Relationship Between Index of Complexity, Outcome and Need and Dental Aesthetic Index in the Assessment of Orthodontic Treatment Complexity and Need of Nigerian Adolescents

Relação Entre o Índice de Complexidade, Resultado e Necessidade e o Índice de Estética Dentária na Avaliação da Necessidade e Complexidade de Tratamento Ortodôntico de Adolescentes Nigerianos

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RESUMO

Objetivo: Avaliar a relação entre o Índice de Complexidade, Resultado e Necessidade (ICON) e o Índice de Estética Dentária (DAI) na avaliação da necessidade e complexidade de tratamento ortodôntico entre adolecentes em Ibadan, Nigéria.

Método: A necessidade e complexidade de tratamento ortodôntico foi avaliada em 274 adolescentes de 4 escolas da cidade de Ibadan, Nigéria, com idades entre 12-17 anos - sendo 142 (51,8%) do sexo masculino e 132 (48,2%) do sexo feminino através do ICON. A necessidade de tratamento da mesma amostra foi avaliada com o uso do DAI por um único examinador. A estatística descritiva, o teste do Qui-quadrado, Correlações não-paramétricas (Spearman e Pearson's) foram utilizadas para testar a relação entre os indíces.

Resultados: Ambos os índices identificaram que 102 (37,2%) dos adolescentes não tinham necessidade de tratamento enquanto que dos 27 (9,9%) que o ICON considerou como portador de um grau de complexidade severo/muito severo, o DAI mostrou 22 (8,0%) destes como possuidores de maloclusões incapacitantes. A concordância entre os índices para ambas as necesidades de tratamento, bem como para a complexidade e severidade das maloclusões foram estatisticamente significativas (p<0,01). De um modo geral, as correlações dos escores de ambos os índices mostraram-se positivamente fortes e estatisticamente significante (r = 0,715; p<0,01).

Conclusão: Ambos os índices ortodônticos concordaram satisfatoriamente em ambas as facetas de avaliação de tratamento ortodôntico, sugerindo que o ICON poderia ser utilizado para a avaliar os cuidados ortodônticos dos Nigerianos.

ABSTRACT

Objective: To assess the relationship between Index of Complexity, Outcome and Need (ICON) and Dental Aesthetic Index (DAI) in the assessment of orthodontic treatment complexity and need among adolescents in Ibadan, Nigeria.

Methods: The orthodontic treatment complexity and need of 274 adolescents drawn from 4 secondary schools in Ibadan city, Nigeria aged 12-17 years – 142 (51.8%) females and 132 (48.2%) males were examined using the ICON. The orthodontic treatment need of the same subjects was assessed using the DAI. One investigator assessed all the subjects. In addition to descriptive and chi-square statistics, non-parametric correlations (Spearman Rank Order and Pearson's Product Moment Correlation Coefficients) were used to test the relationship between the indices.

Results: Both indices agreed that 102 (37.2%) of the subjects had no treatment need while out of 27 (9.9%) that ICON considered as belonging to the difficult/very difficult complexity grades, DAI grouped 22 (8.0%) of them as having handicapping malocclusions. The agreements between the indices for both treatment needs as well as for complexity and severity of malocclusions were very statistically significant (P < .01). Overall, the correlations of the scores by both indices were found to be positively strong and very significant (r = .715; P < .01).

Conclusion: Both orthodontic indices agreed satisfactorily on both facets of orthodontic treatment provision assessed, suggesting that ICON could validly be used to assess such in orthodontic care of Nigerians.

DESCRITORES

Ortodontia; Índices; Adolescentes; Maloclusão.

DESCRIPTORS

Orthodontics; Indexes; Adolescents; Malocclusion.

INTRODUCTION

Occlusal indices are useful for research, audit, practice management, and quality assurance in orthodontics[1]. Over the years, different indices have been developed for various facets of orthodontic provision but they could not enjoy international acceptance[2-9]. This contributed in making international comparison of data difficult.

The Dental Aesthetic Index (DAI) was developed originally based on North American Caucasian sample[10]. However, subsequently the DAI was adopted as a cross-cultural index by the World Health Organization for assessment of orthodontic treatment need[11], and its excellent reliability and validity has also been documented[12].

