Illustrated Manual of Orthognathic Surgery

Combined Bimaxillary Osteotomies in the Facial Skeleton

Peter Kessler
Nicolas Hardt
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Editors
Peter Kessler
Department of Cranio-Maxillofacial Surgery
Maastricht University Medical Center
Maastricht, The Netherlands

Nicolas Hardt
Clinic and Policlinic of Cranio-Maxillofacial Surgery
Kantonsspital Luzern
Lucerne, Switzerland

Kensuke Yamauchi
Department of Oral and Maxillofacial Surgery
Tohoku University
Sendai, Miyagi, Japan

ISBN 978-3-031-73591-2 ISBN 978-3-031-73592-9 (eBook)
https://doi.org/10.1007/978-3-031-73592-9

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

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Peter Kessler and Nicolas Hardt

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1 Introduction

The most significant difference between single-jaw surgery and two-jaw surgery is the fact that the occlusal plane can be redefined. This affects all three dimensions of the space. Furthermore, two-jaw surgery offers the possibility of also correcting vertical and transversal deviations that cannot be corrected or can only be corrected insufficiently by single-jaw surgery. In order not to lose orientation in the oral cavity, the jaw to be osteotomized second can be used as a relation to determine the new position of the jaw osteotomized first. This makes the use of intermediate or intraoperative splints necessary.

P. Kessler (✉)
Department of Cranio-Maxillofacial Surgery,
Maastricht University Medical Center,
Maastricht, The Netherlands
e-mail: peter.kessler@mumc.nl

N. Hardt
Clinic and Policlinic of Cranio-Maxillofacial Surgery,
Kantonsspital Luzern, Lucerne, Switzerland

In this way, facial asymmetries, large sagittal displacement distances, vertical and transversal displacements, such as occur in skeletal and/or dental open bite and transversal crossbite situations, can be corrected with stable and predictable results [1, 2].

As described in Volume I and II shortly after the introduction of general anesthesia in the middle of the nineteenth century, the first single-jaw operations to relocate the mandible were described. However, these remained pioneering acts for a long time fraught with blood loss and complications, such as infections and instable results.

Axhausen, a maxillofacial surgeon, then dared to perform the first complete separation of the upper jaw in 1934 [3]. In 1939, *Axhausen* presented the suitability of the Le Fort I plane for the correction of cleft-related malocclusions of the maxilla at a congress of the Berlin Surgeons' Association. This was followed by numerous reports on maxillary osteotomies for the correction of maxillary malocclusions under various indications [4–6].

P. Kessler et al. (eds.), *Illustrated Manual of Orthognathic Surgery*,
https://doi.org/10.1007/978-3-031-73592-9_1

On the one hand, it was the risk of recurrence when surgically correcting a pronounced prognathism only in the mandible, and on the other hand, the difficulty and, in some cases, the impossibility of establishing a secure overbite between a receding maxilla and a pseudo-prognathic mandible with surgery in only one jaw, that initiated the recent era of bimaxillary osteotomies. These are not new surgical methods, but rather the combination of proven procedures simultaneously on both jaws, often in conjunction with Le Fort I osteotomy and sagittal splitting.

It was not until the middle of the twentieth century that *Schuchardt* [7] in Hamburg and *Obwegeser* in Zürich published the important work establishing the surgical procedures still in use today, and since the 1970s, the operations have become increasingly routine with appropriately designed special instruments and calculable surgical risks, especially for maxillary osteotomies.

In addition to the sagittal split operation, *Obwegeser* started on maxillary surgery in 1960. He was the first to present a large series of Le Fort I osteotomies, at the beginning in non-cleft patients, but a short time later also in cleft patients. In the 1960s, *Hogeman and Wilmar* [8] from Sweden demonstrated Le Fort I osteotomies in cleft patients, but the real boost to maxillary surgery come from *Obwegeser's* unit in Switzerland [9–12]. Since then, courageous surgeons have dared to relocate both jaws in one operation. The development of miniplate osteosynthesis replaced wire osteosyntheses used until then and enabled stable and predictable long-term results [13, 14].

Purely from the point of view of surgical risk, the intention is to correct mandibular or maxillary deformities mostly by means of a monomaxillary procedure. Since dysgnathia is not always limited to one jaw but can manifest as a bimaxillary deformity in both jaws simultaneously, a monomaxillary approach may result in an unsatisfactory profile compared to combined bimaxillary surgical intervention in the mandible and maxilla [2, 15].

A bimaxillary approach often achieves a more balanced facial profile compared to the monomaxillary approach by dividing the skeletal shift into two complementary components [2, 16].

Fixed displacement distances as borderlines between mono-and bimaxillary correction procedures cannot be drawn, since the individual situation determines the planning and surgical procedure. However, it is generally accepted that sagittal displacement distances of 10 mm or more are required for bimaxillary correction. Vertical and transverse displacements can often only be corrected by means of bimaxillary osteotomies.

