

Assessing Orthodontic Treatment Need Using the Dental Aesthetic Index

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Abstract

The Dental Aesthetic Index (DAI) used to objectively determine the orthodontic treatment need by assessing both clinical and esthetic components. To determine the orthodontic treatment need based on DAI on patients who visited the Dental and Oral Hospital, Faculty of Dentistry, Universitas Indonesia named Rumah Sakit Khusus Gigi dan Mulut Fakultas Kedokteran Gigi Universitas Indonesia (RSKGM FKG UI) orthodontic specialist clinic between 2010 and 2014.

Total fifty-two pairs of pretreatment orthodontic study models were used. The assessment was based on ten components of the DAI. Assessment scores were categorized into four levels of orthodontic treatment need. Orthodontic treatment needs were classed as "highly desirable of treatment need" in 36.5% patients, "mandatory treatment need" in 32.7%, "elective treatment need" in 25%, and "no/slight treatment need" in 5.8%. The problems found were mostly anterior mandibular irregularity that was observed in 96.2% patients, anterior maxillary irregularity in 94.2%, abnormal anterior maxillary overjet in 81%, and abnormal molar relationship in 76.9%.

The most common DAI-based orthodontic treatment need of patients who visited the RSKGM FKG UI orthodontic specialist clinic belonged to the "highly desirable" class (36.5%). Thus, the patients who visited the RSKGM FKG UI orthodontic specialist clinic were mostly individuals who needed the treatment when assessed by the DAI.

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Introduction

Undesirable appearance in teeth arrangement poses a problem that needs to be corrected using orthodontic treatment.^{1,2} Such treatments are performed to reduce a patient's psychosocial problems as one of patient's problem by improving their teeth arrangement.³ The demand for orthodontic treatment to improve dental appearance is subjective, which needs to be considered when making a diagnosis via objective assessments.⁴ The diagnosis will determine the appropriate for the orthodontic treatment and assess the degree to which treatment is needed for a particular patient.

Several orthodontic indices are available to help dentists determine orthodontic treatment

needs.² The indices are used to minimize the subjective component in diagnosing and assessing malocclusion severity.⁵ The Dental Aesthetic Index (DAI) is used to assess the aspects of occlusion associated with societal perceptions of dental appearance.⁶ DAI uses ten components with their own regression coefficients and uses formulas to assess malocclusion severity.⁶⁻⁸ It has been adopted by the World Health Organization (WHO) as a cross-cultural index.^{8,9} It provides objective assessment by placing a patient in one of the following four categories of orthodontic treatment needs: (1) no/slight treatment need, (2) elective treatment need, (3) highly desirable of treatment need, and (4) mandatory treatment need.⁷⁻⁹

A study on the DAI-based orthodontic treatment need has never been performed on patients who visited the Dental and Oral Hospital, Faculty of Dentistry, Universitas Indonesia named Rumah Sakit Khusus Gigi dan Mulut Fakultas Kedokteran Gigi Universitas Indonesia (RSKGM FKG UI) orthodontic specialist clinic. This study was conducted in RSKGM FKG UI because of its location in capital city of Indonesia so that

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expected to represent the condition of community in general. This study was conducted to determine the orthodontic treatment need in those patients when assessed using the DAI.

Materials and methods

This was a cross-sectional study conducted at Faculty of Dentistry, Universitas Indonesia (FKG UI) Salemba, Central Jakarta, Indonesia, involving patients who visited the RSKGM FKG UI orthodontic specialist clinic between 2010 and 2014. The subjects of this study were patients who met the inclusion and exclusion criteria. Inclusion criteria involved patients who visited the clinic between 2010 and 2014, had a pair of preliminary study models in permanent dentition, and had a proper base in their study model. Exclusion criteria involved individuals with broken study models and study models with no clear record of impression date. There was obtained fifty-two sets of study models as subjects; these were taken from the medical record storage room of the orthodontic department of FKG UI Salemba, Central Jakarta, Indonesia. Ethical approval was obtained from Dental Ethics Research Commission, Faculty of Dentistry, Universitas Indonesia.

