Relationship Between Four Epidemiological Indices – Index Of Complexity, Outcome And Need, Dental Aesthetic Index, Peer Assessment Rating Index, And American Board Of Orthodontics Objective Grading System— A Comparative Study.

Dissertation Submitted To

THE TAMIL NADU DR. M.G.R. MEDICAL UNIVERSITY

In Partial Fulfilment for the Degree of

MASTER OF DENTAL SURGERY

BRANCH V

ORTHODONTICS AND DENTOFACIAL ORTHOPEDICS

APRIL 2011

CERTIFICATE

This is to certify that the dissertation entitled "To study the Relationship between four epidemiological indexes – Indexes of complexity, outcome and need, Dental Aesthetic Index, Peer assessment rating index, and American Board of Orthodontics objective grading system — A Comparative Study" done by Dr. TOSHIT KUMAR., Post graduate student (M.D.S), Orthodontics (branch V), Tamil Nadu Govt. Dental College and Hospital, Chennai, submitted to the Tamil Nadu Dr.M.G.R.Medical University in partial fulfilment for the M.D.S. degree examination (April 2011) is a bonafide research work carried out by him under my supervision and guidance.

Guided By

Dr. C. KARUNANITHI M.D.S.,
Professor,
Dept. of Orthodontics,
Tamil Nadu Govt Dental College
& Hospital, Chennai- 3

Dr. W.S.MANJULA M.D.S.,
Professor and Head of Department
Dept. of Orthodontics,
Tamil Nadu Govt Dental College &Hospital,
Chennai- 3

Dr.K.S.G.A. NASSER, M.D.S.,
Principal,
Tamil Nadu Govt Dental College
& Hospital, Chennai-3

DECLARATION

I, Dr. Toshit Kumar, do hereby declare that the dissertation titled **"**To study the Relationship between four epidemiological indexes – Indexes of complexity, outcome and need, Dental Aesthetic Index, Peer assessment rating index, and American Board of Orthodontics objective grading system — A Comparative Study**"** was done in the Department of Orthodontics, Tamil Nadu Government Dental College & Hospital, Chennai 600 003. I have utilized the facilities provided in the Government Dental College for the study in partial fulfilment of the requirements for the degree of Master of Dental Surgery in the specialty of Orthodontics and Dentofacial Orthopaedics (Branch V) during the course period 2008-2011 under the conceptualization and guidance of my dissertation guide, **Professor Dr. C. Karunanithi, MDS**.

I declare that no part of the dissertation will be utilized for gaining financial assistance for research or other promotions without obtaining prior permission from the Tamil Nadu Government Dental College & Hospital.

I also declare that no part of this work will be published either in the print or electronic media except with those who have been actively involved in this dissertation work and I firmly affirm that the right to preserve or publish this work rests solely with the prior permission of the Principal, Tamil Nadu Government Dental College & Hospital, Chennai 600 003, but with the vested right that I shall be cited as the author(s).

Signature of the PG student Signature of the HOD

Signature of the Head of the Institution

ACKNOWLEDGMENT

My sincere thanks to **Dr.K.S.G.A.NASSER, M.D.S., Principal**, Tamil Nadu Government Dental College and Hospital, Chennai-3, for his kind support and encouragement.

I express my deep sense of gratitude and great honour to my respected Professor **Dr.W.S.MANJULA M.D.S, Head of the Department**, Department of Orthodontics and Dentofacial orthopaedics, Tamilnadu Govt. Dental College and Hospital, Chennai-3, for her inspiration and encouragement throughout the study and the entire course.

I consider as my privilege and a great honour to express my gratitude to my guide **Dr.C.KARUNANITHI M.D.S., Professor** Department of Orthodontics and Dentofacial orthopaedics, Tamilnadu Govt. Dental College and Hospital, Chennai-3, for his patience guidance, support and encouragement throughout the study.

I owe my thanks and great honour to **Dr.M.C.SAINATH M.D.S, Professor**, Department of Orthodontics and Dentofacial Orthopaedics, Tamilnadu Govt. Dental College and Hospital, Chennai-3, for helping me with his valuable and timely suggestions and encouragement.

I am grateful to **Dr. S. PREM KUMAR., M.D.S., Assistant Professor**, Department of Orthodontics, Tamilnadu Government Dental College and Hospital, Chennai-3 for his support and encouragement.

I am grateful to **Dr. B.BALASHANMUGAM, M.D.S., Assistant Professors**, Department of Orthodontics,Tamil Nadu Government Dental College and Hospital, Chennai –3 for his support and encouragement.

I am grateful to **Dr. USHA RAWAT, M.D.S., Assistant Professors**, Department of Orthodontics,Tamil Nadu Government Dental College and Hospital, Chennai –3 for her support and encouragement.

I thank **Dr.G.RAVANAN M.Sc., M.Phil., Ph.D., Professor of Statistics**, Presidency College, for helping me with the Statistics in the study.

I take this opportunity to express my gratitude to my friends and colleagues for their valuable help and suggestions throughout this study.

I offer my heartiest gratitude to my family members for their selfless blessings.

I seek the blessings of the Almighty God without whose benevolence; the study would not have been possible.

CONTENT

Sl.No.	TITLE	Page No
1.	Introduction	**9**
2.	Aims and Objectives	**14**
3.	Review of Literature	**16**
4.	Materials and Methods	**41**
5.	Results	**70**
6.	Discussion	**79**
7.	Summary and Conclusion	**83**
8.	Bibliography	**85**
9.	Annexure	**92**

LIST OF TABLES

SL NO.	TITLE	PAGE NO.
I	INTRAEXAMINER RELIABILITY FOR 4 ORTHODONTIC INDEXES	71
II	DIFFERENCES IN 4 INDICES ACCORDING TO GENDER	72
III	DESCRIPTIVE STATISTICS FOR ENTIRE SAMPLE FOR ICON, PAR, DAI AND ABO-OGS	73
IV	CORRELATION BETWEEN ICON, PAR, DAI AND ABO-OGS	74
V	DISTRIBUTION OF ORTHODONTIC TREATMENT NEED AND OUTCOME FOR SAMPLE (N = 80) ACCORDING TO 4 INDEXES	74

LIST OF CHARTS

CHART NO.	TITLE	PAGE NO.
I.	**S**CATTER PLOT SHOWING TOTAL DAI SCORE VS PRE-TREATMENT ICON SCORE	75
II.	SCATTER PLOT SHOWING TOTAL PRE-TREATMENT ICON SCORE VS PRE-TREATMENT WEIGHTED PAR SCORE AND TOTAL POST-TREATMENT ICON SCORE VS POST-TREATMENT WEIGHTED PAR SCORE	76
III.	SCATTER PLOT SHOWING DEGREE OF ICON IMPROVEMENT VS PERCENTAGE WEIGHTED PAR SCORE REDUCTION	77
IV.	SCATTER PLOT SHOWING TOTAL POST-TREATMENT ICON SCORE VS ABO-OGS SCORE.	78

LIST OF PHOTOPLATES

SL.NO.	TITLE	PAGE NO.
I.	THE AESTHETIC COMPONENT SCALE OF IOTN	53
II.	DIGITAL VERNIER CALIPERS	56
III.	PRETREATMENT STUDY MODELS- FRONTAL VIEW	57
IV.	PRETREATMENT STUDY MODELS- LATERAL VIEW	58
V.	PRETREATMENT STUDY MODELS- OCCLUSAL VIEW	59
VI.	POST-TREATMENT STUDY MODELS- FRONTAL VIEW	60
VII.	POST-TREATMENT STUDY MODELS- LATERAL VIEW	61
VIII.	POST-TREATMENT MODELS- OCCLUSAL VIEW	62
IX	POST-TREATMENT MODELS- LINGUAL VIEW OCCLUSAL CONTACT RELATIONSHIP	63
X	POST-TREATMENT BUCCOLINGUAL INCLINATION	64
XI	PRE-TREATMENT OVERJET MEASUREMENT	65
XII	PRE-TREATMENT OVERBITE MEASUREMENT	66
XIII	POST TREATMENT O.P.G.	67

INTRODUCTION

INTRODUCTION

A malocclusion is considered to be a variation from the norm rather than an acute condition and the dental, functional, and psychological benefits of orthodontic treatment to correct it are largely unknown. This in turn leads to difficulty in determining orthodontic treatment need (Shaw, 1989)[5]. It has been shown that both providers' and patients' perceptions of orthodontic treatment need are influenced by many variables, but the decisive factor for the patient is usually poor aesthetics.

Historically, orthodontic diagnosis of malocclusion has been taught and practiced as a descriptive, qualitative subject and it is not well suited to quantification. However, in response to an external need for information on the prevalence of malocclusions and for a method to objectively quantify the severity of the various features of malocclusion, several indices have been proposed.

Generally, the goal of the quantification is to assign limited resources (e.g., personnel, facilities, and financial) to the most severe malocclusions.

The usefulness of occlusal indexes in audit, research, decision making, and assessing orthodontic treatment need and outcome is well accepted internationally.

These indices purport to measure severity of malocclusion objectively, either as a deviation from normal/ideal occlusion or in terms of perceived treatment need.

For indices of treatment need, there is a system of protocols or rules to summarize data about malocclusion and return a numeric value. Within each of these indices, a numeric value exists below which the severity of a malocclusion is considered so minor that there is no need for treatment. All numeric values above that point indicate malocclusions for which treatment is indicated.

In effect, an index with a cut-off point functions as a diagnostic test for treatment need, although a definitive ‘‘gold’’ or ‘‘truth’’ standard does not exist.

It’s seen that 2 individuals with the same index score close to the cut-off point will differ in their need for treatment. This is the same situation as with all other diagnostic tests for a disease: test values for known healthy and diseased populations overlap.

Setting a cut-off point depends on a variety of factors. Important considerations are the consequences of missing disease (false-negative results) and the consequences of incorrectly identifying disease as present (False-positive results).

The pooled decision of orthodontic specialists is generally considered as the gold standard against which any index should be validated. Recently, studies have shown that several of these indices accurately reflect the decisions of local orthodontic specialists. Although in practice occlusal indices and treatment need indices have been used interchangeably, there is no single index that has been

developed and validated for both treatment need and deviation from normal/ideal.

There are several quantitative systems of assessing malocclusion and evaluating treatment need have been developed in the last 50 years.

The Dental Aesthetic Index (DAI)[8] has been adopted by the World Health Organization as a cross-cultural index. This index focuses on socially defined standards for dental aesthetics. The DAI evaluates 10 occlusal features: overjet, overbite, missing teeth, diastema, anterior open bite, anterior crowding, anterior spacing, the largest anterior irregularity (mandible and maxilla), and anteroposterior molar relationship.

The peer assessment rating (PAR)[33] index was developed to provide a summary score for occlusal anomalies and an estimate of how far a malocclusion deviates from normal alignment and occlusion. There are 11 components of the PAR Index: Upper right, anterior and left segment; Lower right, anterior and left segment; Right buccal occlusion, Overjet, Overbite, Midline and Left buccal occlusion.

In 1999, the ABO[16] instituted the model and radiographic portions of the objective grading system (OGS) to be officially used to grade the phase III examination portions of candidates' clinical case reports. The ABO's OGS (ABO-OGS) attempts to assess the outcome of orthodontic treatment. The ABO Objective Grading System for scoring dental casts and panoramic radiographs

contains eight criteria: alignment, marginal ridges, buccolingual inclination, occlusal relationships, occlusal contacts, overjet, interproximal contacts, and root angulations.

The Index of Complexity, Outcome and Need (ICON)[6] in 2000, developed and validated in Great Britain.

It included following 5 criteria:

1. Aesthetic assessment based on IOTN aesthetic component,
2. upper arch crowding/ spacing,
3. Crossbite,
4. Anterior vertical relationship including either openbite or deepbite,
5. buccal segment antero-posterior relationship

With above brief history, we can see that there are several quantitative systems of assessing malocclusion and evaluating treatment need have been developed which itself complicate the basic purpose of indices.

So the present study was carried out to evaluate the relationship between Indexes of complexity, outcome and need, Dental Aesthetic Index, Peer assessment rating index, and American Board of Orthodontics objective grading system, and to determine whether the ICON can replace these indexes as a measure of orthodontic treatment complexity, outcome, and need instead of using different indexes for the various facets of orthodontic treatment.

AIMS AND OBJECTIVES

AIMS AND OBJECTIVES

The aim of this study was

1. To determine whether the ICON can replace these indexes as a measure of orthodontic treatment complexity, outcome, and need instead of using different indexes for the various facets of orthodontic treatment.
2. To study the relationship between Indexes of complexity, outcome and need, Dental Aesthetic Index, Peer assessment rating index, and American Board of Orthodontics objective grading system, and

The indexes used in this study assessed need only Dental Aesthetic Index, outcome only (PAR and ABO-OGS), and both need and outcome (ICON).

