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Staub™Cranial

Healthy dentures

Theoretical summary

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1. Introduction

Mathematical calculation is a completely new approach which sets new standards in dentistry and dental technology.
Clearly defined reference points, unknown to date in dentistry, have now appeared to replace relative reference parameters. Thus it is now possible for the first time to use a pure model to calculate a patient's original dental status, regardless of his or her current dental situation.
The scientific method of calculation results in a special type of quality in dental care. The Staub™Cranial dental system developed on the basis of these findings is a real-life system for real-life situations which will point the way ahead for dentistry at the start of this millennium.
Nothing is left to chance. Transparency and measurability open up a previously unknown dimension of treatment and impressively meet the elementary requirement of healthy dentures.
The Staub™Cranial system is an entire concept and not a partial solution. It has an analysis function for models and existing dentures for all variations of fixed and removable dentures. Naturally, it may also be applied when making new dentures.
It is impressive because of its clear specifications and its diverse applications in nearly all dental disciplines.
It is just as indispensable for functional diagnosis and combination technology as it is for implantology and crown/bridge technology. However, the centre of attention is always on the patient's health and physiological balance, with consideration of his or her individual anatomy.

2. Principle of mathematical calculability

The Staub™Cranial analysis and manufacturing system for dentures is a closed system based on the logical principle of mathematical calculation.
An integral approach to the masticatory apparatus is a premise for calculability. Like height, the masticatory apparatus is an anatomical parameter which can be recorded mathematically using clearly defined reference points. By exactly determining points which have a stable position, it is possible to derive and apply mathematical laws.
During his pure research on more than 5500 different models, K.H. Staub was able to demonstrate constant parameters in both the maxilla and mandible which had been unknown in dentistry up until now. These reproducible parameters are called cranial reference points and are the basis for an exact reconstruction of the original dental status which is performed arithmetically on the basis of the model analysis.

2.1 Cranial reference points on the maxillary model

The cranial reference points on the maxillary model are determined based on an integral approach to the masticatory apparatus. For the first time in dentistry, parameters are defined exactly which can be demonstrated scientifically on every model.
If these points are then placed in relation to each other, they fulfil the mathematical property of symmetry. K.H. Staub refers to the different cranial reference points as

- **Direction points**
- **Induction points**
- **Conclusion lines** (see Fig. 1).

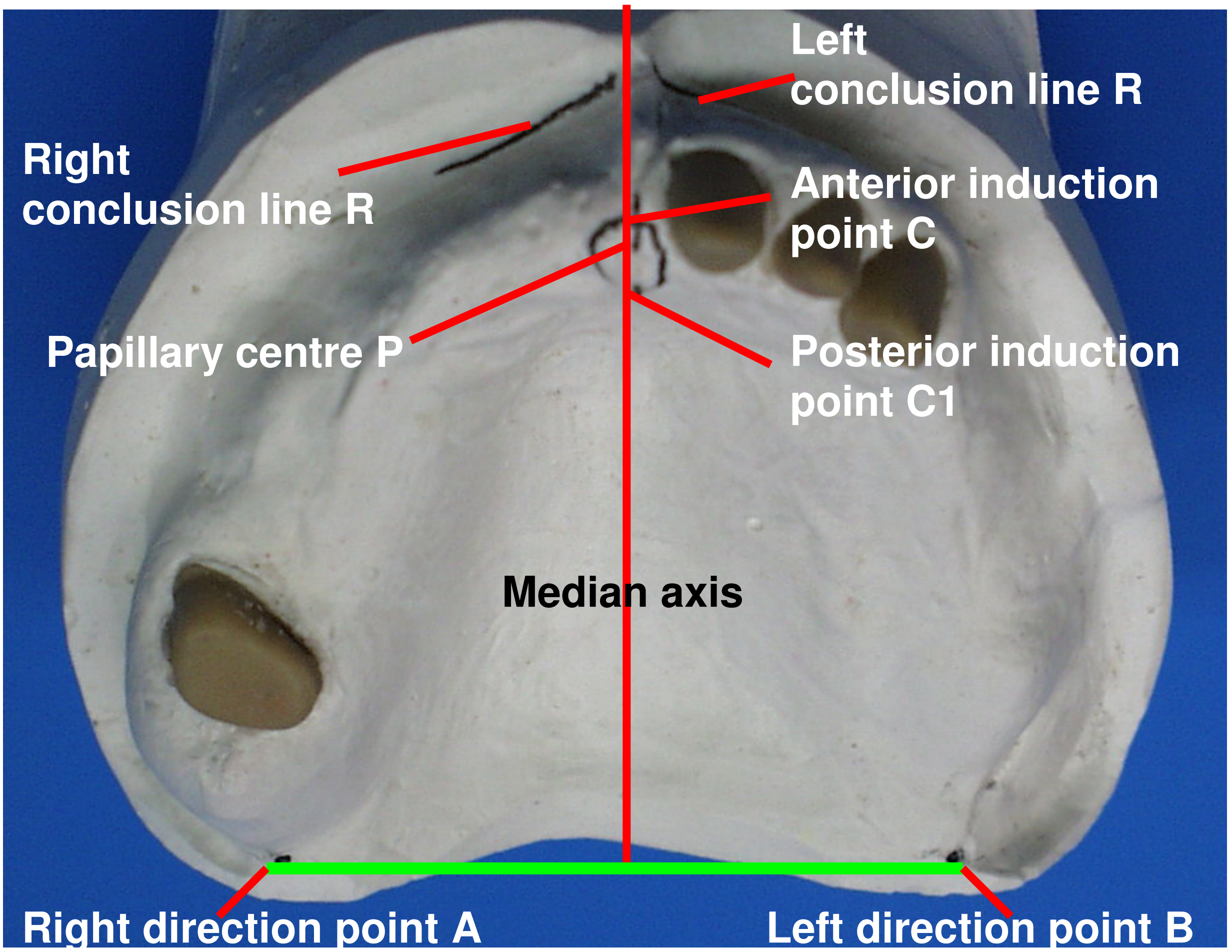


Fig. 1: ► Cranial reference points

2.1.1 Direction point

This point on the ridge connecting line exactly determines the change in direction in the curve of the pterygoid hamulus. It has a stable topography and is present on both sides.
The dental status, from completely dentulous to edentulous, is not important.

- **right direction point A**
- **left direction point B**

The direction points may be determined both manually and with electronic measuring instruments (see Fig. 2.1 and Fig. 2.2).

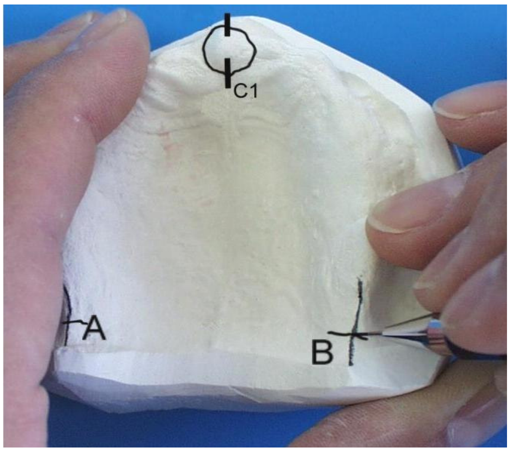


Fig. 2.1: ► Direction points determined manually

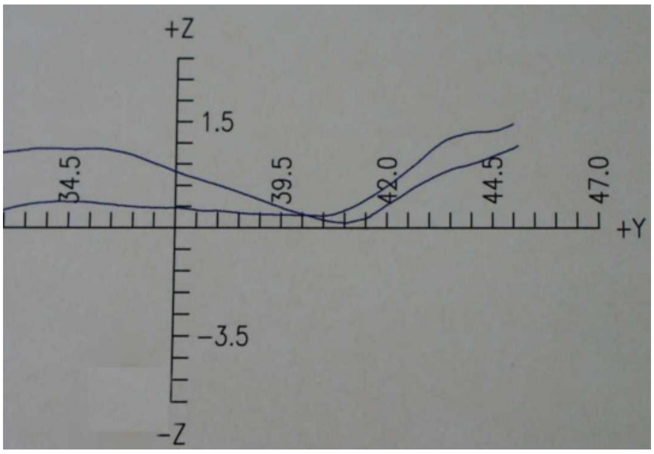


Fig. 2.2: ► Direction points determined electronically

2.1.2 Induction point

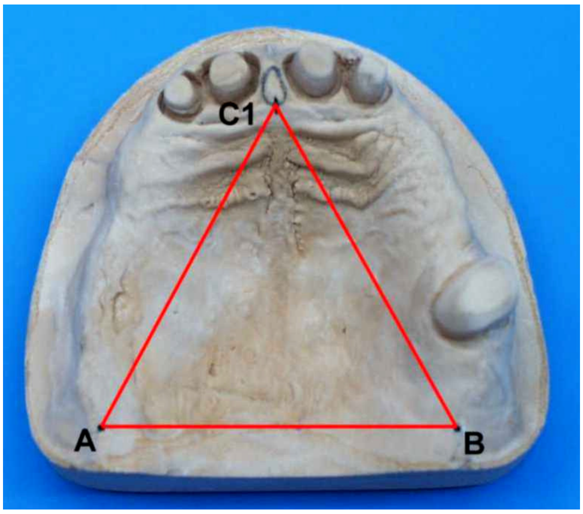


Fig. 3: ► Posterior induction point C1

The point of intersection of the rear contour of the papilla and the median axis of the maxilla produces the posterior induction point C_1.
This is also a fixed point which always forms an isosceles triangle with the two direction points A and B (see Fig. 3).
The anterior induction point C is defined as the point of intersection of the anterior contour of the papilla and the median axis of the maxilla (see Fig. 4). It is the only cranial point which is not topographically stable.

