Correlation of orthodontic treatment demand with treatment need assessed using two indices

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Over the past hundred years or so, various methods and indices for the assessment of malocclusion and grading of orthodontic treatment need have been designed.[1-19] The more commonly used indices include the Occlusal Index,[12] the Treatment Priority Index,[13] and the Handicapping Malocclusion Assessment,[18] all of which were developed in the 1960s. These indices were designed to assess malocclusion severity in a quantitative manner, and orthodontic treatment need would be graded accordingly. Among the many indices for measuring malocclusion severity, the Occlusal Index[12] has been found to have the least amount of bias,[20] the best correlation with clinical standards as judged by members of the dental profession,[21,22] and the greatest validity over time.[23] More recently, in 1989, the Index of Orthodontic Treatment Need[19] was developed. It is a grade index scale where severity is not measured, but malocclusion traits are assessed and graded. It has been shown to be satisfactory in validity and reproducibility.[24]

In an earlier report[25] comparing the Occlusal Index (OI) with the Index of Orthodontic Treatment Need (IOTN), it was found that differences in measuring and weighting the various malocclusion features resulted in significantly different treatment needs for a sample group. Both indices had shortcomings.

The aim of the present study was to correlate the orthodontic treatment need of a group of subjects, assessed using both the OI[12] and the IOTN,[19] with the patients' actual treatment demand. If possible, a preferred index would be suggested for assessing the orthodontic treatment need that would better correlate with the demand in Hong Kong.

Materials and methods

Sample

In 1991, a dental survey was done of first-year students attending the University of Hong Kong. A total of 764 students (403 males and 361 fe-

Abstract

The orthodontic treatment need of 105 first year university students (51 males and 54 females, mean age 19.75 years) at the University of Hong Kong was assessed using the Occlusal Index (OI) and the Index of Orthodontic Treatment Need (IOTN). The results were compared with the subjects' orthodontic treatment demand derived from a questionnaire. The OI assessment correlated better with the individuals' own perceptions of appearance than did the IOTN, and the treatment need indicated by the OI also correlated better with the individuals' actual treatment demands.

Key Words

Orthodontic treatment need • Treatment demand • Occlusal Index • Index of Treatment Need

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Table 1
Relation of subjective classification of occlusion to the Occlusal Index scores[12,22]

Suggested range of OI scores		Class	Description
Class I	0 0 - 2.5	Good occlusion	No evidence of an occlusal disorder.
Class II	2 6 - 4.5	No treatment	Slight deviations in the occlusion, but no treatment indicated at this time.
Class III	4 6 - 7.0	Minor treatment	Minor deviations in the occlusion which could be remedied by simple treatment (e.g., space regainers or removable appliances).
Class IV	7 1 - 11.0	Definite treatment	Major deviations in the occlusion which could be remedied by major treatment; (e.g., treatment that would include banding of many teeth).
Class V	11.1 - 16.0	Worst occlusion	Major deviations in the occlusion which could be remedied by major treatment; these occlusions were highly disfiguring of the patient and would probably rank first in treatment priority.

males) were asked to complete a questionnaire concerning their orthodontic treatment demand. They were then offered free dental examinations by the University Health Service, University of Hong Kong. Impressions for study casts were taken of a randomly selected group of 223 (113 males and 110 females). Written consent was obtained.

From the 223 sets of study casts obtained, 105 subjects (51 males and 54 females, mean age 19.75 ± 0.78 years) were randomly chosen for the present study.

Methods

The study casts of these 105 subjects were independently assessed in a double-blind manner by both authors using both the Occlusal Index[12] and the Dental Health Component of the Index of Orthodontic Treatment Need.[19]

Nine measurements were included in the Occlusal Index:[12] dental age, molar relationship, overbite, overjet, posterior crossbite, posterior openbite, tooth displacement or rotation, midline relations, and missing maxillary permanent incisors. Five different classes of malocclusion severity and treatment need could be related to the Occlusal Index scores (Table 1).

The Index of Orthodontic Treatment Need[19] consists of two components. The esthetic component is used to assess the attractiveness of the dentition, and the dental health component looks for features that could impair the health and function of the dentition. The dental health component[19] of the IOTN has five grades, ranging from grade 1, which represents a negligible need for treatment, to grade 5, which indicates an urgent or high priority for treatment (Table 2). In use, 10 features or traits of malocclusion were observed: overjet, reverse overjet, overbite, openbite, crossbite, displacement of teeth, impeded eruption of teeth, defects of cleft lip and palate, Class II and Class III buccal occlusion, and hypodontia. Grades were allocated to the severity of each trait. However, only the highest scoring trait was recorded. The grade of this trait would then describe the priority for treatment of the case.

