ORTHODONTIC TREATMENT NEED AND OUTCOME AT UNIVERSITY OF MALAYA

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Original Article

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ABSTRACT

The study aimed to assess patient satisfaction with their orthodontic treatment outcome and type of cases accepted for orthodontic treatment at the Faculty of Dentistry, University of Malaya (UM) and to audit the quality of treatment outcome. The standard set were 100% patient should be satisfied with their treatment outcome and less than 5% of the proportion of cases should fall in the "worse/no different' category with a mean reduction of Peer Assessment Rating (PAR) score being greater than 70%. Records of cases that had completed orthodontic treatment were traced. Survey forms were sent to 150 patients that had met the inclusion and exclusion criteria. Their intact study models were assessed for the Index of Orthodontic Treatment Need (IOTN) and PAR. 21.3% responded to the survey, of which 59.4% had treatment involving fixed appliances and 37.6% had either removable or functional appliances or retainers. 93.8% respondents were satisfied with their dental alignment and 87.5% with the overall treatment results. For the dental health component of the IOTN, 63.3% had 'definite need' and 21.1% had 'borderline need' for treatment. For the aesthetic component of the IOTN, 24.2% had 'definite need' and 32.0% had'borderline need' for treatment. For the PAR, 8.0% had an outcome of "worst/no different". The mean PAR reduction score was 75.3%. In conclusion, although majority were satisfied with their treatment results, there is still a need to improve on the standard of care to address the issues of the minority who were not satisfied with the treatment outcome.

Key words: Patient Satisfaction; Index of Orthodontic Treatment Need; Peer Assessment Rating.

INTRODUCTION

Orthodontics is a dental speciality that has recognized benefits of improving dental health, mastication and speech function as well as appearance and self esteem (1-3). However it does has potential risks and limitations such as enamel demineralization, caries, enamel trauma, enamel wear, pulpal reaction, root resorption, periodontal tissues reaction, allergic, burn and trauma to intra and also extra-oral tissues (1, 2, 4). It has also been reported that patients' occlusion may worsen if those with minor malocclusion receive orthodontic treatment (5). Therefore the decision to embark on an orthodontic treatment requires assessing its potential benefits against the potential risks. High standard of care should be given so that favourable outcome of treatment can be achieved. To ensure this, it is necessary to assess the outcome of performance including its improvement after the treatment (6).

Over the years, considerable effort has been put to develop standardized, valid and reliable measurement tools in orthodontics. Epidemiological and clinical orthodontic indices were created so as to standardize the assessment of orthodontic care (7). With the growing demand for orthodontic treatment, a variety of clinician-based indices have been developed to classify various types of malocclusion and determine their orthodontic treatment need. The most commonly employed malocclusion indices are the Dental Aesthetic Index (DAI), Index of Orthodontic Treatment Need (IOTN), Peer Assessment Rating (PAR) and Index of Complexity, Outcome and Need (ICON). Among these, the IOTN, DAI and ICON are used to assess the orthodontic treatment need while ICON and PAR are used to assess the treatment outcome.

The IOTN consists of two components; the Dental Health Component (DHC) and Aesthetic Component (AC). The DHC is a modification from the Swedish Dental Health Board Index to prioritise treatment based on functional dental and aesthetical grounds (8). It evaluates the malocclusion based on their characteristics such as missing teeth, overjet, crossbite, displacement and overbite and are scored based on a hierarchical scale between a scale of 1 with the least need for treatment up to a scale of 5 with very great need of treatment. The AC, which was developed in Cardiff (9) assesses the perceived aesthetics of the anterior teeth in occlusion by comparing it with a visual analogue scale of 10 pictures, with 1 with the least need for treatment up to a scale of 10 with definite need of treatment. The current IOTN have undergone minor modifications from the original publications for

improved consistency and reliability (10). The PAR was developed to assess the treatment outcome by providing a single summation of score for all the occlusal deviants to represent the severity of the malocclusion and the difference of the value pre-and post-treatment would reflect the degree of improvement of the treatment provided (11, 12). It consists of five components that assess the anterior segments, buccal occlusion, overjet, overbite and centreline.

