Orthodontic Indices

What is an index and why we use it?

An index is a tool used to provide a numerical value describing the status of a case on a graded scale. In orthodontics, indices are essential component in diagnosis or assessing treatment need, severity, complexity and outcome.

General requirements of an index:

- **Validity** (can the index measure what it was designed to measure?)
- **Reliability (Reproducibility)** (does the index give the same result when recorded on two different occasions, and by different examiners?)
- **Acceptability to profession and public**
- **Simplicity and cheapness**

This lecture will briefly discuss some of the most commonly used indices in orthodontics.

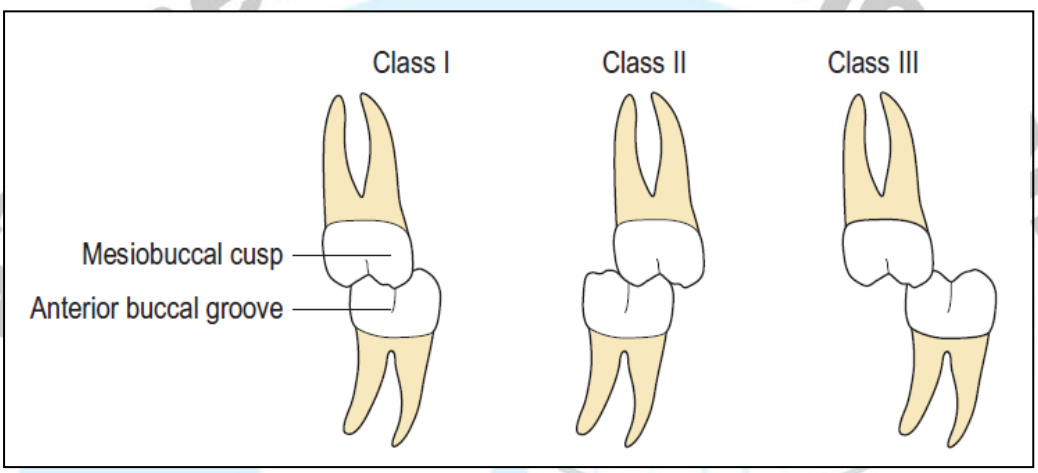
Diagnostic Indices	• Angle's Classification (1899) • Canine Classification • Incisor Classification (1964, 1983) • Skeletal Classification (1993)
Treatment Complexity Indices	• Little's Irregularity Index (LII) (1975) • Discrepancy Index (DI) (2004)
Treatment Need Indices	• Index of Orthodontic Treatment Need (IOTN) (1989)
Treatment Outcome Indices	• Peer Assessment Rating Index (PAR Index) (1992) • Cast-Radiograph Evaluation (CR-EVAL) (1999)
Multi-purpose Orthodontic Indices	• Index of Complexity, Outcome, and Need (ICON) (2000)

Diagnostic Indices

These indices provide descriptive classification of the dentition or skeletons. As all these indices were covered in other lectures, this lecture will just enumerate them.

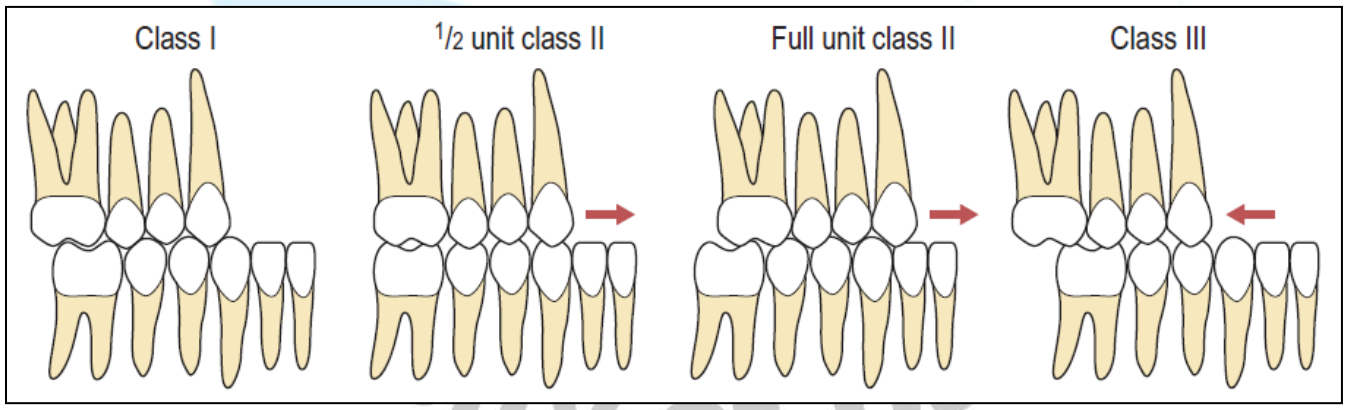
1. ***Angle's Classification***

   The Angle classification of malocclusion was described by Edward H Angle in 1899 and is based on the relative anteroposterior position of the first permanent molars.