A second set of Occlusal Index scores were taken from a random selection of 13 subjects at least 1 week after the first assessment was made. Thirty-five subjects were similarly reassessed using the Index of Orthodontic Treatment Need. The reproducibility (r) of the OI score was 0.96 and that of the IOTN was 0.97.

Orthodontic treatment needs assessed using the OI and the IOTN were correlated with each subject's treatment demand as revealed in the questionnaire.

Results

Of the 105 subjects, 25 demanded orthodontic treatment and the remaining 80 thought that they did not need orthodontic treatment. There were no sex differences in any of the parameters measured, therefore the results were pooled together.

OI assessment

Fifty-three subjects fell into the groups of "good occlusion" or "no treatment" when scored using

Table 2
Orthodontic index of treatment need (dental health component) for use on study models[19]

Treatment grade (need)		Description
5 (very great)	5.1	Defects of cleft lip and/or palate
	5.2	Increased overjet > 9 mm.
	5.3	Reverse overjet > 3.5 mm.
	5.4	Impeded tooth eruption (except third molars) due to crowding, displacement, the presence of supernumerary teeth, retained deciduous teeth and any other pathological cause.
	5.5	Extensive hypodontia, with restorative implication (> 1 tooth missing in any quadrant) requiring pre-restorative orthodontics.
4 (great)	4.1	Increased overjet > 6 mm but ≤ 9 mm.
	4.2	Reverse overjet > 1 mm but ≤ 3.5 mm.
	4.3	Posterior lingual crossbites, unilateral posterior buccal crossbites, and anterior crossbites.
	4.4	Severe displacement of teeth > 4 mm.
	4.5	Extreme lateral or anterior open bites > 4 mm.
	4.6	Increased and complete overbite causing notable indentations of the palatal or labial gingivae.
	4.7	Less extensive hypodontia requiring pre-restorative orthodontics or orthodontic space closure to obviate the need for a prosthesis (Not > 1 tooth missing in any quadrant).
3 (moderate)	3.1	Increased overjet > 3.5 mm but ≤ 6 mm.
	3.2	Increased and complete overbite with gingival contact but without indentations or signs of trauma.
	3.3	Lateral or anterior open bite > 2 mm but ≤ 4 mm.
	3.4	Displacement of teeth > 2 mm but ≤ 4 mm.
2 (little)	2.1	Increased oberbite > 3.5 mm with no gingival contact.
	2.2	Anterior or lateral open bite > 1 mm but ≤ 2 mm.
	2.3	Displacement of teeth > 1 mm but ≤ 2 mm.
	2.4	Reverse overjet > 0 mm but ≤ 1 mm.
	2.5	Class II or Class III buccal occlusions with no other anomalies where there is deviation from full interdigitaion.
1 (none)	1.1	Other occlusions including displacements < 1 mm.

the Occlusal Index (Table 3). Among these 53 subjects, 45 thought they did not need orthodontic treatment, which meant that the treatment need assessed using the OI correlated well with treatment demand. Eight of the subjects, on the other hand, thought they would need orthodontic treatment even though their OI scores indicated they had either good occlusion or only slight deviations that did not warrant treatment. In these eight cases, the OI assessment of orthodontic treatment need disagreed with the treatment demand. Statistical analysis using Chi-square tests, in an attempt to find out whether there was any association between sex difference or OI score difference and the presence or absence of treatment demand from this group of subjects was performed. No statistically significant differences were found in any of the tests.

Fifty-two subjects fell into the groups of "minor treatment," "definite treatment," or "worst

Table 3
Distribution of subjects with/without orthodontic treatment demand according to treatment need assessed using the Occlusal Index[12]

OI Score	Description	Number of subjects With treatment demand F	M	Total	Without treatment demand F	M	Total	Total
0 - 2.5	Good occlusion	2	0	2	16	13	29 *	31
2.6 - 4.5	No treatment	3	3	6	11	5	16 *	22
4.6 - 7.0	Minor treatment	6	2	8 *	8	8	16	24
7.1 - 11.0	Definite treatment	0	2	2 *	5	7	12	14
11.1 - 16.0	Worst occlusion	2	5	7 *	1	6	7	14
Total				25			80	105

F = Females
M = Males
* Demand agreed with assessed need

occlusion" as assessed using the OI (Table 3). Seventeen of these subjects thought they needed orthodontic treatment, which meant their demand correlated well with the OI assessment of treatment need. The remaining 35 thought they did not need orthodontic treatment, in which case the assessed treatment need using the OI did not agree with actual demand. Again, there were no associations between sex difference or OI score and the presence or absence of treatment demand.

The figures marked with an asterisk (*) in Table 3 indicate those individuals whose demand agreed with the treatment need according to the OI assessment. A total of 62 subjects (59%) fell into this category. Treatment demand of the other 43 subjects (41%) disagreed with the assessment results using the OI.

