Orthodontic Treatment Need in an Accredited Graduate Orthodontic Center in North America: A Pilot Study

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Abstract

Aim: To assess the objective orthodontic treatment needs of patients treated in an accredited Orthodontic Clinic in North America using a retrospective cross sectional study and the Dental Aesthetic Index (DAI).

Methods and Materials: One hundred pre- and post-treatment study models were randomly selected from the model storage facility of the clinic. Only the pre-treatment study models were assessed using the DAI. The pre - treatment and post- treatment ages for each case were noted as recorded on the corresponding study models. The range for the pre-treatment age was 10 to 52 years, and from 12 years, 4 months to 54 years for the post-treatment age range. The duration of treatment for each case was calculated by subtracting the pre-treatment age from the post-treatment age (range of treatment duration, 9 to 125 months). Descriptive statistics as well as chi-square statistics were employed to analyze the data.

Results: Fifteen cases had normal or minor malocclusions with no treatment or slight need for treatment. Definite malocclusions with treatment highly desirable accounted for 22 cases and severe malocclusion with treatment highly desirable was found in 16 cases. Forty-seven cases had handicapping malocclusion with treatment considered mandatory. While a statistically significant association (p<0.05) was found between duration of treatment and severity levels of malocclusion (DAI scores), the association between pre-treatment age and DAI scores was not significant (p > 0.05).

Conclusions: Eighty-five percent of the study sample needed orthodontic treatment with different malocclusion severity levels, while 47% of the cases qualified for publicly subsidized treatment due to handicapping malocclusions. The association between duration of treatment and DAI score groups (malocclusion severity levels) was found statistically significant.

It could be helpful for more clinic-based (demand populations) studies on treatment needs be undertaken across the globe using the DAI, at least for the purposes of comparison.

Keywords: Orthodontic treatment need, Dental Aesthetic Index, DAI, demand population, North America

Introduction

Clinical audit is a systematic method to assess whether stated goals are being reached and identifies areas for improvement.[1] Clinical audit activities, including peer review and practice visitation schemes, have been introduced to varying extents in the United Kingdom, Norway, Holland, Denmark, and Sweden.[1] Considering the international nature of orthodontics, international standards for treatment need and treatment outcome as guidance for audit activities was suggested.[1]

When a third party, such as a local authority or a national health service, is responsible for the provision of orthodontic treatment, it is necessary to find some means of determining treatment priority because the demand for treatment frequently outstrips the resources available.[2] Although many orthodontic indices have been used to assess orthodontic treatment needs in different countries, the Dental Aesthetic Index (DAI) has been adopted by the World Health Organization (WHO) as an international cross-cultural index.[2,3,4]

DAI was initially based on dental records (study casts) from Caucasian adolescents in the United States.[3,5-9] However, there is still a paucity of reports on objective orthodontic treatment needs in North America partly because of the former statement from the American Association of Orthodontists (AAO) that "it does not recognize any index rating classification or coding system as scientifically valid measures of the need for orthodontic treatment"[10] which is now changing.

DAI scores are designed to reflect North American cultural aesthetic and psychosocial values without the perceived 'European bias' of most other indices.[11] With the adoption of DAI by the WHO as a cross-cultural index coupled with its simplicity and high examiner reliability, the index has great potential internationally. While the DAI has been widely used to determine orthodontic treatment need in epidemiological studies[12-17], it has the potential to establish orthodontic treatment needed in smaller hospital–based groups.[18]

This paper is aimed at assessing the objective orthodontic treatment need of patients treated in an accredited graduate Orthodontic Clinic in North America, according to the DAI.

Methods and Materials

This study was undertaken at an accredited graduate Orthodontic Clinic in North America after obtaining approval from the Institutional Review Board (Research protocol #2004-0469).