REVIEW OF LITERATURE

REVIEW OF LITERATURE

"Any piece of knowledge we acquire today has a value at this moment exactly proportioned to our skill to deal with it. Tomorrow, when we know more, we recall that piece of knowledge and use it better."

Massler and Frankel (1951)[21] count the number of teeth displaced or rotated. Assessment of tooth displacement and rotation is qualitative- (all or none).

Malalignment index by Vankirk and Pennel (1959)[42] measured tooth displacement and rotation. Tooth displacement defined quantitatively :< 1.5mm or >1.5 mm. Tooth rotation defined quantitatively : <45◦ or >45◦

Handicapping Labiolingual Deviation index by Harry L. Draker (1960)[9] used nine characteristics includes cleft palate, severe traumatic deviations, overjet in mm, overbite in mm, mandibular protrusion in mm, openbite in mm, ectopic eruption, anterior only ,each tooth, anterior crowding separately in maxilla and mandible, and labiolingual spread in mm. The index is applicable only to the permanent dentition. A score of 13 and over constitutes a physical handicap.

Occlusal feature index by Poulton and Aaronson (1961)[32] measurements include lower anterior crowding, cuspal interdigitation, vertical overbite, and horizontal overjet.

Malocclusion severity estimate by Grainger(1961)[13] used first time seven weighted and defined measurements which includes overjet, overbite, anterior

openbite, congenitally missing maxillary incisor, first permanent molar relationship, posterior crossbite, and tooth displacement.

He defined six types of malocclusion:

1. Positive overjet and anterior openbite.
2. Positive overjet, positive overbite, distal molar relationship and posterior crossbite with maxillary teeth buccal to mandibular teeth.
3. Negative overjet, mesial molar relationship and posterior crossbite with maxillary teeth lingual to mandibular teeth.
4. Congenitally missing maxillary incisors.
5. Tooth displacement.
6. Potential tooth displacement.

Treatment priority index by Grainger (1967)[14] used eleven weighted and defined measurements:

1. Upper anterior segment overjet
2. Lower anterior segment overjet
3. Overbite
4. Anterior openbite
5. Congenital absence of incisors
6. Distal molar relation
7. Mesial molar relation
8. Posterior crossbite with maxillary teeth buccal to mandibular teeth.
9. Posterior crossbite with maxillary teeth lingual to mandibular teeth.

10. Tooth displacement
11. Gross anomalies

Seven malocclusion syndromes were defined:

1. Maxillary expansion syndromes
2. Overbite
3. Retrognathism
4. Openbite
5. Prognathism
6. Maxillary collapse syndrome
7. Congenitally missing incisors

Handicapping malocclusion assessment record by Salzmann (1968)[35] weighted measurements consist of three parts:

1. Intra-arch deviation — missing teeth, crowding, rotation, spacing.
2. Inter-arch deviation— overjet, overbite, crossbite, openbite, Mesiodistal deviation.
3. Six handicapping dento- facial deformities
    1. Facial and oral clefts
    2. Lower lip palatal to maxillary incisors
    3. Occlusal interference
    4. Functional jaw limitation
    5. Facial asymmetry
    6. Speech impairment.

Occlusal index by Chester J. Summers, (1971)[39] used nine characteristics: dental age, molar relation, overbite, overjet, posterior cross-bite, posterior open bite, tooth displacement (actual and potential), midline relations, and missing permanent teeth.

He classified the occlusion into seven dental ages, based on the stage of occlusal development; differences in chronologic age, sex, and sequence of tooth eruption are corrected. Different scoring schemes and forms for different stages of dental development are used.

The irregularity index by Little index R M, (1975)[20] used a quantitative score of mandibular anterior alignment. The technique involves measurement directly from the mandibular cast with a calliper (calibrated to at least tenths of a millimetre) held parallel to the occlusal plane. The linear displacement of the adjacent anatomic contact points of the mandibular incisors is determined, the sum of the five measurements representing the Irregularity Index value of the case.

Dental aesthetic index by Cons NC, Jenny J, Kohout FJ: University of Iowa; 1986[8]. They used following 10 criteria for assessing malocclusion:

1. Number of missing visible teeth (incisors, canines, and premolars in maxillary and mandibular arch)
2. Crowding in incisal segment
3. Spacing in incisal segment
4. Midline diastema,

5. Largest anterior maxillary irregularity,
6. Largest anterior mandibular irregularity,
7. Anterior maxillary overjet,
8. Anterior mandibular overjet,
9. Vertical anterior openbite,
10. Anteroposterior molar relationship,

A score of 26 and over shows the requirement of treatment.

The orthodontic treatment priority index or index of treatment need (IOTN) by Brook PH, Shaw WC. (1989)[5] an index developed and validated in Great Britain. The IOTN records orthodontic treatment need on the basis of 2 components, a Dental Health Component (DHC) and an Aesthetic Component (AC).

The aesthetic component of the IOTN consists of a visual 10-point scale, which represents a wide range of dental attractiveness, illustrated by a series of 10 front view photographs arranged from number l, most attractive, to number 10, least attractive.

The DHC is based on an index developed by the Swedish Public Dental Health System. The DHC has 5 levels, ranging from "no need" of treatment to "great need." It included following occlusal traits:

Grade 1 (none)

1 Extremely minor malocclusions including displacements less than 1 mm.

Grade 2 (little)

a) Increased overjet greater than 3.5 mm but less than or equal to 6 mm with competent lips.

b) Reverse overjet greater than 0 mm but less than or equal to 1 mm.

c) Anterior or posterior crossbite with less than or equal to 1 mm discrepancy between retruded contact position and intercuspal position.

d) Displacement of teeth greater than 1 mm but less than or equal to 2 mm.

e) Anterior or posterior open bite greater than 1 mm but less than or equal to 2 mm.

f) Increased overbite greater than or equal to 3.5 mm without gingival contact.

g) Prenormal or postnormal occlusions with no other anomalies. Includes up to half a unit discrepancy.

Grade 3 (moderate)

a) Increased overjet greater than 3.5 mm but less than or equal to 6 mm with incompetent lips.

b) Reverse overjet greater than 1 mm but less than or equal to 3.5 mm.

c) Anterior or posterior crossbite with greater than 1 mm but less than or equal to 2 mm discrepancy between retruded contact position and intercuspal position.

d) Displacement of teeth greater than 2 mm but less than or equal to 4 mm.

e) Lateral or anterior open bite greater than 2 mm but less than or equal to 4 mm.

f) Increased and complete overbite without gingival or palatal trauma.

Grade 4 (great)

a) Increased overjet greater than 6 mm but less than or equal to 9 mm.

b) Reverse overjet greater than 3.5 mm with no masticatory or speech difficulties.

c) Anterior or posterior crossbites with greater than 2 mm discrepancy between retruded contact position and intercuspal position.

d) Severe displacements of teeth greater than 4 mm.

e) Extreme lateral or anterior open bites greater than 4 mm.

f) Increased and complete overbite with gingival or palatal trauma.

h) Less extensive hypodontia requiring pre-restorative orthodontics or orthodontic space closure to obviate the need for prosthesis.

l) Posterior lingual crossbite with no functional occlusal contact in one or both buccal segments.

m) Reverse overjet greater than 1 mm but less than 3.5 mm with recorded masticatory and speech difficulties.

t) Partially erupted teeth tipped and impacted against adjacent teeth.

x) Supplemental teeth.

Grade 5 (very great)

a) Increased overjet greater than 9 mm.

h) Extensive hypodontia with restorative implications (more than 1 tooth missing in any quadrant) requiring pre-restorative orthodontics.

I) Impeded eruption of teeth (with the exception of third molars) due to crowding, displacement, the presence of supernumerary teeth, retained deciduous teeth, and any pathologic cause.

m) Reverse overjet greater than 3.5 mm with reported masticatory and speech difficulties.

p) Defects of cleft lip and palate.

s) Submerged deciduous teeth

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 a number of lesser occlusal deviations. As a result, it may underestimate the severity of malocclusion in some individuals.

The 2 components are mutually exclusive, and the component showing the greatest need takes priority. There may be smaller regional differences that may influence decisions about treatment need.

The peer assessment rating (PAR) index by S. Richmond, W.C. Shaw (1992)[34] was developed to provide a summary score for occlusal anomalies and an estimate of how far a malocclusion deviates from normal alignment and occlusion. There are 11 components of the PAR Index: Upper right, anterior and left segment; Lower right, anterior and left segment; Right buccal occlusion, Overjet, Overbite, Midline and Left buccal occlusion.

Joanna Jenny, and Naham C. Cons, (1996)[15] compared two orthodontic indices, the Index of Orthodontic Treatment Need and the Dental Aesthetic Index. Both accept the premise that a significant benefit of orthodontic treatment is improved aesthetics and, by inference, social and psychological well-being. Both have as their goal the identification of children most in need of orthodontic treatment subsidized by public funds. In the IOTN, the aesthetic component is a separate instrument from the dental health component. The unique aspect of the DAI is its linking of people's perceptions of aesthetics with anatomic trait measurements by regression analysis to produce a single score obviating the need, as in the IOTN, for two separate scores that cannot be combined. Both components of the IOTN have only three grades, "no need," "borderline need," and "definite need." The IOTN cannot rank order cases with greater or lesser need for treatment within grades. In contrast, DAI scores can be rank ordered on a continuous scale and can differentiate cases within severity levels.

Kari Birkeland, Jakob Furevik(1997)[17] studied 224 study models to evaluate the treatment , post-treatment and 5 year follow-up changes by the PAR Index. Orthodontic treatment reduced the malocclusions on average by 76.7 percent, and at follow-up the reduction was 63.8 per cent. Sex and extraction/non-extraction treatments did not significantly affect the results. Age at treatment start accounted significantly for the variability of treatment changes. Less

treatment PAR change should be expected in higher age groups. The treatment success was greatest for Angle Class II division 2 with 80.8 per cent PAR score reduction, closely followed by Angle Class II division 1 (78.4 per cent).

Nikki Atack, Iain Hathorn, Michael Mars (1997)[29] examined features of dental occlusion in patients born with a unilateral cleft lip and palate (UCLP) to develop a 'Goslon type' index for 5 year old children. The Goslon ranking system was used on longitudinal study models taken at 5 and 10 years of age of the same patients. All patients had UCLP and this had been repaired using a Millard type lip repair and a Veau Wardill or Von Langenbeck palatal closure. There was good intra-examiner agreement for ascribing 5 and 10 year old models to one of five categories (excellent–very poor). Inter-examiner agreement on both sets of models was at worst moderate. Two of the examiners identified up to 93 per cent of 5 year old models which either remained in the same category or deteriorated by 10 years of age. At worse the results demonstrated 70 per cent of cases at 5 years of age remained in the same category or deteriorated by 10 years of age. Consensus agreement has produced five categories of outcome for these 5 year old models. This study has therefore provided, for the first time, a mechanism for assessing the results of CLP surgery earlier than indices already available.

The HLD (CalMod) index by William S. Parker (1998)[43] modified HLD index and used following questionnaire:

1) cleft palate deformities,

2) deep impinging overbite
3) crossbite of individual anterior teeth
4) severe traumatic deviations
5) Overjet greater than 9 mm with incompetent lips or reverse overjet greater than 3.5 mm with reported masticatory and speech difficulties.
6) overjet in mm
7) overbite in mm,
8) mandibular protrusion in mm,
9) openbite in mm,
10) Ectopic eruption, anterior only, each tooth,
11) Anterior crowding separately in maxilla and mandible, and
12) Labiolingual spread in mm.
13) Posterior unilateral crossbite

A score of 26 and over constitutes a physical handicap.

Tülin Ugur, Semra Ciger,(1998)[41] evaluated the prevalence of malocclusion and assessed the need for orthodontic treatment among 6–10 year old Turkish primary school 572 children using treatment priority index(TPI). A normal occlusion was present in 40.38 per cent of the population, 21.85 per cent had a slight malocclusion, 25.17 per cent had a definite malocclusion, 7.52 per cent had a severe malocclusion and 5.08 per cent had a very severe malocclusion.

Stephen Richmond and Charles P. Daniels (1998)[38] had undertaken an international survey to assess variation in professional assessment of

orthodontic treatment need. Ninety-seven orthodontists from nine countries examined a standard sample of 240 dental study casts to judge the need for orthodontic treatment in terms of dental health, dental aesthetics, and deviation from normal. The treatment decisions were predicted with an accuracy of 84% by using occlusal score values for the dental aesthetics, the degree of upper arch crowding, the presence of crossbite, the anterior overbite, and the buccal segment sagittal relationship. It is suggested that these traits may form the basis for an internationally validated index of treatment need for use in clinical audit and orthodontic research.

