Classification of Angle Class III malocclusion and its treatment modalities

To obtain the best results in the treatment of patients with Angle Class III malocclusion, the etiologies of the malocclusion should first be clarified, and then an appropriate treatment modality should be decided. Angle Class III malocclusions in 120 subjects who had orthognathic surgery were analyzed with cephalometrics and facial photos and classified into 3 categories based on the abnormalities of the maxilla. Type A is true mandibular prognathism, which means that the maxilla is normal but the mandible is overgrown. Type B is characteristic of the overgrown maxilla and mandible with anterior crossbite. Type C indicates a hypoplastic maxilla with anterior crossbite. Treatment modalities should be differentially decided according to this new classification of Angle Class III malocclusions. (Int J Adult Orthod Orthognath Surg 2001;16:19–29)

An Angle Class III malocclusion means that the mandibular first molar is anteriorly placed in relation to the maxillary first molar. It is a symptomatic or phenotypic description that uses the first molars and canines as criteria, and it has nothing to do with the maxillary and mandibular skeletal bases. It has become the most commonly used classification method of malocclusion because of its simplicity, but its flaws, such as lack of transverse and vertical consideration, have been pointed out and criticized by many authors.1,2

In patients with a Class III malocclusion, correction is aimed at achieving a Class I key relation and normal overbite and overjet, regardless of the position of the maxilla and mandible. Skeletal change, if needed, is usually limited to the mandible. This means that the relationship of the maxillary first molar to the cranial base is not considered. Therefore, it can be applied only to certain types of Class III patients. It is quite important to have an etiologic classification of malocclusion based on the skeletal discrepancy to achieve ideal treatment planning and results.

Malocclusion can also be differentially categorized by the timing of its clinical manifestation, but this has no impact on the choice of treatment. A “congenital” malocclusion manifests itself in a negative anterior overjet in the deciduous dentition and results from congenital anomalies of the maxilla and mandible or fetal
and/or prepubertal trauma to the face. A congenital malocclusion worsens with age and requires surgery after completion of facial growth. A “developmental” malocclusion shows no clinical signs before pubertal growth, but anterior crossbite or mandibular prognathism appear with facial growth. It is associated with abnormal growth of the mandible and/or maxilla. For example, pubertal overgrowth of the condyle leads to mandibular prognathism, which is called bilateral hemimandibular elongation; if unilateral condylar overgrowth occurs, facial (or mandibular) asymmetry results. A “hybrid” malocclusion is a combination of congenital and developmental malocclusion, and it becomes clinically more severe with growth.

The aim of this research was to introduce a new concept of the classification of Angle Class III malocclusion and to outline appropriate treatment modalities.

Materials and methods

One hundred twenty patients with typical Class III malocclusions that had been surgically corrected were selected and classified into 3 types with cephalometric and facial photo analysis, using the position of the maxilla as the primary reference. The patients had been treated in our clinic, were of Korean ethnicity, and were between 15 and 42 years of age. Three photos were used per patient—frontal, right, and left. Riedel analysis, including SNA and SNB angles, Wits appraisal, mandibular body length (gonion to menton), incision superius to Frankfort horizontal plane and sella-nasion line, incisor-mandibular plane angle, overbite, and overjet, was performed using cephalometric radiographs. Soft tissue analysis was performed on profile facial photos, and the frontonasal angle, the nasolabial angle, the labiomental fold, soft tissue nasion to soft tissue pogonion, and soft tissue nasion to soft tissue point B were measured. Pre- and postoperative cephalometric and facial photo tracings were superimposed.

Results

According to the analysis of the preoperative and postoperative cephalometric radiographs and profile facial photos, the Class III malocclusion could be classified into 3 types. The Type A Class III malocclusion had a normal maxilla (SNA = 80.83 degrees, nasolabial angle = 90.96 degrees) and an overgrown mandible (SNB = 82.54 degrees). The Type B malocclusion showed a protrusive maxilla and mandible (SNA = 86.75 degrees, SNB = 91 degrees, nasolabial angle = 84.25 degrees). The Type C malocclusion displayed a retrusive maxilla and anterior crossbite (SNA = 73.83 degrees, SNB = 80.84 degrees, nasolabial angle = 79.17 degrees). However, the nasolabial angle in Type C maloccasions suffered from “under-measurement”: cephalometrics and facial photos in centric occlusion were analyzed, and the collapse of the upper lip as a result of the hypoplastic maxilla, decreased anterior facial height, and overcushioning of the lower lip led to a measurement that was too small. This preoperative measurement error was corrected, and combined surgical and orthodontic treatment resulted in a normal appearance (Tables 1 and 2).

