TRUMATCH® CMF SOLUTIONS

Deliver advanced technology and procedural support for facial reconstruction, orthognathic surgery, distraction and cranial reconstruction.

Our total solution seamlessly integrates virtual surgical planning, intraoperative patient-specific tools and personalized implants to help achieve your goals of:

- **Accuracy** through visualization of anatomy and identification of surgical challenges within a 3D planning environment, intraoperative patient-specific tools to accurately transfer the plan to the OR, and personalized implants
- **Efficiency** through virtual surgical planning assisted by experienced clinical engineers to optimize preparation, surgical time and the number of procedural steps
- **Patient Benefit** by striving to achieve satisfying aesthetic results and minimizing operative time

TRUMATCH® ORTHOGNATHICS

TRUMATCH Orthognathics is a guided system which helps addressing the challenge of vertical maxillary positioning in complex asymmetric cases. The combination of Titanium 3D-printed patient-specific osteotomy/drill guides and personalized plates supports:

- the accurate transfer of the surgical plan to the operating room
- reducing the need of splints and plate bending
- avoiding vital anatomical structures
TI 3D-PRINTED PLATES

Individually designed to meet the needs of each patient and surgeon. Together with the matching guides, they provide a total solution aiming to support:

• the accurate transfer of the virtual surgical plan to the surgical site
• reducing the need for splints and plate bending
• avoiding vital anatomical structures

• Intended to be used in combination with the Ti 3D printed guides
• Screw locations and vectors defined based on surgical access, bone volume and the avoidance of anatomical obstacles (nerves, tooth roots)
• Color coded to the matching guides
• Markers to facilitate the correct placement
• 0.8 mm and 1.0 mm thick, Pure Titanium Grade 2
• Designed and validated for compatibility with MatrixORTHOGNATHIC™ and MatrixMIDFACE™ screws and drill bits

PERSONALIZED PLATES AND IMPLANTS

BSSO Plates

Posterior top
right or left indicator

Single bar or Strut design

Le fort I Plates

In line hole pattern
2x2 hole design

Mixed design and patterns

3x3 hole design
Clover leaf hole pattern

Genioplasty Plates
TI 3D-PRINTED SURGICAL GUIDES

Designed to assist with osteotomies and to accurately transfer the virtual surgical plan to the surgical site.

- Intended to be used in combination with the Ti 3D printed plates
- Design integrates the planned osteotomies, pilot hole locations and drilling vectors
  - Cutting slots to guide the osteotomies, designed based on surgeon’s preference
  - Drilling locations and vectors defined based on surgical access, bone volume and the avoidance of anatomical obstacles (nerves, tooth roots)
- Temporary fixation holes
- Color coded to the matching plates
- Anatomical markers to facilitate correct guide placement
- Designed and validated for compatibility with MatrixORTHOGNATHIC™ and MatrixMIDFACE™ screws and drill bits

Le Fort I guide

Genioplasty guide

BSSO guide
POLYAMIDE SURGICAL GUIDES

Designed to assist with osteotomies and to accurately transfer the virtual surgical plan to the surgical site

Le Fort I guides
- For osteotomies
- Can be used with standard plates (e.g. MatrixORTHOGNATHIC plates)

Genioplasty guides
- For osteotomies and positioning of the chin
- Can be used with standard plates (e.g. MatrixORTHOGNATHIC plates)

1. Drill Guide
   - Drill holes in preoperative mandible
   - Splint indexes to teeth

2. Cutting Guide
   - Flange to guide genioplasty cut
   - Wide enough for chin plate
   - Holes match drill holes from first step

3. Repositioning Guide
   - Holes for temporary guide fixation

* Manufactured by Materialise
ORTHOGNATHIC SPLINTS/WAFERS

• TRUMATCH CMF orthognathic splints are patient-specific surgical tools used to transfer the virtual plan to the OR, indicating the steps of the surgery based on the dentition (occlusal) information
• Intermediate and final occlusion splints available
• Multiple impression depth and buccal contour width available
• Palatal strip for multi-piece maxilla
• Sandwich (splint-in-splint) design to avoid re-wiring
• Various options to submit occlusion data: physical plaster models, optical scans of the plaster models or intraoral scan (no plaster model needed at all)
• Made of sterilizable clear acrylic