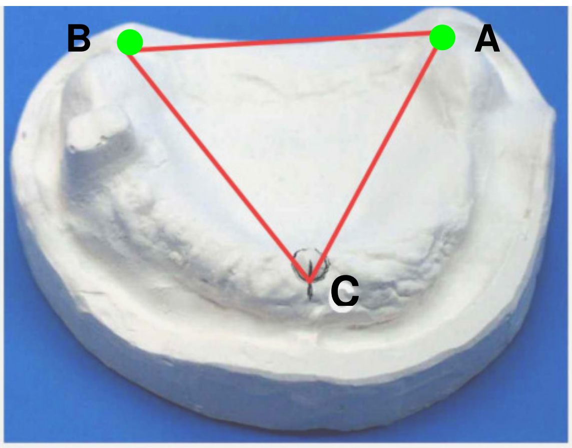


Fig. 4: ► Anterior induction point C

In the case of a transformed papilla due to mechanical irritation (e.g. due to incorrect dentures), this can also lie outside the median axis of the maxilla (see Fig. 5.1). In this case, the anterior point of intersection of the circle and the median axis of the maxilla produces the anterior induction point C,
whereby **$C_C=C_1$** and **$r=C_1C$**
*(**C_c** = centre of the circle; **r** = radius; **C_1C** = distance from **C_1** to **C**).* (see Fig. 5.2)

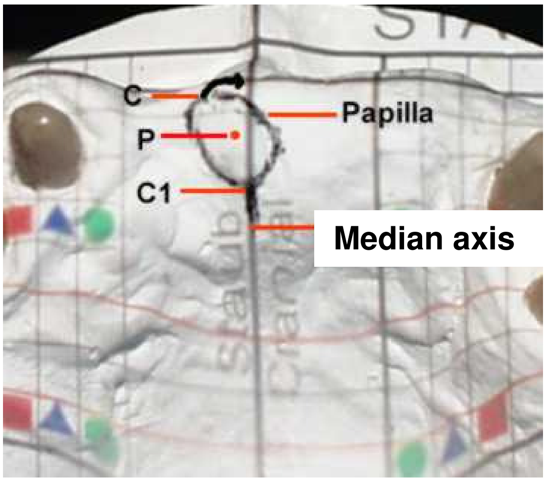


Fig. 5.1: ▶ The transformed papilla

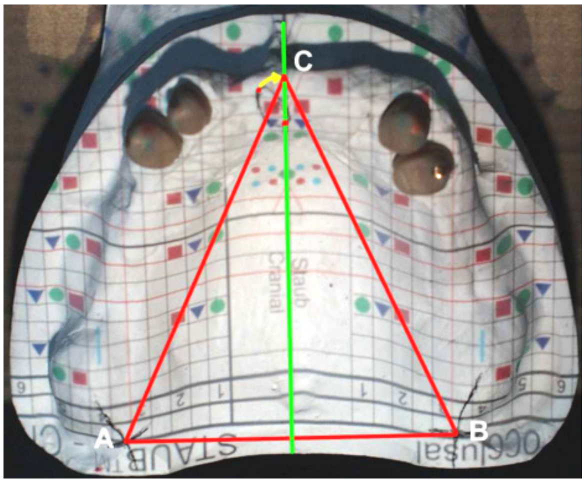


Fig. 5.2: ▶ The A-B-C isosceles triangle

2.1.3 Conclusion line

Like the direction points, the conclusion line is present on both sides and its anatomical position cannot be changed. It forms the boundary between mobile and immobile mucosa and determines the change in position in the curve of the mucolabial fold (see Fig. 6).
The conclusion line defines the transition from the concave to the convex form of the mucolabial fold as an anatomical constant, as the electronic recording impressively shows and proves (see Fig. 7.1 and 7.2).

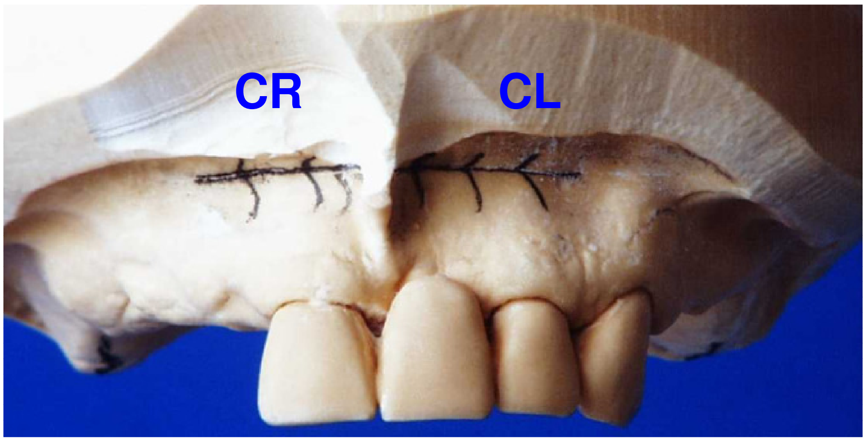


Fig. 6: ▶ Conclusion line

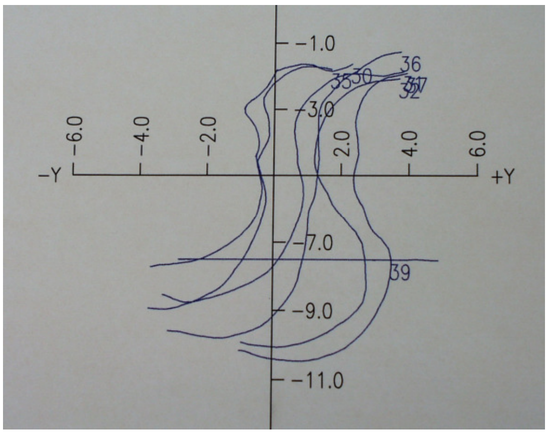


Fig. 7.1: ▶ Electronic depiction of the conclusion line

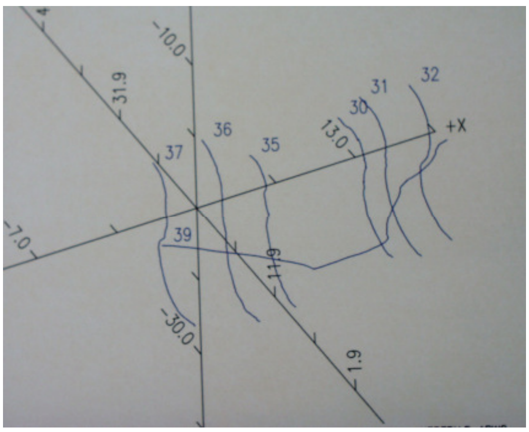
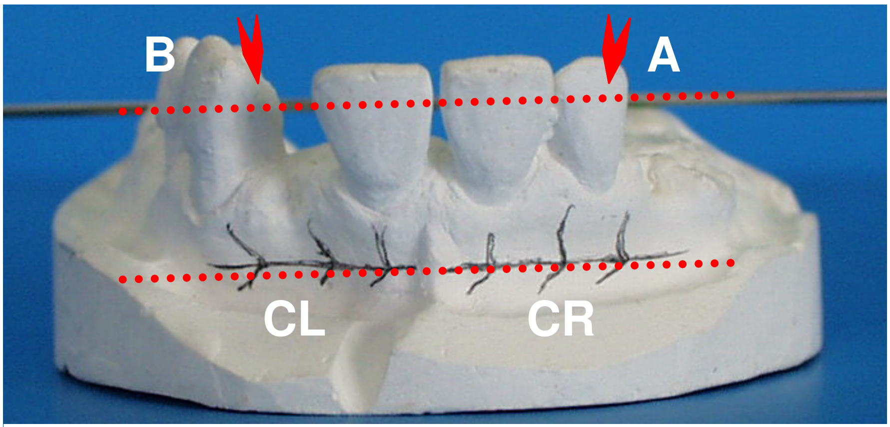


Fig. 7.2: ▶ Electronic depiction of the horizontal conclusion line

The left conclusion line CL and the right conclusion line CR are at the same height and run parallel to the line connecting the two direction points A and B; i.e. CLCR II AB.