As part of quality assurance, there is a need to continually assess the standard of orthodontic care within a practice. In view of this, this research was aimed to audit the orthodontic treatment need and outcome of orthodontic cases treated at Faculty of Dentistry, University of Malaya.

Standard

Cases at Faculty of Dentistry, University of Malaya were accepted based on their suitability for treatment in a teaching institution. Therefore, the standard for this audit to assess the treatment need levels of accepted cases, as scored by the IOTN, was not set. The audit assessed the treatment outcome based on the patient's perception and PAR. The standard set was:

1. 100% patient should be satisfied with their treatment outcome (13).
2. Less than 5% of the proportion of cases should fall in the "worse/no different' category with a mean reduction of Peer Assessment Rating (PAR) score being greater than 70% (10).

MATERIALS AND METHODS

Ethical approval was granted by the Medical Ethics Committee, Faculty of Dentistry. Records of patients who undertook orthodontic treatment at the Faculty of Dentistry, University of Malaya (UM) were traced and cases were selected based on the criteria as below:

a) **Inclusion criteria:** Patients who has completed the active treatment phase as noted in the records. These included the fixed, removable and functional appliances
b) **Exclusion criteria:** Syndromic cases; cases with no or incomplete sets of initial study models; and cases where the records had incomplete information such as there was no indication if the active phase of treatment had ended

Patients that had met the inclusion and exclusion criteria were contacted by phone call to confirm their address and were excluded if their address could not be confirmed. A questionnaire modified from Uslu and Akcam (2007) and consent form were sent to the selected patients. The questionnaire comprised of three parts, which inquired about the orthodontic treatment received by the patient; their opinion on the orthodontic treatment results; and their opinion on the psychosocial benefits from the treatment received (14).

The IOTN and PAR assessment were done on the study models of the selected patients after excluding broken or incomplete study models. Both were assessed using specially designed IOTN (DHC) and PAR rulers (University of Manchester). The AC of IOTN was also scored based on the ten-point visual scale (University of Manchester).

Calibration was conducted on 20 sets of study models that had been previously calibrated for the Index of Orthodontic Treatment Need (IOTN) and PAR assessment. Two examiners were calibrated for the IOTN and one examiner for the PAR index at a two weeks interval (T0: baseline and T1: two weeks later). For statistical purposes, the grades of the dental health component (DHC) and aesthetic component (AC) of the IOTN were categorized into grades that would reflect the treatment need as below:

i) DHC: Definite need (Grades 4 and 5); Borderline need (Grade 3); and No or slight need (Grades 1 and 2) for treatment
ii) AC: Definite need (Grades 8 to 10); Moderate or borderline need (Grades 5 to 7); and No or slight need (Grades 1 to 4) for treatment

Several assumptions had to be included when assessing the DHC. Unless stated in the case notes, for anterior or posterior crossbites, the amount of displacement was assumed to be the least severe that is 1mm or less discrepancy between retruded contact position and intercuspal position; and for reverse overjet, it was assumed that there was no masticatory or speech difficulties. These are clinical assessments that could not be determined using the study models alone.

On the other hand, the PAR index was categorised into grades that would reflect the treatment outcome, which are 'greatly improved', 'improved' and 'worsen/ no different' by plotting on the nomogram (Figure 1) (10). The percentages of agreement were used for inter- and intra-examiner reliability for the calibration of the IOTN whilst the Intra-class correlation coefficient of reliability was used for PAR.

Statistical package for the social sciences (SPSS) software version 12.0.1 for Windows was used for statistical analysis.

RESULTS

1107 case files of the 3712 known orthodontic patient registration numbers could be traced. Of these, 339 cases met the inclusion and exclusion criteria. These cases had been treated by the orthodontists, orthodontic postgraduate students and undergraduate students under direct supervision by an orthodontic lecturer. Only 150 of these patients (35.3% male and 64.7% female; 43.4% Malay, 41.3% Chinese and 15.3% Indian ethnicity) could be contacted to confirm their addresses to post the questionnaire (Table 1).