In response to the need for an international composite index for assessment of different facets of orthodontic provision, the Index of Complexity, Outcome and Need (ICON) was developed based on the expert opinion of 97 practising orthodontists from 9 countries - Germany, Greece, Hungary, Italy, Netherlands, Norway, Spain, UK and the United States of America[1]. Importantly, the ICON has helped to solve the problem of modifying indices for assessment of orthodontic treatment outcome such as the Peer Assessment Rating (PAR) Index for use in different countries as well as being a universal index for clinical application and international comparison of data[13]. In addition to being relatively easy to use and its cost-effectiveness, recent reports have shown that the ICON could replace other orthodontic indices in assessing different facets of orthodontic care in other countries[14,15]. This makes it an index of great potential for both developing and developed economies of the world. Also, a recent clinic-based pilot study in Nigeria[16] on this index agrees with the related North American study[15], thereby suggesting that the ICON could also replace the DAI in assessing orthodontic treatment need in Nigerian patients as a valid index. It was deemed necessary to go beyond the demand population in assessing the relationship between ICON and DAI.

Therefore, this epidemiological study aimed at evaluating the agreement between the Index of Complexity, Outcome and Need and the Dental Aesthetic Index in the assessment of orthodontic treatment complexity and needs of adolescents in Ibadan, Nigeria.

METHODOLOGY

The subjects were Nigerian junior and senior secondary school children selected from four (4) secondary schools in Ibadan city, Oyo State, Nigeria. The schools selected included both public (no fee-paying) and private (high fee-paying) schools in order to involve children from both the low and high socio-economic groups in the society. The authorities of the selected schools were also approached for permission to carry out the study in their schools while only those adolescents who consented to the study were recruited.

In all, two hundred and seventy four (274) adolescents aged 12-17 years – 132 (48.2%) males and 142 (51.8%) females were examined for orthodontic treatment complexity and need using the Index of Complexity, Outcome and Need[1]. The same subjects were also assessed according to the Dental Aesthetic Index[10,11]. One investigator assessed all the subjects clinically in their schools under natural illumination while strictly following the guidelines for both the ICON and DAI. None of the children examined had received any form of orthodontic treatment before the assessment.

ICON: For orthodontic treatment complexity and need, the standard criteria for such classifications were used: treatment complexity graded according to the total ICON scores into easy (<29), mild (29-50), moderate (51- 63), difficult (64 - 77) and very difficult (>77) while treatment need was categorized into 'no treatment' when the total ICON score was less than 43 and 'treatment need' when ICON score was equal or more than 43.

DAI: The standard criteria for grouping the total scores was followed – normal or minor malocclusion with no treatment need or slight need (<25), definite malocclusions with treatment considered elective (26-30), severe malocclusions with treatment highly desirable (31-35) and very severe or handicapping malocclusion with treatment considered mandatory (>36).

Intra-Examiner Reliability Tests

Although excellent intra-examiner reliabilities of the investigator on the uses of these orthodontic indices had been reported[15,17], 20 subjects who were not part of this sample were randomly selected and re-examined after 2-4 weeks interval. The first and second examinations were evaluated statistically using both Pearson Product Moment Correlation Coefficient and Spearman's Rank Correlation Coefficient (Spearman's rho) and excellent agreements were found (According to Pearson, ICON: r = .996, P = .000; DAI: r = .993, P = .000; According to Spearman, ICON: r = .994, P =.000; DAI: r = .985, P =.000).

In addition to descriptive statistics, parametric and non-parametric statistics were applied in the analysis of the data. The cross-tabulation analysis was used to determine the ability of ICON and DAI to detect the same treatment needs as well as to determine the agreement between severity of malocclusion according to the DAI and the complexity of cases using the ICON. The non-parametric correlations (Spearman Rank Order and Pearson's Product Moment Correlation Coefficients) were used to test the relationship between the two indices. All analyses were done using the Statistical Package for Social Sciences (SPSS) for windows release 11.5 (SPSS Inc. Chicago, IL). P values of less than 0.05 were considered as statistically significant.

