

Adopting a healthy sitting working posture during patient treatment.



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1 Introduction

The aim of this review is to explain the way in which different dental procedures can be carried out in the mouth of the patient whilst maintaining a healthy sitting posture. The way in which conditions for adopting this posture need to be applied is shown with the help of pictures. In order to clarify this further many examples of the ways it is possible to work in a symmetrical upright posture without overloading the musculo-skeletal structures are included. Adopting this posture prevents the high percentage of musculo-skeletal complaints which are known to affect about 65 % of dentists and are also the cause of a high percentage of disability.

In the document “Requirements for working in a healthy way with dental equipment” the principles for designing dental equipment appropriate to work in a healthy way are specified. These principles are derived from:

- ISO Standard 6385 “Ergonomic principles in the design of work systems”.
- ISO Standard 11226 ”Ergonomics – Evaluation of static working postures”.
- Working postures and Movements. Tools for Evaluation and Engineering. Editors: Delleman NJ, Haslegrave CM and Chaffin DB. New York, Washington: CRC Press LLC, 2004. This book contains a review of recent research.

2 Principles for working in a stable, active posture

The basic principles for working in a stable, active sitting posture are:

1. to sit in a relaxed, symmetrical posture upright with the arms against the upper body which minimizes the static load of upper arms and shoulders. Furthermore the movements of the upper arm both sideways and forwards must be minimized as much as possible, sideways being within 15-20° and forwards within 25°. The upper body can be bent forward from the hip joints to a maximum of 10-20° but bending sideways/laterally and rotations should be avoided. The head can be bent forward maximally 25°.
2. to aim for a dynamic way of working: making movements with the body during patient treatment as much as possible so that an alternating load and relaxation occurs within the muscles and the vertebral column.
3. to ensure a firm muscle corset by sport and or movement outside office hours thus ensuring recovery of the burdened muscles and increasing the muscle strength, which in turn result in being better able to maintain a correct posture. This issue will not be dealt with in this document.

3 Adopting a stable and active sitting posture.



For adopting a stable, active sitting posture, from which movements can easily be carried out, the operator sits symmetrically upright, with the breastbone pushed slightly forwards and upwards and the abdominal muscles strained slightly. The shoulders are above the hip joints and the line of gravity runs through the lumbar vertebrae and pelvis in the direction of the seat. This posture facilitates good breathing.

4 Conditions for obtaining an optimal working posture

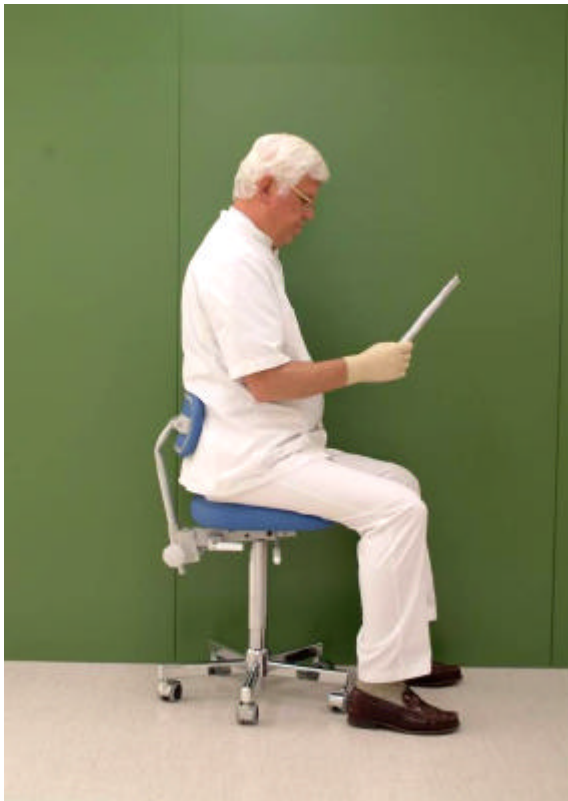
Conditions for obtaining an optimal, stable working posture are the following:

1. sit in a stable upright working posture.
2. place the working field in the mouth straight before the upper body in the symmetrical plane. *This is the mid-sagittal plane that divides the body vertically in 2 equal parts.*
3. look as much as possible, perpendicularly upon the working field. If this does not happen the eye balls steer the head until it reaches this position and then the body posture changes automatically. In this way the eye balls come into the position of looking perpendicularly upon the working field as much as possible. This results in a unfavourable bent posture that is asymmetrical whenever the working field lies outside the symmetrical plane, this frequently happens.