The conclusion lines are usually determined manually in every maxillary model and tested for their parallelism to the A - B direction connecting line (see Fig. 8).

Fig. 8: ► Conclusion line parallel to A / B

2.1.4 Median axis of the maxilla

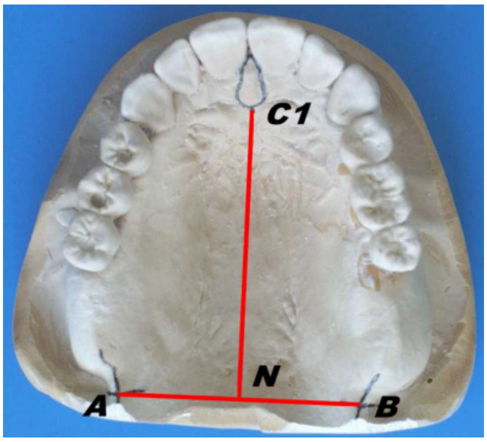


Fig. 9: ► Median axis of the maxilla

The median axis of the maxilla is defined as the perpendicular on the centre of line AB (AB = connecting line between the right and left direction point).
It meets conclusion point C1 exactly and without exception, which is thus always on the median axis of the maxilla (see Fig. 9).

The position of the cranial reference points is laid down exactly. Thus the requirements are met for mathematical calculation of the maxilla, considering its anatomical conditions.

2.2 Mathematical calculation

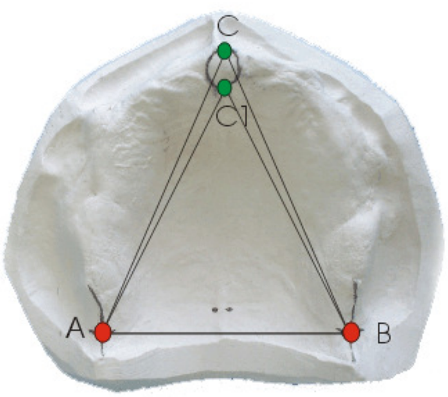
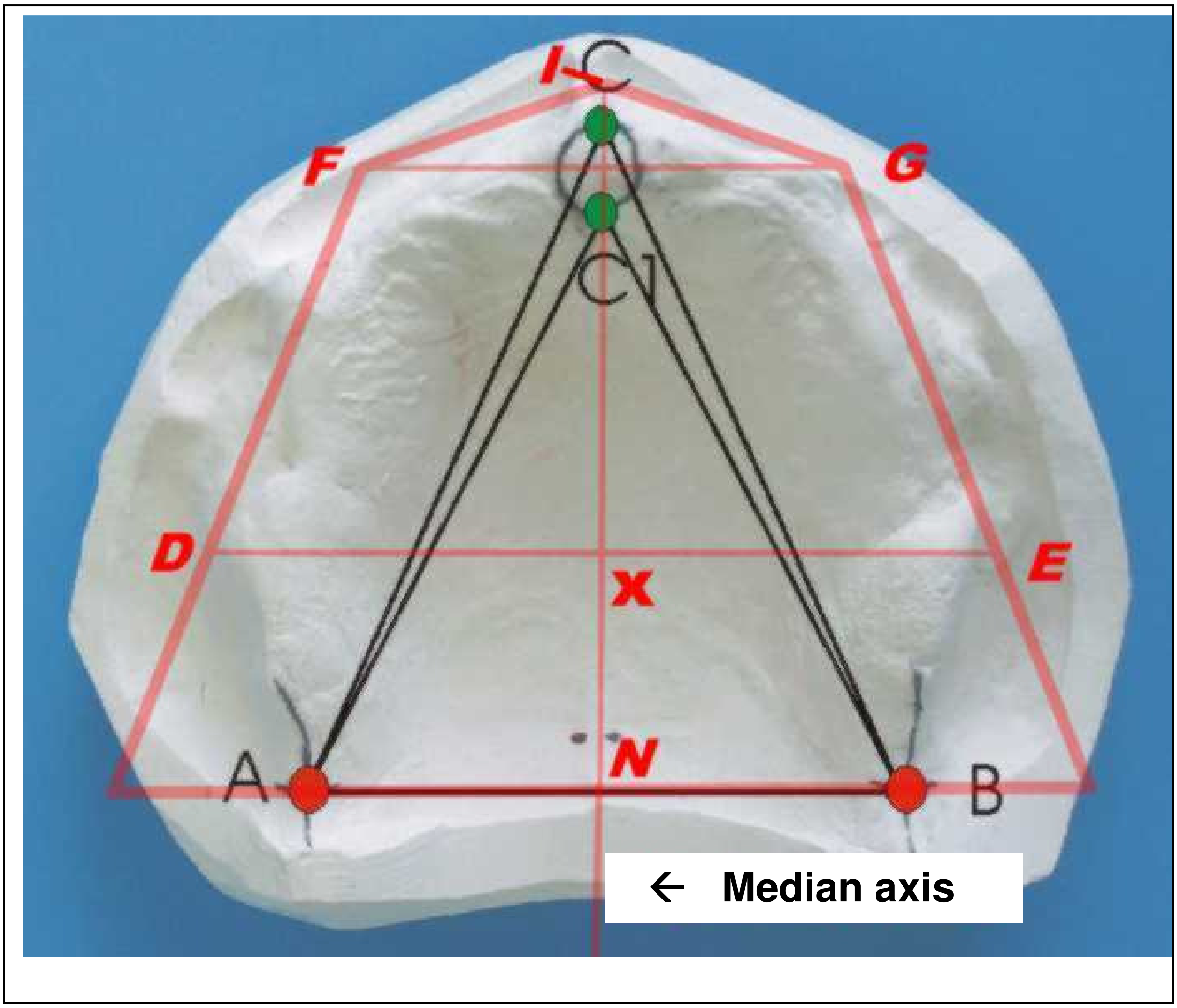


Fig. 10: ► Symmetrical cranial points of the maxilla

The connecting lines between the two direction points A and B and the induction points C and C1 result in two isosceles triangles with AB as the hypotenuse (see Fig. 10).

These parameters are used to calculate the Staub penta area, which is defined as the base of the orthocranial occlusion plane (see Fig. 11).



A = right direction point
B = left direction point
C_1 = posterior induction point
C = anterior induction point

I = incisal point
FG = canine distance
DF = right posterior tooth course
EG = left posterior tooth course
DE = transverse boundary of the posterior tooth course

Fig. 11: ► Calculation of the Staub penta area from A-B-C-C1

2.2.1 Incisal point

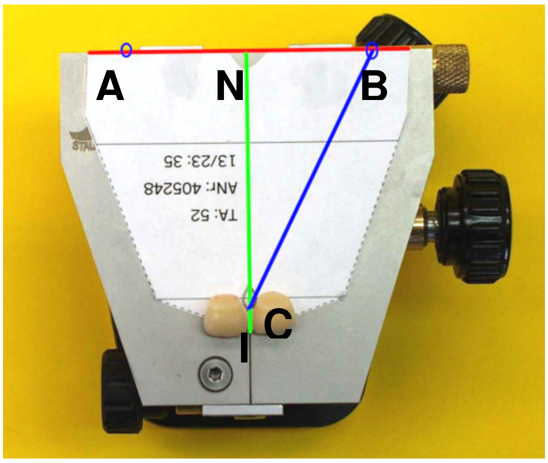


Fig. 12: ► Incisal point I

The position of the maxillary incisal point is very important when reconstructing human dentition. Its position is not only important for phonetics and aesthetics. Together with the exact position of the mandibular incisal point, it enables the vertical dimension of occlusion to be reconstructed beyond doubt. This may be achieved in a technically simple manner with the Staub™Cranial (see Fig. 12)

2.2.2 Canine position

The two isosceles triangles A-B-C and A-B-C1 were determined and measured on completely dentulous models (see Page 8, Section 2.2). The distance from canine apex to canine apex was also determined and measured. During this process, K.H. Staub established clear geometrical laws which enable the position of the canines to be calculated exactly using software. Anatomical conditions of alveolar ridges, palatal fold, etc. do not have an effect. The parameters required for the calculation are topographically stable and enable patient-specific and jaw-specific positioning of the canines.