Today, bimaxillary osteotomies, i.e., relocation of the maxilla and mandible in the same operation, are the predominant treatment modality in many departments worldwide [16]. Preoperative 3D imaging and planning has introduced new aspects to orthognathic surgery that have provided deeper insights into, for example, airway function. In addition to the significant improvement in the accuracy and reproducibility of planning, the possible visualization of the esthetic result, 3D planning has led to the expansion of surgical correction options, which in turn have an impact on the surgical risk of the procedure and the stability of the result [1, 17, 18].

2 Combined Orthodontic and Maxillofacial Surgical Treatment

Treatment begins in the vast majority of cases with the orthodontist's insertion of fixed appliances or clear aligners. The appliances are used to shape the dental arches, straighten tilted teeth or de-rotate rotated teeth. This stage of treatment often lasts about one to one and a half years, but can also be shorter or much longer. The patient then returns to the maxillofacial surgeon to plan the surgical portion of the treatment. The patient is given an appointment to prepare the planning documents.

In principle, bimaxillary corrections can be operated according to the "Maxilla First" or "Mandible First" concept. Maxillary subdivisions—two-piece, three-piece, multipiece maxilla—and genioplasty complete the spectrum of classic orthognathic surgical correction options.

3 Conclusion

Bimaxillary corrections are standard procedures and have greatly expanded the range of orthognathic corrective procedures for malocclusions. This is the only way to achieve true three-dimensional repositioning of the jaws with satisfying esthetical results.

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Typical Facial Deformities for Skeletal Bimaxillary Correction

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Peter Kessler and Nicolas Hardt

Contents

1 Development of Bimaxillary Interventions

The establishment of bimaxillary osteotomies took place between 1975 and 1985, as did the successive expansion of the range of indications for the various bimaxillary disproportions [1–9].

Initially, these osteotomies involved bimaxillary sagittal disproportions, then combined sagittal-vertical and later sagittal–vertical–transverse disproportions [10]

First long-term results in larger patient collectives with bimaxillary osteotomies—simultaneous Le Fort I-osteotomy and bilateral sagittal splitting osteotomies (BSSO) in the mandible—for correction of vertical maxillary excess and mandibular retrognathism/prognathism—were reported by [6, 11–13].

Wolfe and *Berkowitz* [14], expanded the range of indications for other bimaxillary disproportions such as:

- Maxillary prognathism + mandibular retrognathism + anterior open bite.
- Vertical maxillary excess + mandibular prognathism + macrogenia.
- Long face + mandibular retrognathism + anterior open bite with transversal maxillary deficit.

P. Kessler (✉)
Department of Cranio-Maxillofacial Surgery,
Maastricht University Medical Center,
Maastricht, The Netherlands
e-mail: peter.kessler@mumc.nl

N. Hardt
Clinic and Policlinic of Cranio-Maxillofacial Surgery,
Kantonsspital Luzern, Lucerne, Switzerland

P. Kessler et al. (eds.), *Illustrated Manual of Orthognathic Surgery*,
https://doi.org/10.1007/978-3-031-73592-9_2

2 General Considerations in Bimaxillary Facial Correction

As a matter of principle, the surgical goal should be to correct mandibular and maxillary deformities with a mono-maxillary approach. Since dysgnathias, however, are not always limited to one jaw, but may manifest as a bi-maxillary deformity in both jaws simultaneously, a mono-maxillary approach may result in an unsatisfactory functional and esthetic result compared to combined bi-maxillary interventions in the mandible and maxilla [1, 7, 15].

A more balanced profile is often achieved only with a bimaxillary approach compared with the mono-maxillary approach, because the skeletal displacement is divided into two complementary components [7]

If a planned mono-maxillary approach requires a total skeletal displacement in the sagittal plane of more than 10 mm (8–14 mm), a bimaxillary solution should be considered in any case. Vertical displacements and rotations around the temporomandibular joint axis—clockwise and counter clockwise rotations—can actually only be successfully implemented bimaxillary. The same applies to facial asymmetries in the frontal plane [1, 15, 16].

3 Mono-Maxillary Vs. Bimaxillary Correction

The patient cases shown below provide examples of the superiority of bimaxillary correction over mono-maxillary in terms of facial profile and the esthetic impression.

Case 1: Pronounced mandibular prognathism and maxillary retrognathism.

3.1 Therapy - Case I Mono-maxillary Correction

Mono-maxillary correction with mandibular setback by 15 mm.

3.2 Critical Appraisal of the Result

Unsatisfactory facial profile after mono-maxillary mandibular repositioning (Fig. 2.1b).