You may compare the position of the working field in the mouth of the patient with the position in which you hold an apple when peeling it or a needle when preparing to thread it: you will hold these straight before your upper body without bending your head.

Further the oblique position you hold your book when sitting in a chair to read (with the lamp besides/behind you) gives you an impression of how to place the working field so as to be able to look about perpendicularly upon it.

By turning the head of the patient within the three planes it is possible to place the working field in the symmetrical plane of the operator and the surface of the tooth dealt with has to be turned towards the viewing direction. In other words: this surface is positioned parallel with the front side of the head of the dentist.



Looking about perpendicularly upon the working field or mirror is like reading a book.

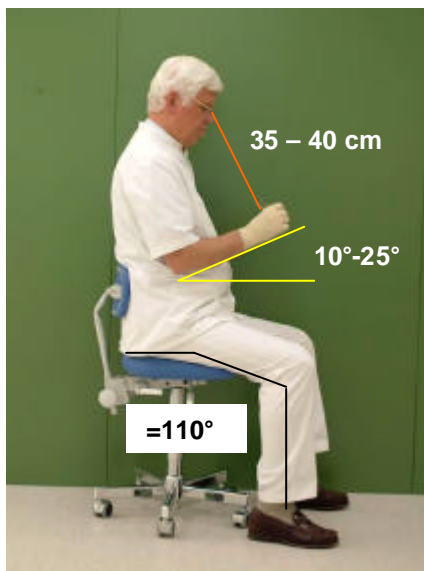


Height of working field: the place for handling instruments in the mouth. Lower arms lifted 10-25°.

5 Features of an optimal, healthy posture

- Sitting as far back as possible in the seat to obtain a stable posture, symmetrically upright.
- Upper arms alongside the upper body to support the arms whilst carrying out treatment.
- Angle between lower and upper legs of about 110° or a little more, with the legs slightly spread.
- Working height adjusted properly, with the lower arms lifted a little from about 10° to a maximum of 25° .
- Distance between working field in the mouth and eyes or spectacles normally between 35 –40 cm.
- The back must be supported at the upper/backside of the pelvis so that as soon as the muscles become too fatigued to maintain an upright position of the back, the back-rest ensures that the desired upright posture can be maintained. This supporting has to occur without pressure against the muscles below and above this point. Because the posture becomes unfavourably influenced by this and a reduction of movements takes place.
- Instruments are handled with the modified pen grip: with the first 3 finger bent in a round form around the instrument and the last 2 fingers resting on a firm basis in or outside the mouth.

This posture is mandatory for a healthy way of working.



Side view working posture.



Frontal view working posture.

In order to support the horizontally positioned bottom and the obliquely sloping down thighs equally, when sitting with an angle of 110° between upper and lower legs, the rear 20 cm of the seat should run horizontally and the front 20 cm downward with an angle of 20° .

6 Alternating between sitting without and with a back

An important principle is to use a dynamic way of sitting. This can be realized by sitting alternately with and without a support for the upper/backside of the pelvis by a back-rest. Begin by actively sitting upright with the breastbone pushed forward and upward, the abdominal muscles strained slightly and the upper body- if necessary bent slightly forward with an angle of not more than 10°. As long as it is possible to maintain this posture, also depending on having a well trained muscles, one may work without supporting the pelvis. The advantage of this is that one is then able to move the body more easily. But this posture requires muscle strength and this leads sooner or later to normal physiological fatigue by which it is no longer possible to maintain the upright posture. However a considerable variation exists in maintenance time. As soon as fatigue occurs and one starts as a consequence of this to sit with a backward bent back - a so called C-back – support of the back-rest against the upper/backside of the pelvis becomes necessary to avoid sitting in an unfavourable, damaging posture. It is essential that the back support only lies against the lower part of the back curvature (lordosis) and that contact is avoided with back and backside muscles, respectively above and below the support of the pelvis at the upper/backside. Further it is important that the back-rest is fixed so far forward that the natural curvature (lordosis) is actually maintained and it is not possible for the back to bent backward. Finally the back-rest upholstery needs to have sufficient flexibility for agility.

