The use of occlusal indices in high-impact literature

C. Bellot-Arcís, J.M. Montiel-Company, J.M. Almerich-Silla, V. Paredes-Gallardo and J.L. Gandía-Franco

Stomatology Department, University of Valencia, Spain

Malocclusion is difficult to define because individuals and cultures vary widely in their perceptions of what constitutes an occlusal problem. A number of occlusal indices have been devised but, probably because of this perceptual problem, none has ever emerged as a standard. **Objective:** The main objective was to review the use of the principal occlusal indices. **Basic research design**: The PUBMED database was searched for the main occlusal indices employed, journals with an impact in dentistry and specialist orthodontics journals. **Results:** The occlusal indices most frequently employed were IOTN (163 studies), PAR (132 studies), DAI (68 studies) and ICON (32 studies). The journals publishing the greatest number of studies using these occlusal indices are those specialising in orthodontics. **Conclusions**: In the high-impact scientific literature, the indices in greatest use are IOTN, followed by PAR, DAI and ICON. DAI and IOTN are mainly used in epidemiological or prevalence studies, while PAR is generally used for longitudinal studies. IOTN is used more in Europe. DAI is used worldwide; though least in Europe.

Key words: *occlusal indices, orthodontic treatment need, DAI, IOTN, ICON, PAR*

Introduction

Malocclusion is difficult to define because individuals and cultures vary widely in their perceptions of what constitutes an occlusal problem. A number of occlusal indices have been devised but, probably because of this perceptual problem, none has emerged as a standard. In epidemiology it is desirable to use easily-applied indices with high reliability and validity. Nowadays, a wide variety of indices to assess malocclusion are available but there is no agreement over which is or are the most suitable for this purpose.

An index to assess orthodontic treatment need classifies a malocclusion feature according to its relative contribution to the overall severity of the malocclusion. The quantitative rating or specific weight of each of these features is assigned on the basis of personal clinical conceptions, consensus among specialists, bibliography reviews, social and administrative needs or scientific studies specifically designed for the purpose. Hence the great variety of occlusal indices for different purposes with large differences between them.

The main purpose of indices of orthodontic treatment need is to determine which patients have malocclusion and how severely and to obtain information on the prevalence and severity of malocclusions in the case of epidemiological studies (Grainger, 1967; Salzmann, 1968; Brook and Shaw, 1989). Although many occlusal or treatment need indices can be found in the literature, studies have shown low levels of diagnostic agreement between the different indices (Freer and Freer, 1999; Manzanera *et al.*, 2010).

Lately it would appear that agreement has been reached on the characteristics that the indices should possess and the occlusal features that should be measured to determine orthodontic treatment need. Also, the importance not only of occlusal features but also of the patients' own perception of their malocclusions is beginning to be recognised (Proffit and Fields; 2001).

Consequently, the objectives of this review are: firstly, to survey the use of the main occlusal indices in high-impact scientific literature and specialist orthodontic journals, from the publication of each of these indices up to the present; and secondly, to analyse the distribution of the main occlusal indices by sample size, type of sample, subject age, study design or geographical location.

Methods

The search process focused on the PUBMED database (www.ncbi.nlm.nih.gov/pubmed). The following terms were used to search the bibliography for the main occlusal indices: IOTN or "Index of Orthodontic Treatment Need" (Brook and Shaw, 1989), PAR or "Peer Assessment Rating" (Richmond *et al.*, 1992), DAI or "Dental Aesthetic Index" (Cons *et al.*, 1986), ICON or "Index of Complexity, Outcome and Need" (Daniels and Richmond, 2000), TPI or "Treatment Priority Index", "ABO grading system" (Casko *et al.*, 1998), "ABO discrepancy index" (Cangialosi *et al.*, 2004), OI or "Occlusal Index" (Summers, 1971), COCSTOC-MOT or "Commission on Classification and Statistics of Oral Conditions - Measure of Occlusal Traits", DFA or "Dental-Facial Attractiveness" (Tedesco *et al.*, 1983), HLD or "Handicapping Labio-lingual Deviation Index" (Draker, 1960), HMAR or "Handicapping Malocclusion Assessment Record" (Salzmann, 1968), OAS or "Orthodontic Attitude Survey"

