ORTHODONTICS

CLASSIFICATION OF SKELETAL AND DENTAL MALOCCLUSION: REVISITED

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Received: July 2, 2016
Accepted: July 4, 2016
Available online: August 12, 2016

Cite this article:
Mageet AO. Classification of Skeletal and Dental Malocclusion: Revisited. StomaEduJ. 2016;3(2);

ABSTRACT
Orthodontic dental classification used is dated more than 100 years ago. Skeletal and dental classification of malocclusion has an important role in diagnosis and treatment planning. The aim of this study is to facilitate the grouping of skeletal and dental malrelationships and to build an accurate diagnosis and to suggest treatment planning.

Material and method
The main orthodontic classification systems for skeletal and dental relationship were reviewed.

Results
The proposed skeletal and dental classification proved detailed accuracy and focus on relating the categories with the suggested treatment planning. The new modification of the skeletal and dental classification explained clearly the occlusal relationship and helped in setting treatment strategies.

Conclusions
This present skeletal and dental classification is faster, accurate and easily applicable clinically and dealt with the shortcoming of the previous classification systems. It also helped in the suggestion of Orthodontic treatment protocols.

Keywords: orthodontic malocclusion, skeletal classification, dental classification

Introduction

In 1930 Simon was the first to relate the dental arches to the face and cranium in the three planes of space: Frankfurt horizontal plane (F-H plane), also called (E-EP). Or-Po plane. Vertical: Attraction or Abstraction; Orbital plane (Perpendicular to F-H plane at the margin of the bony orbit), antero-posterior: Protraction or Retraction; Median sagittal plane (The MSP is determined by points approximate1.5cm apart on the median raphe of the palate. The raphe median plane passes through these two points at right angles to the F-H plane), transverse: Contraction or Distraction.1 Salzmann in 1950 was the first to classify to the underlying skeletal structure, he stated that Skeletal Class I: Purely dental with the bones of face and jaws being in harmony with one another and with the rest of the head. The profile is orthognathic (Straight). Then he added divisions to the skeletal I, Division 1: Local mal-relationship of incisors, canines and premolars; Division 2: Maxillary incisor protrusion; Division 3: Maxillary incisors retrusion; Division 4: Bimaxillary protrusion. Skeletal Class II: Distal mandibular development in relation to the maxilla. The profile is prognathic (Convex). He subclassified skeletal II into: Class II/1: Narrow maxillary arch with crowding in the canine region; Class II/2: Lingually Inclined maxillary incisors, the laterals may be normal or proclined. Skeletal Class III: Over growth of the mandible with obtuse mandibular angle. The profile is retrognathic profile (Concave).2 The scholar Edward Hingley Angle (1899) classified Orthodontic malocclusion in the mesio-distal relationship of teeth. His classification is based on the maxillary permanent 1st molar where he considered it as the key ridge and accordingly he classified the molar relationship into class I, II and III using Roman numbers and subdivided class II into division 1 and 2 using Arabic numbers.3 Because of the drawback of Angle’s classification, listed as; the Maxillary permanent 1st molar is not a fixed anatomic point (key ridge); cannot classify for mesially drifted, impacted, missing or extracted Maxillary permanent 1st molars; did not consider single tooth malposition; cannot classify the primary teeth, in addition did not classify the

