Brunei-Muara district to Specialist Orthodontic Unit, NDC. Other peripheral dental clinics from other districts and referrals from private dental practitioners were not included. Therefore, the findings presented cannot be generalized to be representative of the entire population of Brunei Darussalam. Lastly, there was an inconsistency in scoring AC for category of borderline need of orthodontic treatment (DHC grade 3) which again resulted in few cases with missing AC scores.

There is some recommendations put forth in order to improve this study. Firstly, the scope of this study could be broadened to include a larger sample that more accurately represents the populace at a national level by recruiting the sample from all four districts to their respective central referrals. Secondly, future studies could look at increasing the aggregate number of the sample by extending number of referral period by a few years to investigate upward or downward trends in the eligibility of new patient referrals. With more private clinics in Brunei Darussalam offering orthodontic services to the public; it may be interesting to learn future trends, so that resources may be planned adequately or redirected for better utilization.

7. CONCLUSION

This study attempted to evaluate the appropriateness of orthodontic treatment eligibility as ascertained by GDPs among new patient referrals to the orthodontist. A total of 87.8% of consecutive new patient referrals (in 2018) from GDPs were deemed eligible by specialist orthodontists utilizing the IOTN as an objective measure. Females tended to predominate when compared to males in this study by a ratio of 2.5. A total of 83.7% of new patient referrals were assessed as having definite need for orthodontic treatment. However, only 71.4% of new patient referrals were accepted and placed on the orthodontic waiting list. It is important to minimize the number of new patient referrals that are not eligible for treatment

under IOTN in order to enable more efficient utilization of resources especially when the services are subsidized. It is recommended that GDPs in peripheral clinics have mandatory training in IOTN assessment and periodic re-training to help with more efficient referrals. There is also the prospect that local guidelines could be formulated based on international criteria, so that resources may be directed towards those most in need of treatment.

CONSENT

As this was a retrospective study which did not involve any direct contact with patient, a clinical consent form was not required as there were no anticipated or identified risks (either physical or psychological) to any of the research participants and/or third parties.

ETHICAL APPROVAL

Permission to access Bru-HIMS and to collect data at NDC was granted by the Director of Dental Services, NDC, Brunei Darussalam. Ethical approval for this research was granted by joint ethics committee of Institute of Health Sciences Research and Ethics Committee and Medical and Health Research and Ethics Committee.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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