Correspondence to: Carlos Bellot Arcís. Departamento de estomatología. Unidad docente de Preventiva. Clínica Odontológica. C/ Gascó Oliag nº1. CP: 46010. Valencia. Spain. E-mail: bellot.arcis@gmail.com

(Fox *et al*., 1982), SASOC or "Social Acceptability Scale of Occlusal Condition" (Jenny *et al.*, 1980).

The bibliography search was limited by date to until 1 August 2011. The full search strategy (across All Fields) was: "index of orthodontic treatment need" OR "dental aesthetic index" OR "peer assessment rating" OR (("abstracting and indexing as topic"[MeSH Terms] OR ("abstracting" AND "indexing" AND "topic") OR "abstracting and indexing as topic" OR "index") AND "complexity" AND outcome AND need) OR "treatment priority index" OR (("abo") AND grading AND system) OR (("abo") AND discrepancy AND ("abstracting and indexing as topic"[MeSH Terms] OR ("abstracting" AND "indexing" AND "topic") OR "abstracting and indexing as topic" OR "index")) OR COCSTOC-MOT OR dental-facial attractiveness OR handicapping labiolingual deviation OR handicapping malocclussion assessment record OR Oral Aesthetic Subjective Impact Scale OR SASOC OR social acceptability scale of occlusal condition OR standardised continuum of aesthetic need AND (("1"[PDat] : "2011/08/01"[PDat]))

The criteria for inclusion were: 1, papers in which one of the occlusal indices was employed or studied or an opinion on it was given; and 2, articles published in each of the 74 journals with impact in dentistry according to the 2010 Journal Citation Report which are indexed in PUBMED as well as specialist orthodontic journals such as Journal of Orthtodontics (formerly British Journal of Orthodontics), Clinical Orthodontics and Research and World Journal of Orthodontics.

The variables captured for each publication were as follows: journal, year of publication, indices employed (IOTN, PAR, DAI, ICON), sample size (<100, 100-500, >500), sample age (≤11, 11-17, ≥18 years), type of sample (random, convenience), study design (cross-sectional study, longitudinal study) and place where the study was conducted (USA and Canada, Latin America, Asia, Europe, Africa and Australia/New Zealand).

Results

The search identified 546 articles. The number of published articles for each of the indices was: IOTN, 163; PAR, 132; DAI, 68; ICON, 32; TPI, 28; ABO grading system, 24; ABO discrepancy index, 12; OI (Occlusal Index), 13. Fewer than 10 studies were encountered for the following indices: COCSTOC-MOT, DFA, HLD, HMAR, OAS and SASOC.

On applying the inclusion criteria and restricting the search to the four main occlusal indices found in these scientific publications the number of articles fell to 340: IOTN, 163; PAR, 132; DAI, 68 and ICON, 32 (Table 1).

The journal that had published the greatest number of articles employing these indices was The *American Journal of Orthodontics and Dentofacial Orthopedics*, followed by the *European Journal of Orthodontics* and *Angle Orthodontist* (Table 2).

The distribution of articles by the four main indices and the various variables is presented in Table 3. IOTN was most often employed in cross-sectional studies, generally in a child/adolescent population, with random samples numbering between 100 and 500 subjects. Most of the studies were conducted in Europe. PAR was used

in longitudinal studies, in convenience samples numbering under 100 individuals, in studies of child/adolescent populations and most often in Europe and North America. For its part, DAI was used in cross-sectional studies, in an adolescent/adult population and in random samples numbering 100 to 500 subjects. DAI has a balanced distribution throughout the world, although it is used less in Europe.

Changes in the number of articles using each index with time are presented in Figure 1.

