

Original Article

Evaluation of reliability of index of orthodontic treatment need for assessment of orthodontic treatment need

ABSTRACT

Objective: The aim of this study was to evaluate the reliability of index of orthodontic treatment need (IOTN) for assessment of orthodontic treatment need.

Materials and Methods: A total of 106 subjects of aged between 18 and 25 years with no history of orthodontic treatment were selected by the convenience sampling method from the nondental student population of institutions belonging to North Indian population. The expressed demand for orthodontic treatment by the subjects was assessed using questionnaire. The self-perception of the subjects about orthodontic treatment need was done using aesthetic component (AC) of IOTN. The need for orthodontic treatment was evaluated by the investigator using AC and dental health component (DHC) of IOTN and by a panel of orthodontists using subjective assessment of the patient's study models.

Results: Orthodontic treatment need to be determined by the investigator using DHC of IOTN moderately correlated with the demand of orthodontic treatment by the subjects as assessed using subjects response to questionnaires ($\rho = 0.627$) and orthodontic treatment need to be determined by the opinion of the panel of orthodontists ($\rho = 0.598$).

Conclusion: DHC of IOTN was found to be reliable for evaluating orthodontic treatment need.

Key words: Aesthetic component; dental health component; index of orthodontic treatment need.

Introduction

The demand for orthodontic treatment is complex, subjective, and varies greatly between individuals.^[1-5] Gender, socioeconomic background, and age have been suggested as factors affecting self-perception.

Orthodontic treatment needs can be determined through various occlusal indices. The index of orthodontic treatment need (IOTN),^[6] one of the most widely used occlusal indices was introduced as a combination of the standardized continuum of aesthetic need scale^[7] and the index used by the Swedish Dental Health Board.^[8]

This study was undertaken to evaluate the reliability of IOTN for assessment of orthodontic treatment need in North Indian population.

Materials and Methods

A total of 106 subjects (53 males and 53 females) with no history of previous orthodontic treatment were selected by the convenience sampling method from the nondental student population of institution. They were aged between 18 and 25 years with a mean age of 20.04 ± 1.561 years (mean age of males was 20.53 ± 1.612 years, mean age of females was 19.53 ± 1.353 years). Young adults were chosen for the study because they are capable of expressing their opinion regarding

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their perception of esthetics. The student population was also chosen because of their easy accessibility in the college. Approval for the study was obtained from the Ethics Committee of the institution. The objectives and protocol of the study were explained to the subjects. Then, consent forms were obtained from participants who agreed to participate in the study.

A brief description about braces and orthodontic treatment were given to the subjects, and they were asked not to consider the cost of treatment while responding the questionnaire so as to remove any bias against treatment due to financial constraints. The expressed demand for orthodontic treatment was evaluated with the responses to the questionnaire by the subjects. The following questionnaire was used which carried responses indicating willingness, unwillingness, or uncertainty (borderline treatment need).

- Do you need braces?
No (unwillingness) Yes (willingness)
Not sure (uncertainty)
- Are you happy with the arrangement of your front teeth?
No (willingness) Yes (unwillingness)
Not sure (uncertainty)
- Are you happy with the appearance of your own teeth compared to the teeth of your peers?
No (willingness) Yes (unwillingness)
Not sure (uncertainty)
- Do you consider well-aligned teeth important for overall facial appearance?
No (unwillingness) Yes (willingness)
Not sure (uncertainty)

The questionnaire was scored in the following manner: When the number of responses indicating subject's willingness to undergo orthodontic treatment, were more than 2 out of 4, it indicated subject's willingness for orthodontic treatment. When the numbers of responses indicating subject's unwillingness to undergo orthodontic treatment were more than 2 out of 4, it indicated subject's unwillingness for orthodontic treatment. The remaining subjects were categorized as having borderline treatment need.