Discussion

The concept of the “normal” or “ideal” face is changing. Intimate and frequent contact between cultures via mass communication, magazines, travel, etc, has obliterated traditional and racial differences of the facial norm, resulting in a more conformed concept of facial beauty. A. M. Schwarz divided normal facial profiles into 3 categories: ante-face, in which the lower anterior face is protrusive relative to soft tissue nasion-perpendicular (N’-perpendicular); mid-face, in which the lower anterior face is approximately in line with N’-perpendicular; and retro-face, in which the lower anterior face is behind N’-perpendicular (Figs 1a to 1f). For many years, mid-face was accepted as normal for Asian and ante-face for African, but this is now
changing. Young women and boys want to have retro-face and prefer a 3-dimensional rather than a flat face, with 3 distinct facial concavities (Fig 2). That means that patients are not content with an appearance that includes normal maxillomandibular relationships but is esthetically compromised.

What we today call “ideal occlusion” in association with the normal face was described as early as the eighteenth century by Hunter. Since then, much has been written on the subject, but there was no accepted method for describing irregularities and abnormal relationships of the teeth and jaw until Angle. Angle’s classification of malocclusion was simple and soon became one of the most popular classification methods, but it had deficiencies. First, it disregarded the relationship

Table 1  Pre- and postoperative hard tissue measurements

<table>
<thead>
<tr>
<th>Category</th>
<th>SN A (deg)</th>
<th>SN B (deg)</th>
<th>M and. length (mm)</th>
<th>Wits</th>
<th>Is-SN (mm)</th>
<th>Is-FH</th>
<th>IM PA (deg)</th>
<th>Overjet (mm)</th>
<th>Overbite (mm)</th>
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<tr>
<td>Type A</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Preop</td>
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<td>82.14</td>
<td>80.29</td>
<td>-11.00</td>
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<td>113.57</td>
<td>91.86</td>
<td>-5.29</td>
<td>-2.00</td>
</tr>
<tr>
<td>Postop</td>
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<td>77.57</td>
<td>77.00</td>
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<td>113.57</td>
<td>94.57</td>
<td>3.00</td>
<td>3.00</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Preop</td>
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<td>91.00</td>
<td>85.50</td>
<td>-13.50</td>
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<td>122.50</td>
<td>79.50</td>
<td>-4.00</td>
<td>-2.00</td>
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<tr>
<td>Postop</td>
<td>86.50</td>
<td>85.00</td>
<td>84.00</td>
<td>-3.00</td>
<td>116.00</td>
<td>122.00</td>
<td>87.50</td>
<td>4.50</td>
<td>3.00</td>
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<tr>
<td>Type C</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Preop</td>
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<td>-15.20</td>
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<td>92.00</td>
<td>-9.60</td>
<td>-3.60</td>
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<td>Postop</td>
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<td>78.20</td>
<td>-0.40</td>
<td>101.60</td>
<td>111.40</td>
<td>92.40</td>
<td>3.60</td>
<td>3.20</td>
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</table>

Is = incision superius; SN = sella-nasion line; FH = Frankfort horizontal; IMPA = incisor-mandibular plane angle.