Discussion

Appropriate assessment and measurement of malocclusions is essential in both individual orthodontic diagnoses and epidemiological studies to establish priorities and treatment guidelines and to ascertain the prevalence and incidence of occlusal alterations in a population. There are many indices and measures available for assessing malocclusion but no consensus on which should be used. This review has found that the indices most often employed are, in descending order, IOTN, PAR, DAI and ICON. DAI and IOTN are orthodontic treatment need indices. ICON is a complexity, outcome and need index, and the PAR is an orthodontic procedure outcome index relying on plaster models from before and after treatment.

Table 1. Number of studies published in scientific journals, by index employed

Studies published using indices	Frequency	%
Only IOTN	121	35.6
Only PAR	99	29.1
Only DAI	53	15.6
IOTN and PAR	23	6.8
Only ICON	16	4.7
IOTN and DAI	10	2.9
IOTN and ICON	7	2.1
PAR and ICON	5	1.5
PAR and DAI	2	0.6
PAR, DAI and ICON	2	0.6
IOTN, PAR, and ICON	1	0.3
IOTN, DAI and ICON	1	0.3
Total	340	

Table 2. Number of studies published by journal

Studies published using indices	Frequency	%
AJODO	82	24.1
Eur J Orthod	71	20.9
Angle Orthod	32	9.4
Br J Orthod-J Orthod	26	7.6
Community Dent Oral Epidemiol	21	6.2
Br Dent J	20	5.9
Aust Orthod J	14	4.1
Community Dent Health	13	3.8
Int Dent J	8	2.4
J Public Health Dent	8	2.4
World J Orthod	6	1.8
Others	39	11.4
Total	340	

Table 3. Frequencies of the different study variables, by index employed

Variable Category	All Indices n=340 n	(%)	Only IOTN n=121 n	(%)	Only PAR n=99 n	(%)	Only DAI n=53 n	(%)	Only ICON n=16 n	(%)
Sample										
No information	9	(2.6)	2	(1.7)	0		5	(9.4)	0	
Random	118	(34.7)	48	(39.7)	31	(31.3)	28	(52.8)	3	(18.8)
Convenience	213	(62.6)	71	(58.7)	68	(68.7)	20	(37.7)	13	(81.3)
Design										
No information	5	(1.5)	2	(1.7)	0		1	(1.9)	0	
Cross-sectional	205	(60.3)	108	(89.3)	12	(12.1)	48	(90.6)	8	(50.0)
Longitudinal	130	(38.2)	11	(9.1)	87	(87.9)	4	(7.5)	8	(50.0)
Age										
No information	65	(19.1)	10	(8.3)	31	(31.3)	4	(7.5)	3	(18.8)
Child	27	(7.9)	7	(5.8)	11	(11.1)	2	(3.8)	3	(18.8)
Adolescent	65	(19.1)	35	(28.9)	6	(6.1)	14	(26.4)	1	(6.3)
Adult	40	(11.8)	22	(18.2)	9	(9.1)	3	(5.7)	1	(6.3)
Child/Adolescent	68	(20.0)	25	(20.7)	20	(20.2)	11	(20.8)	3	(18.8)
Adolescent/Adult	35	(10.3)	11	(9.1)	8	(8.1)	12	(22.6)	1	(6.3)
Child/Adolescent/Adult	40	(11.8)	11	(9.1)	14	(14.1)	7	(13.2)	4	(25.0)
Sample size										
No information	9	(2.6)	3	(2.5)	0		3	(5.7)	0	
<100	100	(29.4)	25	(20.7)	50	(50.5)	6	(11.3)	2	(12.5)
100-500	154	(45.3)	55	(45.5)	43	(43.4)	23	(43.4)	10	(62.5)
>500	77	(22.6)	38	(31.4)	6	(6.1)	21	(39.6)	4	(25.0)
Study location										
USA and Canada	65	(19.1)	7	(5.8)	31	(31.3)	9	(17.0)	5	(31.3)
Latin America	30	(8.8)	7	(5.8)	10	(10.1)	12	(22.6)	1	(6.3)
Asia	42	(12.4)	22	(18.2)	7	(7.1)	9	(17.0)	0	
Europe	171	(50.2)	80	(66.1)	49	(49.5)	4	(7.5)	10	(62.5)
Africa	18	(5.3)	5	(4.1)	0		10	(18.9)	0	
Australia/ New Zealand	14	(4.1)	0		2	(2.0)	9	(17.0)	0	