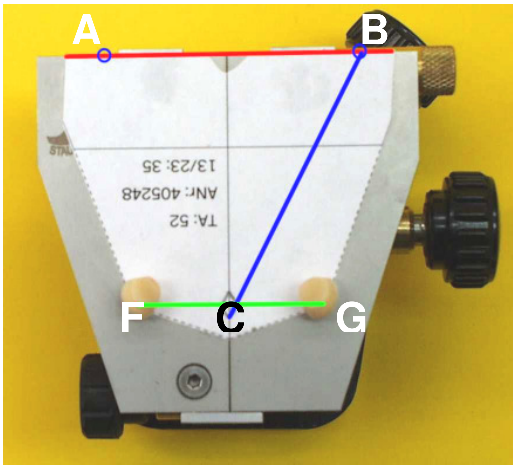


Fig. 13: ► FG, the inter-canine distance

2.2.3 Buccal tooth position

The DE transverse boundary of the posterior tooth course results from the sum of lines XD and XE, the length of these lines being identical (see Fig. 14.1).

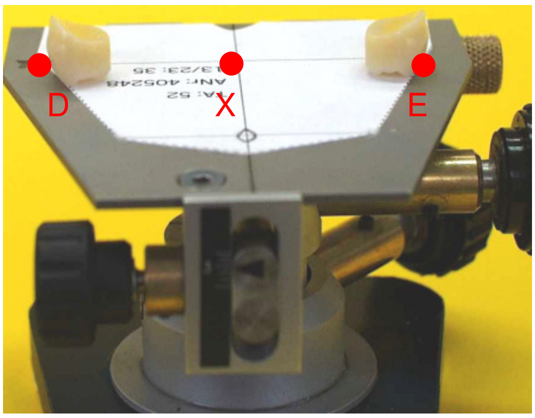


Fig. 14.1: ► Transverse boundary for the posterior teeth

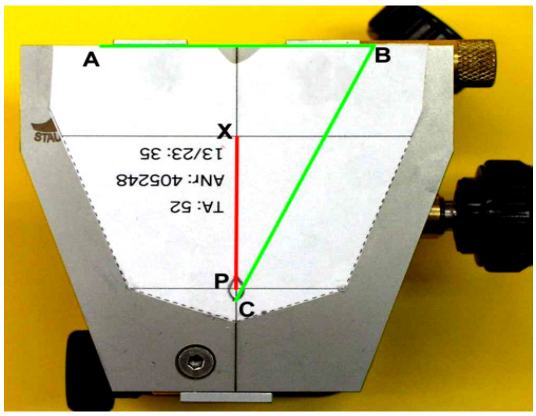


Abb. 14.2: ► Calculation of the posterior tooth course

In his measurements, K.H. Staub established the geometrical and harmonious position of the dental elements to the symmetry he found in the cranial points. It may be deduced from this that the course and position of buccal teeth may also be calculated (see Fig. 14.2).

Nearly all publications on reconstruction of the maxillary dental arch make the unanimous statement that all teeth should be placed where the natural ones were. However, they do not tell us how to find the original position.
Even the widely held view that the position of natural teeth can be recognized directly when they are still present does not always hold true. Firstly, it must be considered whether these teeth have remained stable in their natural position or whether their position has changed due to partial or complete loss of bite height. Displacement, elongation, gaps, etc. are possible effects of a change in position. This is why even remaining teeth do not give an indication of tooth positions, either from a functional or a cosmetic point of view.
We then read on and are informed that already edentulous patients are a difficult case. However, a case is only difficult when knowledge on the topic and proposals made are not suitable for finding a solution. From a specialist and forensic point of view, even implantology should be clearly aware of the fact that although implants can act like one's own teeth, a biological/psychological balance must be created to practise successful dentistry. However, this is asking too much of the unsuitable definitions on tooth position to date.

3. Occlusal plane

Clear determination of the orthocranial occlusal plane is of elementary importance for all prosthetic interventions.

E.W. Sutherland (1915-1974, Nobel prizewinner in 1971) established that the effect of force on the outer surface of the skull has different holistic effects on the body. From a skeletal point of view, the maxilla is an outer surface of the skull. Thus false positioning of dental elements and occlusal planes may lead to holistic disturbances in humans (see Fig. 15.1 and 15.2).

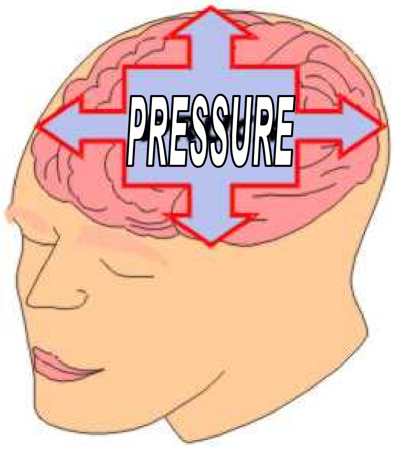


Fig. 15.1: ►Pressure on base of the skull

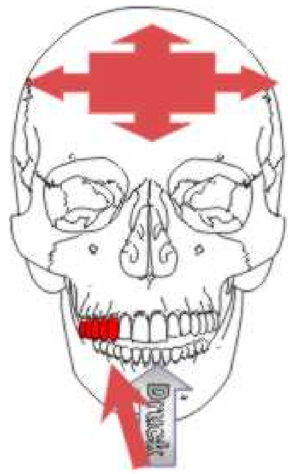


Fig. 15.2: ►Incorrect occlusal plane

Lechner sees the occlusal profile as being essential for the diagnosis and treatment of functional disorders of the masticatory system. He believes that an altered occlusal plane can favour dysfunction of the temporomandibular joints and could thus cause myogenic symptoms (see J. Lechner in the publication entitled ”Das Cranio-sacrale System“, P. 59, Heidelberg 1996).

Following **Lechner** and **Sutherland, Staub** also has no doubt that an altered or incorrectly chosen occlusion plane has a negative effect on the craniosacral system and can cause various kinds of symptoms. This is why a holistic health approach must be chosen when establishing the occlusal plane.

Even in conventional medicine, the occlusal plane is recognized as having an important role, without, however, any generally valid and feasible specifications being given for determining “disturbance-free occlusion”. Instead, there are various opinions and theories in this field which lead to different results. In the end, the question of the “correct occlusion concept“ remains unanswered.

3.1 Staub penta plane

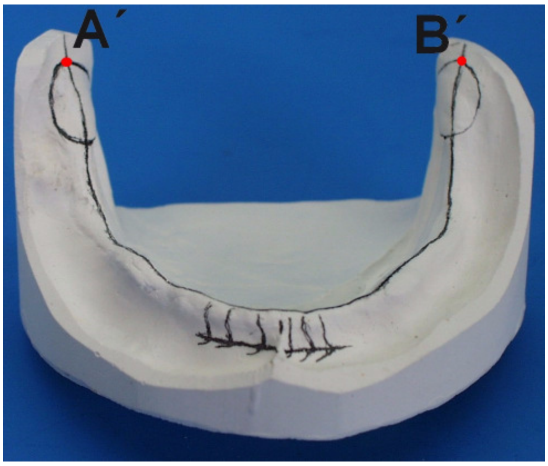
The Staub penta plane is the orthocranial occlusal plane in which tooth positioning and the incisal point are determined exactly, under consideration of the causal connections between the cranium and the maxilla.
The maxilla is the overriding reference point for establishing the orthocranial occlusal plane. It is a fixed skeletal part of the cranium, forming an anatomical unit with it.
The mandible is regarded as being mobile and as having an unstable relation. Harmonious interaction with the maxilla is its main functional importance. It is important that the transmission of force from the mandible to the cranium via the maxilla is uniform.
The Staub penta plane is determined by four parameters:

1. Conclusion line → (see Fig. 6 to Fig. 8)
2. Direction points → (see Fig. 2.1 and Fig. 2.2)
3. Staub penta area → (see Fig. 11)
4. Mathematical constant 19 mm → (see Fig. 16)

The relation parameter of 19 mm is a constant value which was measured in more than 3000 dentulous models and is defined as the distance from the conclusion line to the penta plane. This constant correlates with points N (= centre of AB) and Z (= centre of CLCR). Together with the Staub penta area which is determined mathematically, it determines the incisal point I in the space (see Fig. 16).