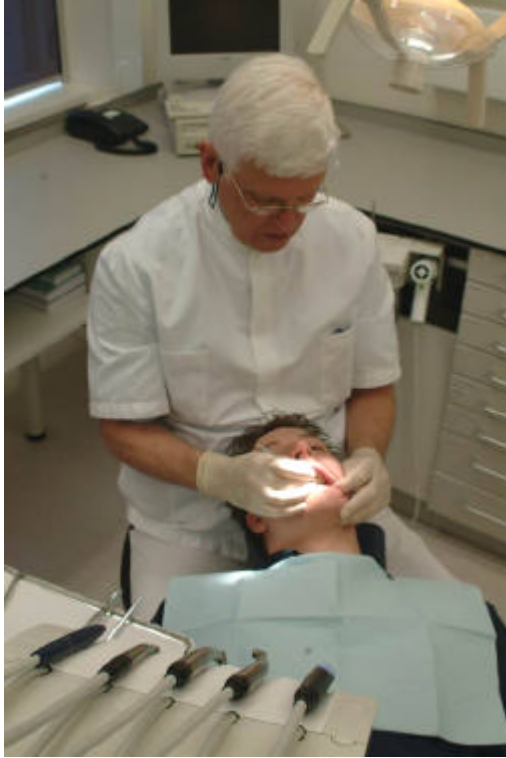


Sitting posture without leaning against back-rest. The movement forward with the back is made from the hip joint. A backward bent C-back is avoided so that a natural curvature is maintained.

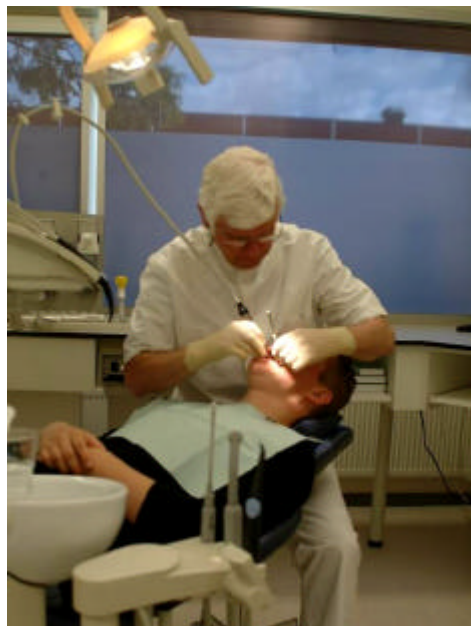


Sitting posture whilst leaning against back-rest. A natural curvature of the back is also realized here.

7 Application of the principles for a good working posture



Working field straight before the upper body, in the symmetrical plane.



An unfavourable posture arises spontaneously when the working field is placed outside the symmetrical plane.



Look perpendicularly as much as possible onto the working field from a correct posture. Otherwise the eye balls steer the posture into an unfavourable, mostly asymmetrical position to achieve this.