All ten DAI components were assessed for each study model, and the results were recorded in a calculation table in the SPSS software version 23 For Windows. The assessment was performed with or without digital calipers based on which component was being measured.

Interobserver test using the Intraclass Correlation Test (ICC) from SPSS version 23 was performed on 10% of the sample between researcher and an expert. The test result was 0.751 which means that the agreement between the researcher and the expert in conducting the assessment was good. Intraobserver test was also carried out using the ICC Test to see the consistency of researcher in conducting repeated assessments. Researcher assessed 10% of the same sample on two different days. The test results obtained was 0.895 which means that the consistency of the researchers in reassessing was very good.

The first component of the DAI was the number of missing incisors, canines, and premolars of the maxilla and mandible,^{6,9,10} and the assessment was performed by observing the models and counting the number of missing teeth

in the two arches.⁶ The total number of missing teeth was the score for component one.

The second component was crowding in the incisal segment.^{6,8-10} The assessment was performed by determining the presence of crowding in four incisor teeth in the maxilla and mandibular arches. Crowding was considered present when the available space between the right and left canine teeth is insufficient to accommodate all four incisors in normal alignment.^{6,8} The result was scored as zero if there was no crowding in the incisal segments of the maxilla and mandible, one if there was crowding in the incisal segment of either the maxilla or mandible, and two if there was crowding in the incisal segments of both the maxilla and mandible.^{6,8-10}

The third component was spacing of the incisal segment.^{6,8-10} The assessment was performed by determining the presence of space between the incisor teeth in the maxilla and mandibular arches. The result was scored as zero if there was no space in the incisal segment of both the maxilla and mandibula, one if there was space in the incisal segment of either the maxilla or mandibula, and two if there was space in the incisal segments of both the maxilla and mandible.^{6,8-10}

The assessment of the fourth component of DAI is the midline diastema.^{6,8-10} The assessment is performed by measuring the space between the mesial surface of the right central incisor tooth to the mesial surface of the left central incisor tooth using a digital caliper. The measurement is done in millimeters.^{6,8-10}

The fifth component was the largest anterior irregularity in the maxilla.^{6,8-10} This was defined as rotation or displacement of the four incisor teeth in the maxilla compared with normal alignment.⁶ The assessment was performed by measuring the largest anteroposterior distance of the most lingually rotated or displaced tooth to the normal arch line using digital calipers placed on the labial surface of that tooth parallel to the occlusal plane.⁶ The measurement was taken in millimeters.

The sixth component was the largest anterior irregularity in the mandible.^{6,8-10} This had the same definition and assessment method as the fifth component did but was instead performed on the mandibular incisor.⁶

The seventh component was the anterior maxillary overjet.^{6,8-10} The assessment was

performed by measuring the anteroposterior distance of the maxillary and mandibular incisor teeth in centric occlusion from the length from the labioincisal edge of the most prominent maxillary incisor tooth to the labial surface of the corresponding mandibular incisor.⁶ The measurement was performed parallel to the occlusal plane using digital calipers.⁶ The measurement was taken in millimeters.

The eighth component was the anterior mandibular overjet.^{6,8-10} The assessment was performed by measuring the anteroposterior distance of the mandibular incisors positioned more labially than the maxillary incisors, measuring from a centric occlusion starting from the labiolincisal edge of the most prominent mandibular incisor tooth to the labial surface of the corresponding maxillary incisor.⁶ The measurement was made in millimeters.

The ninth component was the vertical anterior open bite.^{6,8-10} This was defined as lack of a vertical overlap between any of the opposing pairs of incisors.^{6,8} The assessment was performed by measuring the vertical distance between the incisal edge of the maxillary and mandibular incisors using digital calipers.⁶ The measurement was made in millimeters.