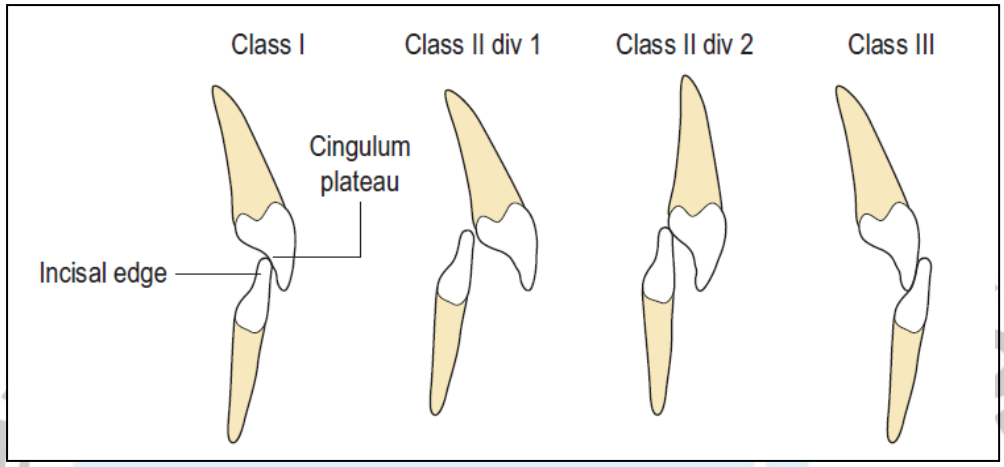
2. ***Canine Classification***

   The canine relationship is based upon anteroposterior position of canines.



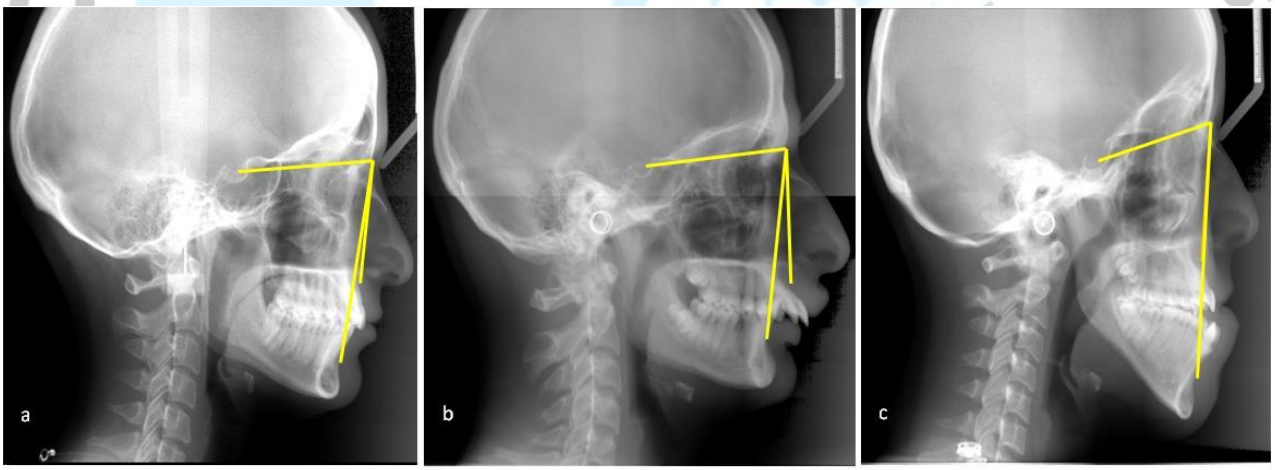
3. *Incisor Classification*

The British Standards Institute classification is based upon anteroposterior position of incisors.