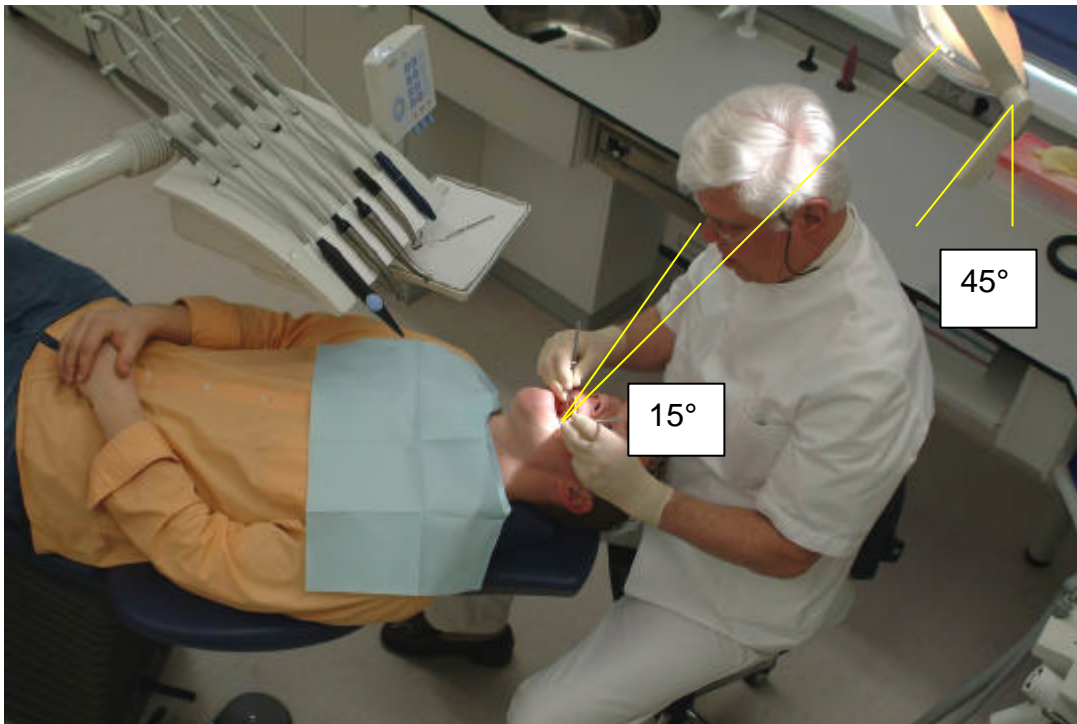


The working field is not adjusted perpendicularly to the direction of the line of vision thus the operator automatically adopts an unfavourable posture.

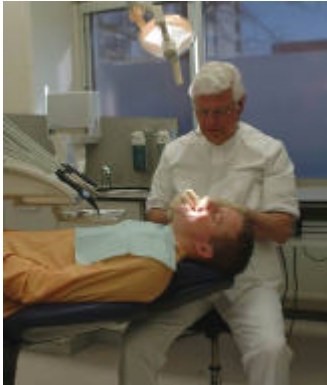
8 Positioning the light beam of the dental operating light parallel to the viewing direction

The aim is to position the light beam of the dental operating light parallel with the viewing direction in order to obtain shadow free lighting and a good balance between lighting in the working field and in the mouth as a whole. This avoids the fatigue forming shadows from the hands, teeth, lips and cheek being seen on and around the working field.

To achieve this the dental operating light needs to have 3 (orthogonal) axes which then enables the lamp to turn in all directions to achieve the desired position next to the head of the dentist and avoid placing the lighting rectangle obliquely over the face of the patient which is uncomfortable for him/her.



Position of the lamp for a right handed dentist, when sitting behind the patient: in principle on the left, slightly above and to the side next to the head of the dentist (for left handed dentists in mirror image). When the lamp is placed on the left side: shadows will be formed under the right hand and instrument.



When sitting at the side of the patient chair: mostly on the right side.

9 Movements of the patient's head in three directions

The patient's head must be moved in three planes in order to achieve the correct position of the working field for:

- positioning the working field in the mouth in the symmetrical plane of the dentist;
- looking on it perpendicularly as much as possible.

Survey three movements of the head.