Nicola E Atack and Tom Dowell et al (1998)[27] evaluated complete unilateral cleft lip and palate repair outcome in the Cleft Unit in Perth, Western Australia, by assessment of dentoalveolar relationships. Main outcome measures were identified through dental arch relationship grading of study models using the 5 Year Old Study Model Index. The results indicate that the surgical outcome was graded as excellent, good, or fair for 77% of patients and poor or very poor for 23% of patients.

American board of orthodontics- objective grading system (ABO-OGS) in 1999[16], the ABO instituted the model and radiographic portions of the objective grading system (OGS) to be officially used to grade the phase III examination portions of candidates' clinical case reports. The ABO's OGS (ABO-OGS) attempts to assess the outcome of orthodontic treatment. The ABO Objective Grading System for scoring dental casts and panoramic radiographs contains

eight criteria: alignment, marginal ridges, buccolingual inclination, occlusal relationships, occlusal contacts, overjet, interproximal contacts, and root angulations.

Ken Danyluk, DMD, Chris Lavelle (1999)[18] studied potential application of the dental aesthetic index to prioritize the orthodontic service needs in a publicly funded dental program. The pre-treatment records of 38 patients were prioritized on a visual-analog scale relative to their differential orthodontic service needs by 16 independent orthodontic specialists. When these same records were prioritized relative to their scores derived from the Dental Aesthetic Index, their assessments proved more consistent, especially when based on a modified Dental Aesthetic Index. The lack of established clinical guidelines to delineate the most appropriate service and timing for specific occlusal discrepancies used to hampers the prioritization of orthodontic service needs. Dental Aesthetic Index case-scores may therefore be considered as just one of many criteria to prioritize orthodontic service needs, although the potential impact of the others has yet to be quantified.

Matthew Shue-Te Yeh, Amir-Reza Koochek(2000)[23] determined the relationship between patients' perceptions of orthodontic treatment need and need as determined with professionally derived indexes, namely the dental aesthetic index and the index of orthodontic treatment need. The pre-treatment study casts of 50 consecutive patients, presenting for orthodontic treatment, were objectively assessed with these indexes by 2 examiners trained and

calibrated in their use. Patients were asked to complete a questionnaire consisting of 4 questions addressing appearance, function, speech, and treatment need, using either a 5-point Likert scale or a yes/no response. The professionally derived indexes showed that statistically significant correlations existed between the aesthetic component and dental health component ($r = 0.46$; $P <$ .01), the aesthetic component and dental aesthetic index ($r = 0.54$; $P < .01$), and the dental health component and dental aesthetic index ($r = 0.46$; $P < .01$). Statistically significant correlations were also found for subjective assessments between biting/chewing and speech ($r = 0.31$; $P < .05$), between speech and the aesthetic component ($r = -0.39$; $P < .01$) and the dental aesthetic index ($r = 0.34$; $P < .05$), and between the aesthetic component and appearance ($r = –0.28$; $P < .05$.They concluded that both the index of orthodontic treatment need and the dental aesthetic index reliably record deviant occlusal traits. The aesthetic component correlates well with the dental aesthetic index and subjective assessments of appearance and speech. The aesthetic component was the only statistically significant factor for the predictive model in assessing patients' perceptions of orthodontic treatment need.

The Index of Complexity, Outcome and Need (ICON), **by Charles Daniels and Stephen Richmond (2000)[6],** developed and validated in Great Britain.

It included following 5 criteria:

1 Aesthetic assessment based on IOTN aesthetic component,

2 Upper arch crowding/ spacing,

3 Crossbite,

4 Anterior vertical relationships including either openbite or deepbite,

5 buccal segment antero-posterior relationship

The aesthetic component of the IOTN consists of a visual 10-point scale, which represents a wide range of dental attractiveness, illustrated by a series of 10 front view photographs arranged from number l, most attractive, to number 10, least attractive.

Each criterion is calculated for particular case and then multiplied by its predetermined weighting.

In any particular case, if the summary score is greater than 43, treatment is indicated. In the post-treatment models, if the summary score is less than 31, the outcome is acceptable.

Neslihan Ucuncu and Esra Ertugay (2001)[25] assessed the need for orthodontic treatment in a Turkish school population and a group of population referred for orthodontic treatment. The study group were 250 school children, 11-14 years of age, and 250 patients, 11-14 years of age, referred to the department of orthodontics. IOTN was used by two examiners in order to estimate the treatment need. The differences between IOTN values for the boy and girl were not statistically significant in both groups. 38.8% of school population showed great treatment need, 24.0% moderate treatment need and slight or no need was 37.2%. The referred population represented an 83.2% great need treatment, 12.0% moderate need treatment and 4.8% no need according to the DHC. The

AC of IOTN in school population showed great treatment need, 4.8% moderate treatment need and slight or no need was 90.4%. The referred population represented a 36.8% great need treatment, 17.6% moderate need treatment and 45.2% no need according to the AC. Grade 8 was 28.8% out of the 36.8% great need percentage in referred population. So it was concluded that the ectopic canines were the driving factor for the referred population.

Frank M. Beglin, DDS, MS, a Allen R. Firestone, (2001)[10] compared 3 indexes of orthodontic treatment need (Dental Aesthetic Index, the Handicapping Labiolingual Deviation with the California Modification, and the Index of Orthodontic Treatment Need) on 170 sets of study casts. The aim of this investigation was to validate the DAI, the HLD (CalMod), and the IOTN against a panel of orthodontists.

Allen R. Firestone, F. Michael Beck (2002)[2] investigated the validity of the ICON as an index of orthodontic treatment need compared with the perception of need as determined by a panel of US orthodontists. One hundred seventy study casts, representing a full spectrum of malocclusion types and severity, were scored for orthodontic treatment need by an examiner calibrated in the ICON. The results were compared with the decisions of an expert panel of 15 orthodontic specialists. The panel found that 64% of the casts required orthodontic treatment; the ICON scores indicated that 65% of the cases needed treatment. There was agreement between the expert panel and the index in 155

of the 170 cases. These results support the use of the ICON as a validated index of orthodontic treatment need.

N. W. Berk, H. Dukich Bush, J. Cavalier (2002)[30] determined the relationship between treatment need assessment scores of orthodontists, general practitioners, and pediatric dentists. Ten general dental practitioners, 18 orthodontists and 15 paediatric dentists reviewed 137 dental casts and recorded their opinion on whether orthodontic treatment was needed. These models represented the full range of severity of malocclusion based on the Dental Health Component of the Index of Orthodontic Treatment Need. They found a high level of agreement between paediatric dentists, orthodontists and general practitioners (Kappa range 0.86–0.95). Between the groups, the amount of agreement was lower.

Nicholas J. Savastano Jr, Allen R. Firestone (2003)[26] studied the validity of the ICON in measuring orthodontic complexity, outcome, and degree of improvement. Fifteen orthodontists evaluated 100 pairs of pre-treatment and post treatment study models for complexity, outcome, and degree of improvement. A calibrated examiner used ICON to score the casts. One month later, a random subset of 40 study casts was re scored by raters and the examined for reliability testing. A simple kappa statistic was used to assess agreement between the scores from the expert panel and from the ICON examiner. Agreement between the raters and the ICON scores was moderate for complexity (_ _ .52) and outcome (_ _ .50) and fair for degree of improvement

(__ .27).So ICON is valid for assessing cases for complexity and outcome. However, lack of agreement among the raters for degree of improvement and between the ICON-based evaluations and the orthodontists' evaluation of degree of improvement suggests that this component should be re-examined.

Andra Liepa, Ilga Urtane(2003)[3] investigated to estimate the need for orthodontic treatment in 12–13-year-old school children in urban and rural schools in Latvia. Five hundred and four school children aged 12–13 years were examined using the Index of Complexity, Outcome and Need (ICON). The children were invited to complete a questionnaire about treatment need and their appearance. There were no statistically significant differences in treatment need between rural and urban settings or between boys and girls. The overall prevalence of individuals needing orthodontic treatment in Latvia was 35.3 per cent. The individuals' perception of the arrangement of teeth and the need for treatment correlated significantly with the ICON score.

Y. V. Kok, P. Mageson, N. W. T. Harradine (2004)[44] compared the use of the Aesthetic Component (AC) of IOTN and the Child Perceptions Questionnaire (CPQ) for measuring quality of life in assessing orthodontic treatment need and concern. The subjects were 204 children aged 10–12 years studying in 10 schools in Bristol, UK. The children gave themselves lower AC scores compared to the examiner. They concluded that there should be a shift towards using quality of life measures to supplement the IOTN in assessing the perceived need for orthodontic treatment.

Matthew Mayers, Allen R. Firestone (2005)[22] Compared Peer assessment rating (PAR) index scores on 48 pairs of plaster and computer-based digital pre-treatment models. They concluded that PAR scores derived from digital models are valid and reliable measures of occlusion.

O.D. Otuyemi K.A. Kolawole(2005)[31]**,** investigated the aesthetic perceptions of 100 consecutive patients and their parents of orthodontic treatment need and compared their observations with that of orthodontists. The sample consisted of 100 consecutive orthodontic patients seen for the first time at a Nigerian Hospital. Of the total sample, 49 were males and 51 were females, with ages ranging from 7 to 21 years. The self-assessment by patients and the recording by parents and orthodontists were carried out using the Aesthetic (AC) and Dental Health (DHC) Components of Index of Orthodontic Treatment Need (IOTN) as applicable. The results showed a strong association in the perception of dental appearance by patients and the views of other dental assessors. These correlations were highly statistically significant ($P<0.001$) with the highest correlation between the parents and the orthodontists ($r =0.791$) while the least was between the patients and the orthodontists ($r = 0.653$). The study also found that about one-half of the patients were in the "definite need for orthodontic treatment".

Mourad Souames, Francis Bassigny (2006)[24] assessed the orthodontic treatment need in a sample of 9- to 12- year-old French children (mean age: 9.77 years; standard deviation: 0.84) attending 12 different schools in the same

geographic area of Ile de France. Two examiners used the Index of Orthodontic Treatment Need (IOTN) in order to estimate treatment need. Five hundred and eleven children (268 males, 243 females) who had not previously received orthodontic treatment were examined. Twenty-one per cent of the children presented an objective need for orthodontic treatment, 28 per cent had crowding, 28 per cent an increased overjet, and 15 per cent an increased overbite. The dental health component (DHC) of the IOTN was found to be reliable and simple to use. Using the DHC, 50.1 per cent of the children were assigned to the no/little need, 28.6 per cent to borderline need and 21.3 per cent to a need for orthodontic treatment. The malocclusion status of French schoolchildren was lower than that recorded in epidemiological studies of European children.

K. M. Templeton, R. Powell (2006)[19] determined among PAR and ICON which indices were the most appropriate for use in the assessment of orthognathic outcome. Study models of 30 patients were scored using PAR and ICON and concluded that both PAR and ICON are suitable indices for assessing the clinical outcome of combined orthodontic treatment and orthognathic surgery

Troy R. Okunami, Budi Kusnoto(2007)[40] determined whether the American Board of Orthodontics objective grading system (ABO OGS) can be assessed accurately from digital dental casts and whether there are statistical differences between digital and plaster dental casts in scoring the ABO OGS. Thirty post-

treatment plaster dental casts were selected and scanned by OrthoCAD. The test result showed significant differences between the plaster and digital casts for occlusal contacts, occlusal relationships, and total scores. No significant differences were found for alignment, marginal ridges, overjet, and interproximal contacts. Buccolingual inclination was not included in the study. They concluded that the current OrthoCAD program (Version 2.2) was not adequate for scoring all parameters as required by the ABO OGS.

Chukwudi Ochi Onyeasoa and Ellen A Begole (2007)[7] studied the relationships among 4 indexes that are used to score orthodontic treatment need and outcome, and to determine whether 1 index could replace the other 3.

The index of complexity, outcome, and need (ICON), the dental aesthetic index (DAI), the peer assessment rating (PAR) index, and the American Board of Orthodontics objective grading system (ABO-OGS) were studied. They concluded that the ICON can be used in place of the PAR and the ABO-OGS for assessing treatment outcome and in place of the DAI for assessing treatment need.

An index of orthodontic treatment complexity by Stuart K. Llewellyn, Ahmad M. Hamdan (2007)[36] developed an index specifically for the measurement of treatment complexity. 120 sets of dental casts, 30 for each of the four main malocclusion classes were graded by sixteen orthodontists for perceived treatment complexity on a six-point scale and then listed, in order of importance, up to three occlusal features which they felt contributed to

complexity from a pre-determined list. Overjet/reverse overjet, lateral open bite, and teeth of poor prognosis had the highest weightings and therefore were most important in the assessment of treatment complexity.

