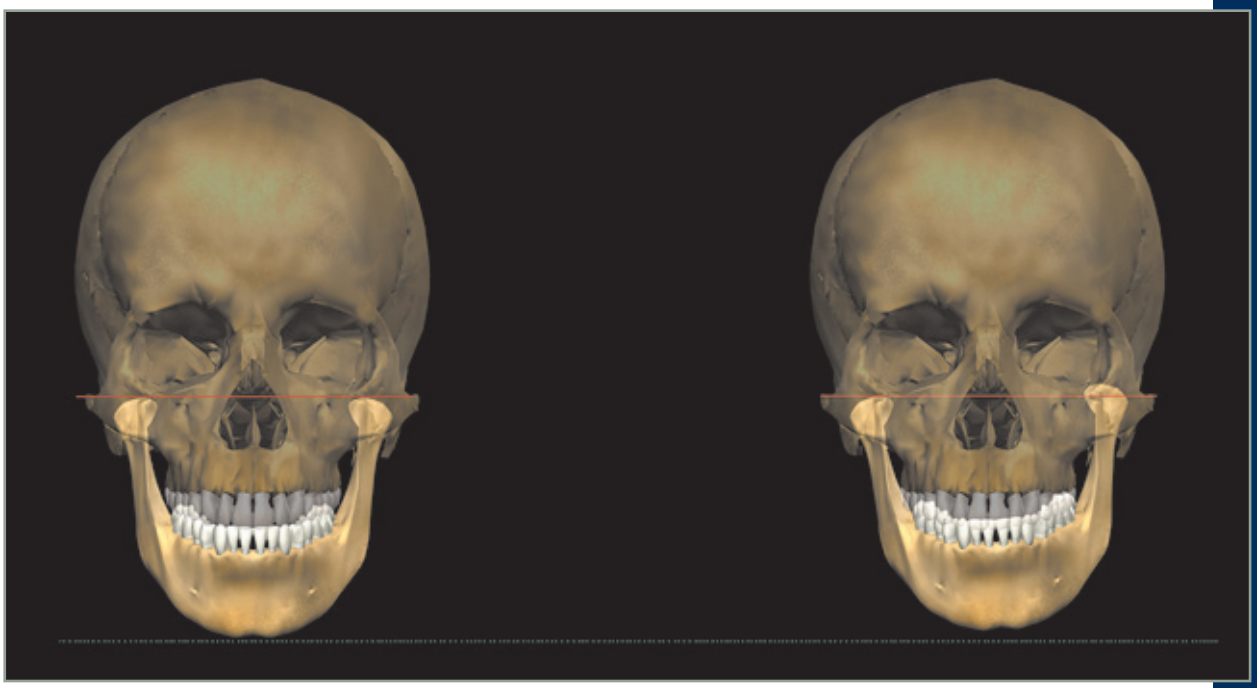
Teeth and Posture

Stefan Schunke, MDT
EAED Affiliate; Specialist of esthetic dental technology (DGÄZ)

Armin Enssle, DMD, DDS, MSc (DGI)
EAED Affiliate; Private practice, Nürnberg, Germany

Alexandra Kreisl, DMD
Specialist of esthetic dentistry (DGÄZ); Private practice, Starnberg, Germany