4. *Skeletal Classification*

Usually assessed by lateral cephalometric radiographs:



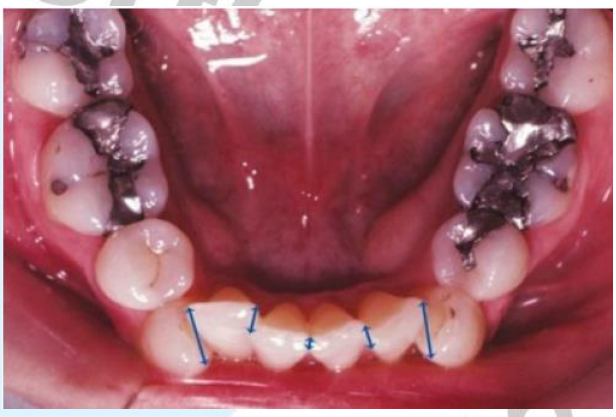
Class I	Class II	Class III
ANB 2-4°	ANB > 4°	ANB < 2°

Treatment Complexity Indices

1. *Little's Irregularity Index (LII)*

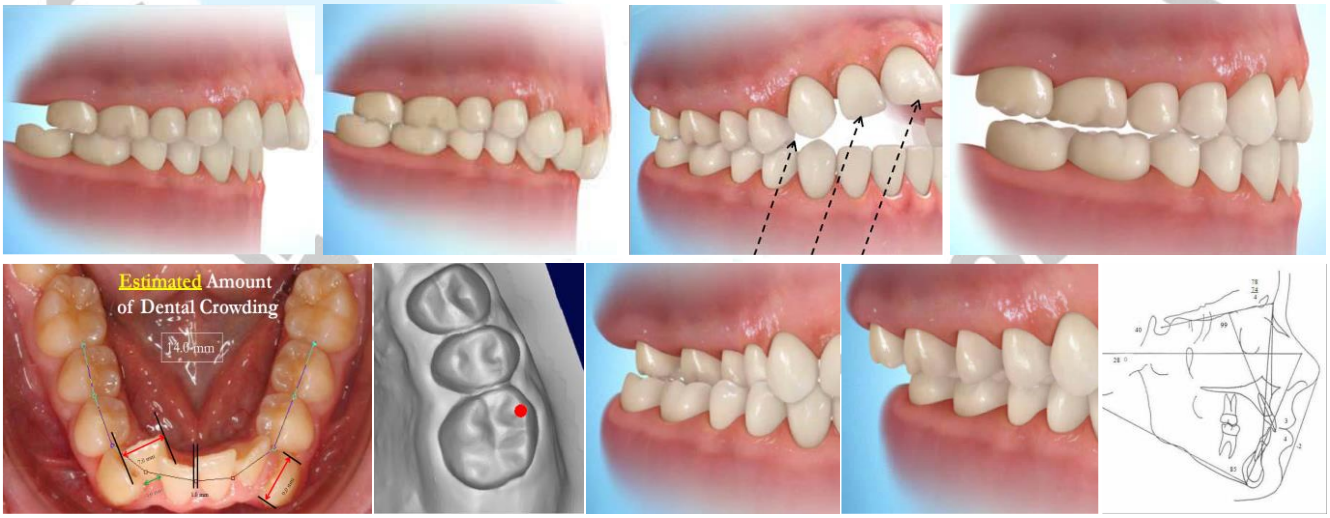
This index assesses irregularity of lower labial segment to establish the severity of malocclusion and priority of treatment by measuring linear displacement of five anatomic contact point (from mesial of right lower canine to mesial of left lower canine). Then, these displacements are summed and the model cast is ranked on a scale ranging from 0-10.

Example: The irregularity index assesses the total of the millimeter distances from the contact point on each incisor tooth to the contact point that it should touch, as shown by the lines. For this patient, the irregularity index is 10 mm.



2. *Discrepancy Index (DI)*

This index used to evaluate the difficulty of the cases presented for the American Board of Orthodontics examination. It evaluates criteria from dental models and cephalometric radiographs. These are overjet, overbite, openbite, crowding, occlusion, lingual/buccal posterior crossbite, cephalometric variables.