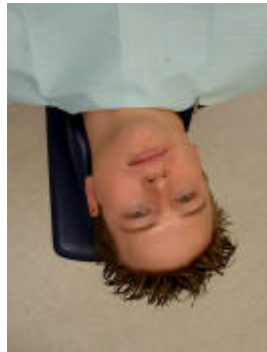
First movement: forward with occlusal surface lower jaw horizontally, about 0°



or turning backward with occlusal surface upper jaw 20-25° backward



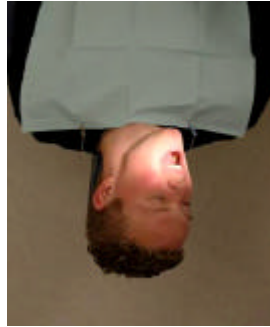
Second movement: lateroflexion to the left



or to the right, about 30°



Third movement: around the length axis of the head of the patient tot the left



or to the right, maximally 45°

N.B. Take care to provide good support underneath the neck at the right place. The head support or pillow plays an essential role at this.

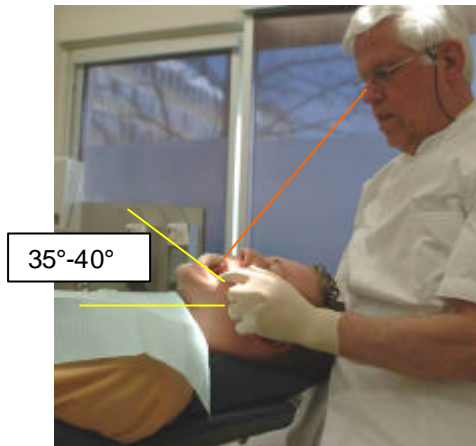
Lower jaw



Moving the head forward: occlusal plane lower jaw approximately horizontal when the dentist is working in the 9.00-10.00 o'clock position in the lower jaw. The back is positioned slightly obliquely, the pillow is positioned backward and the chin is directed towards the breast.



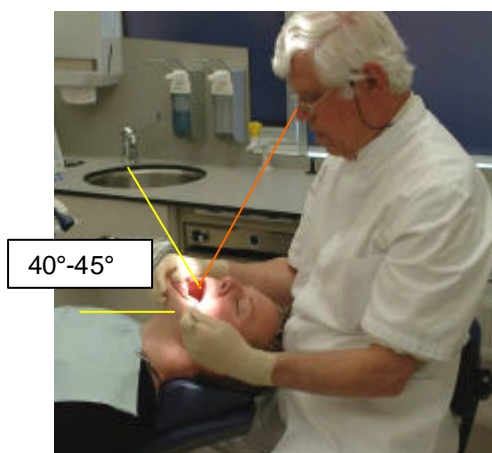
Without placing the occlusal plane approximately horizontally while working in the lower jaw the right arm has to be lifted to be able to position the handpiece or scaling instrument in the right position. The head of the dentist is bent sideward for a good sight.



The occlusal plane of the lower jaw is slightly turned backward in relation to the operator at an angle of about 35° for treating the lower teeth in the front, with the pillow positioned slightly further back while the chin is directed towards the breast. The axes of the lower teeth are directed toward the viewing direction.

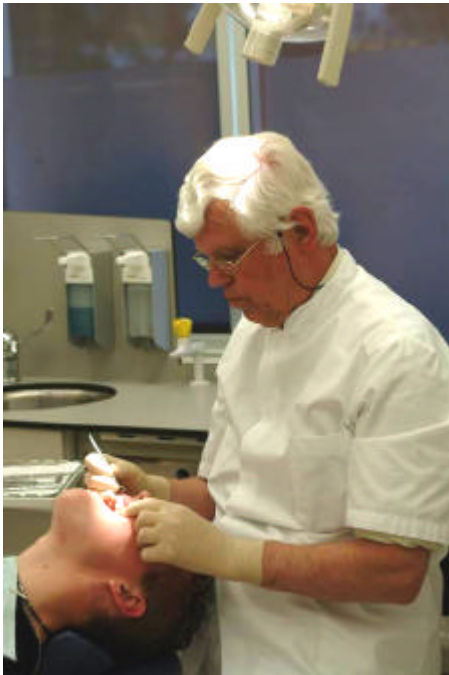


The occlusal plane of the lower jaw is turned backwards, about 40 °, for treating the premolar region.