Fig. 16: ► Relation of the penta area

NY = 5 mm corresponds to a mean value set on the basis of empirical observations. This value is defined as the distance from the right or left maxillary direction point to the corresponding opposing mandibular direction point.
The mandibular direction point is defined as the point which lays down the change in direction of the mesiodistal curve of the ridge connecting line at the distal end of the triangle. This point is present on both sides and is topographically stable (see Fig. 17).
The two mandibular direction points A’ and B’ form an isosceles triangle with every point on the median axis of the mandible (see Fig. 18).



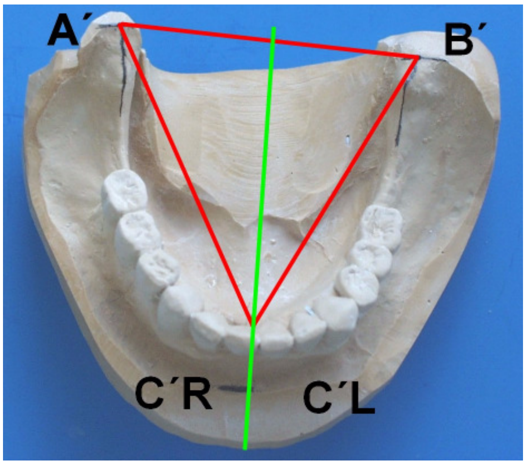


Fig. 17: ► Direction points of the mandible

Fig. 18: ► Symmetrical cranial points of the mandible

3.2 Importance of the Staub penta plane

The Staub penta plane differs from the various occlusion concepts of conventional medicine in terms of its mathematical calculability and its clearly defined spatial determination.

Fig. 19: ► The Staub penta plane

This new occlusal profile is the actual basis of orthocranial prosthetics and is a condition for successful treatment.
Empirical observations and practical figures based on experience lead K.H. Staub to believe without doubt that there can only be one orthocranial occlusal plane, which can also be demonstrated on the dentulous model (see Fig. 19).

The Staub penta plane fulfils this elementary requirement in practice too.
The dominant opinions on a "disturbance-free occlusal plane" have considerable deficits, particularly in respect of their practical application. These deficits are evident above all in prosthetic treatment.

Alone the documented fact that every fifth person with complete dentures regularly uses adhesive cream (see publication entitled "Die Zahnarztwoche" 48/98, P.15), must be regarded as a failure for dentistry in the field of total prosthetics.

Fig. 20: ► Deficient occlusal plane

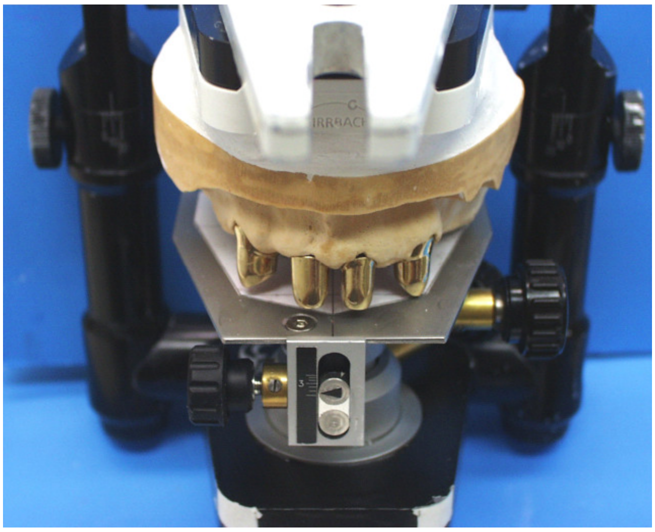


Fig. 21: ► Target/actual comparison of the penta plane

These statistics do not consider the high number of unreported patients with crowns, bridges or implants who have to accept impairment to health due to “incorrect dentures” (see Fig. 20). In contrast, the Staub penta plane is the result of an integral view of the masticatory apparatus which is characterized by transparency and measurability. The spatial limitation of the occlusal plane enables the distribution of masticatory forces on the maxilla to be recorded physically.
This means that it can be demonstrated exactly whether masticatory forces have an equal or one-sided effect on the cranium. In an extremely simple way, the Staub penta plane can be used as a basis to determine every deviation of the masticatory apparatus from the natural, ideal situation (see Fig. 21).

3.3 The rectoral trapezium after Staub™

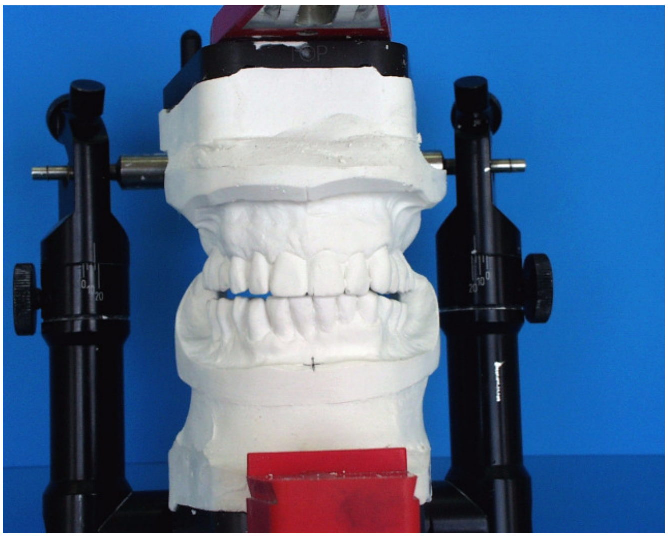


Fig. 22: ► Model pair in the articulator

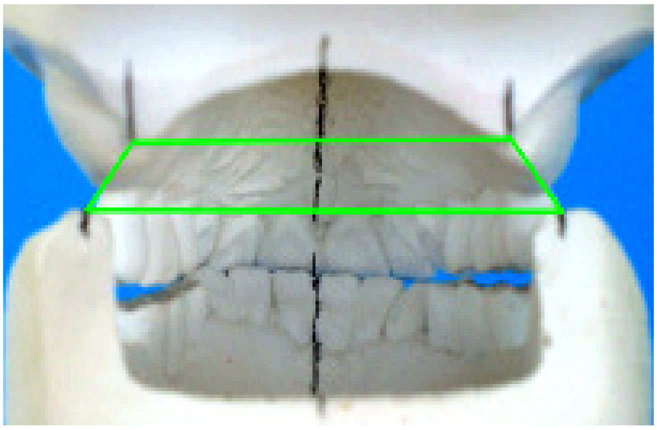


Fig. 23: ► The harmonious rectoral trapezium

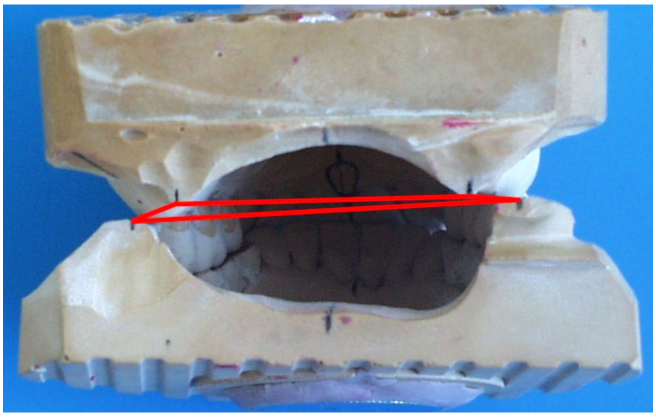


Fig. 24: ► The rectoral trapezium as an indicator of disorders

After jaw relation determination on the patient, the model pair is secured in the articulator (see Fig. 22).

During his model measurements, K.H. Staub established that there is a connection between the skeletal, fixed maxilla and the mobile, unstable mandible. Thus a measurable parameter was created.

An orthocranial relation of the mandible is given when the connecting line of the mandibular direction points is parallel to the connecting line of the maxillary direction points and, from a rear point of view, when the maxillary and mandibular direction points result in the geometrical shape of a trapezium (see Fig. 23).

If the rear aspect of the direction points in the maxilla and mandible has the geometrical shape of a trapezium, the mandible is harmoniously related to the maxilla and thus the cranium.

The inclination of the trapezium in the plane is not important and is usually different from patient to patient.

If the direction points of the maxilla and mandible do not form a trapezium, this is a clear sign of a false relation of the mandible, or of deformation in the area of the temporomandibular joint (see Fig. 24). This diagnosis can be made without complex devices but without being able to supply detailed information.