Treatment Need Indices

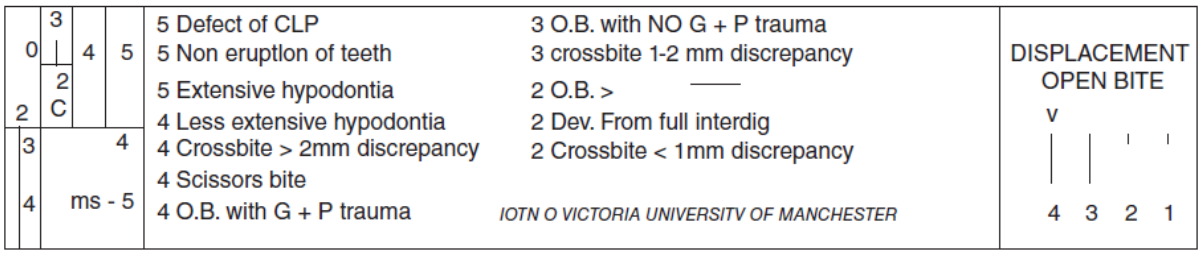
1. *Index of Orthodontic Treatment Need (IOTN)*

This index is used to rank malocclusions in terms of various occlusal features and perceived aesthetic impairment. The intention is to identify those individuals who would receive the greatest benefit from orthodontic treatment. IOTN has two components:

Dental Health Component (DHC)
Aesthetic Component (AC)

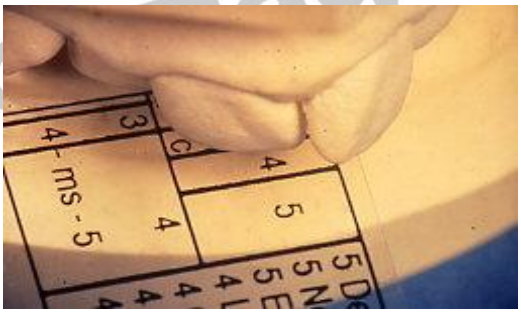
- ***Dental Health Component (DHC):*** The DHC records the worst occlusal feature of the malocclusion that impacts on dental health on a dental cast with a specially designed ruler. A **hierarchal scale** is used to identify the worst feature. In order of reducing dental health impact these are: **M**issing teeth > **O**verjet > **C**rossbite > **D**isplacement of contact points > **O**verbite. The acronym **MOCDO** can be used to remember this hierarchal scale. Once the worst occlusal feature has been recorded, the malocclusion can be characterized into one of five grades:

Grade 1	No need for treatment
Grade 2	Little need for treatment
Grade 3	Moderate need for treatment
Grade 4	Great need for treatment
Grade 5	Very great need for treatment



IOTN ruler





IOTN DENTAL HEALTH	5	4	3	2	1
Missing teeth	5h = extensive hypodontia + restorative implications (more then 1 tooth missing in any quadrant) requiring pre-restorative orthodontics 5s = submerged primary teeth	4h = less extensive hypodontia requiring pre-restorative orthodontics or orthodontic space closure (no prosthesis)			
Overjet	5a = inc OJ > 9 mm 5m = reverse overjet > 3.5 mm + masticatory and speech difficulties	4a = inc OJ 6.1 – 9 mm 4b = reverse overjet > 3.5 mm no masticatory or speech difficulties 4m = reverse overjet 1.1 – 3.5 mm + recorded masticatory or speech difficulties	3a = inc OJ 3.6 – 6 mm + incompetent lips 3b = reverse OJ 1.1 – 3.5 mm	2a = inc OJ 3.6 – 6 mm +competent lips 2b = reverse OJ 0.1 – 1 mm	
Crossbite		4c = ant or post X-bites + > 2 mm discrepancy between retruded and intercuspal position 4l = posterior lingual X-bites: no contact 1 or both buccal segments	3c = ant or post X-bites + 1.1 – 2 mm discrepancy	2c = ant or post X-bites – up to 1 mm discrepancy between retruded contact and intercuspal position	
Displacement of contact points	5i = impeded eruption (except 3rd molars) due to crowding, displacement, supernumerary teeth, retained primary teeth and any pathological cause	4d = displacements > 4 mm 4t = partially erupted teeth, tipped and impacted against adjacent teeth 4x = supplemental teeth	3d = displacements 2.1 – 4 mm	2d = displacements 1.1 – 2 mm	
Overbite (including open bite)		4e = lateral or anterior open bites > 4 mm 4f = increased and complete overbite + gingival or palatal trauma	3e = lat or ant open bite 2.1 – 4 mm 3 f = inc, complete OB no gingival trauma	2e = ant or post open bite 1.1 – 2 mm 2f = inc OB > 3.5 mm no gingival contact	