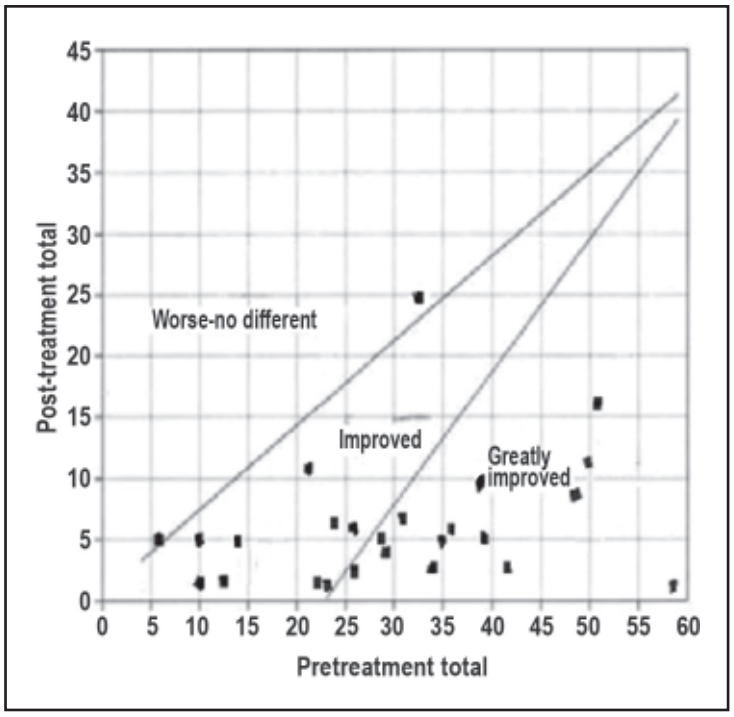

Figure 1. Nomogram of the plotted PAR scores.

Table 1. Demographic data of the subjects

Demographic Data		Questionnaire Sent (%) [n=150]	Questionnaire Received (%) [n=32]
Gender	Male	35.3	31.3
	Female	64.7	68.8
Ethic Group	Malay	43.4	28.1
	Chinese	41.3	53.1
	Indians	15.3	18.8

After excluding the broken or incomplete study casts, 128 pre-treatment casts could be assessed for IOTN and 25 complete sets of pre- and post-treatment casts could be assessed for PAR.

32 patients responded to the questionnaire (31.3% male and 68.8% female; 28.1% Malay, 53.1% Chinese and 18.8% Indian ethnicity) (Table 1). 59.4% had treatment involving fixed appliances (including 6.3% orthognathic surgery), while others had removable appliances (18.8%), functional appliances (9.4%), or retainers (9.4%). One respondent did not specify the type of treatment or appliance received. Less than a third requested treatment due to self motivation (28.1%) while 25% respondent were influenced by their parents and 12.5% by their friends or relatives. 30.3% was referred by their dentists or dental specialists. The most cited reason for preferring treatment at the faculty was due to the expensive rates at private clinics (40.6%). Majority sought treatment because they wanted to straighten their teeth (68.8%) followed by to improved their facial profile (18.8%). Majority was satisfied with their clinician and assistants during treatment (93.8%). About a third respondent informed that their friends or relatives reacted negatively to their appliances while the rest (68.8%) were not affected by the treatment. The most unfavourable condition during treatment was pain (37.5%), followed by the treatment duration (31.3%) and difficulty in speech (12.5%) (Table 2).