RESULTS

The range and mean scores according to both the ICON and DAI for the subjects are shows in Table 1.

Table 1. Descriptive statistics of the scores of the indices for the subjects.

Index	Score Range		Mean	Std. Deviation	N
	Minimum	Maximum			
ICON	7	106	41,93	15,38	274
DAI	15	74	28,68	9,59	274

The cross tabulation between DAI and ICON treatment needs reveals very statistically significant agreement as shown in Table 2 (X^2 = 84.985; df = 3; P = .000). Out of 116(42.3%) subjects that were considered by DAI standard as having no or slight treatment need, 102(37.2%) of them were considered by ICON criteria as having no orthodontic treatment need also. Equally, out of 60(21.9%) subjects that were considered as having very severe / handicapping malocclusion according to DAI criteria, ICON considered 48(17.5%) of them as having need for orthodontic treatment.

Table 3 shows very statistically significant agreement between the orthodontic treatment complexity levels of the malocclusions according to the ICON and the severity levels of the malocclusions according to DAI(X^2 = 150.099; df = 12; P = .000). Out of 55(20.1%) subjects that ICON considered their orthodontic treatment complexity as easy, 52(19.0%) of them had treatment need (severity) considered by DAI as little or no need for orthodontic treatment while 2(0.7%) belonged to severity level of malocclusion with orthodontic treatment considered as elective. Twenty seven (9.9%) subjects had malocclusions considered by ICON as belonging to difficult / very difficult complexity grades while DAI considered 22(8.0%) of them as belonging to the group of malocclusions classified as very severe / handicapping in nature.

Table 2. Cross tabulation of the ICON and DAI treatment needs groups.

DAI Treatment Need levels	ICON Treatment Need				Total	
	No Treatment Need (≤43)		Treatment Need (>43)			
	n	%	n	%	n	%
≤25	102	87.9	14	12.1	116	100
26-30	32	49.2	33	50.8	65	100
31-35	13	39.4	20	60.6	33	100
≥36	12	20.0	48	80.0	60	100
Total	159	58	115	42	274	100

X^2 =84.985; df = 3; P = .000

Table 3. Cross tabulation of the complexity grades of malocclusion according to ICON and severity levels of malocclusion according to DAI.

Complexity (ICON)	Severity Levels of Malocclusion								Total	
	≤25		26-30		31-35		>36			
	n	%	n	%	n	%	n	%	n	%
Easy (<29)	52	94.5	2	3.6	1	1,8	-	-	55	100
Mild (29-50)	59	39.9	43	29.1	25	16.9	21	14.2	148	100
Moderate (51-63)	4	9.1	16	36.4	7	15.9	17	38.6	44	100
Difficult (64-77)	1	4.5	4	18.2	-	-	17	77.3	22	100
Very Difficult (>77)	-	-	-	-	-	-	5	100	5	100
Total	116	42.3	65	23.7	33	12	60	21.9	274	100

X^2 =150.099; df = 12; P = 0.000

The spearman's rank order correlation between the orthodontic treatment according to DAI and ICON derived orthodontic treatment need as shown in Table 4 was found to be very statistically significant (r = .588; P = .000), as well as the correlation between the DAI treatment need/ severity and ICON complexity grades (r = .620; P = .000).

Generally, Pearson correlation coefficient between the ICON- derived scores of the subjects and DAI- derived

scores were found to be very statistically significant (r = .715; P = .000) while almost the same strength was found with Spearman's rank correlation coefficient (r = .699; P = .000).

Table 4. Spearman correlations between DAI treatment need/ severity and ICON treatment need and complexity grades.

DAI	ICON	
	Treatment needs component	Treatment complexity component
	.588**	.620**

DISCUSSION

Quality assurance in every aspect of health care delivery remains crucial to the maintenance good standard. The possibility of using ICON in the assessment of different facets of orthodontic provision holds promise internationally because of its cost-effectiveness in addition to its documented reliability and validity[18,19]. Otuyemi et al.[20] had earlier shown significant similarity in the perception of dental aesthetics in the United States of America and Nigeria, according to the dental aesthetics index.