Table 2  Pre- and postoperative soft tissue measurements

<table>
<thead>
<tr>
<th>Classification</th>
<th>FNA (deg)</th>
<th>NLA (deg)</th>
<th>LMF (deg)</th>
<th>N ’B’ (mm)</th>
<th>N ’Pog’ (mm)</th>
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<tr>
<td>Type A</td>
<td></td>
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<td>Preop</td>
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<td>90.57</td>
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<tr>
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<td>78.50</td>
<td>124.00</td>
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</tr>
<tr>
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<td>73.00</td>
<td>138.40</td>
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<tr>
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<td>89.00</td>
<td>117.80</td>
<td>-0.40</td>
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</table>

FNA = frontal nasal angle; N LA = nasolabial angle; LMF = labiomental fold; N ’ = soft tissue nasion; B’ = soft tissue point B; Pog’ = soft tissue pogonion.
Figs 1a and 1b  The ante-face, in which the lower anterior face is protrusive relative to soft tissue nasion-perpendicular (N'-perpendicular).

Figs 1c and 1d  The retro-face, in which the lower anterior face is behind N'-perpendicular.

Figs 1e and 1f  The mid-face, in which the lower anterior face is approximately in line with N'-perpendicular.
of the teeth to the face (that is, the profile). In other words, it was a simple dentoalveolar description based on the relationship of maxillary and mandibular first molars and anterior overbite and overjet. Therefore, it was difficult to differentiate between dentoalveolar and skeletal discrepancies and to evaluate their relative contributions toward the creation of malocclusion; consequently, ideal treatment planning was difficult. Second, only anteroposterior deviation (sagittal discrepancy) was taken into consideration, although dental malocclusion is a 3-dimensional problem. Third, it merely described the relationship of the teeth and did not include a true diagnosis. Hence, a new classification of dental malocclusions is required to reach etiologic diagnoses and select appropriate treatment modalities.

The Class III malocclusion can be classified into 3 types according to the position of the maxilla in relation to craniofacial skeletal reference points, and different types of surgery are recommended to correct each type of discrepancy. Type A has a normal maxilla and an overgrown mandible. It is called true mandibular prognathism, because the anterior crossbite or Class III malocclusion results from the mandible. It is therefore sufficient to perform mandibular surgery alone (for example, sagittal split ramus osteotomy) to achieve a normal or ideal facial appearance (Fig 3, Table 3).

Type B has maxillary and mandibular excess, but the mandible has grown more than the maxilla, resulting in an acute nasolabial angle and an anteriorly positioned point A. This type of Class III malocclusion is found more frequently in Asians. If mandibular surgery alone were carried out, a newly bimaxillary protrusive facial type (ante-face) would result (Fig 4, Table 4), although a normal (Class I) dentoalveolar relationship and normal overbite and overjet would have been attained. This is not a normal face.
Figs 3a to 3e  A Type A Class III patient, shown before and after mandibular setback and advancing genioplasty.

Figs 3c and 3d  Postoperative photograph and radiograph.

Fig 3e  Superimposition of pre- and postoperative cephalometric tracings (blue = preoperative; red = postoperative).
Therefore, Type B patients require not only mandibular but also maxillary surgery with posterior movement; unfortunately, maxillary setback is not simple. The maxilla can be moved posteriorly with a Le Fort I osteotomy, but the amount of potential posterior movement is restricted because of the need to preserve space in the nasopharyngeal airway. Anterior segmental osteotomy can be used instead of Le Fort osteotomy, but it also has disadvantages. The operation itself is more complicated than a Le Fort I osteotomy, and there is always danger of impairment of circulation to the osteotomized segment, resulting in its necrosis. Two-stage surgery has been considered to avoid such complications. Many surgeons avoid this technique because of its poor results and relatively high relapse rate. These drawbacks should and could be eliminated by a modified anterior segmental osteotomy (Fig 5). This requires a vestibular incision alone, and the osteotomy is done and completed through this facial (vestibular) approach. There is no possibility of impaired circulation to the osteotomized segment, because the palatal mucosa are kept intact. The surgery itself is simplified and the bleeding tendency is greatly reduced, because any necessary cauterization can be done under direct observation. This modified anterior segmental osteotomy has become a routine procedure to move the maxilla posteriorly. With this combined surgery, the nasolabial angle becomes normal, and the upper and lower lips attain a normal relationship to Rickett's E-line. The profile becomes retro-face, and dentoalveolar and skeletal status are normal, with normal overbite and overjet. However, the key relation of the first molars becomes not Class I but Class II (although the canines are in a Class I relationship). But this does not constitute a clinical problem, because interdigititation of the maxillary and mandibular teeth is more important than the key relation. The anterior or canine guidance during mandibular movement and the normal interdigititation of teeth by occlusion are functionally more critical.