Staub™ Cranial can be used both to manufacture healthy dentures in prosthetics and to simply detect pathological changes in the masticatory apparatus as well as irregularities and functional disorders.

4. Orthocranial prosthetics

The Staub™Cranial analysis and manufacturing system for dentures is based on the logical principle of calculability and reproducibility.
Patient-specific, exactly fitting dentures can be manufactured because the masticatory apparatus is considered as a whole and specific anatomical conditions are taken into account.
The procedure of determining the orthocranial dental status, i.e. the ideal target state, is clearly laid down.
In a first step, the cranial reference points are determined in the maxillary model (see Fig. 25) and measured (see Fig. 26). The Staub penta area can then be calculated (see Fig. 27).

Fig. 25: ► Determination of the cranial points

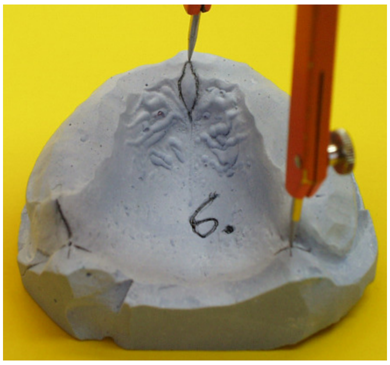


Fig. 26: ► Measurement of the cranial points

Fig. 27: ► The penta jaw plot

During this process, it is not important whether the patient is **completely dentulous** (see Fig. 28), **partly dentulous** (see Fig. 29)**, edentulous** (see Fig. 30) or has **implants** (see Fig. 31).

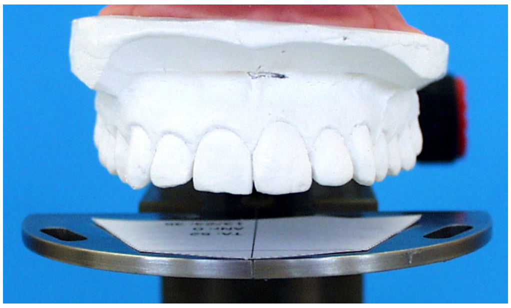


Fig. 28: ► Maxilla – completely dentulous

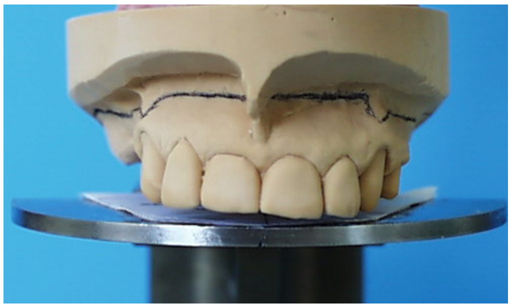


Fig. 29: ► Maxilla – partly dentulous

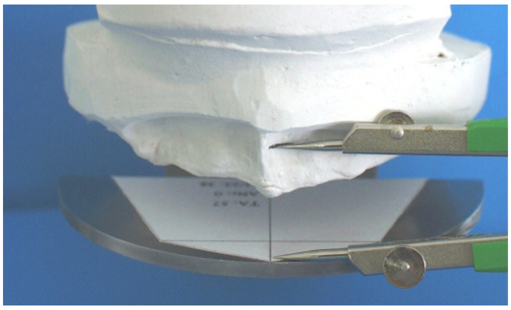


Fig. 30 ► Maxilla – edentulous

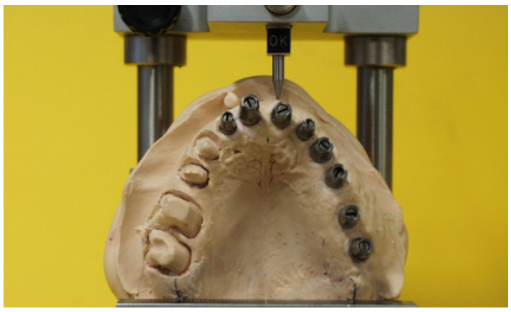


Fig. 31 ► Maxilla – stumps and implants

In a further step, the maxillary model is aligned cranially (see Fig. 32) and cast in the articulator in this relation (see Fig. 33).

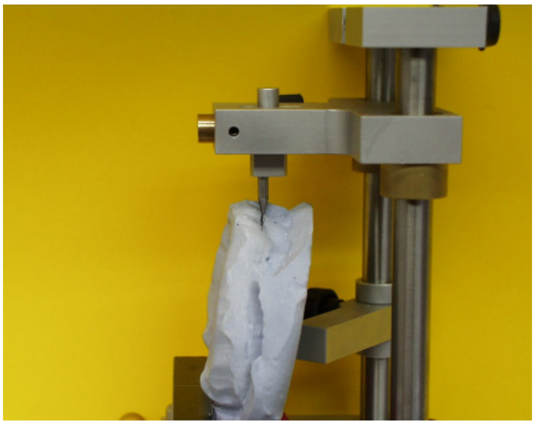


Fig. 32: ► Maxillary model in positioner

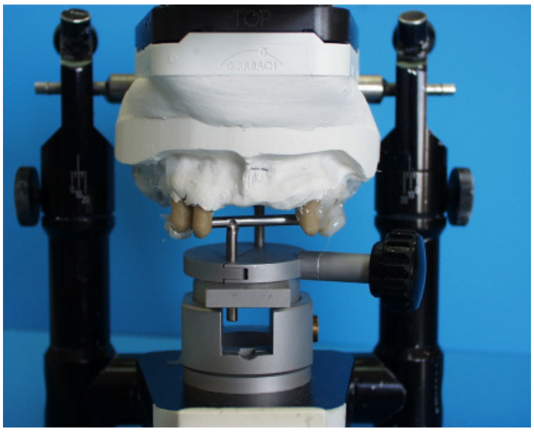


Fig. 33: ► Maxillary model in mounting holder

Due to the relation of the penta plane in the articulator, the reference, the position and the spatial conditions for alveolar ridges (see Fig. 34), teeth (see Fig. 35), stumps (see Fig. 36), implants (see Fig. 37) and planes (see Fig. 38) become visible, analyzable and reproducible. This way of looking at jaw models was completely alien to dentistry and dental technology up until now.