Markus Schlee, DMD, DDS
Private practice, Forchheim, Germany



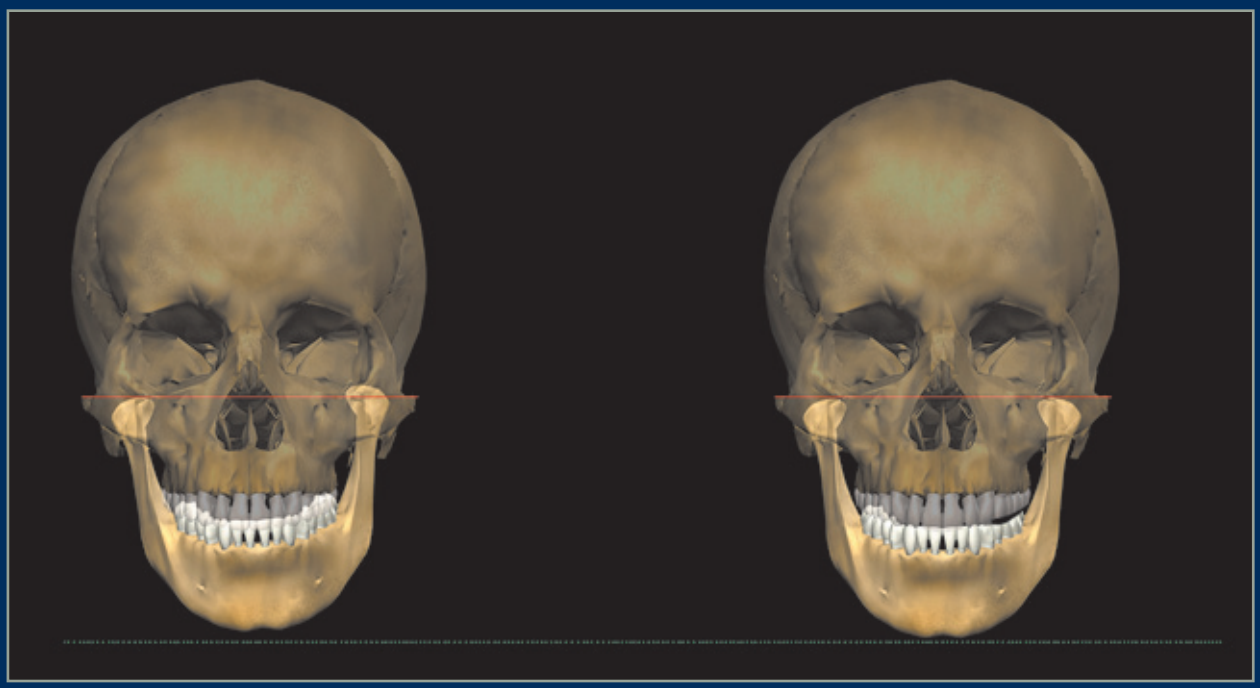
Correspondence to: Stefan Schunke
Bayreutherstraße 39, 91301 Forchheim;
e-mail: st.schunke@arcor.de; web: http://www.schunke-stefan.de/

Abstract

Esthetics is a topic that has become much discussed both in medicine and in dentistry. However, it should be questioned how reliable and reproducible the guidelines and protocols for esthetic procedures really are. This article will describe in detail the interactions between the musculoskeletal and masticatory systems. Dentists are frequently misled by their false interpretation of existing reference lines, without recognizing the true problem. The close relationship between skeletal and dental problems and their impact on the masticatory and musculoskeletal systems will be explained in this paper. Esthetics and function – not only of the teeth – form an entity that needs to be viewed and treated as a whole.

Many of these interactions are thought of as "alternative medicine" and are therefore hardly considered at all in conventional mainstream medicine. This holistic approach will be further explained and discussed with a patient case.

(Eur J Esthet Dent 2011;6:406–427)



The relationships between respiration, posture, and the masticatory system have been known and described in the literature for quite a while.[1] However, in daily work with patients, the focus tends to be on replacing missing teeth or restoring lost tooth structure. Drawing diagnostic reference lines into images of the region of the facial skeleton has been described as an important prerequisite for correct treatment planning in many publications.[2–11]

But how meaningful are such reference lines for the daily work in a dental practice? At first glance, there is nothing special about the patient in Figure 1. The interpupillary line and the intercommissural line are frequently used as reference lines, while the shoulder line is less commonly used (Fig 2). If we take another image focusing on other details and draw in lines, we can see that some are ascending, while others are descending (Fig 3).

What kinds of conclusions can be drawn from these reference lines? And how can this data be transmitted to a dental technician with the help of an articulator? How can the relationship between soft and hard tissues be reproduced or reflected correctly? In the authors' opinion, there should be tools that would allow dentists to draw the appropriate conclusions effectively and reliably in their day-to-day work. The authors use a tool called "Head Line."[12,13,14] At this point, the authors wish to explicitly mention and thank *Udo Plaster*, who has developed this knowledge. In addition to efficient and easy visualization of the actual situation, the Head Line device can also be used as an articulation aid for mounting casts in correct relation to the skull. This article, however, will only deal with the option to provide orientation of the patient's face (Fig 4).

With the Head Line device mounted, the actual situation can be visualized. The relationship between the interpupillary line and the maxilla in the skull is not satisfactory. A faulty posture can be observed, which will be discussed in detail in this article. The question is, whether this discrepancy has an anatomical cause or is caused by an inadequate prosthesis. What can truly be changed?

One can only recognize what one knows. These correlations will be explained with the help of examples and anatomical representations.