With regards to their opinion on their treatment results (Table 3), majority were satisfied with their dental alignment (93.8%), final facial appearance (93.8), final smile aesthetics (98.3%), general facial appearance (98.3%) and overall result of the orthodontic treatment (87.5%). However there were more patients who noted specific dissatisfaction (Questions 3 and 5 of Table 2) than those who were dissatisfied with the overall result and final facial appearance. Five patients (33.3%) thought that the arrangement of their teeth did not meet their expectations, four (26.7%) thought that there were changes to the arrangement of their teeth post treatment and one (6.7%) preferred the arrangement of his/her teeth prior to treatment. With regards to the specific dissatisfaction to their final facial appearance, three (30%) were not satisfied with the lip aesthetics, two (20%) with the appearance of the maxilla and one (10%) with their mandible. When asked to recall on conditions that may occur or improve as an effect from orthodontic treatment, there was an increase by two (6.3%) respondents for more pain or click to the temporomandibular joint (TMJ) region, three (9.3%) thought they may have more restriction in mouth opening, ten (31.3%) thought they had more caries or

Table 2. Part 1 of the Questionnaire – About the orthodontic treatment received by the patient

1. What type of treatment or appliance(s) did you have?							
	Removable appliance	Fixed appliance	Functional appliance	Orthognathic surgery	Retainer	No answer	Total
n	6	17	3	2	3	1	32
%	18.8	53.1	9.4	6.3	9.4	3.1	100

2. Who referred you or suggested you for orthodontic treatment?							
	Dentist	Dental specialist	Self	Parents	Friends/relatives	Others*	Total
n	7	3	9	8	4	1	32
%	21.9	8.4	28.1	25	12.5	3.1	100

**Dental student (1)*

3. Why did you prefer University Clinic (University of Malaya) for orthodontic treatment?							
	Official dispatch	Confidence	Expensive privates	Near	Long waiting list in government	Others*	Total
n	5	5	13	3	1	5	32
%	15.6	15.6	40.6	9.4	3.1	15.6	100

**Staff or students of the university (5)*

4. Which was the most important issue for you concerning orthodontic treatment?						
	Straighten teeth	Improve facial profile	Improve speech	Improve chewing	Others*	Total
n	22	6	1	2	1	32
%	68.8	18.8	3.1	6.3	3.1	100

**Lack of space for the teeth to erupt (1)*

5. Were you satisfied with your doctor and dental nurses?				
	Completely satisfied	Satisfied	Dissatisfied	Total
n	11	19	2	32
%	34.4	59.4	6.3	100

6. Did your friends or relatives react negatively or teased your treatment appliances?			
	Sometimes	No absolutely not	Total
n	10	22	32
%	31.3	68.8	100

7. Which was the most unfavourable condition for you during the orthodontic treatment?						
	Long duration	Difficulty in jaw control	Pain in teeth/jaws	Difficulty in speech	Others*	Total
n	10	3	13	4	1	31
%	32.3	9.7	41.9	12.9	0.03	100

** Appointment times not flexible (1)*

Table 3. Part 2 of the questionnaire – Patient's opinion on their orthodontic treatment results

1. Are you satisfied with the arrangement of your teeth after the treatment?					
	Completely satisfied	Satisfied	Dissatisfied	Completely dissatisfied	Total
n	6	24	2	0	32
%	18.8	75.0	6.3	0.0	100.0

2. How satisfied are you with the overall result of the orthodontic treatment?					
	Completely satisfied	Satisfied	Dissatisfied	Completely dissatisfied	Total
n	4	24	4	0	32
%	12.5	75.0	12.5	0.0	100.0

3. If you are dissatisfied, what is the reason?					
	Arrangement of teeth did not meet expectations arrangement	There have been changes to teeth after treatment	Arrangement of teeth was better before treatment	Did not use the appliance issued	Total
n	5	4	1	5	15
%	33.3	26.7	6.7	33.3	100.0

4. How satisfied are you with your final facial appearance?

	Completely satisfied	Satisfied	Dissatisfied	Completely dissatisfied	Total
n	7	23	2	0	32
%	21.9	71.9	6.4	0	100.0

5. If you are not satisfied with your final facial appearance, what is the reason?

	Prognathic mandible	Prognathic maxilla	Lip aesthetics not satisfactory	Others*	Total
n	1	2	3	2	8
%	12.5	25.0	37.5	25.0	100.0