The tenth and final component was the anteroposterior molar relation.^{6,8-10} This was based on the relationship between the maxillary and mandibular first molar teeth while occluded.⁶ The assessment was performed by determining the largest deviation of the anteroposterior molar relation from the normal relation, i.e., angle class 1.^{6,8,9} The result was scored zero if there was a normal relation of molars, one if the mandibular first molar was ½ a cusp to the mesial or distal maxillary first molar, and two if the mandibular first molar was one cusp or more to the mesial or distal maxillary first molar.⁶

The DAI score was calculated by multiplying the score of each component with its regression coefficient and summing the products.^{7,8} The result was then added with a constant number, 13. The result was the final DAI score. The DAI score provides an objective assessment divided into four classes of orthodontic treatment needs.⁸ the DAI scores obtained were grouped into four classes: a score lower than or equal to 25 would be equivalent to no or slight treatment need, a score between 26 and 30 would be equivalent to elective treatment need, a score between 31 and 35 would

be equivalent to highly desirable of treatment need, and a score greater than or equal to 36 would be equivalent to mandatory treatment need.⁷⁻⁹

Results

Total fifty-two pairs of preliminary study models fulfilled the subject inclusion criteria. Most subjects in this study were from the year 2011, with total fifteen patients, and the fewest were from the year 2012, with total five patients. There were forty-six female (88.5%) and six male patients (11.5%; Table 1).

Gender	Quantity (N)	Percentage (%)	Year				
			2010	2011	2012	2013	2014
Male	6	11.5	0	1	0	1	4
Female	46	88.5	13	14	5	10	4
Total	52	100	13	15	5	11	8

Table 1. Subject characteristics based on gender and year.

The study was initiated with an inter- and intra-observer compatibility using Intraclass Correlation (ICC) test to assess 10% of the subjects. The inter-observer compatibility test produced a result of 0.751, indicating a good level of agreement between the researcher and expert performing the assessment. The intra-observer compatibility test produced a result of 0.895, indicating excellent researcher consistency in performing reassessments. The results for each DAI component are shown in Figures 1–10. The composite score from the ten DAI components was then obtained using the DAI formula, and the final scores for each patient were then categorized as shown in Table 2.

DAI Score	Orthodontic Treatment Need	Quantity (N)	Percentage (%)
≤25	No/slight treatment need	3	5.8%
26–30	Elective treatment need	13	25%
31–35	Highly desirable of treatment need	19	36.5%
≥36	Mandatory treatment need	17	32.7%
Total		52	100%

Table 2. Orthodontic treatment need based on patient DAI.

Discussion

This study was performed to identify the orthodontic treatment need based on the DAI in patients who visited the RSKGM FKG UI orthodontic specialist clinic between 2010 and 2014. Most subjects were females (88.5%). This was consistent with Haniputra's study (2006), which found that 65% of all orthodontic patients were female.¹¹ This may be due a greater concern about appearance in women than in men.

Assessment of the first component (Fig. 1) showed that 94.2% of the patients did not have missing teeth and that the remainder patients were missing one tooth. This was in line with Cendikiawan's study (2015), which showed that only 5.2% patients had missing teeth.¹² Almeida's study (2013) also produced a similar result, with 5.5% of the patients missing teeth in the maxillary arch and 0.9% in the mandible.¹³ These numbers suggest that patients who presented for orthodontic treatment did not do so because of missing teeth. However, even a single missing tooth may contribute to determination of treatment need because this component has substantial regression coefficient in the DAI.⁶

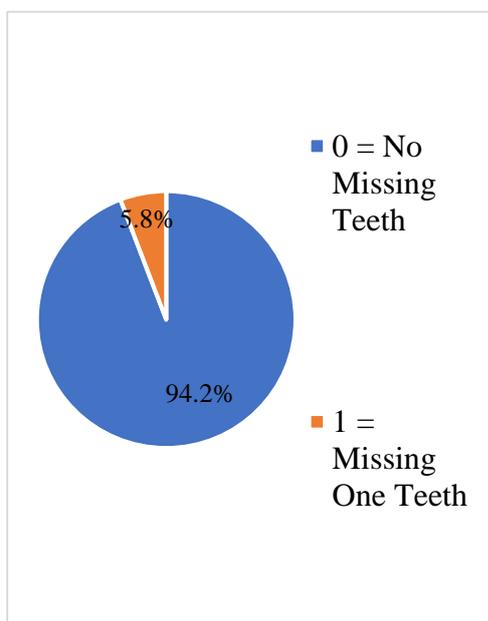


Figure 1. First DAI component: Number of missing incisors, canines, and premolars on patients of RSKGM FKG UI orthodontic specialist clinic between 2010 and 2014.