First of all, it must be asked if this topic is a serious one. There are various reports in the literature[15–27] and seminars[28,29] on this topic that are listed here as examples. The level of evidence of these papers was assessed by Hanke et al in a literature review.[30] They used the following assessment criteria: year of publication, main topic, and scientific quality (level of evidence). The results were as follows:

The research yielded 359 articles (195 electronically, 164 in bibliographies, 355 could be evaluated). Since the 1980s in particular, the number of publications has been increasing. A description of an interaction between dental findings and:

- findings in the vertebral column could be found in 266 articles
- head posture could be found in 216 articles
- pelvic obliquity could be found in 53 articles
- leg length discrepancies could be found in 35 articles.

Figs 1 to 3 Information derived from reference lines is not always meaningful. A shift of perspective can be helpful.

Fig 2

Fig 3

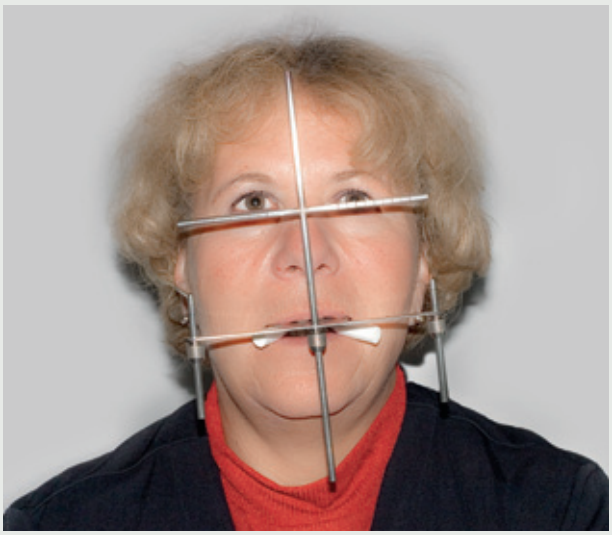


Fig 4 With the help of a tool such as the "Head Line" device, the required information can be obtained.

Fig 5 Through the accurate transmission, it was possible to find out exactly what needed to be changed. The result speaks for itself.

Conclusions from dental findings to the presence of orthopedic findings were found in 131 articles, while 171 articles stated conclusions in "opposite direction." Levels of evidence were represented in the proportions that follow.

- Evidence level I: 0 articles
- Evidence level II: 3 articles (0.8%)
- Evidence level III: 63 articles (17.7%)
- Evidence level IV: 178 articles (50.1%)
- Evidence level V: 111 articles (31.3%).

In any case, increasing interest and tendencies can be found in the literature.

The skeleton can be divided into the spinal columns, the atlas, shoulder, hip, and knee regions (Fig 6a). Imagine a patient who has been treated with a bridge in infraocclusion (probably not a rare occurrence) on the right side.[31] To be able to make contact on this bridge, the patient has to tilt his or her head to the right (Fig 6b). This will cause the

Fig 6a–c Infraocclusion of a bridge alone can change posture.

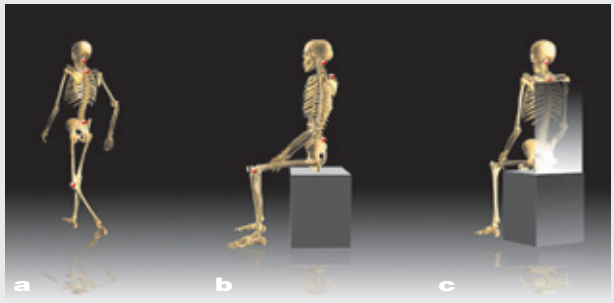


Fig 7a–c By sitting down, the patient can only compensate in two locations instead of four in a way that is visible and traceable.

patient's gaze to be crooked with their head cocked to one side. Their organs of equilibrium, the eyes and brain, however will tell the patient to look straight. The patient will thus try to bring his or her head into a vertical position on the spinal column. As all muscles are connected with each other via the skeleton, the shoulders will subconsciously follow this movement. For the same reason, the pelvic region will follow this motion, but in an opposite direction, and the region of the knee will follow in the opposite direction of the pelvic region (Fig 6c).

Subsequently, it can be observed that the right leg is too short. Now the question has to be is the leg too short and only following a wrong occlusion, or is the wrong occlusion following the short leg? In other words, is there a problem in the upper part of the body that descends all the way down or is there a problem in the lower part that goes all the way up? Another question is whether internal organs, bacteria, or anything else may be responsible for such a posture. Human beings need to be seen in their entirety.[32] Many of these reflections belong to the realm of alternative medicine and are challenged by conventional, mainstream medicine.