A sample of 100 pre-treatment and post-treatment study models was selected randomly from the model store of the graduate Orthodontic Clinic in Chicago, IL, USA. The pre-treatment models were objectively assessed using the DAI in line with the WHO guidelines[4], whereas the post-treatment study models were used in assessing the correlation between age, duration, and the DAI. One calibrated examiner (COO) from another country assessed all the models. As the component DAI parameters and their weightings have been described in details elsewhere[19, 20], only their summary is shown in Table 1. The DAI scores for each case were then obtained from summed products of the components with their respective weightings (regression coefficients) plus the addition of a constant (as listed in Table 1).

The ages at the onset of treatment (pre-treatment age) and at the end of treatment (post-treatment age) as indicated on the models were noted (pre-treatment age range, 10-52 years; post-treatment age range, 12 years, 4 months-54 years). The duration of treatment for each case was calculated by subtracting the pre-treatment age from the post treatment age (range, 9-125 months).

Intra-examiner Reliability

Intra-examiner reliability was assessed by repeating the examination of a random subset of 20 cases. This was done for four weeks after the initial examinations.

Statistical Analysis

In addition to descriptive statistics used, the chi-square statistic was employed to test the significance of associations between pre-treatment age and DAI scores as well as between duration of treatment and DAI scores.

The intra-examiner reliability was tested statistically using the spearman-rank order correlation coefficient. Also, a scatter plot showing the double readings for the repeated random subset of 20 cases is shown in Figure 1, which is consistent with Robert and Richmond.[21]

Table 1. The standard DAI regression equation.

| DAI Components	Rounded weight
Number of missing visible teeth (incisors, canines, and premolars teeth in maxillary and mandibular arches)	6
Crowding in the incisal segment: 0 = no segment crowded, 1 = 1 segment crowded, 2 = 2 segments crowded.	1
Spacing in the incisal segment: 0 = no spacing, 1 = 1 segment spaced, 2 = 2 segments spaced	1
Midline diastema in millimeters	1
Largest anterior irregularity on the maxilla in millimeters	1
Largest anterior irregularity on the mandible in millimeters	1
Anterior maxillary overjet in millimeters	2
Anterior mandibular overjet in millimeters	4
Vertical anterior openbite in millimeters	4
Antero-posterior molar relation, largest deviation from normal either left or right: 0 = normal, 1 = 1/2 cusp either mesial or distal, 2 = one full cusp or more either mesial or distal	3
Constant	13
Total	DAI score
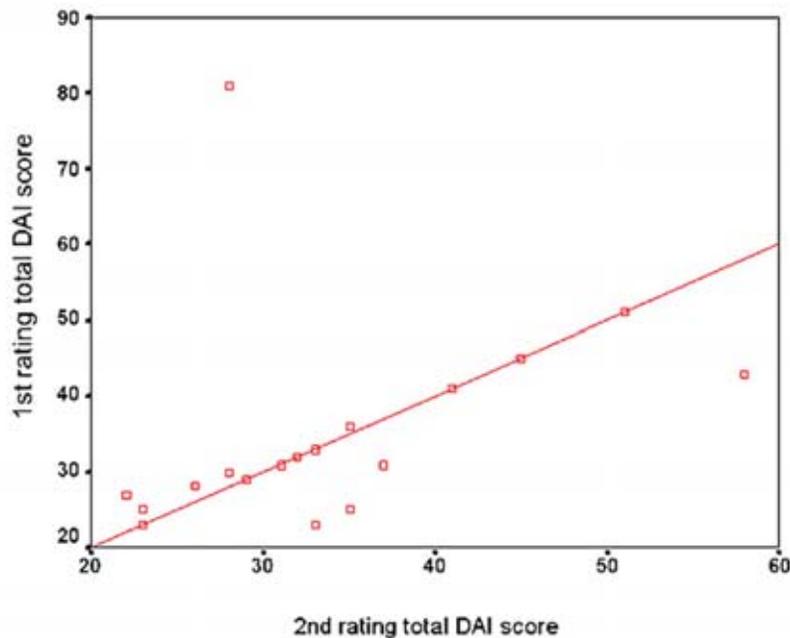
Figure 1. Scatter plot showing the first rating of the total DAI score versus second rating of the total DAI score for the 20 subset.