Assessment of the second component (Fig. 2) showed that 92.3% of all patients had crowding in their incisal segment. This result was in line with the results of Goyal *et al.* (2013), who found

that 81% of all patients had crowded teeth in their maxillary and mandibular incisal segments.⁸ This result showed most of the patients who came for doing orthodontic treatment had crowding in the incisal segment. Soh *et al.* (2006) showed that dental crowding, particularly in the maxillary arch, significantly correlates with the perception of dental esthetics in Asian laypeople.¹⁴

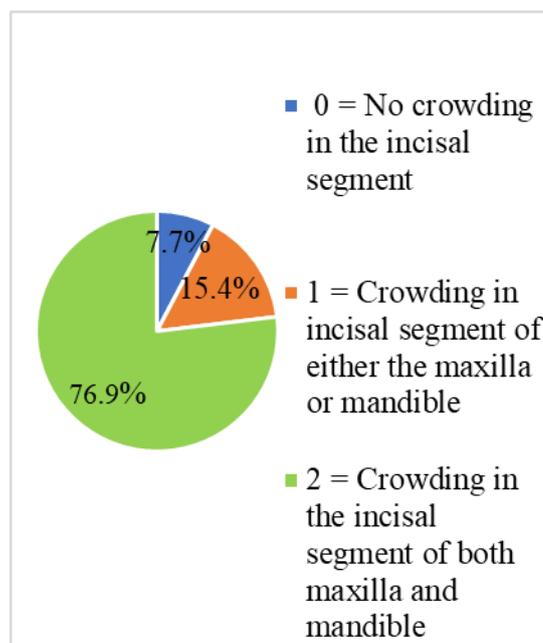


Figure 2. Second DAI component: Crowding in the incisal segment on patients of RSKGM FKG UI orthodontic specialist clinic between 2010 and 2014.

The third component (Fig. 3) showed that more patients had no spacing in their teeth (65.4%) than did. This conforms with the study conducted by Tessarollo *et al.* (2012), which showed that patients with no spacing made up 70% of their population.¹⁵ This result also showed that dental spacing in the incisal segment is a rare condition than dental crowding. However, spacing in the incisal segment also needs to be considered when determining treatment need as it affects people's perception of a less pleasing dental esthetic.⁶

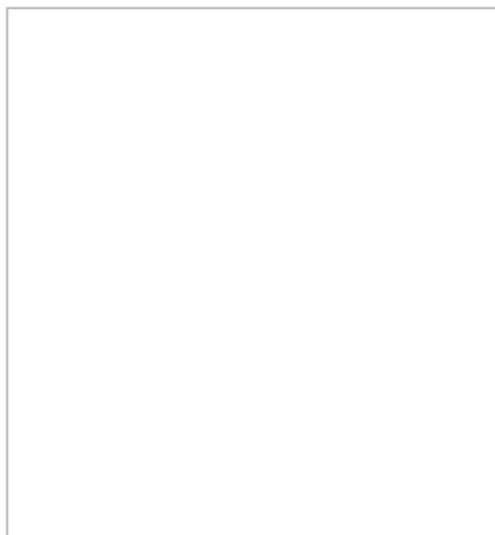


Figure 3. Third DAI component: Spacing in the incisal segment on patients of RSKGM FKG UI orthodontic specialist clinic between 2010 and 2014.