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skeletal relationship and did not predict the etiological factors, so revisiting was always needed. Deway’s in 1915 modified Angle’s Class I and III malocclusion by segregating malposition of anterior and posterior segments, CL I: type 1 (Crowding of Max anterior teeth); type 2 (Proclined Max incisors); type 3 (Max incisors are in cross-bite); type 4 (Posterior cross-bite); type 5 (Mesial drift of molars). CL II (no modifications). CL III: type 1: (Edge to edge bite), type 2: (Crowded Mandibular incisors and lingual to Max incisors); type 3: (Underdeveloped crowded Maxillary arch and a well developed Mandibular arch).4 Lischer in 1933 further modified Angle classification by giving substitute names; CL I (Neutroclusion); CL II (Distocclusion); CL III (Mesiocclusion). He also proposed terms to designate individual tooth malposition, Mesio-version (Mesial to normal position); Disto-version (Distal to normal position); Linguo-version (Crossbite); Labio-version (Increased OJ); Infra-version (Submerged tooth); Supra-version (Super-erupted); Axio-version (Tipped tooth); Torsi-version (Rotated tooth); Trans-version (Transposed tooth).5 Ackerman and Proffit (1969) introduced a very comprehensive system of classification using the Venn diagram. The classification considered five characteristics and their inter-relationships were assessed, namely; alignment, profile, transverse, class and overbite.6 Angle’s classification still seems the method of the most popular tool for classification of malocclusion, despite its well-known disadvantages.7 Hans et al., (1994), noted the inadequacy of Angle’s classification when they were unable to classify approximately 7% of a large sample (n=4309) of models in the Broadbent-Bolton study.8 Another study conducted by Baumrind et al., (1996) on whether to extract in orthodontic treatment, found that 28-33% disagreement among the 5 participating orthodontist.9 Katz (1992a) showed inter-examiner disagreement of 49% among 270 orthodontists using Angle’s classification.10 The percentage agreement of Katz’s technique proved superior to that of the classical Angle’s classification.1112 Rinchuse found Angle’s classification to be limited because it is a system of discrete classes as compared to continuous transition of maxillo-mandibular dental arches in sagittal plane.13 The British Standard Institute (BSI) in 1983 classified dental malocclusion according to the maxillary and mandibular incisors relationship. Class I: When the mandibular incisor edges lie or below the cingulum plateau of the maxillary incisors. Class II: When the mandibular incisor edges lie posterior to the cingulum plateau of the maxillary incisors, the maxillary incisors could be proclined where it is classified as Class II / 1, or retroclined maxillary centrals and proclined laterals, or both central and lateral incisors are retroclined where it is grouped under Class II / 2. Class III: where the mandibular incisor edges lie anterior to the cingulum plateau of the maxillary central incisors.14 The BSI classification was more accurate in grouping the malocclusion.15 The British method of overjet and overbite assessment15 and the quantitative technique proposed by Katz (1992b)16 developed over the years, proved to be more amenable to reproduction than Angle’s classification.1115 Du et al., (1998) in their study where four orthodontic faculty at one dental school classified 25 dental casts according to the classification systems of Angle, Katz, and the British Incisor Classification.11 The dental casts were selected from a pool of 350 pretreatment graduate orthodontic cases and were those deemed the most atypical. The results demonstrated that Katz’s classification was more reliable than both Angle and the British. Angle’s classification was the least reliable of the three methods.

Figure 1. Skeletal classification

The author view Orthodontic skeletal classification could be grouped into class I (straight), class II (convex) and class III (concave). Salzmann classification did not specify that the problem is due to maxillary protrusion, mandibular retraction or a combination of both. The same for the concave profile, his method did not specify that the problem is due to maxillary retraction, mandibular protrusion or a combination of both. The author agrees with all scholars that skeletal class I has straight profile (Fig. 1), which explains homogeneous relationship between the maxilla and mandible, or in another terms they grow in unison. In cases of Skeletal I the problem is dental malrelationships. It is present in two planes, the vertical and the transverse planes where the
antero-posterior plane is normal or within average. There is always a question arises in cases where it is straight to mild convexity or mild concavity. The author view is to enlarge the description of skeletal I so as to include the mild convexity and mild concavity as far as it is confirmed by the ANB angle. The range of skeletal I would be straight to mild convexity or mild concavity.

Salzmann Skeletal II (convex profile) did not indicate either it is due to protruded maxilla or retruded mandible or a combination of both. In this present study, Skeletal II could be of three types; type 1 (retruded mandible), type 2 (protruded maxilla) and type 3 (combination of both). (Fig. 1) The same applies for Class III (concave profile), again Salzmann did not specify either it is due to maxillary retrusion or mandibular protrusion. According to my explanation it could be due to maxillary retrusion (Skeletal III type 1), or mandibular protrusion (Skeletal II type 2), or a combination of both (skeletal III type 3), which gives detailed explanation aiding in diagnosis and treatment planning. (Fig. 1)

Occlusal Classification: revisited
The BSI and Katz’s classification deal with partial