The typical feature of the Type C Class III malocclusion is hypoplasia of the maxilla. Its facial profile is concave, with an excessively large nasolabial angle, but
Figs 4a to 4f  A Type B Class III patient.

Figs 4a and 4b  Preoperative photograph and radiograph.

Figs 4c and 4d  Patient following maxillary and mandibular setback.

Fig 4e  (Left) Simulated appearance showing a compromised result following mandibular setback only.

Fig 4f  (Right) Superimposition of cephalometric tracings of all 3 results (preoperative, postoperative, and simulated). Blue = preoperative; red = postoperative; green = simulated.
this is frequently camouflaged by den-
toalveolar compensation (eg, excessively
protrusive maxillary anterior teeth). For
correction, anterior repositioning of the
maxilla with maxillary osteotomy is re-
quired to obtain a normal position of the
upper lip and an adequate nasolabial
angle, and Le Fort osteotomies are most
commonly used. Mandibular surgery is
then performed to achieve normal over-
bite and overjet. Mandibular surgery
alone would result in an excessively
retro-placed face (Fig 6, Table 5).

We have discussed the Class III maloc-
clusion and suggested a new classifica-
tion in hopes that more explicit treatment
plans can be developed. Additional clas-
sifications should be developed that could
be applied to all facial anomalies, such
as Angle Class II or III malocclusion; verti-
cal abnormalities (eg, open bite, deep
bite, long face, and short face); and trans-
verse discrepancies (ie, asymmetry).

Conclusions

Angle’s Class III malocclusion can be
categorized into 3 types, of which the cri-
teria is the status of the maxilla. Type A
has a normal maxilla, Type B has a hy-
perplastic maxilla, and Type C has a hy-
poplastic maxilla. Type A Class III maloc-
clusion requires mandibular surgery
alone, but Type B and C need not only
mandibular but also maxillary surgery to
achieve a normal facial appearance. The
concept of the normal face has changed,
Figs 6a to 6f  Patient with Type C Class III malocclusion.

Fig 6a and 6b  Preoperative photograph and radiograph.

Figs 6c and 6d  Patient following maxillary advancement and mandibular setback.

Fig 6e  *(Left)* Simulated appearance showing a compromised result following mandibular setback only.

Fig 6f  *(Right)* Superimposition of cephalometric tracings of all 3 results. Blue = preoperative; red = postoperative; green = simulated.
and retro-face is now accepted as normal and ideal. Therefore, Type B requires the posterior movement of the maxilla in addition to that of the mandible. Retraction of the maxilla is not easy, but technical difficulties can be overcome by a modified anterior segmental osteotomy. Class III discrepancy should be diagnosed and classified according to its etiology and treated with appropriate surgery, including if necessary not only mandibular but also maxillary surgery.

Acknowledgments

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References


<table>
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<tr>
<th>Table 5</th>
<th>Measurement of Type C prognathic patient*</th>
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<td>Hard tissue measurements</td>
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<tr>
<td>Time</td>
<td>SN A (deg)</td>
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<tr>
<td>Preop</td>
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<tr>
<td>Postop</td>
<td>79</td>
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<td>Compromised</td>
<td>72</td>
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<td></td>
<td>Soft tissue measurements</td>
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<tr>
<td>Time</td>
<td>FNA (deg)</td>
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<td>Preop</td>
<td>120</td>
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<tr>
<td>Postop</td>
<td>120</td>
</tr>
<tr>
<td>Compromised</td>
<td>120</td>
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</table>

* Patient KOJ, a 20-year-old male. Is = incision superior; SN = sella-nasion line; FH = Frankfort horizontal; IM PA = incisor-mandibular plane angle; FNA = frontonasal angle; NLA = nasolabial angle; LM F = labiomental fold; N = soft tissue nasion; B = soft tissue point B; Pog = soft tissue pogonion.