** Nose not aligned (1); wrinkle lines around the mouth but unsure if that is related to the treatment (1);*

6. How satisfied are you with your final smile aesthetic?

	Completely satisfied	Satisfied	Dissatisfied	Completely dissatisfied	Total
n	9	21	2	0	32
%	28.1	65.6	6.3	0.0	100.0

7. How satisfied are you with your general facial appearance?

	Completely satisfied	Satisfied	Dissatisfied	Completely dissatisfied	Total
n	8	22	2	0	32
%	25.0	68.8	6.3	0.0	100.0

8. Did you have pain or click in your temporomandibular joint (TMJ) region (the jaw joint), before/after the orthodontic treatment?

		Yes, absolutely	Yes, I think so	No, I don't think so	No, absolutely not	Cannot remember	Total
Before	n	1	4	14	13	0	32
	%	3.1	12.5	43.8	40.6	0.0	100.0
After	n	3	4	11	12	2	32
	%	9.4	12.5	34.4	37.5	6.3	100.0

9. Did you have restriction during mouth opening, before/after the treatment?

		Yes, absolutely	Yes, I think so	No, I don't think so	No, absolutely not	Cannot remember	Total
Before	n	1	2	16	13	0	32
	%	3.1	6.3	50.0	40.6	0.0	100.0
After	n	1	5	14	12	0	32
	%	3.1	15.6	43.8	37.5	0.0	100.0

10. Did you have an increase in dental caries (tooth decay) and/or gum problems, before/after the treatment?

		Yes, absolutely	Yes, I think so	No, I don't think so	No, absolutely not	Cannot remember	Total
Before	n	1	1	21	9	0	32
	%	3.1	3.1	65.6	28.1	0.0	100.0
After	n	4	8	13	7	0	32
	%	12.5	25.0	40.6	21.9	0.0	100.0

11. Did you have white spots/discolouration on your teeth, before/after the treatment?

		Yes, absolutely	Yes, I think so	No, I don't think so	No, absolutely not	Cannot remember	Total
Before	n	0	0	21	8	3	32
	%	0.0	0.0	65.6	25.0	9.4	100.0
After	n	3	6	13	8	2	32
	%	9.4	18.8	40.6	25.0	6.3	100.0

12. Did you have a decrease in your speech quality, before/after the treatment?

		Yes, absolutely	Yes, I think so	No, I don't think so	No, absolutely not	Cannot remember	Total
Before	n	1	2	10	19	0	32
	%	3.1	6.3	31.3	59.4	0.0	100.0
After	n	0	3	9	20	0	32
	%	0.0	9.4	28.1	62.5	0.0	100.0

13. Do you feel that the treatment has improved your chewing/biting ability?

		Yes, absolutely	Yes, I think so	No, I don't think so	No, absolutely not	Cannot remember	Total
Before	n	2	5	18	4	1	30
	%	6.7	16.7	60.0	13.3	3.3	100.0
After	n	7	14	9	2	0	32
	%	21.9	43.8	28.1	6.3	0.0	100.0

periodontal related diseases, nine (28.2%) thought that had more white spots while one (3.1%) respondent thought he/she had a decrease in his/her speech quality and another (3.1%) thought his/her speech had improved. Fourteen (42.3%) respondents felt that the treatment had improved their chewing/biting ability.

Majority (87.6%) noted that they were willing to go through the same treatment at the UM dental clinic if they were to have the same situation today (Table 4). Majority (90.7%) reported that the orthodontic alignment of their teeth had a positive influence on their self-confidence. More than half of the respondents reported that the orthodontic treatment had a positive influence in finding relationship and/or career (62.5%), in their performance at work or school (53.2%) and social communication (71.9%).