The self-perception of the subjects about orthodontic treatment need was done using aesthetic component (AC) of IOTN. The AC of IOTN has ten colored photographs in increasing order of severity of malocclusion with grading from 1 to 10 allocated according to the position photograph. These photographs were presented to the subjects to choose the one with which they could identify themselves on esthetic basis and allocate grades for AC of IOTN. The grades for AC of IOTN were also recorded by the investigator using same photographs (Grades 1–4 represented no need

to treatment, 5–7 moderate need, and 8–10 highly needed to treatment).

The need for orthodontic treatment was evaluated by the investigator using dental health component (DHC) of IOTN. There were five grades within the DHC which were grouped the following validation as follows: Grades 1 and 2 as score 1 represents no need for treatment, Grade 3 as score 2 represents borderline treatment need, Grade 4 and 5 as score 3 represents definite treatment need [Table 1].

Table 1: Dental health component of index of orthodontic treatment need

Grade 1: No treatment required
Extremely minor malocclusions, including displacements <1 mm
Grade 2: Little need
Increased overjet >3.5 mm but ≤6 mm (with competent lips)
Reverse overjet >0 mm but ≤1 mm
Anterior or posterior crossbite with ≤1 mm discrepancy between retruded contact position and intercuspal position
Displacement of teeth >1 mm but ≤2 mm
Anterior or posterior open bite >1 mm but ≤2 mm
Increased overbite ≥3.5 mm (without gingival contact)
Pre- or post-normal occlusions with no other anomalies. Includes up to half a unit discrepancy
Grade 3: Borderline need
Increased overjet >3.5 mm but ≤6 mm (incompetent lips)
Reverse overjet >1 mm but ≤3.5 mm
Anterior or posterior crossbites with >1 mm but ≤2 mm discrepancy between the retruded contact position and intercuspal position
Displacement of teeth >2 mm but ≤4 mm
Lateral or anterior open bite >2 mm but ≤4 mm
Increased and incomplete overbite without gingival or palatal trauma
Grade 4: Treatment required
Increased overjet >6 mm but ≤9 mm
Reverse overjet >3.5 mm with no masticatory or speech difficulties
Anterior or posterior crossbites with >2 mm discrepancy between the retruded contact position and intercuspal position
Severe displacements of teeth >4 mm
Extreme lateral or anterior open bites >4 mm
Increased and complete overbite with gingival or palatal trauma
Less extensive hypodontia requiring prerestorative orthodontics or orthodontic space closure (one tooth per quadrant)
Posterior lingual crossbite with no functional occlusal contact in one or more buccal segments
Reverse overjet >1 mm but <3.5 mm with recorded masticatory and speech difficulties
Partially erupted teeth, tipped and impacted against adjacent teeth
Existing supernumerary teeth
Grade 5: Treatment required
Increased overjet >9 mm
Extensive hypodontia with restorative implications (more than one tooth missing in any quadrant requiring prerestorative orthodontics)
Impeded eruption of teeth (apart from 3 rd molars) due to crowding, displacement, the presence of supernumerary teeth, retained deciduous teeth, and any pathological cause
Reverse overjet >3.5 mm with reported masticatory and speech difficulties
Defects of cleft lip and palate

Dental health component of index of orthodontic treatment need

The study models were given to a panel of orthodontists for subjective evaluation of orthodontic treatment need. The scores given by a panel of orthodontists were as follows No need of treatment as score of 1, borderline treatment need as score of 2, and definite treatment need as score of 3.

Results

On the evaluation of orthodontic treatment need determined by the responses of the subjects to the questionnaires, it was found that a majority (54.7%) of the subjects were willing to undergo orthodontic treatment whereas around quarters (25.5%) were unsure about their orthodontic treatment need. Around one-fifth (19.8%) of subjects expressed no desire for orthodontic treatment. The proportion of males expressing a willingness to undergo orthodontic treatment (73.6%) was more than that of females (35.8%). The proportion of females expressing unwillingness for orthodontic treatment (34.0%) was higher than that of males (5.7%). Thus, it was observed that expression of orthodontic treatment demand was different in males and females [Table 2].