How can one make use of such knowledge? As long as the patient is moving, he or she has the aforementioned four parts of the body (atlas, shoulders, hips, knees) to compensate for any existing postural deformities (Fig 7a). When the patient is sitting down, however, although he or she still has all the body parts that are capable of compensation, he or she can only use the atlas and shoulders for compensation in the region that is of interest to us. The appropriate information can then be obtained (Fig 7b and c).

If patients are viewed with this in mind, it becomes clear how difficult it must be to take the appropriate bite records. Looking at the patient in Figure 8, it can be seen that he has physical restrictions and a faulty posture: a tilted head, a rotated shoulder on the left, asymmetrical facial features, different facial heights, and a head that is rotated backwards. The medical history revealed that the patient practiced martial arts and had already suffered several bone fractures and similar injuries. It is not very difficult to imagine how the muscles have to pull and tear at the bones to keep this man in balance. Usually such patients will have to be treated with splint therapy and accompanying treatment by a physiotherapist and/or osteopath to get back into a state of stability and equilibrium. It has been documented in related literature that physiotherapy can improve the natural head posture and reduce bruxing.[33] In the same way, bruxism can depend on the head posture.[34] But what happens if a patient refuses such treatment or if the appropriate treatment is not available?

The skeleton is usually depicted in an idealized, well-proportioned way (Fig 9). But what happens if this theoretical idealized image is not fulfilled? Asymmetries can have a multitude of causes: a fall as a child, joint problems or problems with the hips or intervertebral disks, tense muscles in the neck, organic diseases, etc. In this example, let it be assumed that the left temporomandibular joint is compressed. Thus the mandible will be displaced dorsocranially with ensuing consequences and complications.

Fig 8 This patient bites down his teeth; while doing so, he is convinced he is sitting straight and looking straight ahead.

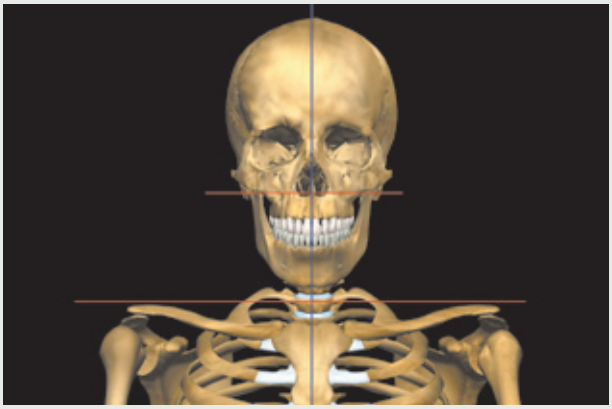


Fig 9 The "theoretical" image of a skeleton.

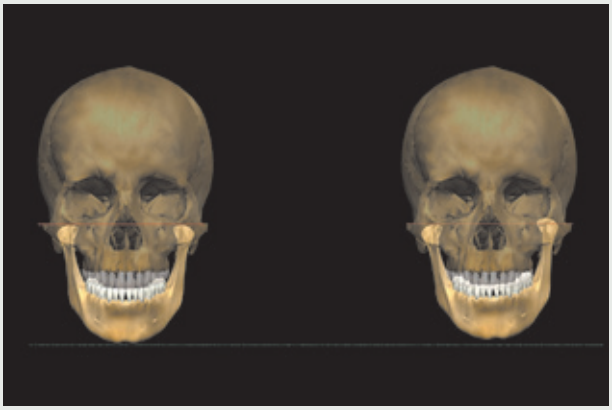


Fig 10 What happens if you observe asymmetries or a compressed joint (as in the example on the left)?

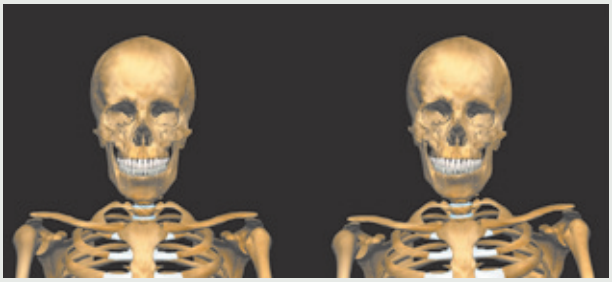
This may affect the bilaminar zone, with disk displacement, deformation of the condyle, or of the involved soft-tissue structures surrounding the left-sided mandibular bite with parafunction (Fig 10).

The original scenario turns into a completely oblique situation, ie, the patient will not only have to take the shoulder with him to be able to look straight ahead, but this will also cause the mandible and the cranial floor to be crooked in relation to each other and to the spinal column (Figs 11 to 12).