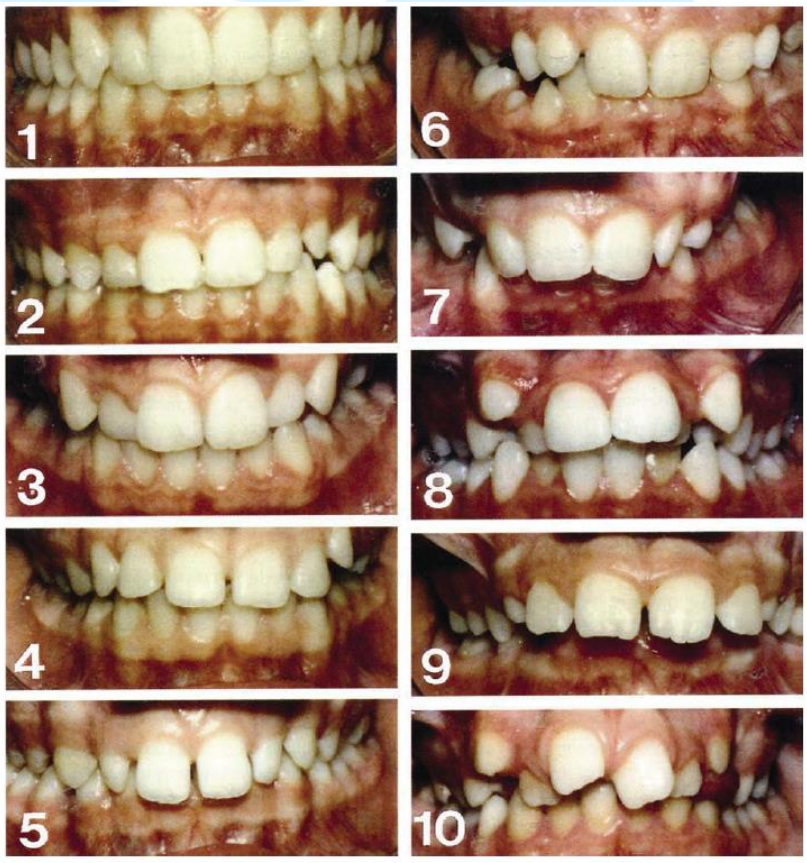
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Aesthetic Component (AC): It consists of 10 color photographs showing different levels of dental attractiveness. The patient is asked to close the front teeth together and the examiner compares the appearance of the patient's teeth with the visual 1-10 scale. Sometimes, the patients (or parents) are also asked to choose a photograph which most closely represents their own dental appearance to give a score according to this scale (1: the most attractive and 10: the least attractive). Treatment need can be categorized according to the score given as follows:

Score 1 or 2	No need for treatment
Score 3 or 4	Slight need for treatment
Score 5, 6, or 7	Moderate/borderline need for treatment
Score 8, 9, or 10	Definite need for treatment

A total score combining the DHC and AC can be given to define treatment need.

IOTN has its limitations when it is applied to the mixed dentition patients and the AC component can be considered as subjective assessment. Nonetheless, the DHC component of the IOTN provides a structured method for the assessment of a malocclusion.



The AC of IOTN

Treatment Outcome Indices

1. *Peer Assessment Rating Index (PAR Index)*

This index has been developed to:

- Provide a single score assessing the degree of malocclusion (Pre-treatment PAR score).
- Assess the quality and standard of orthodontic treatment results, and the degree of improvement by comparing pre- and post-treatment PAR scores on a dental cast using a specially designed ruler. It measures the following features of the malocclusion:

Anterior crowding (×1)	upper and lower labial segment contact point displacements
Buccal occlusion (×1)	Left and right molar relationship, crossbites and lateral open bites
Overjet (×6)	
Overbite (×2)	
Centrelines (×4)	

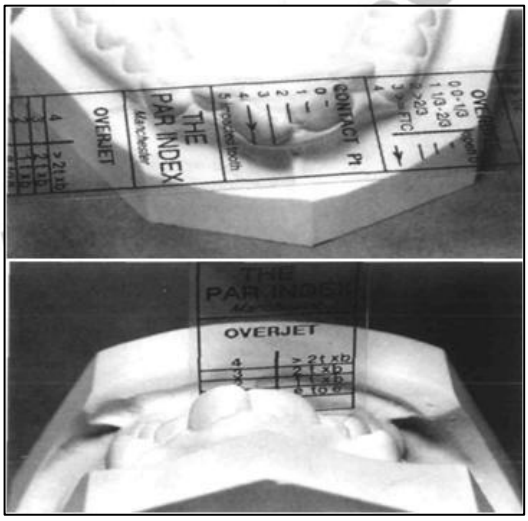
The score for each feature is multiplied by weighting factors (given in brackets above), so that some occlusal features bear more importance than others

The difference between pre- and post-treatment PAR scores can be calculated and from this the percentage change in PAR score is derived.