The traditional indices give no information on how the malocclusion affects the patient's life from a psycho-social or functional point of view. It seems that this aspect has acquired particular importance recently (Kok *et al*., 2004). It is the patient who decides to receive the orthodontic treatment, generally from a desire to improve a situation rather than because it is strictly necessary. The inclusion of aesthetic considerations in the IOTN, DAI and ICON indices may explain their more frequent use. The DAI was, in 1997, included in the latest WHO (1997) oral health survey update and their recommendation of this method for assessing dento-facial anomalies is a step forward in its diffusion as a method for assessing malocclusions.

Criteria for inclusion in this review were that the study should employ one of the indices under consideration and be published in one of the 74 journals with an impact in dentistry according to the 2010 Journal Citation Reports indexed in PUBMED or a specialist orthodontics journal. The last criterion could be disputed but it should be borne in mind that there have been no great changes in the list of journals with an impact factor in recent years and that most studies which employ these indices were published in specialist orthodontics publications, such as the *American Journal of Orthodontics and Dentofacial Orthopedics*, *European Journal of Orthodontics* and *Angle Orthodontist*, which have always been recognised as journals with an impact factor.
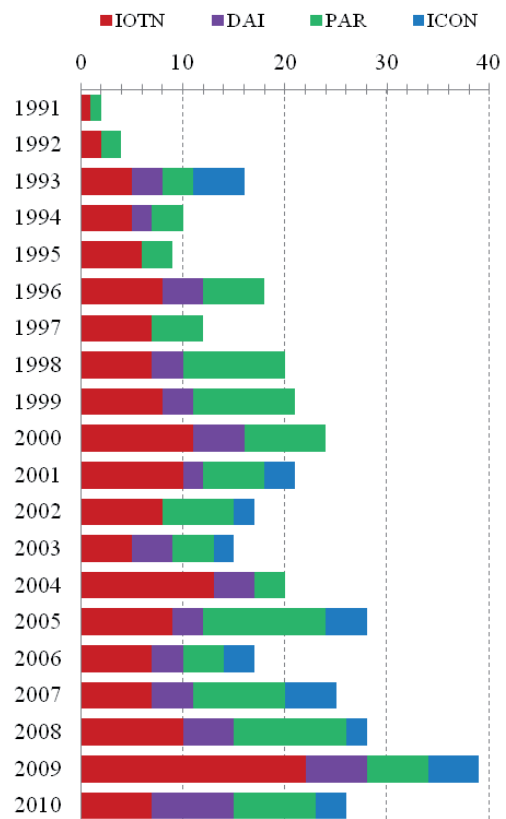
Figure 1. *Evolution of the use of four occlusal indices in the scientific literature over the 1991-2010 period*

Conclusions

In this review we observed that the indices most frequently employed in recent years have been IOTN, PAR, DAI and ICON. On analysing the variables considered in each of the studies, we found that both DAI and IOTN were more often used in cross-sectional studies, with sample sizes in excess of 100, generally random and possessing the characteristics of epidemiological or prevalence studies. Further, while IOTN is used more in Europe, DAI is employed to a similar extent throughout the world, though least in Europe. Also, while IOTN is used above all in child and adolescent populations, DAI is employed in the adolescent/adult group. PAR, by contrast, is generally used in longitudinal studies, since it measures the outcome of the treatment by comparing the situation before and after treatment. PAR's use in small convenience samples is characteristic of analysing success in treating orthodontic patients using particular appliances.

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