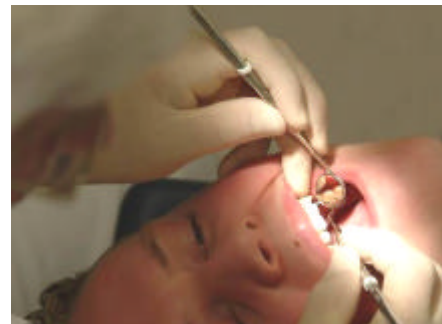


The occlusal plane is turned further backwards, about 45°, to be able to look at the molars without bending the upper body.

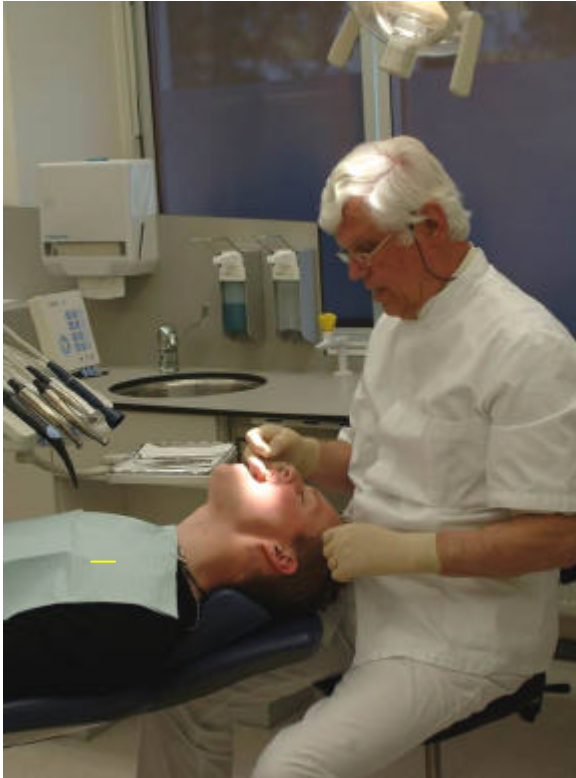
Upper jaw



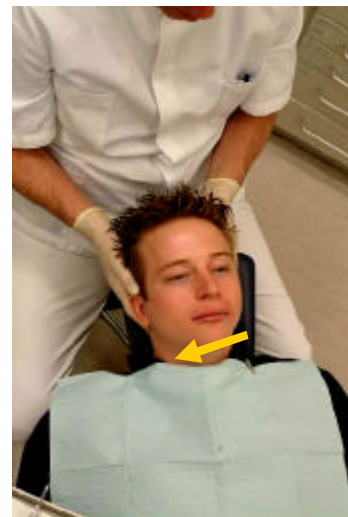
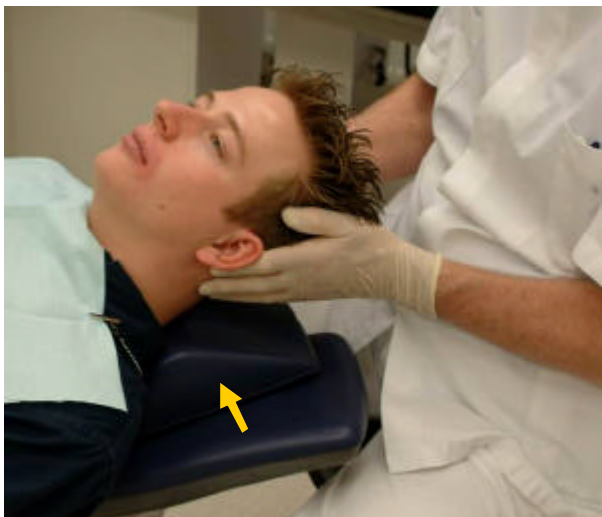
Tilting the head backwards: occlusal surface of the upper jaw 20-25° backwards in relation to the vertical plane to be able to look approximately perpendicularly at the incisors, like reading a book. The incisors are so positioned to make an angle of 20-25° upwards.