What would happen if the patient (see Fig 7) was left in exactly this situation and was only treated with a dental restoration? Primarily, nothing would happen. But imagine this patient decided one day to see a physiotherapist, who maybe even advised him to wear orthotics. In this case, the patient would straighten up at least partly into his normal skeletal position, ie, this patient could straighten up in such a way that he would have more contact on the right side and would lose all contacts on the left side. This would mean that the restorations on the right would be abraded, while non-occlusion would be the result on the left side (Fig 13).

If one assumes a straight head posture in the sagittal plane, it should be asked what would happen if the head is tilted forward. The muscles push the mandible forward, which creates loss of contact in the dorsal region and causes stronger contact in the anterior region. If the head is tilted back, this works the other way around: the mandible is pulled backwards by the muscles and the bite gets stronger in the posterior region, while contact is lost in the anterior region (Fig 14).

Based on these considerations, centric bite registrations taken with the patient lying down must lead to wrong results. The centric bite registration is taken with the patient sitting in a position where the backrest is at an angle of approximately 20 degrees sitting upright. The head support at the chair has to be adjusted appropriately to ensure that the patient looks "straight" ahead and that the head support does not guide the patient's head into a situation where the head is hyperextended.



Figs 11 to 12 Oblique postures of the head and body.

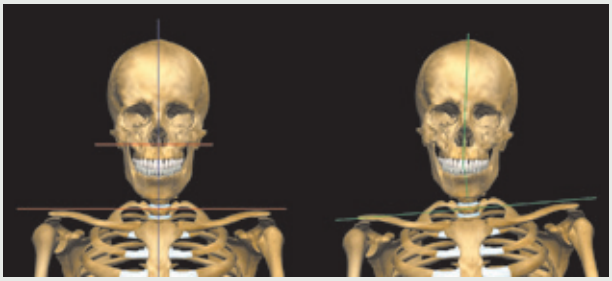


Fig 12

Fig 13 Through a change in body statics it may happen that the mandible no longer matches the skull, ie, the maxilla.

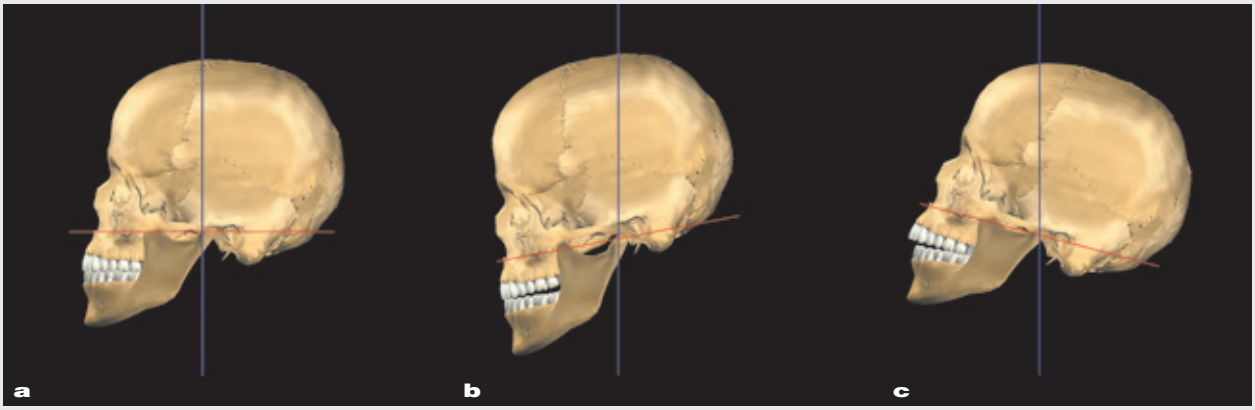


Fig 14a–c Depending on the head posture, the mandible is shifted by the muscles in such a way that either the anterior or the posterior region loses contact.

Fig 15 Left: patient biting down. Right: patient with teeth apart. Why the two different head postures?

Learning to see

Fig 15 shows clearly that the patient is taking different head postures. The image on the left shows the patient while she is biting down, the one on the right shows her with relaxed muscles. What could be causing this difference?

Malpositions of the head can be observed frequently. Looking into the patient's mouth, however, will not reveal the immediate reasons. Only by analyzing the models in an appropriate centric bite can the problem be recognized. Fig 16 shows the habitual situation of the patient, while Fig 17 shows the centric situation (first day centric) of the patient. It becomes clear that there are marked differences between the two. The maximum intercuspation and the centric relation were not identical. A premature contact at the mandibular left second molar became evident (Figs 18 and 19).