The fourth component (Fig. 4) showed that 80.8% of patients had no midline diastema and that the variation ranged from 0.5 to 5 mm in those who did. A study conducted by Rahman *et al.* (2013) also reported a similar result, with 86.4% patients having no midline diastema.¹⁶ This indicates that midline diastema is a rare condition. However, 27% of patients had moderate midline diastema as reported in a study conducted by Goyal *et al.* (2013).⁸ This was thought to have occurred because the subjects in this study were from an African population with a higher prevalence of midline diastema compared with other ethnicities.⁸

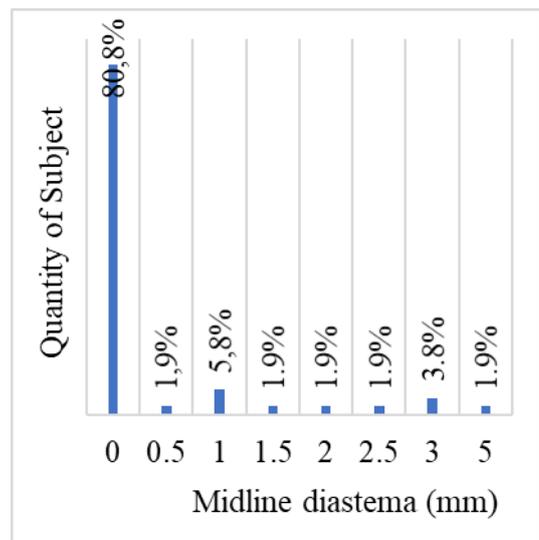


Figure 4. Fourth DAI component: Midline diastema on patients of RSKGM FKG UI orthodontic specialist clinic between 2010 and 2014.

The fifth component (Fig. 5) showed that 94.2% patients had anterior irregularity in the maxilla that ranged between 1 and 6 mm, whereas the sixth component (Fig. 6) showed that 96.2% patients had an anterior irregularity in the mandible that ranged between 0.5 and 3.5 mm. This was consistent with the findings of Haniputra's study (2006), which showed that 74.6% patients had anterior irregularities in the maxilla and 80% in the mandible.¹¹ More irregularities are known to occur in the mandible.

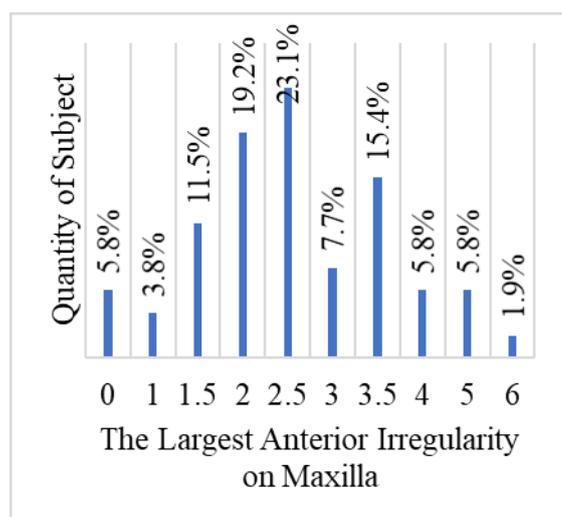


Figure 5. Fifth DAI component: The largest anterior irregularity on the maxilla on patients of RSKGM FKG UI orthodontic specialist clinic between 2010 and 2014.

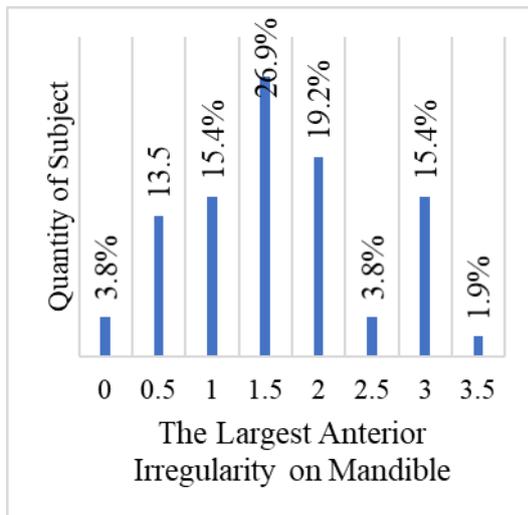


Figure 6. Sixth DAI component: The largest anterior irregularity on the mandible on patients of RSKGM FKG UI orthodontic specialist clinic between 2010 and 2014.