Figure 2. Incisor’s Classification

Table 1. Suggested Treatment Protocol for Skeletal bases

<table>
<thead>
<tr>
<th>Skeletal I</th>
<th>Type 1</th>
<th>Functional appliance (growing children) or mandibular surgery (adult or syndromic patients e.g. Pierre Robin).</th>
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<td></td>
<td>Type 2</td>
<td>Headgear (children and adolescents) or maxillary surgery for adults.</td>
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<td>Skeletal II</td>
<td>Type 3</td>
<td>Here the treatment could of combination, functional [removable e.g. twin block or fixed e.g. Forsus], Headgear, camouflage with the extraction of upper 1st premolars alone or in combination with lower 2nd premolars or Bi-maxillary orthognathic surgery.</td>
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<tr>
<td></td>
<td>Type 1</td>
<td>Functional appliances e.g. Yanagisawa Class III shield (YC3). Palatal expansion ± facemask (Delaire, reverse pull headgear by Nakamura) advised before the age of 10 years.</td>
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<tr>
<td></td>
<td>Type 2</td>
<td>Mandibular excess is treated with surgery e.g. Bilateral sagittal split osteotomy (BSSO).</td>
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<tr>
<td>Skeletal III</td>
<td>Type 3</td>
<td>Here the treatment could of combination: functional (Yanagisawa,YC3), palatal expansion ± facemask, camouflage with the extraction of lower 1st premolar and upper 2nd premolars, or extraction of a single lower central incisor, Bi-maxillary orthognathic surgery (Le Fort I ± BSSO) or genioplasty in some cases.</td>
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description of the malocclusion. The British system of classification related to the anterior teeth where it needs further elaboration while Katz system focuses on the premolar occlusion and ignore the canines and molar classification.

Snyder and Jerrold (2007), have concluded that a modification of Angle’s system that is more descriptive is needed, after they have sent e-mail survey to the department chair or the program director of every orthodontic program in the United States, Canada, and Puerto Rico (n = 80). The survey included photos of models placed into ¼ cusp, ½ cusp, and ¾ cusp distal occlusions, and the participants were asked to classify them by selecting from a list of terms or writing one of their own. They were also asked whether they thought that the Angle molar classification was adequate for communication and diagnosis. A forty surveys were completed and returned. The results showed a variety of terminology being taught, and most educators do not use Angle’s classification as he defined it. About half of the respondents were dissatisfied with the Angle molar classification system.17

Siegel in 2002 conducted 57 surveys which were mailed to department chairs in the United States, asking them to identify the definition to which their orthodontic residency program subscribes; 34 surveys were returned. Twenty-two responses supported the notion that subdivision refers to the Class II side, 8 responses said that it refers to the Class I side, 3 responses supported neither view, and 1 response indicated that not everyone in the program could agree on the meaning of subdivision. Although the prevailing belief appears to be that subdivision indicates the side with a molar malocclusion, the orthodontic community does not have a consistent standard, and it is time to resolve this controversy.18 Due to the low reliability of the Angle’ method, a reconsideration is needed to develop the older classification. The reconsideration is done in the antero-posterior and on both sides, where molar classification is more elaborated. In this revision class IV, V and VI are generated which helped in treatment planning and suggesting treatment protocol.

Accurate and detailed classification is always needed to drive an accurate diagnosis and treatment plan.

The author followed the BSI incisor classification with modifications for class II and III, accepts canine classification and modifies molar classification, which are further elaborated for the ease of diagnosis and accuracy of treatment planning in orthodontics.

Incisor’s Classification (Fig. 2)

Class I: When the mandibular incisor edge lie or below the cingulum plateau of the maxillary incisors (BSI, 1983), the overjet is 2-4 mm.

Class II: When the mandibular incisors edges lie posterior to the cingulum plateau of the maxillary incisors (BSI, 1983). It could be:

Class II/1: Proclined maxillary incisors with overjet more than 4 mm.

Class II/2a: Retroclined maxillary centrals and proclined laterals, or both central and lateral incisors are retroclined with normal or reduced overjet.

Class II/2b: Retroclined maxillary centrals and proclined laterals, or both central and lateral incisors are retroclined but with increased overjet.

Class III: When the mandibular incisors edges lie anterior to the cingulum plateau of the maxillary incisors (BSI, 1983).

Class III type 1: Positive overjet but less than 2 mm.

Class III type 2: Edge to edge incisors relationship.

Class III type 3a: Negative overjet.

Class III type 3b: Negative overjet but patient can make edge to edge (pseudo Class III).

The author believes that incisor classification could also be used for esthetic considerations.
Canine’s Classification (Fig. 3)
Class I: mesial incline of the upper canine overlaps the distal slope of the lower canine (The maxillary canine occludes between the mandibular canine and 1st premolar).
Class II: Distal slope of the maxillary canine occludes or contact the mesial slope of the lower canine.
Class III: The mandibular canine is displaced anterior to the maxillary canine with no overlapping.