PAR reduction < 30%	Worse or no better
PAR reduction > 30%	Improved
PAR reduction > 70%	A high standard of treatment
PAR reduction of 22 points or greater	Greatly improved

Since the pre-treatment PAR score gives an indication of the severity of a malocclusion. Obviously, it is difficult to achieve a significant reduction in PAR in cases with a low pre-treatment score.

PAR index is totally dependent on the patient's study models and does not account for improvement in the facial profile, tooth inclinations, arch width and spacing between posterior teeth. It also is not appropriate for assessment of mixed dentition treatment results. However, it is a valid and reliable tool in assessing performance of practitioners or services.



PAR scoring

2. *Cast-Radiograph Evaluation (CR-EVAL)*

The American Board of Orthodontics Cast-Radiograph Evaluation (ABO CR-EVAL) was developed to evaluate orthodontic treatment outcomes of the cases presented for the American Board of Orthodontics examination. It has been subsequently considered as a precise and objective index when compared to other indices.

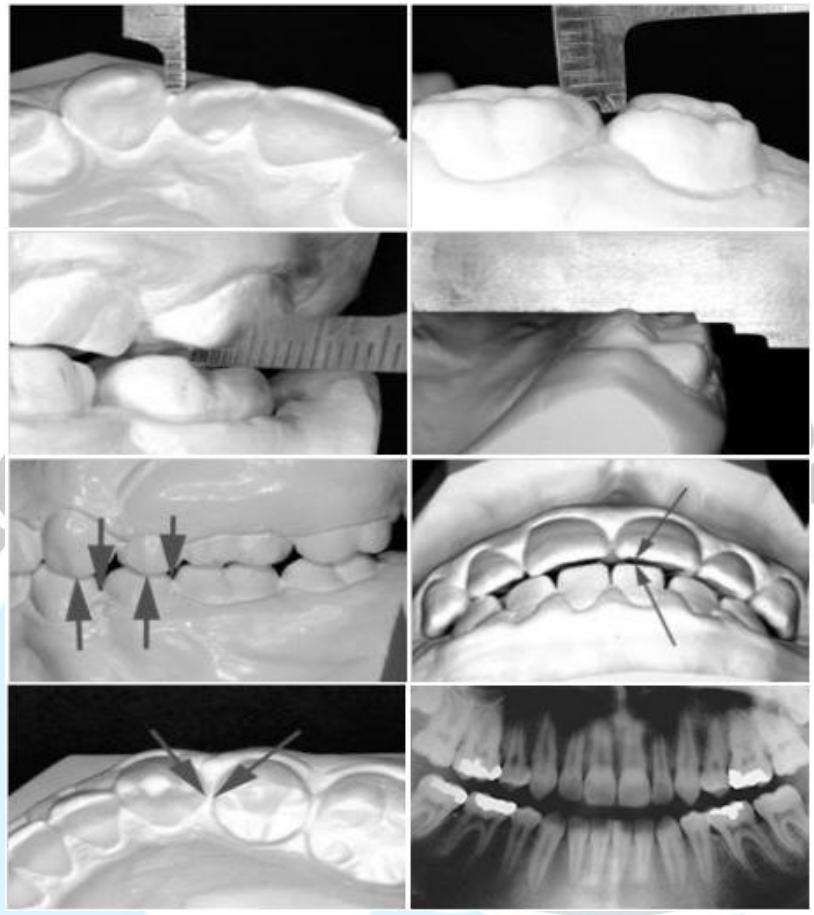
The CR-EVAL included eight criteria:

Alignment/rotation	Study model
Marginal ridges	Study model
Buccolingual inclination	Study model
Overjet	Study model
Occlusal contacts	Study model
Occlusal relationship	Study model
Interproximal contacts	Study model
Root angulation	Panoramic radiograph

Post-treatment study models and panoramic radiographs are measured according to the above eight criteria and scored 0, 1, or 2 depending on the amount of deviation from the standards established by the ABO. The sum of points of these criteria for each treated case represents the overall score of the ABO CR-EVAL.