The mean ICON score recorded in this study is expectedly lower than those – 67.38 $\pm$ 19.63 (SD), 72.5, 69 and 72.9 $\pm$ 13 (SD), reported in previous clinic-based studies in Nigeria[16], Sweden[21], Greece[22] and UK[14]. Meanwhile, the present mean ICON score in this study is comparable to 42.05 being the average for the two overall mean ICON score for Riga and Daugavpils secondary school children in Latvia reported in a similar epidemiological study[23]. Similarly, the mean DAI score in the present study is lower than that reported in a similar Nigerian clinic-based study[16].

The highly significant relationship between orthodontic treatment needs as assessed by ICON as well by DAI in the present study is in agreement with the similar Nigerian clinic-based study by Onyeaso[16] and a North American report[15]. It is also comparable to the finding of Fox et al.[14] in UK involving ICON and IOTN.

The present finding of highly significant relationship between orthodontic treatment complexity according to ICON and severity of malocclusion according to DAI is consistent with an earlier Nigerian study in a demand population[16]. Complexity or treatment difficulty has been defined in orthodontic literature to mean the degree of effort associated with correcting malocclusion and obtaining normal or ideal occlusion[24]. Cassinelli et al.[25] reported treating the cases they identified as difficult for a longer time and more frequently than those cases they identified as easy without even achieving the same final results. They reported that besides patients' characteristics, severity of malocclusions

contributed to the difficult cases. Both Richmond et al.[21] and Onyeaso and Begole[26,27] reported that pre-treatment ICON scores were equally significantly associated with duration of orthodontic treatment with cases having higher pre-treatment scores taking longer time to treat.

Generally, in this present study, the high correlations of .7 found between ICON scores and the DAI scores using both Spearman rank order and Pearson product moment correlation coefficients is an indication that the power of prediction of the scores by either index for the other in these subjects was not a matter of chance. When correlation (r) values for positive correlations are up to .7 and above, it is indicative of strong and very reliable prediction[28].

The present Nigerian epidemiological study has not only supported earlier similar but clinic-based studies[15,16] but has provided the first African epidemiological study reporting on such facets of pretreatment orthodontic assessment involving these two important international orthodontic indices.

CONCLUSIONS

1) The ICON promises to be a cost-effective and valid index for the assessment of pretreatment needs of Nigerian orthodontic patients;
2) The present study has also confirmed the strong significant relationship between severity of malocclusions as assessed by the DAI and the complexity of malocclusions as assessed by ICON.

RECOMMENDATIONS

The authorship recommends the use of this composite index – Index of Complexity, Outcome and Need (ICON) in the pre treatment assessment of Nigerian patients.

More studies involving ICON is encouraged especially from other parts of the world at least for the purposes of comparison of data.

REFERENCES

1. Daniels C, Richmond S. The development of Index of Complexity, Outcome and Need (ICON). J Orthod 2000; 27:149-62.

2. Draker HI. Handicapping labio-lingual deviations: a proposed index for public health purposes. Am J Orthod 1960; 46:295-305.

3. Grainger RM. Orthodontic treatment priority index. National Centre for Health Services, Washington DC. Department of Health, Education and Welfare, No. 25, series 11, 1967.

4. Salzmann JA. Handicapping malocclusion assessment to establish treatment priority. Am J Orthod 1968; 54:749-65.

5. Summers CJ. The Occlusal Index. A system for identifying and scoring occlusal disorders. Am J Orthod 1971; 59:552-66.

6. Eismann D. A method of evaluating efficiency of orthodontic treatment. Trans Eur Orthod Soc 1974; 223-32.

7. Brook PH, Shaw WC. The development of an index of orthodontic treatment priority. Eur J Orthod 1989; 11:309-20.

8. Espeland LV, Ivarsson K, Stenvik A. A new Norwegian index of orthodontic treatment need related to orthodontic concern among 11-year-olds and their parents. Community Dent Oral Epidemiol 1992; 20:274-9.

9. Richmond S, Shaw WC, O'brien KD, Buchanan IB, Stephens CD, Roberts CT, Andrews M. The development of the PAR Index (Peer Assessment Rating): reliability and validity. Eur J Orthod 1992; 14:125-39.