Molar’s Classification (Fig. 4)
The author modified Angle’s classification to include different molar relationship on both sides and renamed the subdivision.
Class I: The mesio-buccal groove of the mandibular 1st permanent molar occludes with the mesio-buccal cusp of the Maxillary 1st permanent molar.
Class II: The mesio-buccal groove of the mandibular 1st permanent molar lie posterior to the mesio-buccal cusp of the Maxillary 1st permanent molar.
Class II ½ unit: When the maxillary 1st permanent molar cusps occlude with the mandibular 1st permanent molar cusps an edge to edge.
Class II full unit: When the maxillary 1st permanent molar cusps occlude anterior to the mandibular 1st permanent molar.
Class III: The mesio-buccal groove of the mandibular 1st permanent molar lie anterior to the mesio-buccal cusp of the Maxillary 1st permanent molar. Relationship between right and left buccal occlusion is further grouped to resolve the notion of subdivisions:
Class IV: Class I on one side and Class II (either ½ unit or full unit) on the other side.
Class V: Class I on one side and Class III on the other side.
Class VI: Class III on one side and Class II (either ½

Table 2. Suggested Treatment Protocol for dental malocclusion

| Class I malocclusion | Non extraction: stripping, expansion, derotation, uprighting or distalisation
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<th>Extraction: U/L 4s, U/L 5s, U/L 6s, U/L 7s or a symmetric extraction e.g. right U/L 4s + left U/L 5s, U/L 6s + U/L 4s or 5s, single tooth extraction.</th>
</tr>
</thead>
</table>
| Class II malocclusion| Type 1 Non extraction: Distalisation with headgear
|                      | Extraction: 4s, (U 4s + L 5s), (U/L 6s), (U/L 7s) or a symmetric extraction e.g. (right U/L 4s + left U/L 5s), (U/L 6s + U/L 4s or 5s), or a single U4. |
|                      | Type 2a Always advise non extraction treatment using a headgear + Nudger or an intra-oral distalizer. If crowding is to be relieved by extraction, then it is advisable to extract the 2nd premolar than the 1st premolar because of difficulty of space closure. Transfer the case to CL II/1 and treat accordingly. |
|                      | Type 2b Headgear + Nudger
|                      | Orthognathic surgery treatment (proclined upper anteriors and retroclined lower anteriors-decompensation: plan for surgery) |
|                      | Type 1 Camouflage with stripping lower arch and proclining upper teeth. Expansion of upper arch ± fixed appliance therapy. |
| Class III malocclusion| Type 2 Expansion of upper arch ± fixed appliance therapy with CL III elastics. Extraction of lower 1st premolars and upper 2nd premolars + U/L fixed orthodontic therapy with CL III elastics. |
|                      | Type 3a Expansion of upper arch ± fixed Orthodontic therapy. Extraction of lower 1st premolars and upper 2nd premolars + U/L fixed Orthodontic therapy with CL III elastics. |
|                      | Type 3b Expansion of upper arch ± fixed Orthodontic therapy. Extraction of lower 1st premolars and upper 2nd premolars + U/L fixed Orthodontic therapy. |

Suggested Treatment Protocol
unit or full unit) on the other side. A suggested treatment protocols are easily derived from the present classification skeletal (Table 1) dental (Table 2). This is varying from mechanics to mechanics, but the idea is to help the undergraduate to understand orthodontic diagnosis and treatment planning and for the postgraduate residents and the orthodontists to formulate an accurate stable orthodontic treatment results.

**Figure 4. Molar’s Classification**

**Conclusion**

The author concluded that an incisor, canine and molar classification should always be used accurately to diagnose and to plan the final occlusion. The present study pressing on a class I incisor and canine relationship at the end of treatment to assure long term stability while molar relationship could be class I, II (full unit) or III relationship. The author recommends further study on methods of classification and establishing orthodontic treatments’ protocols.

**REFERENCES**

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Licensed by CPQ (UAE), the Saudi Commission for Higher Specialties and the Sudanese Medical Council as a consultant orthodontist. I treat orthodontic problems from mild to complex cases with variety of treatment options, removable, functional, fixed, clear orthodontics, orthodontic part of orthognathic surgery and cleft lip / palate cases. I also manage snorers and mild to moderate obstructive sleep apnoea hypopnoea patients using intra-oral appliances. I have been working as an orthodontist for the past 20 years. Examiner of the RCSEd for the 2nd part MFDS and the M.Orth. Reviewer of the Oral Hygiene and Dental Management Journal. Published many articles in reputable journals.