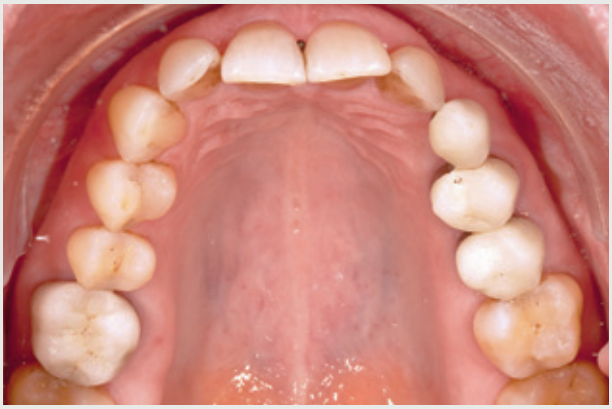
This premature contact is found on the distal surface of a cusp. To be able to close her teeth and bite down to thus regain occlusion, the patient has to rotate her head forward by the distance of this premature contact. The resulting tension in the muscles moves her mandible forwards so she can take her maximum intercuspal position again.

This would be similar to Figure 14b of the skeleton. Moreover this illustrates more conclusions and insights. If one looks at the maxillary anterior teeth, it becomes evident that they seem very long. Whether the incisal edges are in the correct position cannot be judged in this way. However, it is evident that the bone in this region has undergone strong resorption. The patient confirmed that the restorations for the mandibular left teeth had been made before those for the maxillary anterior teeth. Through the resulting premature contact at the mandibular left second molar and the slight forward rotation of her head, the pressure on the maxillary front teeth increased continuously. The tooth mobility increased and the bone receded. The restoration then served as a splint for the anterior teeth.

Figs 16 and 17 The maximum intercuspation and the centric relation differ considerably.

Figs 18 and 19 A premature contact at the mandibular left second molar was found to be the cause. The oblique distal surfaces of the distobuccal and the distolingual cusp force the patient to bring her mandible into a forward position, while the remaining muscles force the patient to "rotate" her head to compensate.

Fig 20 Marked malpositions are evident in this patient. This patient is sitting "comfortably" and closes her teeth. The illustrations show the changes in position.



Figs 21 to 25 The intraoral status.

Fig 22

A common case

The patient presented as illustrated in Figure 20. It was obvious that the posture of her head and body were not especially good. In the dental office, the head and shoulder region was assessed. If any malposition presents itself, it is certainly no longer the dentist's function to identify, describe, or treat the exact disorder. In cases like this, it is necessary to consult a physiotherapist or an osteopath for consultation and treatment. Only very few malpositions, as depicted in the illustrations, can be clearly identified by a dentist.

If the patient is viewed from above it becomes clear that her head and, to compensate for this, her right shoulder are rotated slightly to the right. From a frontal view it can be seen that her head is rotated to the right, the distance towards the right shoulder is shortened, and that her left shoulder is "hanging down" slightly. From a lateral view, the head is rotated slightly to the right and backwards towards the neck. The patient is unaware of any malposition.

In a next step, the intraoral status is recorded. What seems like a class II relationship at first glance is actually an Angle class I. Inversely curved arches and a deep bite can be observed (Figs 21 to 25).

Patients with Angle class I usually show significantly less bruxism compared with class II or III.[35] The midline's offset is caused by tense muscles.[16,36]

How the intraoral situation really presents itself can only be revealed by analyzing the casts. To be able to do this, precise impressions are required; it has to be ensured that the surrounding ana-

tomical structures are clearly reflected. By analyzing the casts it is possible to assess the teeth, their positions in different planes, and the soft tissues as well as the bone profile. Through this different perspective, additional information can be gathered (Figs 26 to 28).

Analyzing the casts starts with what is called a "manual analysis." This means that the two casts are simply put on top of one another and assessed. Thus, the actual habitual occlusion of a patient can be checked. At this point, the focus is only on the occlusion. If the casts are viewed from behind, this shows an occlusion that can be called stable (Figs 29 to 31).

The second part of analyzing the casts consists in the instrumental analysis. This involves articulating the situation models in a first centric position. Subsequently, the occlusion is reviewed and compared. In this patient, as is often the case, the habitual and the centric position are not identical. A massive deviation, especially of the vertical in the posterior region, can be observed (Figs 32 to 34).