The seventh component (Fig. 7) showed that 80.8% patients had an abnormal maxillary overjet. The normal overjet is 2–3 mm,² but here, the overjets ranged between 0 and 17.5 mm. A study conducted by Soh *et al.* (2006) showed that an overjet of more than 6 mm was very influential in people's dissatisfaction with their dental esthetic.¹⁴

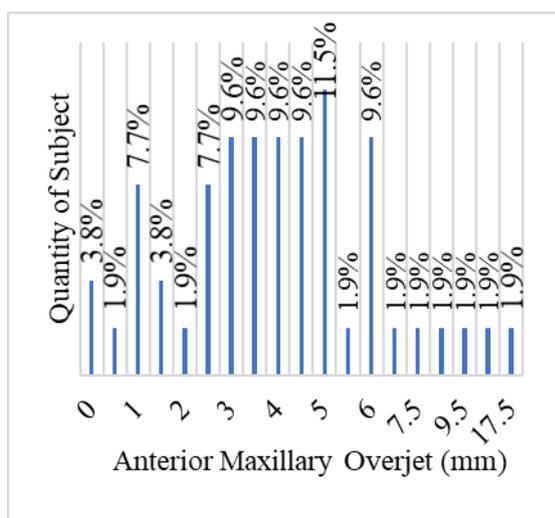


Figure 7. Seventh DAI component: Anterior maxillary overjet on patients of RSKGM FKG UI orthodontic specialist clinic between 2010 and 2014.

The eighth component (Fig. 8) showed that 86.5% patients had no anterior mandibular

overjet and that the distance variation was 0.5 to 4.5 mm. A similar result was obtained in Haniputra's study (2006), which showed a large percentage of patients with no anterior mandibular overjet (96.3%).¹¹ Although anterior mandibular overjet was not experienced by many patients, this condition has to be considered when assessing the need for orthodontic treatment. Soh *et al.* (2006) noted that dental crossbite negatively affects dental esthetic according to orthodontics experts.¹⁴

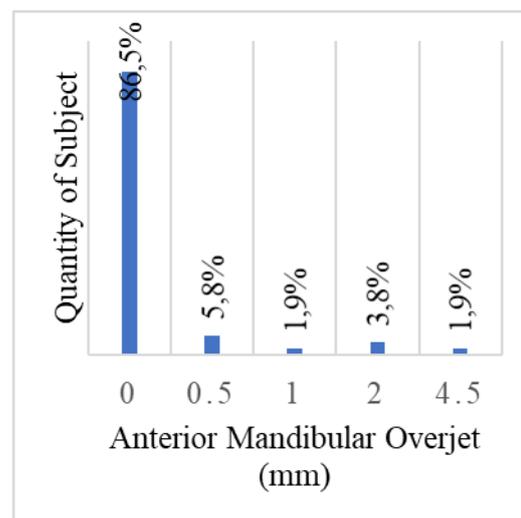


Figure 8. Eighth DAI component: Anterior mandibular overjet on patients of RSKGM FKG UI orthodontic specialist clinic between 2010 and 2014.

The ninth component (Fig. 9) showed that 88.5% patients had no vertical open bite and that the range was from 1 to 2.5 mm. Tessarollo *et al.* (2012) reported a similar result, in which 98.02% patients had no open bite,¹⁵ suggesting that anterior open bite is a rare condition.

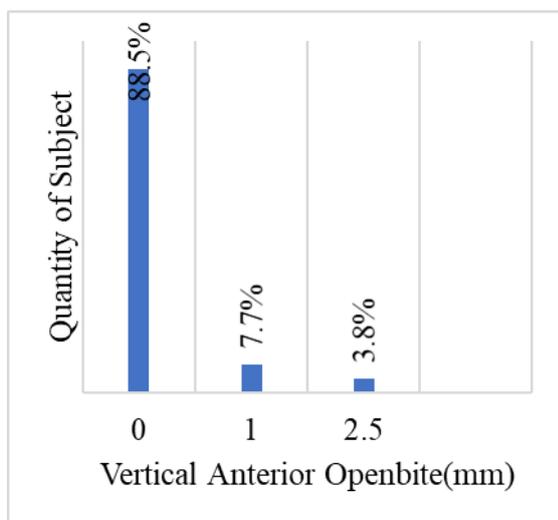


Figure 9. Ninth DAI component: Vertical anterior open bite on patients of RSKGM FKG UI orthodontic specialist clinic between 2010 and 2014.