There were a total of 80 subjects who had no demand for treatment. Forty-five of these were among the 53 subjects who were judged by the OI to need no orthodontic treatment; while 35 were among the 52 students who, according to the OI scores, did need orthodontic treatment (Table 3). Statistical analysis using the z-test on sample proportions revealed that these two sample proportions were different ($P < 0.05$). This indicated that the Occlusal Index had split these subjects into two groups whose treatment demands were different.

The questionnaires revealed the reasons the 80 individuals gave for not demanding treatment. Each subject could choose one or more of the reasons shown in Table 4. Among the 35 subjects who did not demand treatment but who were judged by the OI to need it, 63% thought that their teeth looked nice, 37% thought that orthodontic treatment would be too expensive, and 29% thought that orthodontic treatment was time-consuming. Of the remaining 45 subjects, who were judged by the OI to need no treatment, 84% thought that their teeth looked nice, 44% thought that treatment would be too expensive, and 33% thought that orthodontic treatment was time-consuming. These were the major reasons for not demanding treatment. The percentage of subjects who thought their teeth looked nice was statistically higher ($P < 0.05$) in the group judged by the OI to need no treatment (84%) than in the group judged to need treatment (63%).

Reasons given by the 25 subjects who demanded treatment are shown in Table 5. The main reason given for demanding treatment was "to improve appearance and popularity." A significant percentage of the subjects who were judged by the OI to need treatment demanded treatment because they wanted to improve their chewing function and have better dental health.

IOTN assessment

When assessed by the IOTN, only 18 subjects fell into grades 1 or 2, indicating their treatment need was either "none" or "little" (Table 6). Among these 18 subjects, 16 had no treatment demand, which implied that the assessed treatment need using the IOTN correlated well with the actual demand. However, two subjects

thought they would need orthodontic treatment. In these two cases, the IOTN assessment of orthodontic need disagreed with the actual demand. Statistical analysis using the Chi-square tests found no statistically significant differences in the distribution of sex or IOTN grades among these two groups of subjects who did and did not demand treatment.

The total number of subjects with IOTN grades of 3, 4, or 5 indicating "moderate", "great" or "very great" treatment need, was 87 (Table 6). Of these, 23 subjects demanded orthodontic treatment, which correlated with the assessed need. On the other hand, 64 subjects had no demand despite the presence of an assessed need; the IOTN scores did not agree with the patients' self-perception. Again, no associations were found between sex difference or IOTN grades and the presence or absence of treatment demand among this group of subjects with objectively assessed need.

The figures marked with an asterisk in Table 6 indicate a total of 39 subjects (37%) whose demand agreed with the need assessed using IOTN. For the remaining 66 subjects (63%), demand disagreed with assessed need.

There were 80 subjects who did not demand treatment. Among these 80 subjects were 16 of the 18 subjects who had no assessed need according to the IOTN and 64 of the 87 subjects who had "moderate," "great," or "very great" assessed treatment need (Table 6). Statistical analysis using the z-test on sample proportions revealed that the two sample proportions were of no statistically significant difference. Hence the IOTN could not sort subjects into groups with different orthodontic treatment demands.

The questionnaires revealed the reasons given by the 80 individuals for not demanding treatment. Each subject could choose one or more reasons, as shown in Table 7. Among the 64 subjects who were judged by the IOTN to need orthodontic treatment, 72% thought that their teeth looked nice, 45% thought that orthodontic treatment would be too expensive, and 28% thought that orthodontic treatment was time-consuming. For the 16 subjects who were judged by the IOTN not to need treatment, 87% thought that their teeth looked nice, 25% thought that treatment would be too expensive, and 31% thought that orthodontic treatment was time-consuming. There were no statistically significant differences between the groups who were judged by the IOTN to need or not to need treatment in the reasons stated for not demanding treatment.

Reasons given by the 25 subjects who demanded treatment are shown in Table 8. The main reasons these subjects gave were "to improve appearance and popularity," "to improve chewing," and "to improve dental health." There were no statistically significant differences regarding the reasons put forth by these subjects.

Table 4
Reasons for not demanding orthodontic treatment according to treatment need assessed using the OI[12]

Reasons*	Need treatment according to OI (n = 35)	Need no treatment according to OI (n = 45)
My teeth look nice	22 (62.9%)	38 (84.4%)
Treatment is painful	8 (22.9%)	5 (11.1%)
Treatment is time consuming	10 (28.6%)	15 (33.3%)
Treatment is too expensive	13 (37.1%)	20 (44.4%)
Don't know who can help	3 (8.6%)	4 (8.9%)
Extractions are needed	0 (0.0%)	0 (0.0%)
Applicances look ugly	6 (17.1%)	11 (24.4%)
I'm too old for treatment	2 (5.7%)	2 (4.4%)

* Each individual could choose more than 1 reason.