On the evaluation of orthodontic treatment need determined by self-perception of the subjects using AC of IOTN, it was

found that a small proportion 12.6% subjects had a definite need of treatment and 20.4% subjects had a borderline treatment need. A majority (67%) of subjects had no treatment need. A gender-wise comparison of orthodontic treatment needs revealed a significantly higher definite treatment need in males (21.6%) as compared to females (3.8%), whereas females had a significantly higher proportion of subjects with no treatment need (75%) as compared to males (58.8%) [Table 3].

On the evaluation of orthodontic treatment need determined by the investigator using AC of IOTN, it was found that a small proportion 13.6% subjects had a definite need of treatment and 16.5% subjects had borderline treatment need. A majority (69.9%) of subjects had no treatment need. A gender-wise comparison of orthodontic treatment needs using AC of IOTN revealed a significantly higher definite treatment need in males (23.5%) as compared to females (3.8%). Females had a significantly higher proportion of subjects with no treatment need (78.8%) compared to males (60.8%). The AC of IOTN could not be evaluated for three subjects, either by the investigator or the subjects themselves, as they did not match any photograph of AC [Table 4].

On the evaluation of orthodontic treatment need to be determined by the investigator using DHC of IOTN, it was

Table 2: Evaluation of orthodontic treatment demand by the subjects using questionnaire

Expressed demand	n	%	Males (n=53)		Females (n=53)		Statistical significance		
			n	%	n	%	χ^2	P	Inference
Denial	21	19.8	3	5.7	18	34.0	13.361	<0.001	***
Unsure	27	25.5	11	20.8	16	30.2	1.242	0.265	NS
Willingness	58	54.7	39	73.6	19	35.8	15.230	<0.001	***

P>0.05 - NS (Not significant), ***P<0.001 - most significant

Table 3: Self-perception of orthodontic treatment need evaluated using aesthetic component of index of orthodontic treatment need by the subjects (n=103)

Orthodontic treatment need	n	%	Males (n=51)		Females (n=52)		Statistical significance		
			n	%	n	%	χ^2	P	Inference
No treatment need	69	67.0	30	58.8	39	75.0	4.106	0.043	*
Borderline treatment need	21	20.4	10	19.6	11	21.2	0.087	0.768	NS
Definite treatment need	13	12.6	11	21.6	2	3.8	6.933	0.008	**

P>0.05 - NS (Not significant), *P<0.05 - significant, **P<0.01 - very significant

Table 4: Orthodontic treatment need evaluated using aesthetic component of index of orthodontic treatment need by the investigator (n=103)

Orthodontic treatment need	n	%	Males (n=51)		Females (n=52)		Statistical significance		
			n	%	n	%	χ^2	P	Inference
No treatment need	72	69.9	31	60.8	41	78.8	3.992	0.042	*
Borderline treatment need	17	16.5	8	15.7	9	17.3	0.049	0.825	NS
Definite treatment need	14	13.6	12	23.5	2	3.8	8.493	0.004	**

P>0.05 - NS (Not significant), *P<0.05 - significant, **P<0.01 - very significant

found that 41.5% subjects had definite treatment need and 27.4% subjects had borderline treatment need whereas 31.1% subjects had no treatment need. There was no significant difference in treatment need between males and females when assessed using DHC [Table 5].

On the evaluation of orthodontic treatment need to be determined by the opinion of the panel of orthodontists, it was noted that 73.6% subjects had definite treatment need and 16.0% subjects had borderline treatment need whereas 10.4% subjects had no treatment need. Definite treatment needs in males (86.8%) was higher compared to that in females (60.4%). Females with borderline or no treatment need were more as compared to males [Table 6].

On evaluation of correlation among different methods, it was found that the demand of orthodontic treatment need by the subjects using questionnaire was moderately correlated with orthodontic treatment need determined by the investigator using DHC of IOTN ($\rho = 0.627$) and also orthodontic treatment need

determined by the subjective evaluation of a panel of orthodontists ($\rho = 0.598$) [Table 7].

Orthodontic treatment need to be determined by the investigator using DHC of IOTN and that determined by the subjective evaluation of a panel of orthodontists were also found to be moderately correlated ($\rho = 0.525$) [Table 7].