Results

The reliability assessment of the DAI using the spearman-rank order correlation was found to show very good agreement (r = 0.93; p<0.001). Figure 1 shows the graph of the double readings illustrating the line of agreement, which is very satisfactory.

Table 2 shows the distribution of the mean DAI scores, minimum and maximum scores, and the frequency of the various DAI severity groups. Cases with DAI scores of 25 or less (having normal or minor malocclusion with no treatment or slight need) accounted for 15%, while cases with DAI scores of 36 and above (handicapping malocclusion with treatment considered mandatory) was 47%. In all 85% of the cases needed orthodontic treatment ranging from definite malocclusion with treatment elective to handicapping malocclusion with treatment considered mandatory.

Association between age at the onset of treatment (pre-treatment age) and DAI score groups is shown in Table 3. The association was not found statistically significant (p = 0.086).

Table 4 shows the statistically significant (p = 0.040) association between duration of orthodontic treatment and the DAI score groups.

Discussion

Due to the increasing demand for orthodontic care globally, there is a need to develop methods to assess and grade malocclusion in order to prioritize treatment, particularly for publicly-funded programs. The adoption of the DAI by the WHO as a cross-cultural index[3,4], coupled with its relative simplicity and high examiner reliability, makes it an index with great potential internationally. While the DAI has been widely used in epidemiological studies[13-17,19], it has also shown the potential of establishing orthodontic treatment needed in smaller hospital-based groups.[18,22]

This present retrospective cross-sectional study of patients treated in an accredited graduate Orthodontic Clinic in the United States has revealed 47% of the study sample had very severe or handicapping malocclusion with treatment considered mandatory. A similar study in Nigeria reported 35.3% for group of subjects with this degree of orthodontic need.[18] Normal or minor malocclusions with no treatment needed or slight treatment needed accounted for about 29% in the Nigerian study[18], compared to 15% in the American study. The percentage of cases belonging to definite malocclusion with treatment elective (22%) and cases with severe malocclusion with treatment highly

Table 2. Mean DAI scores for the various levels of malocclusion severity for the study sample.

DAI score group	Mean (S.D)	Minimum	Maximum	Number
≤ 25 (Normal or minor malocclusions with no treatment need or slight need)	23.27(1.58)	21.00	25.00	15
26-30 (Definite malocclusion with treatment elective)	28.00(1.35)	26.00	30.00	22
31-35 (Severe malocclusion with treatment highly desirable)	32.75(1.44)	31.00	35.00	16
≥ 36 (Very severe or handicapping malocclusion with treatment considered mandatory)	46.87(7.74)	36.00	67.00	47
Total	36.92(11.16)	21.00	67.00	100

**Table 3. Association between age at onset of treatment and (pre-treatment age) and DAI score groups.**

	DAI score groups				
	≤ 25	26-30	31-35	≥ 36	Total
Below average age of the sample (≤ 16)	6(9.1)	14(21.2)	13(19.7)	33(50)	66(66)
Above average age of the sample (> 16)	9(26.5)	66(66)	3(8.8)	14(41.2)	34(34)
Total	15(15.0)	22(22.0)	16(16.0)	47(47.0)	100(100.0)

$X^2 = 6.6034$; df = 3; P = 0.0857

Table 4. Association between duration of treatment and DAI score groups.