Standard design

Sandwich / Splint-in-Splint Design

ANATOMIC MODELS

• Tactile representation of the anatomy or preoperative plan for surgical simulation and communication to the patient
• Facilitate communication with the surgical team and patient
• Highlighted critical anatomical structures like tooth roots and nerves
PROPLAN CMF
Technology for precise and accurate surgical planning

- 2D and 3D preoperative visualization of the patient anatomy and condition
- Virtual simulation and optimization of the skeletal osteotomies and reconstruction
- Improved communication between patient and surgery team
- Reduced surgical time¹
- Making critical clinical decisions preoperatively
- Multiple cephalometric analysis options
- Soft-tissue simulation and photomapping (2D and 3D)
- Live interactive virtual planning session with a knowledgeable clinical engineering team
- No software installation or software knowledge required

Preoperative planning for virtual simulation of maxillary and mandibular osteotomies

Starting from CBCT patient data, the software generates 2D and 3D visualizations of the pre-operative patient anatomy. Where applicable, this can also be combined with facial pictures and scans of the dentition (optical scans of dental casts or intra-oral scan of the dentition).

Most common osteotomies
- Maxilla (single and multi-piece)
  - Le Fort I
  - Le Fort II
  - Le Fort III
- Mandible
  - BSSO
  - VRO
  - Genioplasty
- Any other osteotomies according to surgeon preferences

¹ Results from case studies are not predictive of results in other cases. Results in other cases may vary.

² Value Brief Virtual Surgical Planning and TRUMATCH CMF Solutions, 2015
Cephalometric analysis

- Automatically perform cephalometric analyses
- Perform accurate 3D cephalometric analyses (e.g. Steiner, McNamara, Downs North Western, Ricketts)

Soft tissue simulation* and photo mapping

- Assessment of the effect of planned treatments on soft tissue
- Overlay of simulated planned soft tissue with pre-operative soft tissue
- Assessment of the overall appearance, by using 3D photomapping

Movement analysis

- Overall movement summary of selected points of occlusal and bony anatomical landmarks from the preoperative scan position to simulated postoperative position

* Displays a prediction of the behavior of the patient’s soft tissue after surgically modifying the facial skeleton. Although the biomechanical algorithm has been successfully validated by Materialise on real-life cases, no guarantees are given on the accuracy of the predicted outcome on specific patients or surgical routines. Interpret the results with clinical judgment.
CASE WORKFLOW

- Start by downloading PROPLAN CMF Connect and request a new account via the web interface (visit www.trumatchcmf.com to access the download link and instructions)
- Alternatively, ask your sales consultant for support
- Create a new case in PROPLAN CMF Connect and upload the patient CT Scan. Fill in the preferences for the planning, guides, splints, models and implants
- Join the interactive virtual surgical planning session with an experienced clinical engineer
- Approve your virtual surgical plan, followed by the patient-specific tools and the personalized implants
- The guides, models and implants are manufactured and delivered to you
- You can now transfer the virtual plan to the patient, as you imagined it
PATIENT PROFILE AND PRE-OPERATIVE SITUATION

A 22-year-old male patient was referred from a local orthodontist for evaluation of a combined orthodontic surgical approach for correction of a class III malocclusion. The challenges included a frontal and lateral open bite in combination with a maxillary transversal deficiency. The patient showed a midfacial hypoplasia which resulted in concave facial profile and positive lip step. The large tongue showed lateral teeth impressions and the patient had an immature swallowing pattern.

The young patient complained about his difficulty eating and especially biting. Prior to the start of the orthodontic treatment the third molars were removed. After an intensive case discussion with the orthodontist the first idea of a rapid palatal extension prior to the bimaxillary surgery was discarded and a two-piece Le Fort I osteotomy with maxillary advancement and posterior widening in combination with a mandibular setback was planned.