For calibration of the DHC of the IOTN, the intra-examiner percentages of agreement were 85% and 95% whilst the inter-examiner percentages of agreement ranged from 85% to 95%. Meanwhile for the AC, the intra-examiner percentages of agreement were 70% and 85% whilst the intra-examiner percentages of agreement ranged from 50% to 75% (Table 5). For calibration of the PAR index, the intra-class correlation coefficient value was 0.95 for intra-examiner reliability and 0.867 for the examiner reliability with the calibrated values. The DHC assessment indicated that 63.3% of cases had a 'definite need' for treatment and 21.1% had 'borderline need' for treatment. The AC assessment indicated that 24.2% had a definite need for treatment, 32% had a borderline need for treatment and 43.8% were in the category of slight or no need for treatment (Table 6). For the PAR assessment, 56% had a 'greatly improved' treatment outcome, 36% had 'improved' whilst 8% had a 'worse/no different' treatment outcome. The mean PAR score reduction was 75.3% (Figure 1).

DISCUSSION

Currently, there has not been any published research that assesses the patients' satisfaction with the orthodontic treatment outcome at the faculty. The standard of the audit was set high at 100%. This was the gold standard suggested by Richmond (2000). This may be an ideal outcome but since this was the first audit done at this institution, the gold standard was employed.

The questionnaire was modified from Uslu and Akcam (2007) as it covered the three main aspects of interest for this study, the orthodontic treatment received by the patient; their opinion on the orthodontic treatment results; and their opinion on the psychosocial benefits from the treatment received. Although the questionnaire and consent forms were posted to 150 confirmed addresses, the response rate was low (21.3%). However, this rate was still higher than the study by Uslu and Akcam (2007), which was 15.8%. When compared to previous study that did a telephone interview to inquire on the reasons for seeking orthodontic treatment of patients who were on the waiting list for treatment at the faculty (15), our response rate was much lower than the previous survey

Table 4. Part 3 of the questionnaire – Patient's opinion on the psychosocial benefits from the treatment received

1. Consider your pre-treatment condition. If you were in the same situation today, would you have chosen to go through the same treatment at the University of Malaya dental clinic?					
	Yes, absolutely	Yes, I think so	No, I don't think so	No, absolutely not	Total
n	18	10	3	1	32
%	56.3	31.3	9.4	3.1	100.0

2. Has the orthodontic correction of your teeth from our dental clinic had a positive influence on your self-confidence?					
	Yes, absolutely	Yes, I think so	No, I don't think so	No, absolutely not	Total
n	18	11	2	1	32
%	56.3	34.4	6.3	3.1	100.0

3. Has the result of orthodontic treatment had a positive influence for you in finding relationship and/or career?						
	Yes, absolutely	Yes, I think so	No, I don't think so	No, absolutely not	Not relevant	Total
n	8	12	7	0	5	32
%	25.0	37.5	21.9	0.0	15.6	100.0

4. Has the result of orthodontic treatment had a positive influence on your performance at work or school?					
	Yes, absolutely	Yes, I think so	No, I don't think so	No, absolutely not	Total
n	7	10	13	2	32
%	21.9	31.3	40.6	6.3	100.0

5. Has the result of orthodontic treatment had a positive influence on your social communication?					
	Yes, absolutely	Yes, I think so	No, I don't think so	No, absolutely not	Total
n	12	11	8	1	32
%	37.5	34.4	25.0	3.1	100.0

Table 5. Percentage of agreement for the Aesthetic Component (AC) and the Dental Health Component (DHC) of the IOTN

Aesthetic Component		Examiner 1		Examiner 2		Standard
		T1	T2	T1	T2	
Examiner 1	T1	–	85%	60%	50%	70%
	T2	85%	–	65%	50%	75%
Examiner 2	T1	60%	65%	–	70%	75%
	T2	50%	50%	70%	–	65%
Standard		70%	75%	75%	65%	–

Dental Health Component		Examiner 1		Examiner 2		Standard
		T1	T2	T1	T2	
Examiner 1	T1	–	95%	90%	95%	80%
	T2	95%	–	85%	90%	75%
Examiner 2	T1	90%	85%	–	85%	80%
	T2	95%	90%	85%	–	75%
Standard		70%	80%	75%	80%	75%