Georgios Tsakos (2008)[12] Combined Normative and Psychosocial Perceptions for Assessing Orthodontic Treatment Needs. Generally perception of malocclusion by the public is mainly subjective, currently orthodontic treatment needs are predominantly determined using normative need. There are considerable differences between normative and subjective perceptions of orthodontic need. He used subjective oral health-related quality of life (OHRQoL) for need assessment and predicting perceived need.

A. T. Shelton, R. S. Hobson (2008)[4] determined the relationship, between the Peer Assessment Rating (PAR) Index, the Index of Complexity, Outcome and Need (ICON), and the Dental Aesthetic Index (DAI) score and the severity of hypodontia. 57 patient's casts were scored with the mean patient age at presentation was 12 years, with a standard deviation of 1.89 and a range of 9 – 16 years, and a female to male ratio of 1.1:1. The correlation between DAI score and the number of missing teeth indicated the relative sensitivity of the index to malocclusions in subjects with hypodontia.

Nihal Hamamci and Guvenc Basaran (2009)[28] investigated the relationship between Turkish university students' awareness of malocclusion, their satisfaction with their personal dental appearance, and the severity of their

occlusal irregularities. The sample consisted of 841 randomly selected university students, 522 (62.1 percent) males and 319 (37.9 percent) females, aged 17 – 26 years (mean age, 21.91 ± 1.92 years). A pretested questionnaire was used to assess the subjects' awareness of malocclusion and satisfaction with their personal dental appearance; the actual severity of malocclusion was determined using the Dental Aesthetic Index (DAI). This study showed that age had a significant effect on satisfaction and gender on DAI score variation. Females had a greater need for normative treatment except in the 20- to 22-year-olds, and satisfaction decreased with age.

C. Veenema, C. Katsaros (2009)[1] compared 30 pre and 30 post treatment standard plaster models with their digital counterparts for the applicability of the Index of Complexity, Outcome, and Need (ICON). ICON scores performed on computer-based models found as accurate and reliable as ICON scores on plaster models.

S. T. Barlow, M. B. Moore (2009)[37] assessed the severity of any underlying malocclusion in subjects presenting for treatment of a palatally impacted canine (PIC) using a modification of the Dental Health Component (DHC) of the Index of Treatment Need (MIOTN), which does not factor in the impacted canine.

The pre-treatment study models of 54 subjects who had previously undergone surgical exposure of a PIC, followed by fixed appliance orthodontic alignment, were scored independently by two examiners on two occasions using the MIOTN system. Forty-six and 41 per cent of the sample still scored either an

MIOTN grade 4 or 5 (i.e. a great or very great need of orthodontic treatment). However, 20 and 25 per cent of the subjects were graded with a MIOTN score of 1 or 2, indicating little or no need for treatment when the PIC was not taken into consideration. This finding emphasizes the importance of early diagnosis of an impacted canine and the need to institute interceptive measures where necessary, as up to 25 per cent of patients might otherwise require no other orthodontic treatment.

MATERIAL AND METHODS

MATERIALS AND METHODS

CASE SELECTION CRITERIA:

The sample of the study consisted of Pre and Post Study models and Orthopantomograph of 80 patients who got treatment in **Department Of Orthodontics and Dentofacial Orthopaedics, Tamilnadu Government Dental College and Hospital, Chennai**.

Criteria for patient selection:

1) The patients were in permanent dentition with all the tooth in dentition was erupted except third molars.
2) The age groups of the samples were selected to be between 13 years to 20 years of age.
3) The sample consists of 40 males and 40 females selected randomly.
4) All the patients got treated with pre-edgewise fixed appliance mechanotherapy by post graduate student under the supervision of experienced professors of Department of Orthodontics and Dentofacial Orthopaedics.

Exclusion criteria

1) Cases in which any tooth are unerupted, or impacted except third molar.

2) Cases in which any tooth are extracted due to dental caries or periodontal disease or other than for orthodontic treatment purpose.

3) Patient who have attrition or abraded tooth due to various pathology.

4) Cases in which treatment are not finished satisfactorily.

DIAGNOSTIC RECORDS:

MODELS:

Pre and post treatment models were taken with alginate impression material. The impressions were poured in Orthokal. The models were used to assess the following pre and post treatment measurements—

1) Missing teeth
2) Alignment
3) Marginal Ridge
4) Buccolingual Inclination
5) Occlusal Contacts
6) Occlusal Relationship
7) Overjet
8) Overbite
9) Interproximal Contacts
10) Midline
11) Open bite; Anterior & Posterior

12) Deep bite

13) Crossbite; Anterior and Posterior

14) Crowding

15) Aesthetic components of ICON

ORTHOPANTOMOGRAPH

Post-treatment OPG were taken for each patient for assessing the parallelism of root of tooth and root angulations. For a properly treated fixed appliance cases, the root of all the teeth should be parallel to each another and perpendicular to the occlusal surfaces.

MEASUREMENTS:

STUDY CAST EVALUATION:

Pre-treatment and post-treatment study models were scored with the PAR and the ICON. Only pre-treatment models were scored with the DAI, and only post-treatment models were scored according to the ABO-OGS.

MEASUREMENT of ABO-GS —

The ABO Objective Grading System for scoring dental casts and panoramic radiographs contains eight criteria: alignment, marginal ridges, buccolingual inclination, occlusal relationships, occlusal contacts, overjet, interproximal

contacts, and root angulations. Measurements are done with special ABO measuring gauge.

1. Alignment –

   In the maxillary and mandibular anterior regions, proper alignment is characterized by coordination of alignment of the incisal edges and lingual incisal surfaces of the maxillary incisors and canines, and the incisal edges and labial incisal surfaces of the mandibular incisors and canines.

   In the mandibular posterior quadrants, the mesiobuccal and distobuccal cusps of the molars and premolars should be in the same Mesiodistal alignment.

   In the maxillary arch, the central grooves should be should all be in the same plane.

   0- Within 0.50 mm of alignment

   1- 0.50 to 1 mm of deviation

   2- Greater than 1 mm

2. Marginal Ridges-

   In both maxillary and mandibular arches, marginal ridges of adjacent posterior teeth shall be at the same vertical level.

   0- Marginal ridges of adjacent posterior teeth within 0.50 mm level

1- 0.50 to 1 mm deviation

2- Greater than 1 mm deviation

3. Buccolingual inclination-

The buccolingual inclination of posterior teeth shall be assessed by using a flat surface that is extended between the occlusal surfaces of the right and left posterior teeth. When positioned in this manner, the straight edge should contact the buccal cusps of contralateral mandibular molars. The lingual cusps should be within 1 mm. In the maxillary arches, the straight edge should contact the lingual cusps of the maxillary molars and premolars. The buccal cusps should be within 1 mm of the surface of the straight edge.

0- Within 1 mm

1- 1 to 2 mm

2- Greater than 2 mm

4. Occlusal contacts-

It represents the occlusal contact or intercuspation of maxillary and mandibular posterior teeth.

0- Intercuspation present

1- A cusp is out of contact with the opposing arch and within 1 mm

2- The distance is greater than 1 mm

5. Occlusal relationship- the occlusion can been finished in an angle class I, II, or III.

    0- Occlusal relationship within 1 mm of ideal

    1- Deviation between 1 and 2 mm

    2- Deviation more than 2 mm

6. Overjet-

    The buccal cusps of the mandibular molars and premolars will contact in the center of the occlusal surfaces, buccolingually, of the maxillary premolars and molars. In the anterior region, the mandibular incisor and canines will contact the lingual surfaces of the maxillary canines and incisors.

    0- If above relationship exist

    1- Deviation within 1 mm

    2- Deviation more than 1 mm

7. Interproximal contacts-

    The mesial and distal surfaces of the teeth should be in contact with one another.

0- No interproximal space exist

1- Upto 1 mm of space exist

2- More than 1 mm of space exist

8. Root angulations-

The relative angulations of the roots of the maxillary and mandibular teeth are assessed on the panoramic radiograph. The roots of the maxillary and mandibular teeth should be parallel to one another and oriented perpendicular to the occlusal plane.

0. Deviation of apex is within 1 mm

1. Deviation between 1 and 2 mm

2. Deviation more than 2 mm

MEASUREMENT of PAR Index—

PAR Index contains 5 criteria: Displacement score, Buccal Occlusion, Overjet, Overbite and Midline.

1. Displacement scores-

To score displacement score, the dental arch is divided into three recording segment, left buccal, right buccal and anterior.

The occlusal features recorded are crowding, spacing and impacted teeth.

Displacements are recorded as the shortest distances between contact points of adjacent teeth parallel to the occlusal plane.

Displacement Score	Discrepancy
0	0 mm to 1 mm
1	1.1mm to 2 mm
2	2.1 mm to 4 mm
3	4.1 mm to 8 mm
4	Greater than 8 mm
5	Impacted teeth

2. Buccal occlusion-

Score	Discrepancy
Antero-posterior	
0	Good interdigitation class I, II or III
1	Less than half unit discrepancy
2	Half a unit discrepancy
Vertical	
0	No discrepancy in intercuspation
1	Lateral openbite on at least two teeth greater than 2 mm
Transverse	
0	No cross bite
1	cross bite tendency
2	Single tooth in cross bite
3	More than one tooth in cross bite
4	More than one tooth in scissor bite

3. Overjet-

Score	Discrepancy
Overjet	
0	0 – 3 mm
1	3.1 – 5 mm
2	5.1 – 7 mm
3	7.1 – 9 mm
4	Greater than 9 mm
Anterior cross bite	
0	No discrepancy
1	One or more teeth edge to edge
2	One single tooth in crossbite
3	Two teeth in crossbite
4	More than two teeth in crossbite

4. Overbite -

Score	Discrepancy
Openbite	
0	No open bite
1	Open bite less than and equal to 1 mm
2	Openbite1.1 mm- 2 mm
3	Openbite 2.1mm – 3 mm
4	Openbite greater than or equal to 4 mm
Overbite	
0	Less than or equal to one third coverage of the lower incisor
1	Greater than one third, but less than two thirds coverage of the lower incisor
2	Greater than two thirds coverage of the lower incisor
3	Greater than or equal to full tooth coverage

5. Midline assessments—

Score	Discrepancy
0	Coincident and up to one quarter lower incisor width
1	One quarter to one half lower incisor width
2	Greater than one half lower incisor width

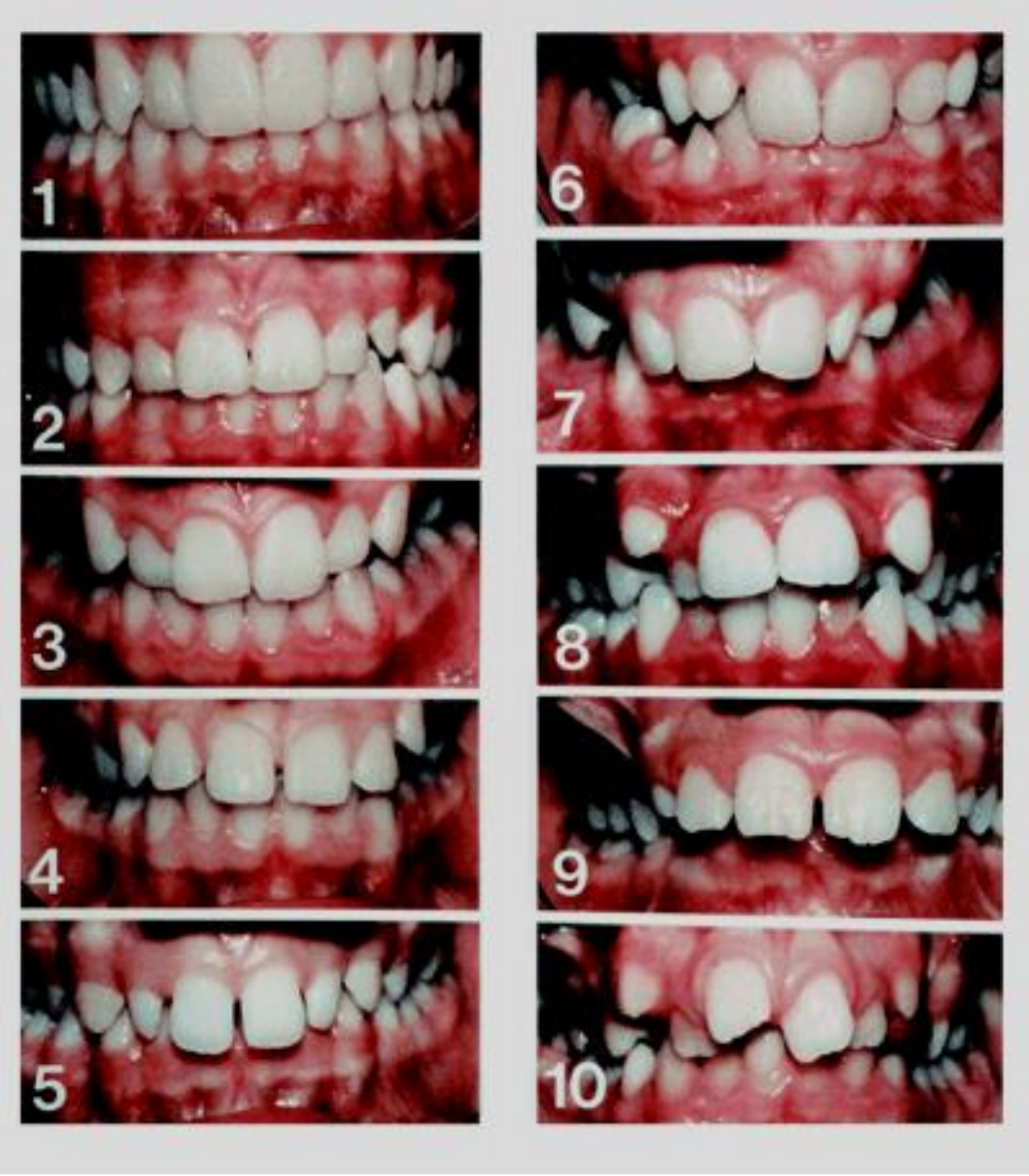
MEASUREMENT of ICON Index—

It included following 5 criteria:

Aesthetic index	1- 10 as judged using IOTN aesthetic component						
Dental health component	Score	0	1	2	3	4	5
Upper arch crowding	Score only the highest trait either spacing or crowding	less than 2 mm	2.1to 5mm	5.1 to 9 mm	9.1 to 13	13.1 to 17 mm	>17 mm or impacted teeth
upper spacing		Upto 2 mm	2.1 to 5 mm	5.1 to 9 mm	> 9 mm		
Crossbite		No crossbite	Crossbite present				
Incisor openbite	Score only the highest trait either open bite or overbite	Complete bite	Less than 1 mm	1.1 to 2 mm	2.1 to 4 mm	>4 mm	
Incisor overbite		Upto 1/3 tooth	1/3- 2/3 coverage	2/3 up to full covered	Fully covered		
Buccal segment AP relation	Left and Right added together	Any cusp to embrassure relation	Any cusp relation up to but not including cusp to cusp	Cusp to cusp relation			

AESTHETIC COMPONENT – The AC has 10 levels from most to least attractive.

THE AESTHETIC COMPONENT SCALE OF IOTN



Measurement of DAI Index—

The Dental Aesthetic Index (DAI) has been adopted by the World Health Organization as a cross-cultural index. The DAI evaluates 10 occlusal features: overjet, overbite, missing teeth, diastema, anterior open bite, anterior crowding, anterior spacing, the largest anterior irregularity (mandible and maxilla), and anteroposterior molar relationship.

DAI	Component		Weighting
1	No. Of missing teeth visible teeth	Incisors ,canines &premolars in the both arches	6
2	Incisal segment crowding	0- No segment crowded	1
		1- 1 segment crowded	
		2- 2 segment crowded	
3	Incisal segment spacing	0- No segment spaced	1
		1- 1 segment spaced	
		2- 2 segment spaced	

4	Measurement of and midline diastema	In mm	3
5	Largest anterior irregularity on the maxilla	In mm	1
6	Largest anterior irregularity on the mandible	In mm	1
7	Anterior maxillary overjet	In mm	2
8	anterior mandibular overjet	In mm	4
9	Vertical anterior openbite	In mm	4
10	AP molar relation; largest deviation from normal either left or right	0- Normal 1- 1/2cusp either mesial or distal 2- Full cusp or more mesial or distal	3
11	Constant		13

DIGITAL VERNIER CALIPERS

PRETREATMENT STUDY MODELS- FRONTAL VIEW

PRETREATMENT STUDY MODELS- LATERAL VIEW

PRETREATMENT STUDY MODELS- OCCLUSAL VIEW

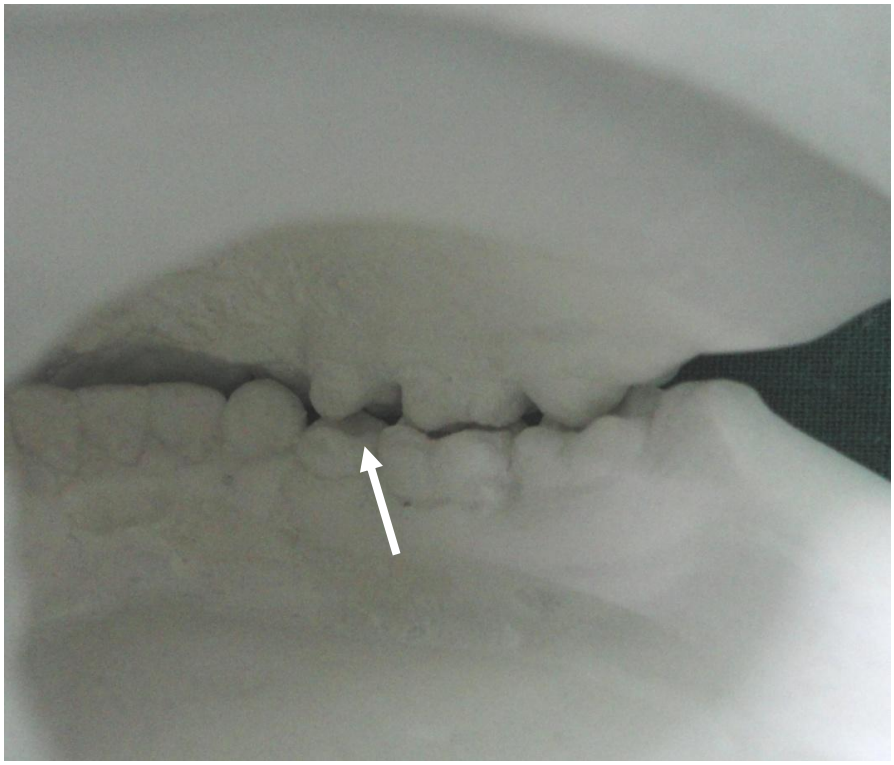
POST-TREATMENT STUDY MODELS- FRONTAL VIEW

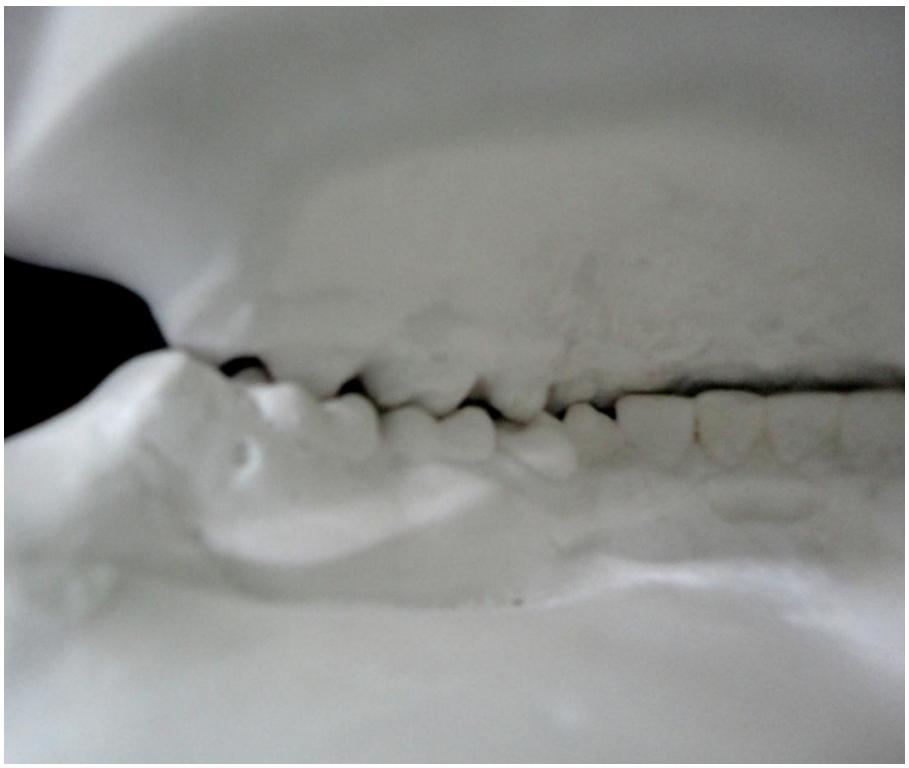
POST-TREATMENT STUDY MODELS- LATERAL VIEW