The patient returned to the orthodontist to be set up for surgery.

Following the additional orthodontic leveling and aligning, the surgical plan included the following procedures:
- a two-piece Le Fort I osteotomy with maxillary advancement
- posterior maxillary widening to compensate the transversal deficiency
- posterior maxillary impaction to close the open bite and normalize the occlusal plane
- a bilateral sagittal split osteotomy with mandibular setback and autorotation.

VIRTUAL SURGICAL PLANNING

Preoperative multi-slice computer tomography (MSCT) was obtained and uploaded in PROPLAN CMF Connect. During a web-based meeting with a clinical engineer, the surgical procedures were planned.

First the skull was oriented in the natural head position in accordance to the Frankfurt horizontal plane and the bipupillary line. Afterwards, a two-piece Le Fort I osteotomy with maxillary advancement and posterior impaction were planned. In addition the plan included a posterior maxillary widening to compensate the transversal deficiency in relation to the mandible. Then a bilateral split osteotomy with mandibular setback and autorotation was simulated to achieve the final occlusion.

As the final step, the midline, the position of the incisors, the maxillary canting and the chin position were checked in relation to the facial midline, the lips and the natural head position. Fine tuning of the position was performed by moving the mono-block out of maxilla and mandible in final occlusion. A soft tissue simulation in the planned position of the bones was also performed, as shown below.

* Results from case studies are not predictive of results in other cases. Results in other cases may vary.
**IMPLANT AND GUIDE DESIGN**

After the final position of the maxilla was virtually determined along with the necessary osteotomies, the placement, clustering and angulation of the screws was determined taking into consideration bone availability, teeth roots and surgical access. The plates were designed based on these constraints.

Next, the osteotomized bone segments (with the associated planned screw position and osteotomies) are virtually moved back to the preoperative position. The guides could be now designed with the drilling and cutting features as virtually planned.

The plate and the guide were then produced from Pure Titanium Grade 2 using a laser melting process.

**INTRAOPERATIVE SURGICAL DETAILS**

Under general anesthesia via nasal endotracheal intubation, a maxillary vestibular approach was used to gain access for the two-piece Le Fort I osteotomy.

Upon maxillary exposure, the surgical guide was placed and fixed with two MatrixMIDFACE 1.5 mm screws on the maxilla. The position of the guide was determined by the precise fit of the guide which allows a unique position.

Then the screw holes were pre-drilled (black arrow) and Le Fort I osteotomy (white arrow) was performed in accordance to the surgical guide.

After removal of the guide the two-piece Le Fort I osteotomy was completed and the down fracture in combination with the midline split was performed.

Maxillary positioning in all three dimensions (sagittal, transversal and vertical) was achieved by fixing the patient specific plate in accordance to the pre-drilled screw holes at the maxilla first and at the midface second.

Additional transversal stability of the two-piece Le Fort I osteotomy was achieved by using a transversal wire enforced palatal plate which was manufactured prior to surgery by the dental technician.

The new maxillary position in sagittal, transversal and vertical dimension is encoded in the shape of the patient specific plate. No additional splint (wafer) or intraoperative measurements were necessary for positioning of the maxilla.

After closing the maxilla, a classical BSSO with semi rigid SplitFix fixation was performed and the final occlusion was adjusted using a splint (wafer) in final occlusion.
RESULTS AND DISCUSSION

The patient did well postoperatively. A stable Class I occlusion could be achieved and the open bite could be closed safely. He had full sensation along the V2 and V3 distribution of the trigeminal nerve six weeks postoperatively.

There are two main benefits of this wafer-less maxillary positioning.

The first benefit is the high precision of maxillary positioning according to the virtual plan without the loss of vertical control of the maxilla. We could achieve an accuracy between plan and result of median below 0.5 mm in all 3 axes x, y and z (in a series of 12 cases).

The second benefit is the significant reduction of surgery time of up to one hour due to the straightforward procedure, without the need of an intermediate splint/wafer, which eliminates the intraoperative plate bending and any measuring for the adjustment of the vertical dimension.

Surgeons Profile

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