Assessments for orthodontic treatment need using AC of IOTN by the investigator, and the subjects were found to be strongly correlated ($\rho = 0.950$) [Table 7].

Discussion

The results of the present study revealed that a majority of subjects in the study sample were willing to undergo orthodontic treatment. Out of which, the orthodontic treatment demand was expressed by more males than females. This might have been due to the greater severity of malocclusion in the males of our study sample as compared to females as the treatment need was required more in

Table 5: Orthodontic treatment need evaluated using dental health component of index of orthodontic treatment need

Orthodontic treatment need	n	%	Males (n=53)		Females (n=53)		Statistical significance		
			n	%	n	%	χ^2	P	Inference
No treatment need	33	31.1	15	28.3	18	34.0	0.492	0.483	NS
Borderline treatment need	29	27.4	14	26.4	15	28.3	0.079	0.779	NS
Definite treatment need	44	41.5	24	45.3	20	37.7	0.507	0.477	NS

P>0.05 - NS (Not significant)

Table 6: Subjective evaluation of orthodontic treatment need by a panel of orthodontists

Orthodontic treatment need	n	%	Males (n=53)		Females (n=53)		Statistical significance		
			n	%	n	%	χ^2	P	Inference
No treatment need	11	10.4	2	3.8	9	17.0	5.141	0.023	*
Borderline treatment need	17	16.0	5	9.4	12	22.6	3.617	0.057	NS
Definite treatment need	78	73.6	46	86.8	32	60.4	9.264	0.002	**

P>0.05 - NS (Not significant), *P<0.05 - significant, **P<0.01 - very significant

Table 7: Correlation between different evaluation methods (Spearman correlation coefficient “ ρ ”)

	Self-perception by the subjects		Need of orthodontic treatment determined by investigator		Subjective evaluation of treatment need by a panel of orthodontists
	Responses to questionnaire	Using AC of IOTN	Using AC of IOTN	Using DHC of IOTN	
Self-perception by the subjects					
Responses to questionnaire	1				
Using AC of IOTN	0.287	1			
Need of orthodontic treatment determined by investigator					
Using AC of IOTN	0.316*	0.950***	1		
Using DHC of IOTN	0.627**	0.463*	0.498*	1	
Subjective evaluation of orthodontic treatment need by a panel of orthodontists	0.598**	0.370*	0.343*	0.525**	1

$\rho < 0.3$ weak correlation, $\rho = 0.3-0.5$ mild correlation, $\rho = 0.5-0.7$ moderate correlation, $\rho > 0.7$ strong correlation. AC: Aesthetic component, IOTN: Index of orthodontic treatment need

males than females according to the subjective evaluation by the panel of orthodontists. The demand for orthodontic treatment was reported to be influenced by the gender of the patient as has been reported by Roberts *et al.*^[9] and Hedayati *et al.*,^[10] but in their study, a higher proportion of females demanded orthodontic treatment compared to males. In the study by Burden,^[11] gender had no influence on the uptake of orthodontic treatment.

Self-perception of orthodontic treatment need by the subjects using stimulus photographs of AC of IOTN revealed that a majority of subjects (67.0%) perceived themselves to be in AC grade 1–4 indicating no treatment need. It could possibly be due to the subjects subconsciously trying to allocate themselves on the attractive side. However, this was in contrast to expressed demand for treatment reflected in the questionnaires responded by the subjects. This disparity of treatment need using AC and expressed demand could be explained by the fact that stimulus photographs of AC of IOTN were a two-dimensional representation of malocclusion in the frontal view. The sagittal or vertical discrepancies of the malocclusion and occlusal traits such as crowding in the lower arch might not be readily appreciated. Evaluation of treatment needs using AC of IOTN by the investigator also placed a majority of subjects in grade 1–4 indicating no treatment need. More males as compared to females were found to be in treatment need as assessed using AC either by the investigator or the subjects.