Fig. 34: ► Maxillary model in relation to the penta plane

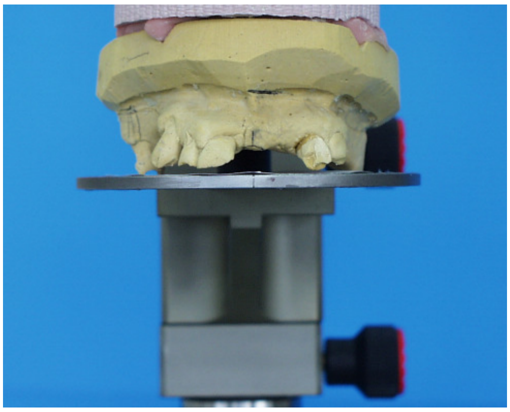


Fig. 35: ► Maxillary teeth in relation to the penta plane

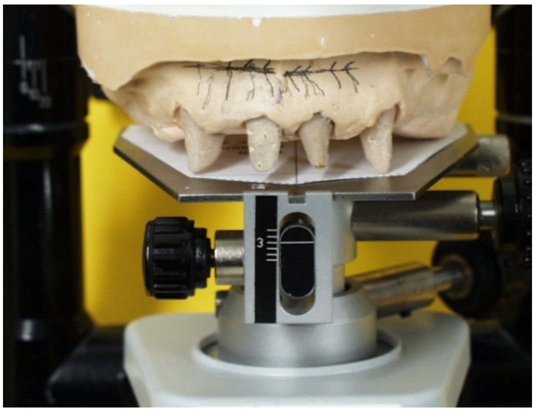


Fig. 36: ► Stumps in relation to the penta plane

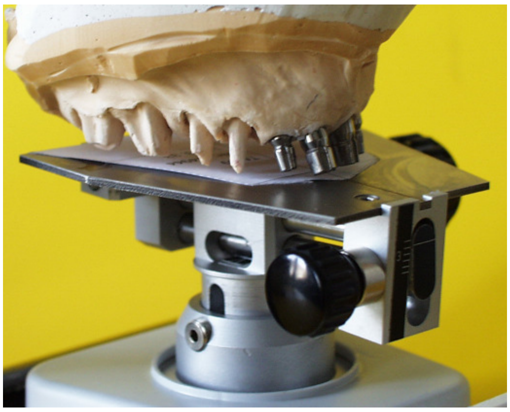


Fig. 37: ► Implants in relation to the penta plane

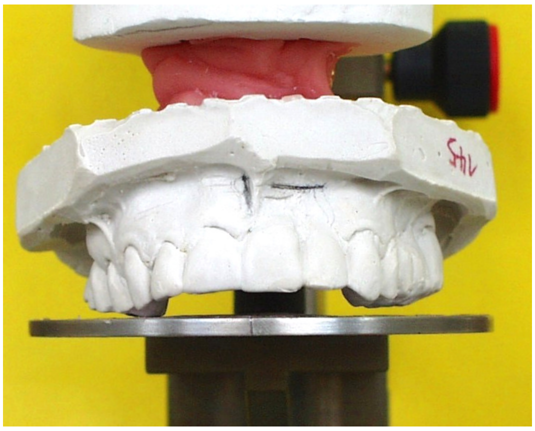
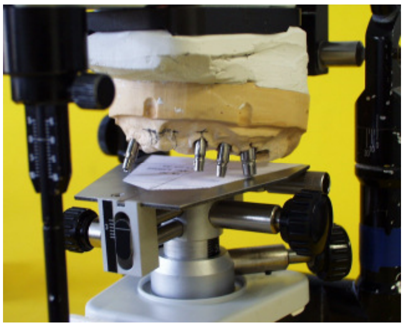


Fig. 38: ► Maxillary treatment in relation to the penta plane

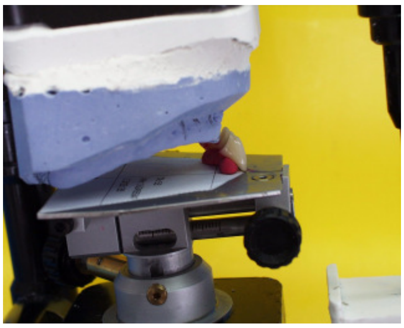
Even at this stage, it is clear that the orthocranial approach brings about a completely new type of result. Patient handling is easier, safer and clearly shorter for the treater. Dental technology profits from the clear, foresighted approach and is saved from unnecessary work caused by complex improvements.

Technical realization in the Staub™Cranial system has clear guidelines and specifications such as:

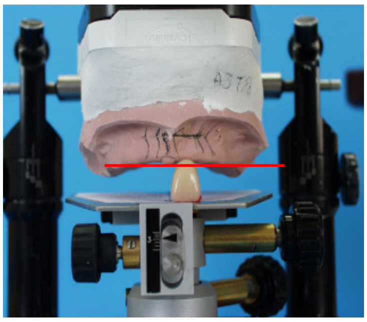
- The cranial penta plane



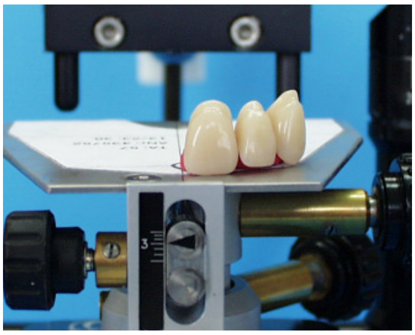
- The incisal point in the space



- The biological tooth length




- The physiological inter-canine distance




- The posterior tooth course with buccal corridor

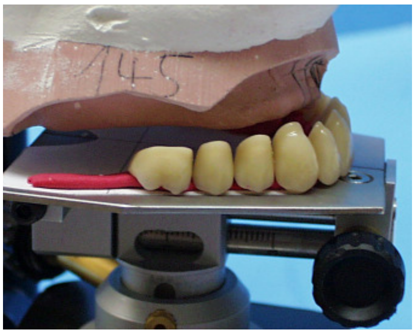



Fig. 39: ► Plate on penta statements

Denture functionality and the patient's health are the focal points of this new approach, thus achieving a completely new dimension of quality.

4.1 The technique of the penta plane

The model is then aligned three-dimensionally in the Ortho 1A positioner, both direction points being put up against the device scale in such a way that the median axis of the maxillary model runs through zero (see Fig. 40).
The distance from the conclusion line to the linear occlusal plane is laid down with the maxillary adjustment. It is 19 mm in the maxilla.
Using an adapter, the model is then mounted on the Ortho 2A mounting holder and secured directly in an articulator (see Fig. 41). This positioning does not eliminate the skull-axis relation by facebow.
The Ortho 3A cranial holder is used to bring the patient-specific model and the penta area calculated using the individual cranial reference points into relation with the mathematical constant 19 mm (see Fig. 42)

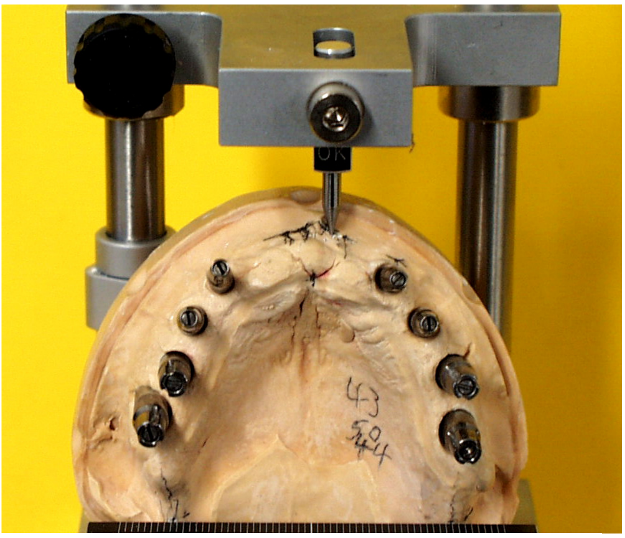


Fig. 40: ► Maxillary positioning

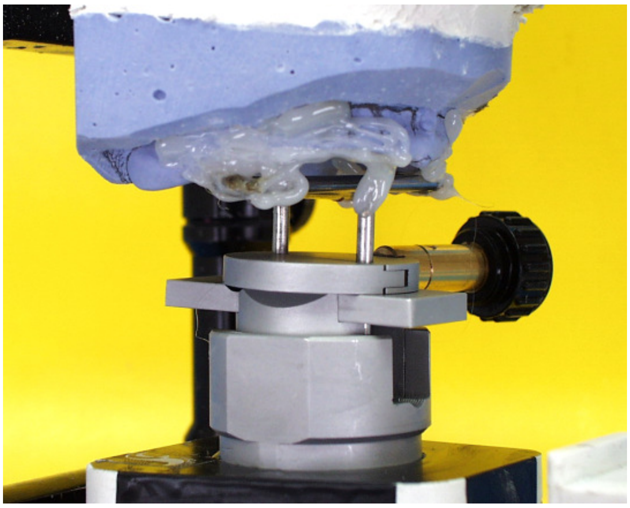


Fig. 41: ► Maxillary mounting holder

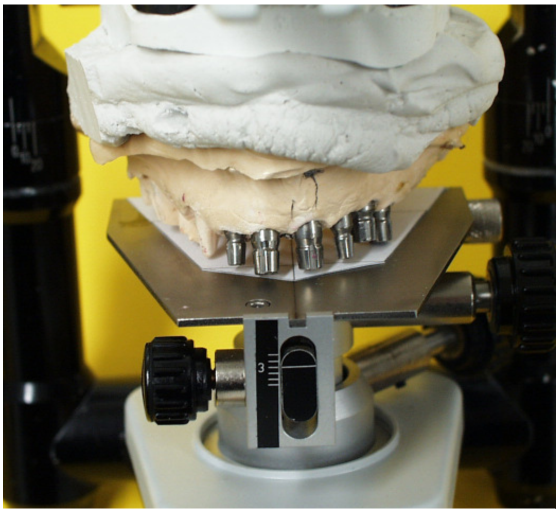


Fig. 42: ► Maxillary penta aspect

4.2 Application of the technique

Ortho1A

The maxillary model is aligned three-dimensionally to the cranial reference points A/B/C in the Ortho1A positioner. The horizontal line is laid down via the direction points, the vertical line via the conclusion line (see Fig. 43).