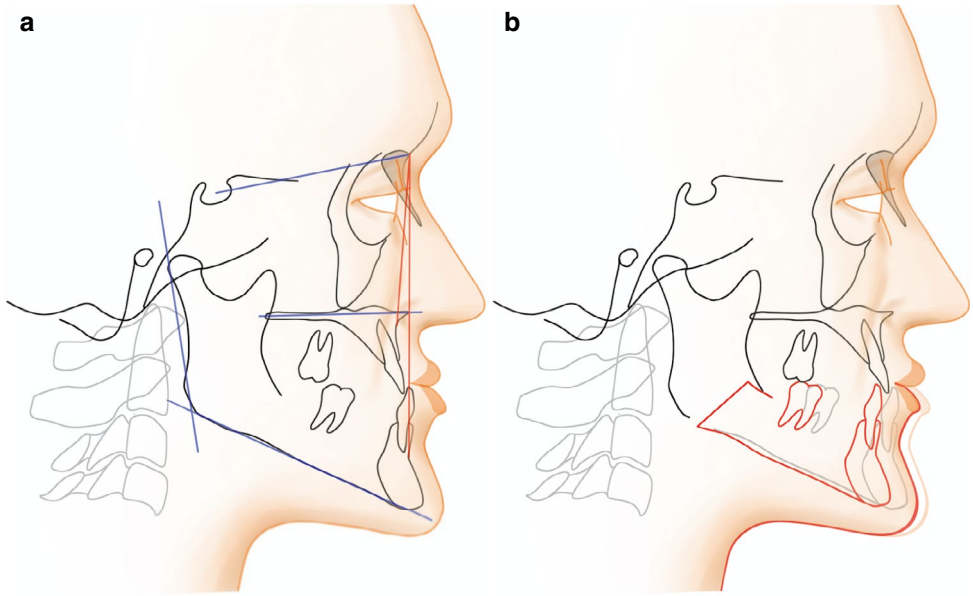

Fig. 2.1 Tracing of a patient's cephalogram with mandibular prognathism and midface hypoplasia and maxillary retrognathism. (**a**) before surgical correction. (**b**) after mono-maxillary mandibular setback. ©Copyright Keisuke Koyama 2022. All rights reserved

Case 2: Pronounced mandibular prognathism and maxillary retrognathism (Fig. 2.2a).

3.3 Therapy - Case II Bimaxillary Correction

Bimaxillary correction: Le Fort I osteotomy and maxillary advancement and BSSO with mandibular setback.

3.4 Critical Appraisal of the Result

Satisfactory facial profile after bimaxillary correction (Fig. 2.2b).

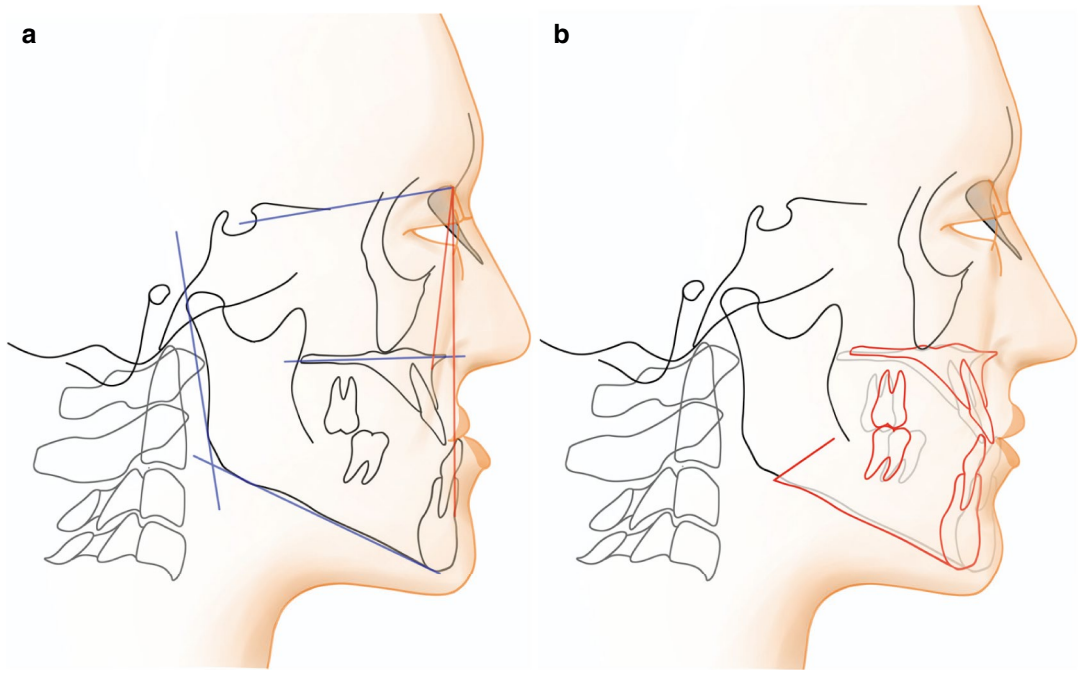

Fig. 2.2 Patient with mandibular prognathism and maxillary hypoplasia. (**a**) before surgical correction. (**b**) after bimaxillary correction.

4 Conclusion

Satisfactory profile result after mandibular repositioning and maxillary Le Fort I—advancement in case II, whereas in case I, the growth-related deficit in the midface region was not corrected and the phenotypically determining image of the flat midface remained. Other effects of the bimaxillary approach could increase the posterior airway and thus improve the patient's breathing. Preoperative 3D planning is unavoidable in order to analyze other functional and esthetic aspects besides the jaw position.

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