The correlation of expressed demand for orthodontic treatment by the subjects with self-perception of treatment need by themselves using AC of IOTN was weak ($\rho = 0.287$). This was in contrast to the findings by Grzywacz^[12] and Birkeland *et al.*^[13] who found moderate correlation between expressed demand for orthodontic treatment and self-perception using AC of IOTN.

Three subjects in the present study could not be scored for AC either by the subjects themselves or by the investigator because their malocclusion could not be matched to any of the photographs. Out of these three cases, two had anterior open bite, and one had anterior crossbite. This indicated that AC of IOTN was not sensitive enough to account for all types of malocclusion such as class III, open bite, and crossbite.

There was a strong correlation between perception of orthodontic treatment need as judged by the patient and investigator using AC of IOTN ($\rho = 0.95$). This was similar to that found by Grzywacz^[12] but higher compared to the results of Birkeland *et al.*^[13] and Hedayati *et al.*^[10]

While assessing DHC, the major occlusal traits in the definite treatment need and borderline treatment need groups

were increased overjet and displacement. Treatment need was similar in both the sexes when evaluated using DHC of IOTN as reported earlier by Uçüncü and Ertugay^[14] and Chew and Aw.^[15]

The correlation of orthodontic treatment need using DHC and that using AC of IOTN was mild ($\rho = 0.463$). Hedayati *et al.*^[10] earlier reported poor correlation ($\rho = 0.291$) between the two.

The disparity between AC and DHC of IOTN could be explained on the basis that occlusal traits such as crowding in lower arch, increased overjet, missing posterior teeth, and impacted canines could not be visualized on the anterior frontal view photographs of AC which placed them in the “no treatment need” category.

Subjective evaluation by the panel of orthodontists revealed a definite treatment need in 73.6% subjects which was more than that evaluated using DHC of IOTN. This could be due to a tendency among orthodontists to qualify even those cases for treatment which did not have treatment need according to IOTN. The correlation of orthodontic treatment need using DHC with a subjective assessment by the panel of orthodontists was found to be moderate ($\rho = 0.525$) which was similar to that reported by Grzywacz.^[16] The DHC score is based on a grade assigned to the single worst occlusal trait, which makes it an easy and reliable index to use but ignores the cumulative effect of lesser occlusal deviations. As a result, it might underestimate the severity of malocclusion in some individuals. The discrepancy between the orthodontists' opinion and DHC criteria could be mainly attributed to cases of bimaxillary dentoalveolar protrusion with mild or no crowding, displacement of teeth >2 mm to <4 mm, lateral open bite >2 mm to <4 mm, increased and incomplete overbite without gingival or palatal trauma and increased overjet which were placed in the “no treatment” or “borderline treatment” category according to DHC, but the panel of orthodontists placed them under “definite treatment need.”

In the present study, the maximum treatment need was assessed by the panel of orthodontists while minimum treatment need was assessed using AC.

The moderate correlation of DHC with demand for orthodontic treatment expressed by the subjects and orthodontists' opinion of treatment need make it a reliable way to assess treatment need.

Conclusion

The following conclusions were drawn from the study:

1. Assessments for orthodontic treatment need using AC

of IOTN by the investigator, and the subjects were found to be strongly correlated ($\rho = 0.950$)

2. Maximum treatment need was assessed by the subjective evaluation of a panel of orthodontists while minimum treatment need was assessed by AC of IOTN
3. Self-perception of orthodontic treatment need by the subjects using AC of IOTN correlated weakly with the expressed demand of orthodontic treatment by the subjects indicating failure of AC of IOTN to identify all cases with orthodontic treatment need
4. Orthodontic treatment need was more in males than that in females as assessed by expressed demand for orthodontic treatment by the subjects, AC of IOTN, as well as opinion of the panel of orthodontists whereas there was no genderwise difference in treatment, need assessed by DHC of IOTN
5. Orthodontic treatment needs assessed by DHC of IOTN correlated moderately with expressed demand of orthodontic treatment by the subjects and orthodontic treatment need assessed by the subjective evaluation of a panel of orthodontists thereby making it a reliable tool for evaluating orthodontic treatment need.

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Conflicts of interest

There are no conflicts of interest.

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