The tenth component (Fig. 10) showed that 76.9% patients had an abnormal anteroposterior molar relation. However, this was contrary to the observations of Cendikiawan (2015), who reported that 80% patients had a normal anteroposterior relation.¹² These differences may have had occurred owing to the characteristics of the subjects in Cendikiawan's study, who were students that were not seeking orthodontic treatment and therefore were not verified as having indications for orthodontic treatment.

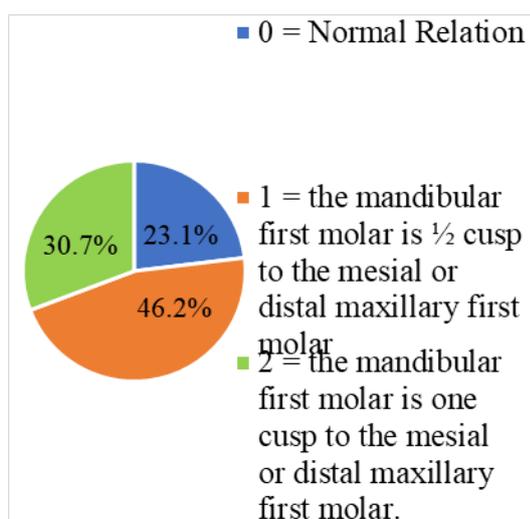


Figure 10. Tenth DAI component: Anteroposterior molar relation on patients of RSKGM FKG UI orthodontic specialist clinic between 2010 and 2014.

The results for orthodontic treatment need from the calculated DAI scores showed that 36.5% patients were in the “highly desirable of treatment need” class, 32.7% in the “mandatory treatment need” class, 25% in the “elective treatment need” class, and only 5.8% in the “no/slight treatment need” class. This indicates that the treatment provided at the RSKGM FKG UI orthodontic specialist clinic in the past has been in line with the objective needs of the patients.

Similar results were obtained by Goyal *et al.* (2013), who showed that most patients (51%) were in the “mandatory treatment need” class, followed by 23% in the “highly desirable of treatment need” class.⁸ This may have been because of the insurance system in the hospitals where Goyal *et al.* (2013) conducted their study. Therefore, the patients who came to the hospitals have been assessed previously to prioritize the service. Different conditions was found in a study conducted by Haniputra (2006), which showed that the largest number of patients were in the “no/slight treatment need” class (32.73%).¹¹ In the DAI classification system, this category indicates that the patient has no or only mild malocclusion. Differences in the percentages of patients in each treatment requirement category between studies may be due to differences in environment conditions, sociodemography, and other factors that cause variations in the pattern of malocclusion in each population, because the natural etiology of malocclusion is influenced by many factors.^{1,5}

This study has shown that DAI is easy to implement as an index for assessing orthodontic treatment need. The DAI has the advantage of enabling the objective determination of orthodontic treatment need through the assessment of ten components that affect a patient's subjective perception regarding his dental esthetics. Moreover, this study has shown the classification of treatment need which can help in planning the health services, especially for orthodontic care in the community. However, this study still needs to be developed in population-based and the number of subjects so can give better results to be generalized. The DAI also has some disadvantages; the properties of several malocclusions are not considered in the assessment.⁸ Although some malocclusion properties may alter the subjective perceptions of the orthodontic treatment by considering the

functional purpose and not only the esthetic aspects.⁸

Conclusions

The patients who visited the RSKGM FKG UI orthodontic specialist clinic between 2010 and 2014 were mostly in the “highly desirable of treatment need” class. This shows that the patients who visited the clinic were mostly those who truly needed treatment when assessed by DAI. The problems found were mostly crowding in the incisal segment, anterior mandibular irregularity, anterior maxillary irregularity, abnormal anterior maxillary overjet, and abnormal molar relationships. Other problems, too, were found, but at lower levels; these included spacing in the incisal segment, midline diastema, anterior mandibular overjet, vertical anterior open bite as well as missing incisors, canines, and premolars.

Declaration of Interest

The authors declare no conflict of interest.

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