POST-TREATMENT MODELS- OCCLUSAL VIEW

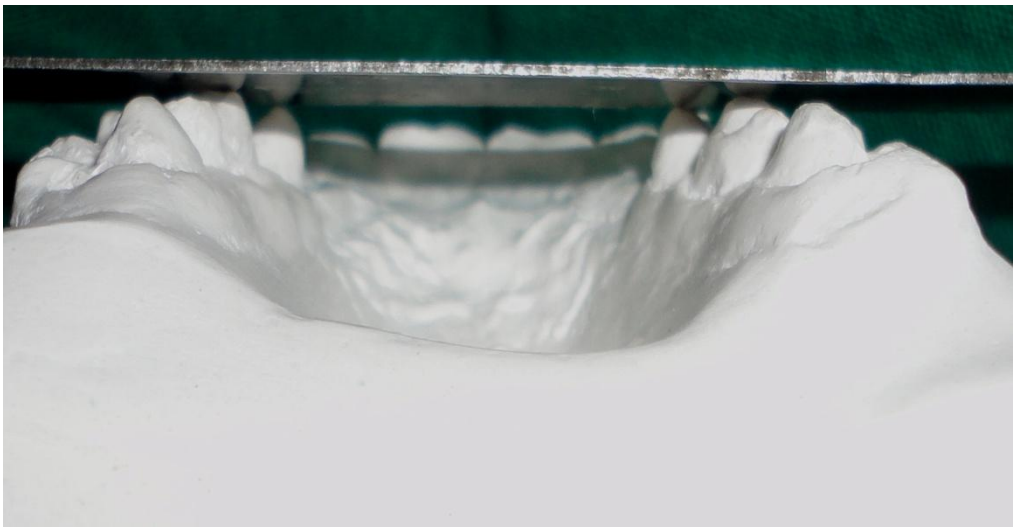
POST-TREATMENT MODELS- LINGUAL VIEW

OCCLUSAL CONTACT RELATIONSHIP



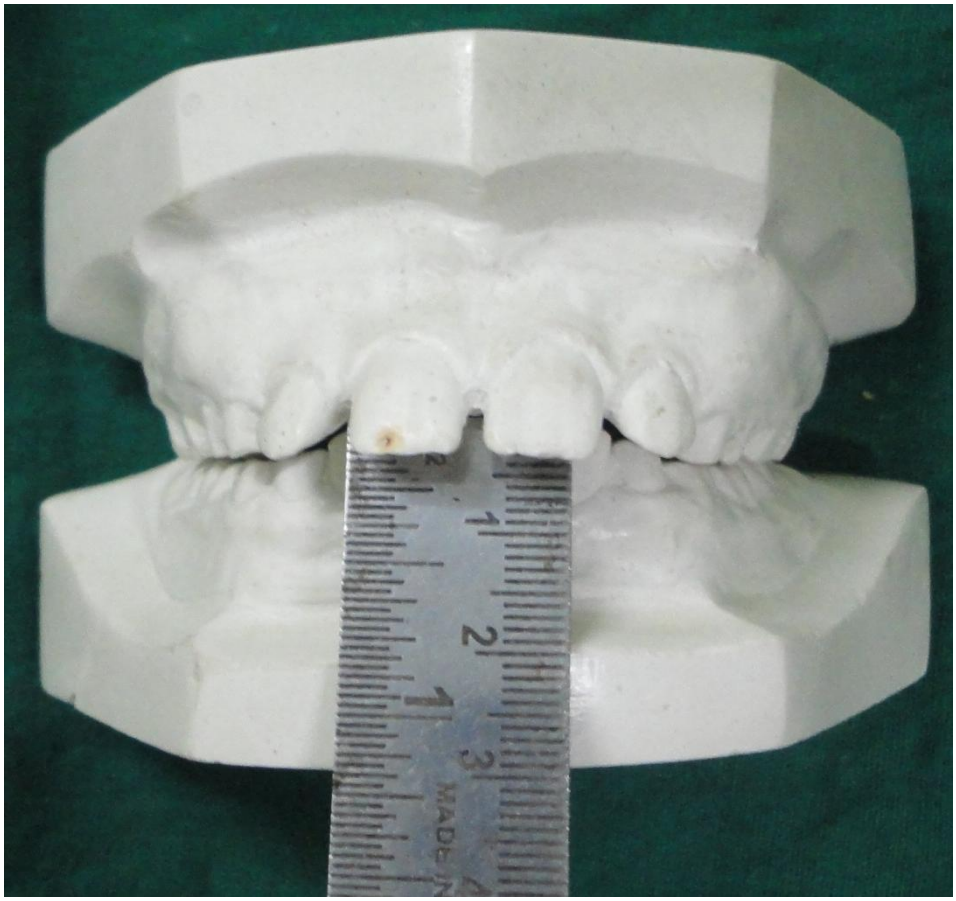


POST-TREATMENT BUCCOLINGUAL INCLINATION

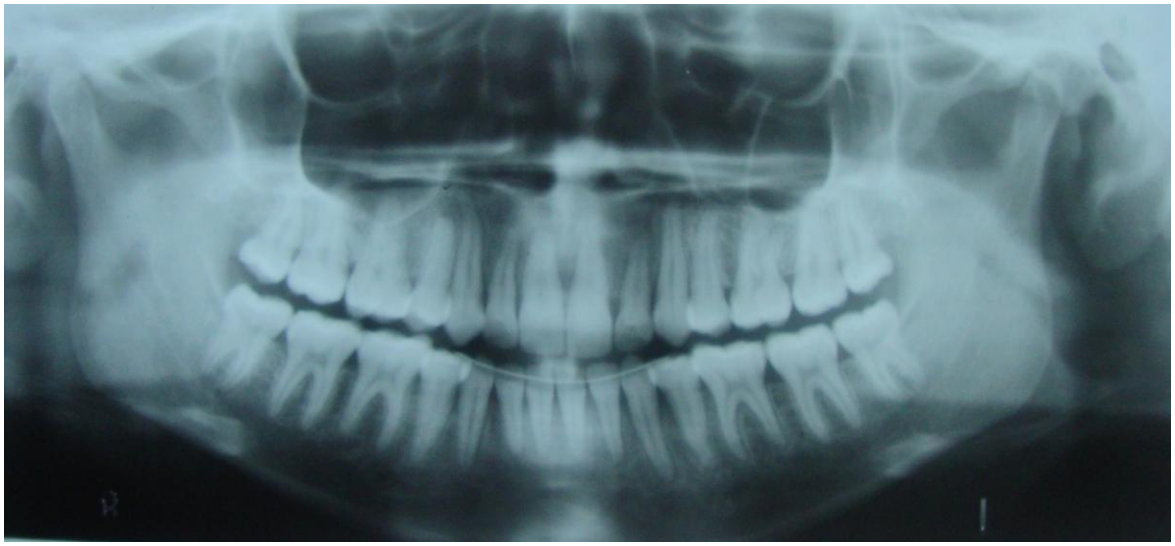


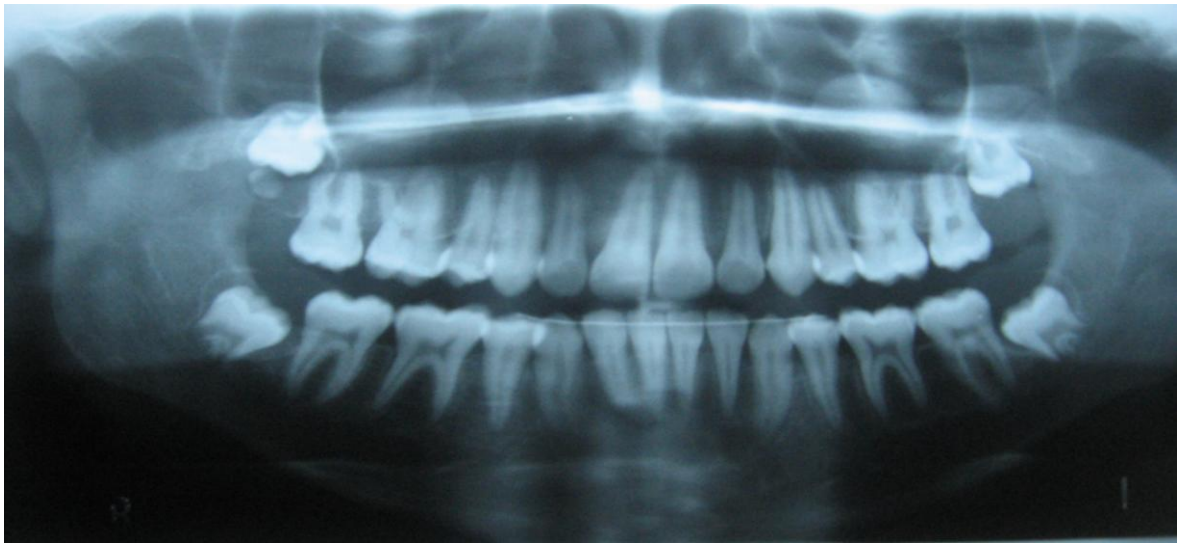
PRE-TREATMENT OVERJET MEASUREMENT

PRE-TREATMENT OVERBITE MEASUREMENT



POST TREATMENT O.P.G.





RESULTS

RESULTS

STATISTICAL ANALYSIS:

The findings of measurements of the dental casts were statistically analysed. The arithmetic mean and standard deviation were calculated for all the measurements using NPar test. The level of significance was set at $P< 0.05$. The differences between the gender were evaluated using a student‘t’ tests. The correlation between the 4 indices was tested by using spearman correlation coefficient.

Table 1 shows the intraexaminer reliabity assessment of the indexes with the spearman rank order correlation coefficient. It shows that all the measurement is significant at 0.01 levels.

Table 2 shows no differences in each index between male and female. Each index was carried out on 40 males and 40 females study cast and student‘t’ test was done to check for any differences between two which was found none.

Table 3 shows the descriptive statistics for the indexes.

The pre-treatment mean ICON score was 55.15± 15.086(SD).

The post-treatment mean ICON score was 12.13±5.349 (SD).

The pre-treatment mean PAR score was 32.85± 13.230(SD).

The post-treatment mean PAR score was 6.80±5.110 (SD).

The pre-treatment mean DAI score was 38.18± 6.114(SD).

The post-treatment mean ABO-OGS score was 22.19±3.323 (SD).

As pre-treatment score of PAR and ICON is higher than post-treatment score of the same. It shows that there is definitive improvement by treatment.

Table 4 shows the correlation between ICON, DAI, PAR and ABO-OGS using spearman rank order coefficient correlation test. The highest correlation was found between ICON vs PAR post-treatment scores ($r = 0.784$, $P<0.001$), followed by ICON vs DAI pre-treatment scores ($r =0.659$, $P<0.001$). There was no significant positive correlation was found between PAR vs ABO-OGS ($r =0.006$, $P =0.958$). All the indexes showed statistically significant positive correlations with the ICON.

Table 5 showed the distribution of orthodontic treatment needs and outcome for the study sample according to 4 indexes. According to ICON 14 and DAI 10 cases was in treatment need. According to ICON 6, PAR 4 AND ABO-OGS 10 cases had unacceptable outcome.

Figure 1 shows the plot of the DAI vs the ICON (pre-treatment). Definite treatment needs starts at DAI scores of 26 and above, whereas treatment need starts at ICON score greater than 43. This shows good agreement between ICON and DAI scores.

Figure 2 is the plot of PAR scores against ICON scores for pre-treatment and post-treatment study casts. Good agreement between the ICON and the PAR is shown.

The degree of ICON improvement (pre-treatment ICON score minus 4 times the post-treatment ICON score) vs percentage of PAR reduction is shown in Figure 3. It represents the reduction in severity of malocclusion due to provided treatment.

A plot of post-treatment ICON scores vs ABO-OGS scores is shown in Figure 4. Significant agreement between post-treatment scores of ICON and ABO-OGS is shown.

Table no 1: Intraexaminer reliability for 4 orthodontic indexes

	ICON		PAR		DAI	ABO -OGS
	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment		
RMS						
Spearman rank order correlation coefficient	0.704**	1.000*	0.720**	0.784**	0.623**	0.510*

* Correlation is significant at the 0.005 level (2-tailed).

** Correlation is significant at the 0.001 level (2-tailed).

Table no.2: Differences in 4 indices according to gender:

T-Test — Group Statistics

Indexes	Sex	N	Mean	Std. Deviation	Std. Error Mean	P value
ABO-OGS - Post	Male	40	22.33	3.050	.482	0.714
	Female	40	22.05	3.609	.571	0.714
PAR-Pre Test	Male	40	31.85	11.217	1.774	0.502
	Female	40	33.85	15.056	2.381	0.502
PAR-Post Test	Male	40	6.23	4.638	.733	0.317
	Female	40	7.38	5.541	.876	0.317
ICON-Pre Test	Male	40	54.90	12.186	1.927	0.883
	Female	40	55.40	17.675	2.795	0.883
ICON-Post Test	Male	40	11.80	4.916	.777	0.590
	Female	40	12.45	5.795	.916	0.590
DAI -Pre Test	Male	40	37.92	6.379	1.009	0.717
	Female	40	38.42	5.909	.934	0.717

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Table no.3: Descriptive statistics for entire sample for ICON, PAR, DAI and ABO-OGS

Descriptive Statistics using NPar Tests

Index	N	Mean	Std. Deviation	P value
PAR-Pre Test	80	32.85	13.230	<0.001
ICON-Pre Test	80	55.15	15.086	<0.001
DAI -Pre Test	80	38.18	6.114	<0.001
PAR-Post Test	80	6.80	5.110	<0.001
ICON-Post Test	80	12.13	5.349	<0.001
ABO-OGS -Post	80	22.19	3.323	<0.001

Table no. 4: correlation between ICON, PAR, DAI and ABO-OGS

Nonparametric Correlations (Spearman Test)

Spearman correlation between indexes	Pre-treatment	Post-treatment
ICON vs DAI	.659(**)	---
ICON vs PAR	.572(**)	.784(**)
ICON vs ABO-OGS	---	.513(**)
PAR vs DAI	.528(**)	---
PAR vs ABO-OGS	---	-.006

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

TABLE 5: Distribution of orthodontic treatment need and outcome for sample (n = 80) according to 4 indexes

Index	Treatment Need		Treatment Outcome	
	Present	Absent	Acceptable	Unacceptable
ICON	66	14	74	6
DAI	70	10	---	---
PAR	---	---	76	4
ABO-OGS	---	---	70	10

Figure1. Scatter plot showing total DAI score vs pre-treatment ICON score.

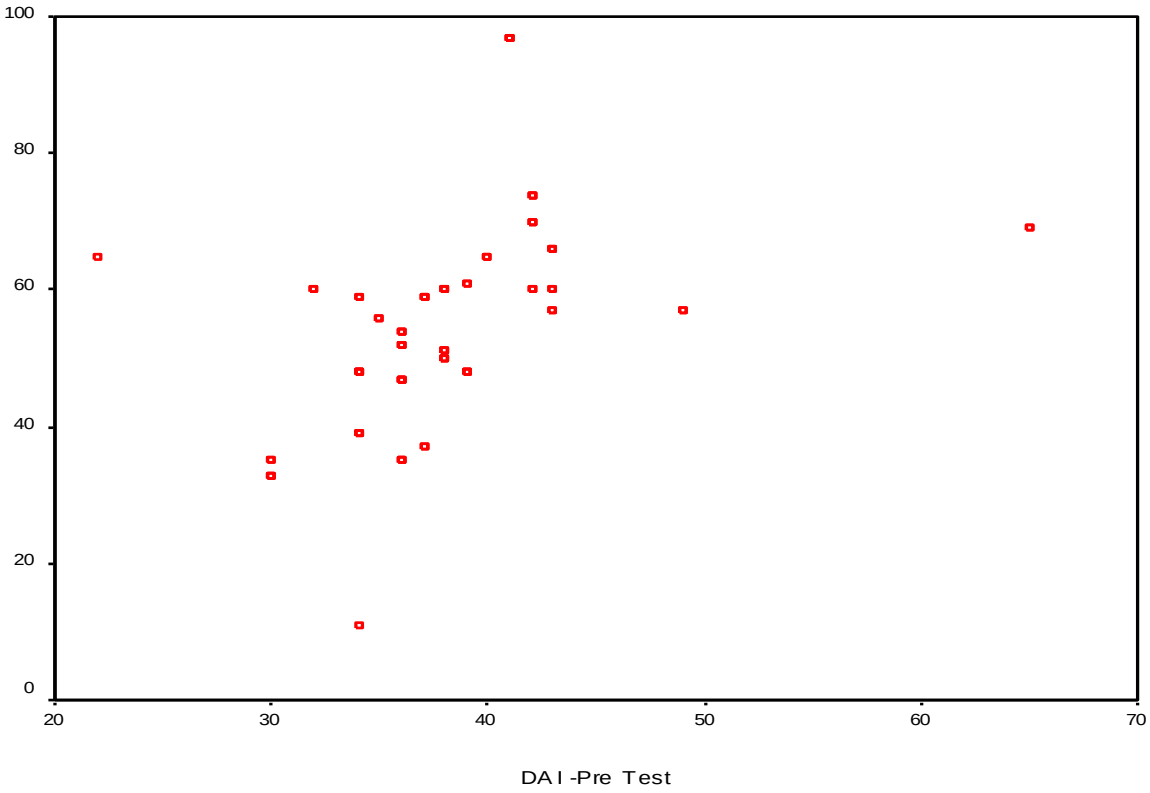


Figure2. Scatter plot showing total pre-treatment ICON score vs pre-treatment weighted PAR score and total post-treatment ICON score vs post-treatment weighted PAR score.