Table 5
Reasons for demanding orthodontic treatment according to treatment need assessed by the OI[12]

Reason*	Need treatment according to OI (n = 17)	Need no treatment according to OI (n = 8)
Improve appearance, popularity	14 (82.4%)	6 (75.0%)
Enhance chance of career success	0 (0.0%)	0 (0.0%)
Improve speech	1 (5.9%)	1 (12.5%)
Improve chewing	7 (41.2%)	1 (12.5%)
Improve dental health	9 (52.9%)	0 (0.0%)

* Each individual could choose more than 1 reason.

Discussion

Among the 105 subjects, 62 individuals (59%) had treatment demand that correlated well with

Table 6
Distribution of subjects with/without orthodontic treatment demand according to treatment need assessed using the IOTN[19]

IOTN Grade	Treatment need	Number of subjects: With treatment demand F	M	Total	Without treatment demand F	M	Total	Total
1	None	2	0	2	9	7	16 *	18
2	Little							
3	Moderate	3	0	3 *	15	12	27	30
4	Great	8	12	20 *	17	20	37	57
5	Very great							
Total			25			80		105

F = Females
M = Males
* Demand agreed with assessed need

the treatment need assessed using the Occlusal Index, while only 39 individuals (37%) had treatment demand that agreed with the treatment need assessed using the Index of Orthodontic Treatment Need. The difference between these two sample proportions was satistically significant ($P<0.001$). Hence, in the present study, the OI assessment correlated better with actual treatment demand than did the IOTN.

The OI was also able to sort subjects into two groups whose treatment demands were different. The percentage of subjects who demanded treatment was significantly higher in the group judged by the OI to need treatment than in the group judged not to need treatment. However, the IOTN was unable to sort the subjects similarly.

The percentage of subjects who thought their teeth looked nice was statistically higher in the group judged by the OI not to need treatment than in the group judged to need treatment. This meant that the OI was better correlated with the individuals' perceptions of their own appearance. On the other hand, subjects who did not demand treatment tended to give the same reasons, regardless of their assessed need.

The other integral part of the IOTN is the Aesthetic Component, which is a strong indicator of the subject's demand. However, this component was omitted in the present study to correlate with treatment need because it had been found in an earlier report[26] that the present sample had an extremely low level of dental awareness or perception of dental irregularity. Hence, it was believed that the Aesthetic Component of the IOTN would be less strong in this investigation.

Conclusion

In an earlier report by the same authors,[25] it was found that when these two indices were used to assess the same group of individuals, significant differences in treatment needs resulted. These differences were attributed to variations in measuring and weighting missing teeth, crossbites, and tooth displacements. The IOTN puts very heavy weights on missing teeth, crossbites, and tooth displacements, which could make the

IOTN oversensitive, especially when used as an epidemiological tool. On the other hand, the OI does not take missing teeth into account at all, except in cases of missing maxillary permanent incisors; nor does it score mesiodistal or buccolingual tipping of teeth that would occur subsequent to tooth loss. This would result in an underestimation of orthodontic treatment need. The authors therefore concluded that both indices had shortcomings and neither was ideal. However, because the OI is much more time-consuming to use than the IOTN, the simplicity of the latter gives it some advantage, as it would facilitate the study of a large population group.[25]

The present study could be considered a follow-up to the previous one. The present results indicate that the OI assessment correlates better than the IOTN with individuals' perceptions of their own appearance, and the treatment need judged by the OI correlates better with treatment demand.

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Table 7
Reasons for not demanding orthodontic treatment according to treatment need assessed using the IOTN[19]

Reasons*	Need treatment according to IOTN (n = 64)	Need no treatment according to IOTN (n =16)
My teeth look nice	46 (71.9%)	14 (87.5%)
Treatment is painful	12 (18.8%)	1 (6.3%)
Treatment is time consuming	18 (28.1%)	5 (31.3%)
Treatment is too expensive	29 (45.3%)	4 (25.0%)
Don't know who can help	7 (10.9%)	1 (6.3%)
Extractions are needed	0 (0.0%)	0 (0.0%)
Applicances look ugly	15 (23.4%)	3 (18.8%)
I'm too old for treatment	4 (6.3%)	1 (6.3%)

* Each individual could choose more than one reason.

Table 8
Reasons for demanding orthodontic treatment according to treatment need assessed by the IOTN[19]

Reasons*	Need treatment according to IOTN (n = 23)	Need no treatment according to IOTN (n = 2)
Improve appearance, popularity	19 (82.6%)	1 (50%)
Enhance chance of career success	0 (0.0%)	0 (0.0%)
Improve speech	3 (13.0%)	0 (0.0%)
Improve chewing	7 (30.4%)	1 (50.0%)
Improve dental health	11 (47.8%)	1 (50.0%)

* Each individual could choose more than one reason

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