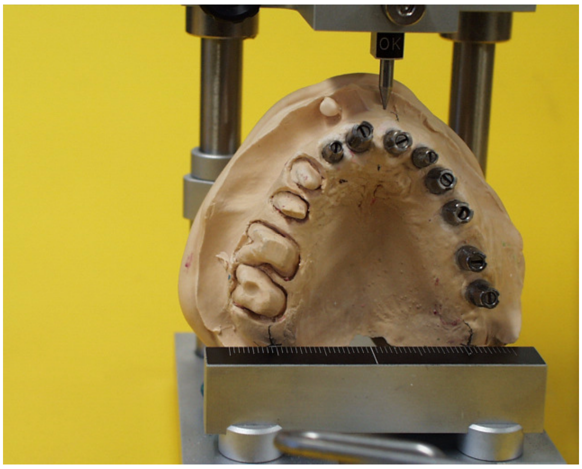


Fig. 43: ▶ Model in Ortho1A

Ortho2A

Using the adapter, the maxillary model secured in the Ortho1A is mounted on the Ortho2A mounting holder and cast directly in the articulator (see Fig. 44).

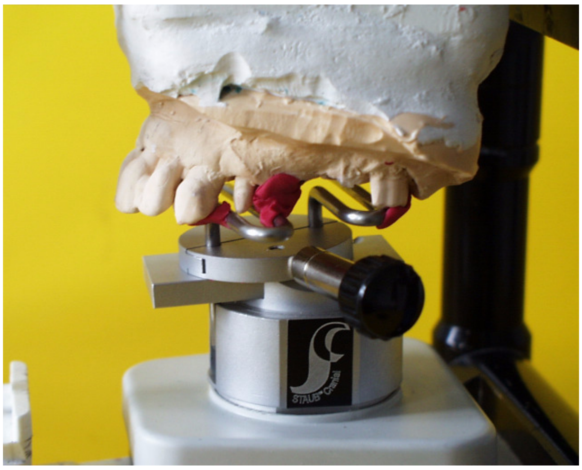


Fig. 44: ▶ Model in Ortho2A

Ortho3A

The Ortho3A is used to bring the patient-specific model and the penta area calculated using the individual cranial reference points into relation with the mathematical constant 19 mm (see Fig. 45).

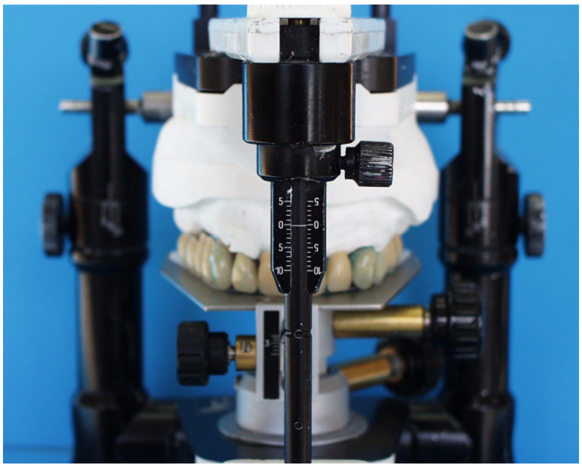


Fig. 45: ▶ Model for Ortho3A

4.3 Equipment

A range of ortho devices developed by K.H. Staub is used to align the maxillary model in the Staub penta plane, i.e. in the cranially harmonious occlusal plane.
This range comprises three devices, supplemented by a computer program which calculates the Staub penta area within a few seconds. The Ortho1A positioner is a stand-alone device, the Ortho2A mounting holder and the Ortho3A cranial holder are used in all common articulator systems.

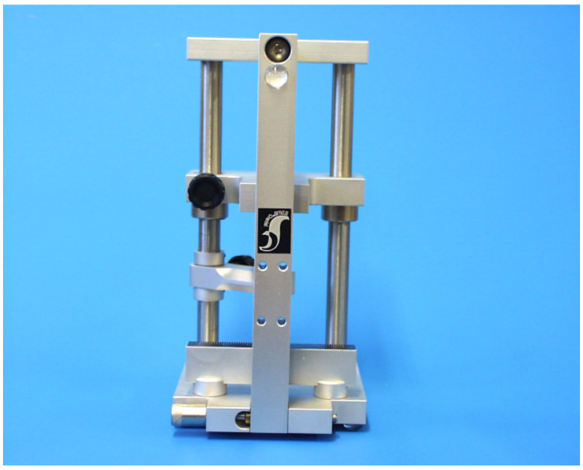


Fig. 46: ▶ Ortho1A positioner

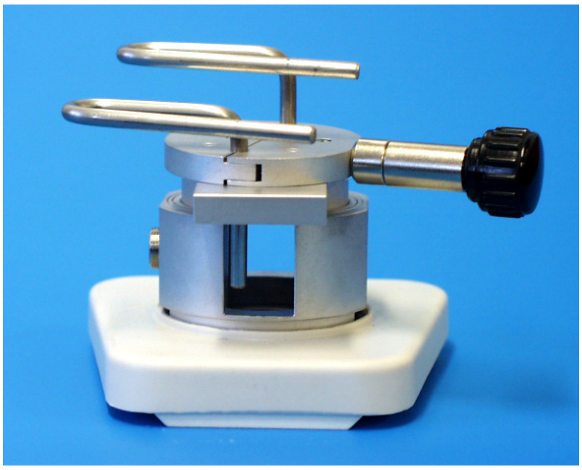


Fig. 47: ▶ Ortho2A mounting holder

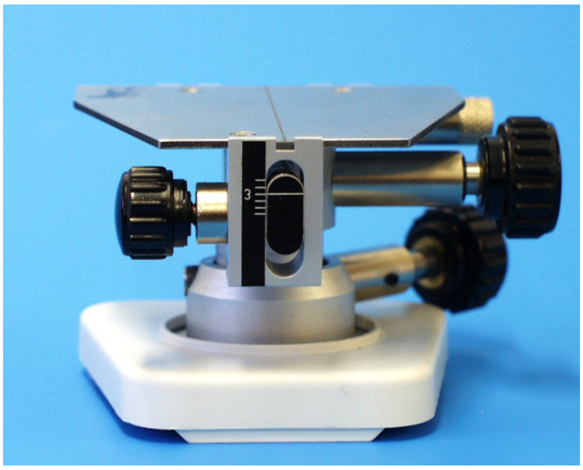


Fig. 48: ▶ Ortho3A cranial holder

Fig. 49: ▶ Staub™Cranial software

5. Applications

Staub™Cranial makes reorientation and rethinking inevitable in all fields of dentistry. This system is based on an implicit holistic way of thinking which necessitates a change in procedure when producing dentures.
The functionality of the masticatory apparatus and the patient's health are now the centre of attention of dental treatment.
Mathematical and physical laws, derived from newly defined reference points, make everything reproducible and measurable.

5.1 The principle of reproducibility

In orthocranial prosthetic treatment, it is of the utmost importance to manufacture reproducible, healthy dentures.
Regardless of whether in partial or total prosthetics, in combination or splinting technology, in crown or bridge technology, in implantology or in functional disorders, there can only be one denture for a patient which is correctly aligned cranially.
To date, all scientific hypotheses and opinions in these areas have failed in respect of this elementary demand because they have not been able to be provide proof of their practical application.
In contrast, the Staub™Cranial analysis and manufacturing system offers a practically feasible and tested total solution. It is based on mathematical calculation according to which every denture is correctly aligned cranially under consideration of the patient's anatomy.

5.2 Analysis function

In addition to the manufacturing element, the analysis function of the new cranial system is actually the outstanding achievement.
The target or ideal situation (= Staub penta plane) is directly compared with the actual situation (= patient situation) in the Ortho3.
Direct comparison means that every anatomical deviation or pathological alteration of the masticatory apparatus can be diagnosed.
Changes in the temporomandibular joint, the alveolar ridge, tooth positions and occlusal plane are established clearly without complicated devices. Appropriate medical measures may then be taken to eliminate them.
Factors responsible for disturbing the harmonious balance are identified beyond doubt.
Only a stable, cranially aligned holder ensures uniform transmission of masticatory and swallowing forces, and is a precondition for harmonious balance in the masticatory system.

6. Concluding remarks

Staub™Cranial stands for a reorientation and a new way of thinking in dentistry and dental technology. Everything is measurable and reproducible based on mathematical calculations derived from new reference points.
Denture functionality and the patient's health are now the centre of attention of a type of dental treatment which achieves a completely new dimension of quality.
Besides the scientific aspect, the practical application and feasibility in nearly all disciplines and fields of dentistry is what is most convincing. The analysis and manufacturing function of this system may be used in partial or total prosthetics, in combination or splinting technology, in crown or bridge technology, and even in orthodontics.
Thus the dentist and dental technician have a total solution which is convincing both in practice and in theory.
The mathematical and physical recordability of the masticatory apparatus as an anatomical parameter is the basic element of a contemporary type of dentistry which puts functionality and harmony of the masticatory apparatus to the fore and which is both understandable and realizable for everyone.

Staub™Cranial for modern dentistry.