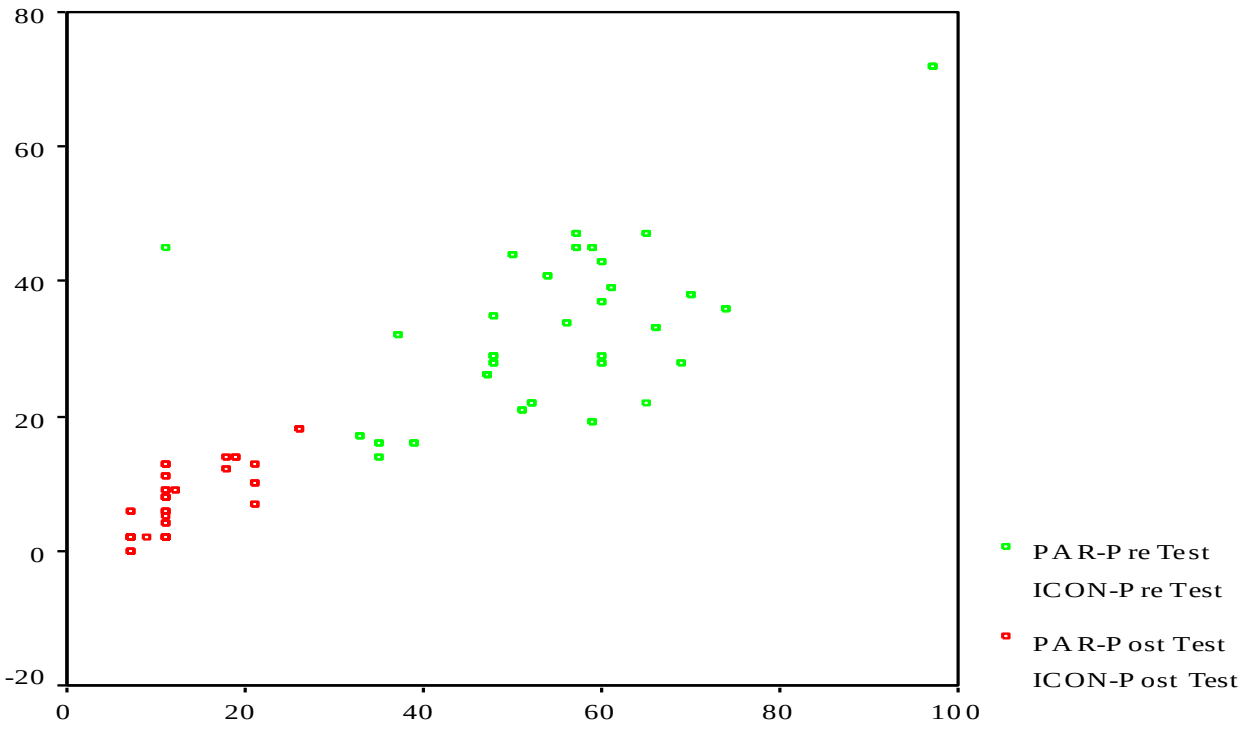


Figure3. Scatter plot showing degree of ICON improvement vs percentage weighted PAR score reduction.

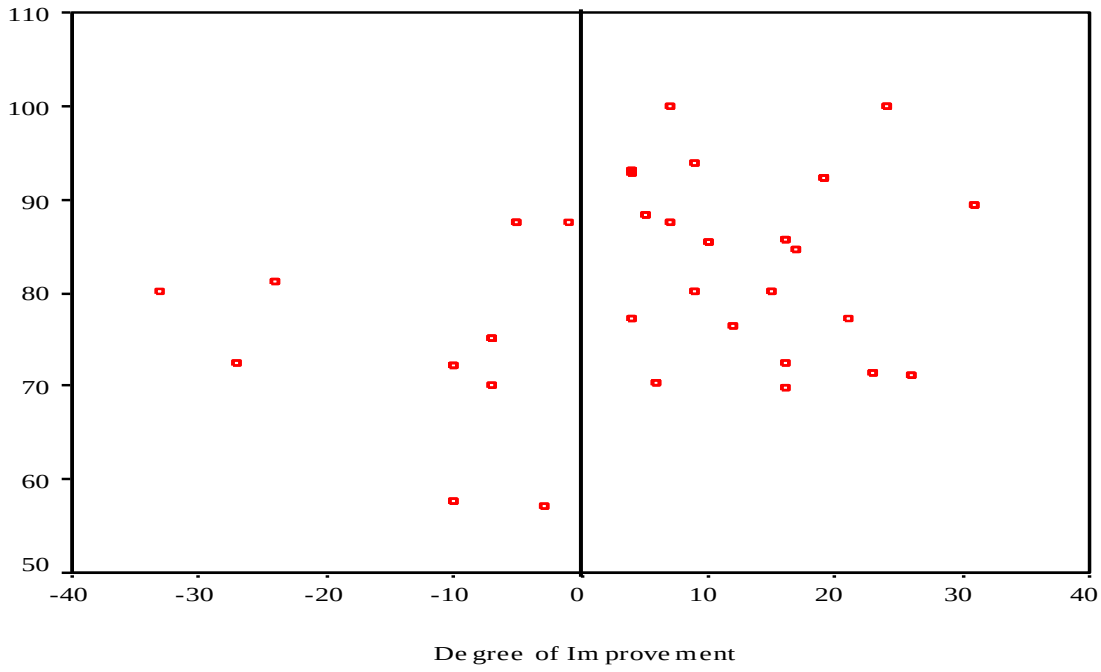
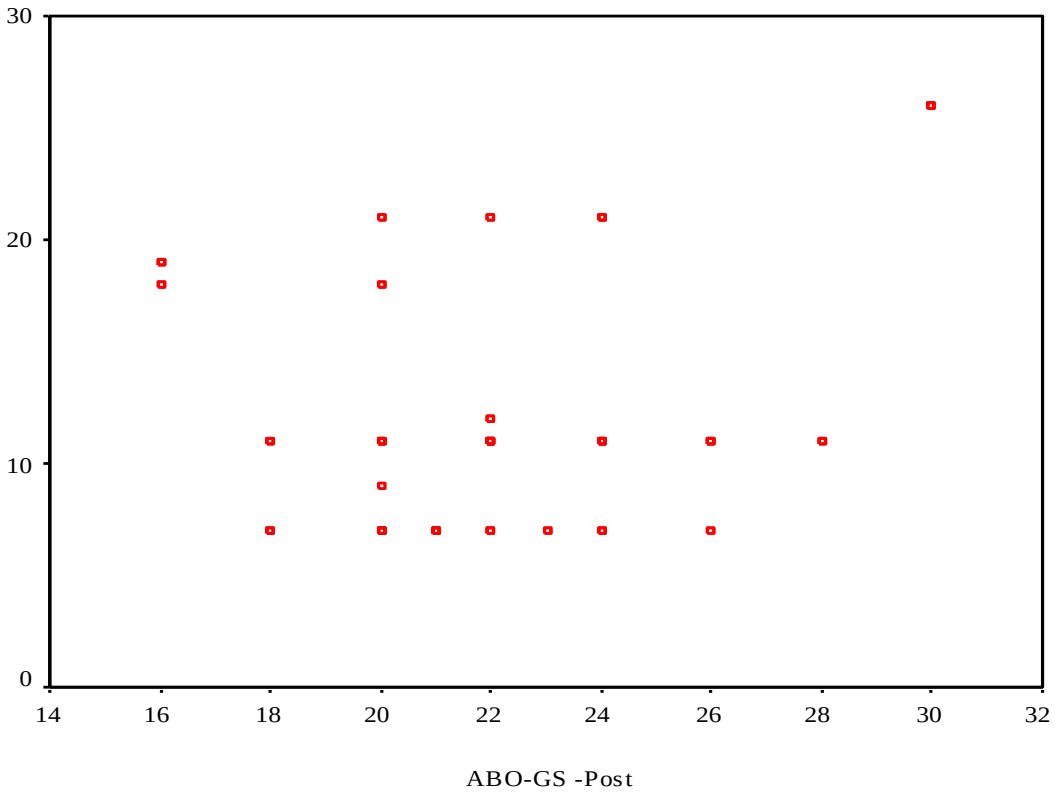


Figure4. Scatter plot showing total post-treatment ICON score vs ABO-OGS score.



DISCUSSION

DISCUSSION

Several authors have described the criteria of an ideal occlusal index. As with any diagnostic test, the most important criteria for any index are reliability and validity.

Observer reliability is the extent to which a measurement is repeatable under identical conditions. The term intra-rater reliability referring to consistency of repeated observation by an observer with himself .While inter-rater reliability relates to observations being consistent amongst a group of observers.

Observer validity is the extent to which a measurement measures what it purports. In a clinical or epidemiological context the measurement of validity takes place against a validity or ‘gold’ standard.

In the case of an occlusal index to determine treatment need, the gold standard is commonly the expert opinion of a group of orthodontists. There have been validations and reliability studies with a large panel of experts for a limited number of occlusal indexes.

In this study, the intraexaminer reliability assessment outcome is considered satisfactory and is comparable to several related previous reports. Indexes that assess only outcome of orthodontic treatment, such as the ABO-OGS, often do not seem to consider the severity of the pre-treatment need or the complexity of the treatment. Those assessing need only, such as the DAI, often do not offer information on the complexity of the treatment. The ICON (assessing need,

outcome, and complexity) seems to provide answers to these shortcomings. Using different indexes to assess need and outcome to some extent implies that malocclusion is not a continuum and that, after treatment, the occlusion cannot be considered to need further treatment. Using the same assessment before and after treatment seems to be more valid.

It also had a fairly broad range of treatment starts as did the previous study, but a major difference between these studies was that all patients in this Indian study were treated by postgraduate students under the supervision of experienced professors of orthodontics; in the United Kingdom (UK) study[11], some patients were treated by clinical assistants. Also, even though the IOTN was used for treatment need whereas the DAI were used in this study, the relationship between the ABO-OGS and the ICON was also assessed. The US study[7] included patients who did not complete treatments in line with normal orthodontic treatment protocol, whereas our study did not.

The pre-treatment mean PAR score in the UK study was 38.2 _ 10.6 (SD) and in the US study was 23.8 _ 11.5 (SD) compared with 32.85 _ 13.23 (SD) in this Indian study. The post-treatment means PAR score was 5.4 _ 5.9 (SD) in the UK study; 1.7 _ 3.8 (SD) in the US study; in this study, it was 6.8 _ 5.1 (SD). The pre-treatment ICON mean score was 55.1 _ 15.08 (S.D) in our study compared with 72.8 _ 13.0 (SD) and 67.8 _ 20.6 (S.D) in the UK and US study respectively.

The results of the correlation between ICON and the other indexes showed that pre-treatment models had higher correlations than post treatment models. This agrees with the UK study. We found the highest correlation between the post-treatment ICON and the post-treatment PAR scores.

In assessing treatment need, the general performance of the ICON seemed to generally agree with the DAI. In our study, 14 patients had no orthodontic treatment need as assessed by the ICON compared with 10 according the DAI (Table V). This suggests that the ICON could probably substitute for the DAI and produce similar results.

The general performance of the ICON was also comparable with the PAR and the ABO-OGS because 6 and 4 patients had unacceptable results, according to the ICON and the PAR, respectively.

The ICON was shown to be more stringent in assessing outcome than the PAR in this study. This supports the findings of Fox et al.