Table 6. Distribution of the AC and the DHC IOTN scores

	Index of Orthodontic Treatment Need score		
	No or slight need	Moderate Need	Definite Need
Aesthetic Component	56 (43.8%)	41 (32.0%)	31 (24.2%)
Dental Health Component	20 (15.6%)	27 (21.1%)	81 (63.3%)

(100% response rate). The possible suggestions for the differences in the response rate with that by Abdullah *et al.* (2001) included that signed consent forms were required prior to use of data in this study for ethical reasons. Previous study did not mention if written consent was required or obtained (15). The previous study investigated on patients who were waiting for treatment while the current study inquired on patients who have had treatment. Therefore, there may be differences in the motivational factors to voluntarily participate in the studies. Direct telephone interview could also ensure immediate response while postal questionnaire is affected by the dependability of external factors beyond the control of the researchers such as the patient's willingness to complete and post the forms and the efficiency of the postal services.

This pilot study included a convenient sample of patients that has completed treatment whose addresses were confirmed by telephone. The proportion of the subjects' gender and ethnic groups that was included for the survey was similar to Abdullah *et al* (2001) with slightly more than 60% of subjects to be female. Similarly the proportion of Malay and Chinese subjects included in the both study were quite similar and almost equal with Indian being the least. This suggests that the proportion of patients seeking treatment based on gender and ethnic at the faculty has not changed significantly over the past decade. The higher proportion of female subjects may be due to the fact that they are more concerned towards aesthetic appearance than men (16, 17). The ethnic proportion also seemed to reflect the recent national census of the Malaysian citizens residing in Kuala Lumpur of approximately 45% Malay, 43% Chinese and 10% Indian (18).

About less than a third of patients who sought treatment was self-referred, which was similar to Abdullah *et al.* (2001). Slightly more than a third were prompted for treatment by their parents, relatives or friends. This were less compared to the previous study that had 61% respondents who sought treatment due to suggestions by family or friends (15). Compared to previous study, this study showed that more dentists and/or dental specialists recommend orthodontic treatment for their patients (15). The main reason for seeking orthodontic treatment was to straighten their teeth followed by improving the facial profile. Few patients sought treatment to improve their biting ability or speech. Previous study also found quite similar findings but they also reported that improving self-confidence and dental health as the second most important factors after to enhance their dental appearance (15). Orthodontic appliances have been perceived to cause more teasing (19). However,

majority of our respondents reported that they did not experience any negative reaction towards their appliances but about a third noted that they were sometimes teased.

Majority of the patients were satisfied with the outcome of their orthodontic treatment. However, there was a few who noted some specifics of dissatisfaction than those who were dissatisfied with their overall treatment outcome. This may suggest these factors were minor such that it did not affect their overall satisfaction to the treatment. Nevertheless, these aspects should be taken into consideration for future strategies to further improve the standard of care of orthodontic treatment at the faculty. About a third of the respondents reported increased incidence in caries or periodontal related diseases and white spot lesions. Less proportion of patients reported increase incidence of pain or click to the TMJ region and restriction in mouth opening. This need to be taken with caution as the questions depended on the patients' memory which may be influenced by time and perception. Caries and periodontal disease have been associated with crowding but convincing evidence to support crowding as a cause for the diseases is lacking, with oral hygiene habits suggested to play a more significant role than the malocclusion itself (20). However, the disease may be more prevalent during orthodontic treatment (21) particularly with poor oral hygiene control due to the tendency for plaque retention on the appliances. Development of white spot lesions is a common complication with orthodontic treatment particularly with fixed appliances (22). Although it is accepted that patient, parent and clinicians perceived that it is the patients' responsibility to prevent the development of the lesions (23), common risks with orthodontic treatment such as white spot lesions, caries and periodontal disease should be discussed with the patient as part of the consent taking procedure. In order to reduce these risks, more emphasise should be placed on preventive care management such as including the involvement of hygienists for continuous adjunct oral health care management during orthodontic treatment. Other risks that have ambiguity in current evidences of the effect of orthodontic treatments towards the TMJ, mouth opening and speech (14, 20) should also be informed and warned that the effect could vary depending on individuals.