10. Cons NC, Jenny J, Kohout FJ. DAI: The Dental Aesthetic Index. Iowa City, Iowa: University of Iowa, 1986.

11. World Health Organization. Oral Health Surveys Basic Methods. 4th Edn Geneva. WHO 47-52, 1997.

12. Beglin FM, Firestone AR, Vig KWL, Beck FM, Kuthy RA, Wade D. A comparison of the reliability and validity of 3 occlusal indexes of orthodontic treatment needs. Am J Orthod Dentofacial Orthop 2001; 120:240-6.

13. Georgiakaki I, Papadopoulos MA. Ioannidou - Marathiotou, I. Evaluation of orthodontic treatment outcome of Angle class 11 division 1 malocclusion by means of ICON index. Hell Orthod Rev 2003; 6:113-28.

14. Fox NA, Daniels C, Gilgrass T. A comparison of the Index of Complexity, Outcome and Need (ICON) with the Peer Assessment Rating (PAR) and the Index of Orthodontic Treatment Need (IOTN). Br Dent J 2002; 193:225-30.

15. Onyeaso CO, Begole EA. Relationship between Index of Complexity, Outcome and Need, Dental Aesthetic Index, Peer Assessment Rating Index and American Board of Orthodontics objective grading system. Am J Orthod Dentofacial Orthop 2007; 131(2):248-52.

16. Onyeaso CO. Orthodontic treatment complexity and need in a group of Nigerian patients: The relationship between the Dental Aesthetic Index (DAI) and the Index x of Complexity, Outcome and Need (ICON). J Contemp Dent Pract 2007; 8(3):37-44.

17. Onyeaso CO. An assessment of the relationship between self-esteem, orthodontic concern, and the Dental Aesthetic Index (DAI) scores among secondary school students in Ibadan, Nigeria. Int Dent J 2003; 53(2):79-84.

18. Firestone AR, Beck FM, Beglin FM, Vig KW. Validity of Index of Complexity, Outcome and Treatment Need (ICON) in determining orthodontic treatment need. Angle Orthod 2002; 72:15-20.

19. Savastano Jr NJ, Firestone AR, Beck M, Vig KWL. Validation of complexity and treatment outcome components of Index of Complexity, Outcome and Need (ICON). Am J Orthod Dentofacial Orthop 2003; 124:244-8.

20. Otuyemi OD, Ogunyinka A, Dosumu O, Cons NC, Jenny J, Kohout FJ, Jakobsen J. Perceptions of dental aesthetics in the United States and Nigeria. Community Dent Oral Epidemiol 1998; 26(6):418-20.

21. Richmond S, Ikonomou C, Williams B, Ramel S, Rolfe B, Kurol J. Orthodontic treatment standard in a public group practice in Sweden. Swed Dent J 2001; 25:137-44.

22. Richmond S, Ikonomou C, Williams B, Ramel S, Rolfe B. Orthodontic treatment standard in Greece. Hell Orthod Rev 2001; 4:9-20.

23. Liepa A, Urtane I, Richmond S, Dunsten F. Orthodontic treatment need in Latvia. Eur J Orthod 2003; 25:279-84.

24. Bergstrom K, Halling A. Comparison of three indices in evaluation of orthodontic treatment outcome. Acta Odontol Scand 1997; 55:36-43.

25. Cassinelli AG, Firstone AR, Beck FM, Vig KW. Factors associated with orthodontists' assessment of difficulty. Am J Orthod Dentofacial Orthop 2003; 123:497-502.

26. Onyeaso CO, Begole EA. Orthodontic treatment standard in an accredited graduate orthodontic clinic in North America assessed using the Index of Complexity, Outcome and Need (ICON). Hell Orthod Rev 2006; 9:23-34.

27. Onyeaso CO, Begole EA. Orthodontic treatment need in an accredited graduate orthodontic center in North America: A pilot study. J Contemp Dent Pract 2006; 7(2):87-94.

28. Bishara SE, Khadivi P, Jakobsen JR. Changes tooth size-arch length relationships from the deciduous to permanent dentition: a longitudinal study. Am J Orthod Dentofacial Orthop 1995; 108(6):607-13.

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