Total score > 30 points	Unacceptable or incomplete treatment results
Total score of 20-30 points	Needs re-evaluation and then will be passed or considered incomplete
Total score < 20 points	Satisfactory treatment results

CR-EVAL offers an objective and stringent assessment of treatment outcomes, especially for detailed tooth position. When compared to the PAR index, it adds angulation, spacing and crowding of buccal segments, and root parallelism. Additionally, it uses the final models only to assess treatment outcomes, unlike the PAR index where both pre- and post-treatment models.



ABO CR-EVAL scoring

Multi-Purpose Orthodontic Indices

1. ***Index of Complexity, Outcome, and Need (ICON)***

   This index was developed to evaluate the complexity of a case, as well as treatment need and outcome. It incorporates features of both IOTN and PAR indices:

IOTN AC (x7)
Crossbite (x5)
Upper arch crowding and spacing (x5)
Buccal segment anteroposterior relationships (x3)
Anterior vertical relationship (x4)

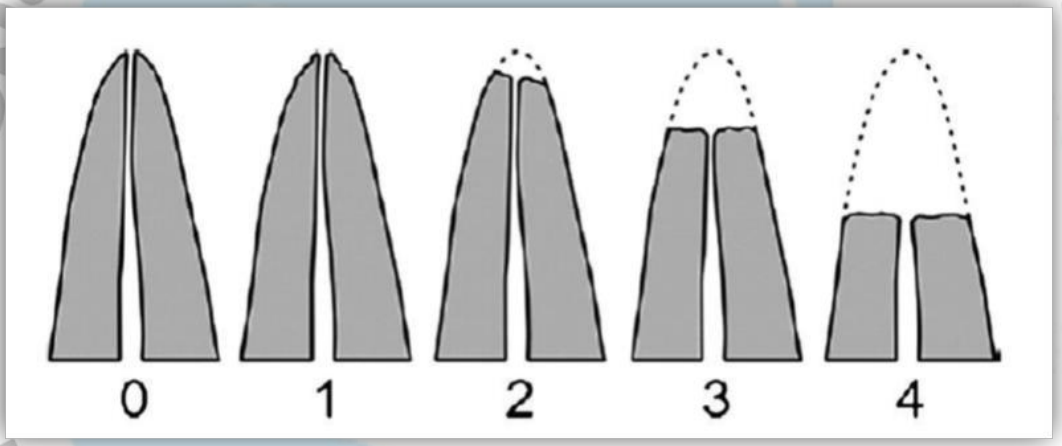
Note: The IOTN and PAR indices are widely used in the UK, while the ABO CR-EVAL is widely used in the USA.

Other Indices used with Orthodontic Treatment

1. *Root Resorption Index*

This scoring index was developed by Malmgren et al. (1982) was used to evaluate root resorption which induced by orthodontic treatment. This scoring index has four grades:

- *Grade 0:* No apical root resorption.
- *Grade 1:* Irregular contour of the root.
- *Grade 2:* Minimal apical root resorption less than 2 mm.
- *Grade 3:* Severe apical root resorption ranging from 2 mm to one-third of the original length of the root.
- *Grade 4:* Extreme apical root resorption more than one-third of the original length of the root.



Root Resorption scoring

2. *Adhesive Remanent Index*

This index was developed by Artun and Bergland (1984), which ranges the amount of remaining adhesive on tooth surface after bracket removal from 0 to 3 as follows:

- *Score 0:* No adhesive left on the tooth.
- *Score 1:* Less than 50% of adhesive left on the tooth.
- *Score 2:* More than 50% of adhesive left on the tooth.
- *Score 3:* 100% of adhesive left on the tooth.

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3. *Gorelick Index for White Spot Lesions (WSLs)*

This index was developed by Gorelick et al. (1982) to determine the severity of white spot lesion as follows:

- *Score 0:* No WSLs.
- *Score 1:* Slight WSL (thin rim).
- *Score 2:* Excessive WSL (thicker bands).
- *Score 3:* WSLs with cavitation.

References

- Littlewood SJ, Mitchell L. *An introduction to orthodontics*. 5th edition. Oxford University Press. 2019.
- Phulari BS. *Orthodontics principles and practice*. 2nd edition. Jaypee. 2017.
- Cobourne M, DiBiase A. *Handbook of orthodontics*. 2nd edition. Elsevier. 2016.

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