Duration of Treatment (months)	DAI score groups				
	≤ 25	26-30	31-35	≥ 36	Total
Less than average duration (≤ 26)	11(21.6)	6(11.8)	8(15.7)	26(51.0)	51(51)
Greater than average (> 26)	4(8.2)	16(32.7)	8(16.3)	21(42.9)	49(49)
Total	15(15.0)	22(22.0)	16(16.0)	47(47.0)	100(100)

$X^2 = 8.3074$; df = 3; P = 0.0401   (Percentages in parentheses)
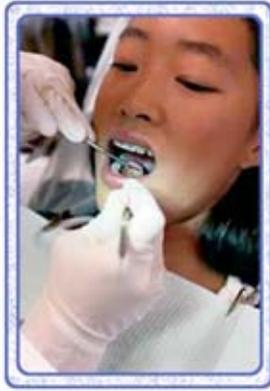
desirable (16%) in this present study is comparable to the Nigerian study.[18] Comparing the treatment needs of this present study and the Nigerian studies[18, 22] shows more Nigerian patients with normal or minor malocclusion needing no treatment or slight need demanded for orthodontic treatment than in this American study. This suggests an improving orthodontic awareness in Nigeria. However, the Nigerian reports[18,22] were on patients who sought treatment and not necessarily those who eventually received the orthodontic care they needed. The receipt of orthodontic care is dependent on various factors including cost of treatment.[23] Many patients who show an interest in receiving orthodontic treatment in Nigeria do not eventually obtain it due to the high cost of treatment, which is not unconnected with the general poor economic climate in Nigeria.

Although similar perceptions of dental aesthetics among Nigerians and the Americans using the DAI was reported by Otuyemi et al.[24], the DAI scores for the two populations could differ due to genetic differences and environmental factors. A report by Katoh et al.[25] suggested the possibility of a genetic factor reflected in the prevalence and severity of malocclusion in three ethnic groups of Asian origin. Epidemiological data concerning occlusal conditions have been accumulated by the WHO from all over the world using the DAI.[25]

Having been recognized by the WHO as a cross-cultural international index, the DAI is becoming a common standard for evaluating malocclusion. The study by Katoh et al.[25] confirmed Japanese and Native Americans showed significantly poorer dental esthetics than found among American white populations using the evaluation of the DAI

in previous studies.[19,26] However, the present study did not consider the sample in relation to nationalities or ethnic origins.

The literature on the relationship of age with DAI scores is still inconclusive. This present study did not show a statistically significant relationship between the pre-treatment age and the DAI scores. The recent Nigerian studies[18,22] on child and adult populations showed similar patterns in the DAI scores. The Nigerian reports[18,22] show 29.4% of the child population had normal or minor malocclusions with no treatment or slight treatment needed, while 32.6% of the adult population was in this group. Also, 32.6% of the adult population had very severe or handicapping malocclusion with treatment considered mandatory, and 35.3% in the child population belonged to this severity group.

The duration of orthodontic treatment is an important factor influencing the cost and efficiency of healthcare.[27,28] Also, an analysis suggested complex cases demanded more and longer appointments to treat.[29] This present study has revealed a statistically significant association between duration of treatment and DAI score groups.

The present American study, being clinic-based, gives a good idea of the severity levels of malocclusions being treated at the centre, which is different from the treatment need from epidemiological reports. One can say with caution this could also be suggestive of the severity levels of malocclusions being treated in North America.

Conclusions

1. The present study has shown 85% of the study sample needed orthodontic treatment ranging from elective to mandatory cases, according to the DAI.
2. Forty seven percent of the cases were considered as needing mandatory orthodontic treatment due to handicapping malocclusions and should qualify for publicly-funded or subsidized orthodontic care.
3. Although no statistically significant association was observed in the various malocclusion severity levels (DAI score

groups) and pre-treatment age (p>0.05), statistically significant association was noted between the DAI score groups and duration of orthodontic treatment.

Since DAI has been accepted as a cross-cultural index by the WHO, more clinic-based studies (demand populations) should be encouraged across the globe. This could be helpful in assessing the severity of malocclusions (including those qualifying for publicly-funded programs) being treated in various parts of the world as this is different from epidemiological reports, at least for purposes of comparison.

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