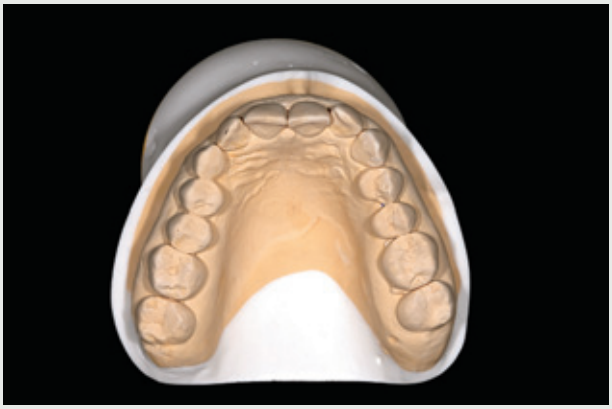
Is the habitual position really correct or is this a case of massive deviations or is the first centric simply wrong? Again, analyzing the casts can help assess the situation. With the models, wear facets can be identified and interpreted. Only those that occur in natural teeth are relevant. It is necessary to distinguish between active and passive facets, static and dynamic facets, adapted and compensated facets, as well as those occurring close to the joints and those further away from the joints.

In this case, several types of facets can be seen, without any judgment at this point (Figs 35 to 38).

Fig 23

Fig 24

Fig 25



Figs 26 to 28 Only through analyzing the casts can we collect information that would not be visible intraorally.

Fig 27

Fig 28

Figs 29 to 31 The patient's habitual occlusion can be called stable.

Fig 30

Fig 31

Figs 32 to 34 The instrumental analysis shows a discrepancy between habitual occlusion and the first-day centric. A bilateral disclusion, stronger on the left than on the right, indicates instability.

Fig 33

Fig 34

Figs 35 to 38 It is important to be able to see, understand, and interpret the wear facets. This reveals both the patient's past and present.

Fig 37

Fig 38

Figs 39 to 48 This series of images illustrates how the very same motion can differ. It becomes obvious that the distances of the dental arches differ in the patient's mouth, in the articulator, and if the models are guided by hand.

Fig 40

Fig 41

When positioning the models to investigate the facets, it has to be considered that in about one-third of cases, the articulation on the patient and in the articulator are not identical, and that the articulator has too much "play."[37] A combined analysis between articulator and free-hand occlusion allows for a somewhat more exact reproduction (Figs 39 to 48).

As it can be seen on the photographs, almost identical movements are really rather different in terms of the distances between the teeth. Certainly, such images and statements are not standalone proof, but this can be easily checked with individual cases. It is not without reason that some say "the patient's mouth is the best articulator." In other words, even with the best efforts and using the best mounting techniques, the intraoral situation can only be reflected approximately with passive models. The morphology of natural teeth supports the structures of the joints and the muscles of the skull and helps them to work the delivered forces.

If the maxillary molars of this case (Fig 49) are compared with the pertinent motions, it is clear that these facets should not be able to occur, except if the models were guided by hand. Yet still, they are present.

On the one hand, the causes for such facets can be found in the closer occlusal region. The teeth closer to the joint, ie, the molars, are influenced more strongly by the movement of the joint than by the anterior teeth, ie, the anterior-canine guidance. If the appropriate forces are acting on the masticatory system, these teeth are subject to higher stress levels.

Another factor that certainly also has an impact in this case is posture. As

Fig 42

Fig 43

Fig 44

Fig 45

Fig 46

Fig 47

Fig 48

Fig 49 How did the facets at these molars develop? There was no contact with the facets either in the patient's chewing pattern or in the articulator.

has already been shown, the habitual situation (closed occlusion) is completely different from the actual centric position. If the patient's head posture is considered as well, the true problem becomes evident (Figs 50 to 52).

When the patient is in the physiologic rest position, she holds her head in a completely different way than when she is occluding, where she takes the head posture already described. This also explains why the habitual and the centric bite differ from each other. But how can the wear facets at the molars be explained? This phenomenon is directly linked to the patient's glasses, which cause her to take three different head postures at work and when she is reading. This results in the engagement of different groups of muscles. Usually, people wearing glasses can compensate for their weakness by movements of the head. In this case however, the patient, who was a teacher, also had a lot of work to do at her computer. To be able to read something from the screen, she had to focus on the same point of her lenses as when she was reading from paper. As this point is located in the lower section of the glasses, the person wearing them is forced to tilt his or her head back to be able to get a sharp focus on the screen through this focal point in the lens. Knowing these interrelations of posture, this means that the mandible is pulled further back by the muscles. This is why the posterior teeth get contact, while the anterior teeth lose theirs. If someone is working a lot in this posture at a computer, they will either get an unstable occlusion or they will work with their teeth for as long as it takes for their teeth to match again when they occlude (Fig 53). This phenomenon has already been described in the literature.[38,39]

Should this patient's bite be recorded in the presence of all these obvious malpositions? What kinds of results would be revealed? Pathology? If so, why register? If not, when should the bite be recorded and who determines the right time to do it?