Ten patients had unacceptable outcomes according to the ABOOGS.

It would seem that the ABO-OGS is the most stringent in assessing treatment outcomes compared with the ICON and the PAR.

SUMMARY AND CONCLUSION

SUMMARY AND CONCLUSION

● The ICON can substitute for the DAI to measure orthodontic treatment need. A value greater than 43 for the ICON defines need for treatment, as does a DAI score of 26 or above. The relationship between these 2 indexes was statistically significant (*P* _.001).

● The PAR had a close relationship with the ICON in this study; thus, the ICON can be used to assess orthodontic treatment outcome.

● The ABO-OGS requires more stringent standards than the PAR or the ICON for assessing the outcome of orthodontic treatment. A case report that loses more than 30 points will fail and loses less than 20 points will pass.

● Overall agreement between the ICON and the other indexes assessed in this study was good. Therefore, the ICON appears to be a reasonable means of assessing the standard of orthodontic treatment in terms of complexity, need, and outcome rather than using various indexes. Use of the ICON will encourage international comparison and professional standardization.

BIBLIOGRAPHY

BIBLIOGRAPHY

1. A. C. Veenema, C. Katsaros, Index of Complexity, Outcome and Need scored on plaster and digital models, European Journal of Orthodontics 31 (2009) 281–286
2. Allen R. Firestone, DDS, MS; F. Michael Beck, Validity of the Index of Complexity, Outcome, and Need (ICON) in Determining Orthodontic Treatment Need (*Angle Orthod* 2002; 72:15–20.)
3. Andra Liepa, Ilga Urtane, Orthodontic treatment need in Latvia, European Journal of Orthodontics 25 (2003) 279–284
4. A. T. Shelton, R. S. Hobson and D. Slater, A preliminary evaluation of pre-treatment hypodontia patients using the Dental Aesthetic Index. How does it compare with other commonly used indices? European Journal of Orthodontics 30 (2008) 244–248
5. Brook PH, Shaw WC. The development of an index of orthodontic treatment priority. Eur J Orthod 1989; 20:309-20.
6. Charles Daniels and Stephen Richmond, The Index of Complexity, Outcome and Need (ICON), journal of orthodontics 27(2000)149-162
7. Chukwudi Ochi Onyeaso and Ellen A Begole, 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; 131:248-52)

8. Cons NC, Jenny J, Kohout FJ. DAI: The dental aesthetic index. College of Dentistry, Iowa City, IA: University of Iowa; 1986.
9. Draker, H. L.: Handicapping labio-lingual deviations: A proposed index for public health purposes, J. Public Health Dent. 18: l-17, 1958.
10. Frank M. Beglin, Allen R. Firestone, A comparison of the reliability and validity of 3 occlusal indexes of orthodontic treatment need Am J Orthod Dentofacial Orthop 2001; 120:240-6).
11. 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.
12. Georgios Tsakos, Combining Normative and Psychosocial Perceptions for Assessing Orthodontic Treatment Needs Journal of Dental Education August 2008 Volume 72, Number 8.
13. Grainger, R. M.: Indexing Handicapping Malocclusions. Working paper for meeting of Expert Committee on Dental Health, World Health Organization, Geneva, 1961.
14. Grainger, R. M.: Orthodontic treatment priority index, PHS Publication No. 1000, Series 2, No. 25, Washington, 1967, U. S. Government Printing Office.
15. Joanna Jenny, and Naham C. Cons Comparing and contrasting two orthodontic indices, the Index of Orthodontic Treatment Need and the

Dental Aesthetic Index. Am J Orthod Dentofacial Orthop 1996; 110:410-416.

16. John S, Casko, James V. Vaden, American board of orthodontics-objective grading system (ABO-OGS), Am J Orthod Dentofacial Orthop 1998; 114:589-99.)
17. Kari Birkeland, Jakob Furevik, Evaluation of treatment and post-treatment changes by the PAR Index European Journal of Orthodontics 19 (1997) 279–288
18. Ken Danyluk, Chris Lavelle, Potential application of the dental aesthetic index to prioritize the orthodontic service needs in a publicly funded dental program Am J Orthod Dentofacial Orthop 1999; 116:279-86
19. K. M. Templeton, R. Powell, Are the Peer Assessment Rating Index and the Index of Treatment Complexity, Outcome, and Need suitable measures for orthognathic outcomes? European Journal of Orthodontics 28 (2006) 462–466
20. Little R M, The irregularity index: a quantitative score of mandibular anterior alignment. American Journal of Orthodontics1975; 68: 554 – 563
21. Massler M, Frankel J. Prevalence of malocclusion in children aged 14 to 18 years. Am J Orthod Dentofacial Orthop 1951; 37:751-68.
22. Matthew Mayers, Allen R. Firestone Comparison of peer assessment rating (PAR) index scores of plaster and computer-based digital models, Am J Orthod Dentofacial Orthop 2005; 128:431-4.

23. Matthew Shue-TeYeh, Amir-Reza Koochek, The relationship of 2 professional occlusal indexes with patients' perceptions of aesthetics, function, speech, and orthodontic treatment need, Am J Orthod Dentofacial Orthop 2000;118:421-8

24. Mourad Souames, Francis Bassigny, Orthodontic treatment need in French schoolchildren: an epidemiological study using the Index of Orthodontic Treatment Need European Journal of Orthodontics 28 (2006) 605–609

25. Neslihan Ucuncu and Esra Ertugay the use of the index of orthodontic treatment need (IOTN) in a school population and referred population (2001) , Journal of Orthodontics, Vol. 28, 2001, 45–52

26. Nicholas J. Savastano Jr, Allen R. Firestone, Validation of the complexity and treatment outcome components of the index of complexity, outcome, and need (ICON) Am J Orthod Dentofacial Orthop 2003;124:244-8

27. Nicola E atack and tom dowell et al, Early detection of differences in surgical outcome for cleft lip and palate BJO 1998; 25: 181-185

28. Nihal Hamamci, Guvenc Başaran Dental Aesthetic Index scores and perception of personal dental appearance among Turkish university students European Journal of Orthodontics 31 (2009) 168–173

29. Nikki Atack, Iain Hathorn, Study models of 5 year old children as predictors of surgical outcome in unilateral cleft lip and palate, European Journal of Orthodontics 19 (1997) 165–170

30. N. W. Berk, H. Dukich Bush, J. Cavalier, R. Kapur Perception of orthodontic treatment need: opinion comparisons of orthodontists, paediatric dentists, and general practitioners, Journal of Orthodontics, Vol. 29, 2002, 287–291
31. O.D. Otuyemi, K.A. Kolawole, Perception of Orthodontic Treatment Need: Opinion Comparisons of Patients, Parents and Orthodontists, African Journal of oral Health Volume 2 Numbers 1 & 2 2005: 42-51
32. Poulton D.R. and Aaronson S.A., The relationship between occlusion and periodontal status, Am J Orthod Dentofacial Orthop 1961; 47:690-699.
33. Richmond S. Shaw WC, O'Brien KD et al. The development of the PAR Index (Peer Assessment Rating): reliability and validity. Eur J Orthod 1992; 14:125-39.
34. S. Richmond, W.C. Shaw et al, The peer assessment rating (PAR) index: methods to determine outcome of orthodontic treatment in terms of improvement and standards reliability and validity European Journal of Orthodontics 14 (1992)180-187.
35. Salzmann JA., Handicapping malocclusion assessment to establish treatment priority. Am J Orthod Dentofacial Orthop 1968; 54:749-65.
36. Stuart K. Llewellyn, Ahmad M. Hamdan, An index of orthodontic treatment complexity European Journal of Orthodontics 29 (2007) 186–192

37. S. T. Barlow, M. B. Moore, Palatally impacted canines and the modified index of orthodontic treatment need, European Journal of Orthodontics 31 (2009) 362–366

38. Stephen Richmond and Charles P. Daniels International comparisons of professional assessments in orthodontics: Part 1—Treatment need, Am J Orthod Dentofacial Orthop 1998; 113:180-5.

39. Summers CJ. The occlusal index: a system for identifying and scoring occlusal disorders. Am J Orthod Dentofacial Orthop 1971; 59:552-67.

40. Troy R. Okunami, Budi Kusnoto Assessing the American Board of Orthodontics objective grading system: Digital vs. plaster dental casts, Am J Orthod Dentofacial Orthop 2007; 131:51-6

41. Tülin Ugur, Semra Ciger, Ata Aksoy, An epidemiological survey using the Treatment Priority Index (TPI) European Journal of Orthodontics 20 (1998) 189–193

42. Van Kirk LE Jr, Pennell EH. Assessment of malocclusion in population groups. Am J Orthod Dentofacial Orthop 1959; 45:752-8.

43. William S. Parker, the HLD (CalMod) index and the index question Am J Orthod Dentofacial Orthop 1998; 114:134-41.)

44. Y. V. Kok, P. Mageson, N. W. T. Harradine and A. J. Sprod Comparing a quality of life measure and the Aesthetic Component of the Index of Orthodontic Treatment Need (IOTN) in assessing orthodontic treatment need and concern, Journal of Orthodontics, Vol. 31, 2004, 312–318.

ANNEXURE

ANNEXURE

Proforma used for various indices -:

ABO-GS

Case no. –

CONTENTS	SCORE
1. ALIGNMENT	
	TOTAL= 64 – Deduction
2. MARGINAL RIDGE	
	TOTAL= 32 – Deduction
3. BUCCOLINGUAL INCLINATION	
	TOTAL= 40 – Deduction
4. OCCLUSAL CONTACTS	
	TOTAL= 64 – Deduction
5. OCCLUSAL RELATIONSHIP	
	TOTAL= 24 – Deduction
6. OVERJET	
	TOTAL= 32 – Deduction
7. INTERPROXIMAL CONTACTS	
	TOTAL= 60 – Deduction
8. ROOT ANGULATION	
	TOTAL= 64 – Deduction
TOTAL	

PAR INDEX (Pre-treatment)

Case no. –

CONTENTS		SCORE (UNWEIGHTED)		WEIGHTING	SCORE (WEIGHTED)
1.DISPLACEMENT SCORES	UR			0	
	UA			1	
	UL			0	
	LR			0	
	LA			1	
	LL			0	
2. BUCCAL OCCLUSION	AP			1	
	VERTICAL				
	TRANSVERSE				
3.OVERJET	OVERJET			6	
	ANT. CROSSBITE				
4.OVERBITE	OVERBITE			2	
	OPENBITE				
5.MIDLINE				4	
TOTAL					

PAR INDEX (Post treatment)

Case no. –

CONTENTS		SCORE (UNWEIGHTED)		WEIGHTING	SCORE (WEIGHTED)
1.DISPLACEMENT SCORES	UR			0	
	UA			1	
	UL			0	
	LR			0	
	LA			1	
	LL			0	
2. BUCCAL OCCLUSION	AP			1	
	VERTICAL				
	TRANSVERSE				
3.OVERJET	OVERJET			6	
	ANT. CROSSBITE				
4.OVERBITE	OVERBITE			2	
	OPENBITE				
5.MIDLINE				4	
TOTAL					

ICON INDEX (Pre treatment)

Case no. –

CONTENTS		SCORE	WEIGHTING	TOTAL
1.AESTHETIC COMPONENT			7	
2. CROSSBITE			5	
3. ANT. VERTICAL RELATION	OPEN BITE		4	
	DEEP BITE		4	
4. UPPER ARCH	CROWDING		5	
	SPACING		5	
5. BUCCAL SEGMENT AP RELATION	RIGHT		3	
	LEFT		3	
TOTAL				

ICON INDEX (Post treatment)

Case no. –

CONTENTS		SCORE	WEIGHTING	TOTAL
1.AESTHETIC COMPONENT			7	
2. CROSSBITE			5	
3. ANT. VERTICAL RELATION	OPEN BITE		4	
	DEEP BITE		4	
4. UPPER ARCH	CROWDING		5	
	SPACING		5	
5. BUCCAL SEGMENT AP RELATION	RIGHT		3	
	LEFT		3	
TOTAL				

DAI INDEX

Case no. –

CONTENTS	SCORE	WEIGHTING	WEIGHTED SCORE
1. NO. OF MISSING TEETH		6	
2.INCISAL SEGMENT CROWDING		1	
3.INCISAL SEGMENT SPACING		1	
4.MIDLINE DIASTEMA		3	
5.LARGEST ANT, IRREGULARITY ON MAXILLA		1	
6. LARGEST ANT, IRREGULARITY ON MANDIBLE		1	
7.OVERJET (MAXILLARY)		2	
8.OVERJET (MANDIBULAR)		4	
9.OPENBITE		4	
10.AP MOLAR RELATION		3	
CONSTANT		13	
TOTAL			