With regards to the improvements in psychosocial benefits of orthodontic treatment, previous survey found that 75% of patients expected the outcome from orthodontic treatment would help improve their self-confidence, 64% expected an improvement in their social relationship and 43% expected a positive influence in their career (15). The current study found that a much higher proportion of respondents noted positive influences from their orthodontic treatment; 90.7% reported positive influence in their self-confidence; 71.9% in finding relationship and/or career; and 62.5% in their performance at school or work. This suggests the outcome of treatment could potentially exceed the patients' expectations. This may be due to patients' placing lower expectations on how the treatment could benefit them psychosocially prior to treatment. However, it is prudent to avoid extrapolating the results from two different sets of sample. Further study should be conducted on the same sample before and after treatment for a more reliable outcome.

Calibration was done on 20 sets of study models. Due to the small number of casts used and the limitation of the statistical method used using nominal data for both the DHC and AC, the percentage of agreement was chosen to measure the reliability of IOTN instead of the Weighted Kappa coefficient. The percentage of agreement for the AC was lower than that for the DHC. This is probably due to the AC being a more subjective method of assessment. Unlike the AC, the DHC has higher a percentage of agreement which can be due to the objective assessment of the deleterious effects of the various deviant occlusal traits in order of severity (10). Other studies that have applied the AC and DHC has also shown lower calibration values for the AC than the DHC (24, 25), indicating that the calibration of this study was at an acceptable range. For the PAR Index reliability, both intra- and inter-examiner showed excellent agreement. The reason why the reliability of the PAR Index was high because the probably similar to the DHC, the PAR Index is also an objective assessment of orthodontic treatment outcome created by a group of orthodontic professionals (10).

One of the difficulties of assessing the DHC retrospectively is that one has to depend on the reliability of the case notes to record for the components not measurable from the casts. These include the degree of displacement in relation to crossbite, which has to be measured clinically and the masticatory or speech difficulty, which depends on the patients' complain. For this audit, the best outcome was taken as it had to be assumed that clinicians would have recorded the worst outcome, if known. Therefore, the results for the DHC should be taken with caution as the results may be under reported.

This study demonstrated that the cases selected for treatment at the faculty had a similar trend in the DHC to the study by Sarah and Sundralingam (1995), which was highest in the groups of Grades 4 and 5 (Definite need), followed by the Grade 3 (Moderate need) and then Grades 1 and 2 (No or slight need) (26). However, the AC trend was the opposite, with more cases in the no or slight need, followed by the moderate need and definite need in this study while their study had more cases in the definite need category compared with the moderate and no or slight need categories. For the PAR Index, this audit found much improvement compared to the previous study done by Leong *et al.* (2001). Majority of their cases were in the category of

'improved' (67.3%), followed by 'greatly improved' (18.2%) and 'worse/no different' (14.5%) (27), while this study had more cases in the 'greatly improved' category (56%), followed by 'improved' (36%) and 'worse/no different' (8%). This may suggest an improvement in the standard of treatment outcome at the faculty. However, it should be taken with caution as the sample size in this study was much less than that of the previous study. The standard set for the PAR outcome was based on the recommendation by Richmond (2005). Although cases that were 'worse/no different' were slightly more than the less than 5% set criteria, the mean reduction in PAR score was above the standard set of 70%. PAR outcome is affected by the pre and post scores, therefore cases with lower scores to begin with may not show significant changes at the end of treatment. The improvement in the outcome measure could be due to more stringent case selections or improvement in management of cases.

CONCLUSION

Majority of the patients were satisfied with the treatment outcome. However, this was still below the set level of 100%. The mean PAR reduction score was above the set standard but the standard was not achieved to attain less than 5% under the category of 'worse/no different'. This audit suggests an improvement in the treatment outcome compared to previous study (27). This audit has demonstrated an overview of the patients' perception and outcome of cases treatment at the faculty. There was also an insight of the current range of cases selected for treatment at this institution. Further study is recommended to develop strategies for improvements in the standard of care to achieve a better outcome.

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