Due to these findings, the team treating the patient decided to first secure the bite by fabricating "table tops" and to then attach these in the patient's mouth (Figs 54 and 55).

Figs 50 to 52 The patient's different head postures can be clearly distinguished. This correlates with the following: head posture when teeth are without contact (Fig 50 left) and day centric in the articulator (Fig 51); head posture with occluding teeth (Fig 50 right) and habitual occlusion (Fig 52).

Fig 52

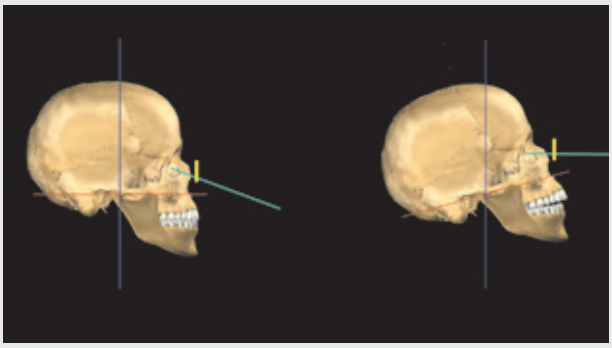


Fig 53 Glasses with progressive lenses are suitable for reading, provided the newspaper lies on a table in front of you. However, the same lenses are not suitable for working at a computer, since you have to rotate your head to be able to read.

Figs 54 and 55 The laboratory-made "table tops" were placed in the patient's mouth to secure the current bite.

Fig 55

Figs 56 to 58 The altered and stabilized bite also changed the patient's head posture. This led to a different chewing pattern, which had yet to be accounted for.

Fig 57

Fig 58

Fig 59 The restorations were finalized in increments, one quadrant at a time

Figs 60 to 62 The final intraoral situation.

With the "table tops" in place, the patient stated that she was now getting more pressure onto her front teeth during chewing movements. The anterior crowding and altered head posture could explain this phenomenon. As the patient had arrived at a different – more upright – head posture and her mandible was pulled forward slightly, her chewing motions and chewing loop (envelope of function[40,41]) were altered.

Fig 61

Fig 62

Figs 63 and 64 The most impressive change is certainly the head posture. Both pictures have been taken with the teeth closed: left is before treatment and right is after treatment. The patient has bought another pair of glasses for working at her computer.

This problem could be resolved with the help of minimal corrections through grinding in the maxillary palatal region, which corresponds to the natural wear that would have occurred over time (Fig 56 to 58).

Due to several aspects, such as the time available, the patient's financial situation and age, etc., the rehabilitation was carried out incrementally, restoring one quadrant at a time (Fig 59).

This approach has both advantages and drawbacks. In this case, the most important question was whether the bite would remain stable over the duration of the treatment, with the "table tops" bonded to the teeth. Another disadvantage is certainly the difficulty of always finding the right shades. In this case, however, the advantages outweighed the disadvantages. The final situation showed an attractive result. All four quadrants had

been restored. To provide better guidance, an implant with a porcelain-fused-to-metal crown was placed in the position of the maxillary right canine, and a palatal veneer was placed at the maxillary left canine (Figs 60 to 62).

The crucial factor is the patient's head posture. It is clearly visible that the head posture has improved. In addition, the patient states that her overall physical well-being has also improved (Figs 63 and 64).

Discussion

The interrelations highlighted in this article illustrate two basic problems that will have to be further discussed and explained in other papers.

On the one hand, it could be shown that drawn reference lines and suspected esthetic problems cannot be illustrated simply by the outer appearance. It needs to be asked how far these esthetic features can be transferred to daily work – in a reproducible manner and with a consistent rating.

When bite registrations are taken with correct relation to the skull, this raises the question of the correct posture and/or the importance of the correct position of the patient in the chair while the records are being taken. This is also connected to the issue of recording the condylar paths. How can there be certainty with the presence of malpositions, that the values measured are not pathological? There is a multitude of possible causes of errors if these factors are not considered. Raising the bite, for example, can also lead to changes of posture, which can in turn lead to a different chewing pattern.

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