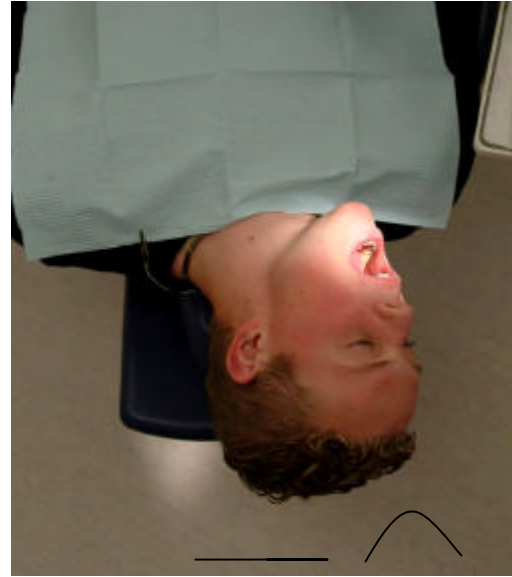
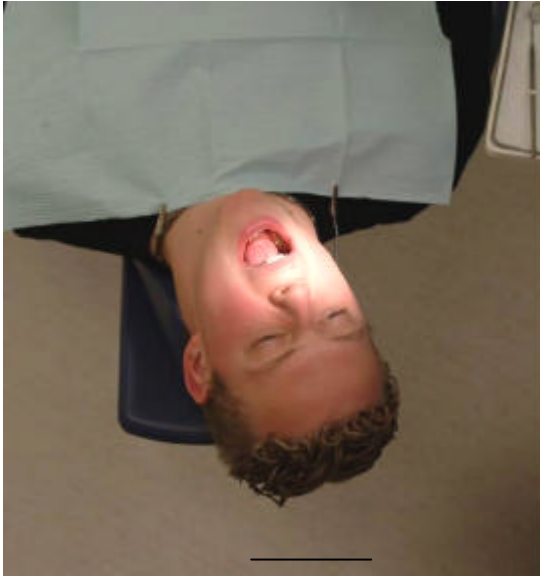
Idem for working with indirect vision with a mirror in an oblique position to be able to look upon it more or less perpendicularly, like reading a book; with the light beam parallel with the viewing direction and as far as possible perpendicular to the mirror.



If it is not possible to turn the head of the patient with the occlusal surface of the upper jaw sufficiently backwards, after positioning upper body and head of the patient horizontally, the head can usually be turned in the desired position by pressure with a finger behind the upper incisors..



To turn the head of the patient in lateroflexion about 30°, obliquely sideways to the right or the left, the patient is requested to lift his head. The dentist then places the pillow in an oblique position about 4 cm sideways because the neck is moved sideways. Then the head of the patient is guided sideways onto the pillow into the desired position. This movement is necessary in order to place the working field in the symmetrical plane and to be able to look upon it approximately perpendicularly. It is explained more extensively further on. Lateroflexion is the most ignored movement of the patient's head. This is also frequently the consequence of unsuitable headrests.



Turning the head of the patient around the length axis to the right or the left is used to complete the movements of the head to obtain the desired position or final position of the working field in the mouth. It results in fine tuning of the positioning of the working field with respect to the viewing direction, when seated in the proper posture. Without a lateroflexion this is generally not possible and subsequently leads to bending and rotating of the upper body and head of the dentist. Lateroflexion to both the right and to the left should be used by both right and left handed dentists.

10 Positioning the patient when the dentist works from behind

The patient needs to be positioned with both head and body horizontally, both for treatment of the lower and the upper jaw, for 3 reasons:

1. to be able to move freely from 8.30 - 12.30 o'clock with the legs beneath the back of the patient chair; for left handed dentists from 3.30 – 11.30 o'clock.
The aim is to move as much as possible during patient treatment or to change the sitting position so that the dentist acquires a dynamic method of working;
2. so that the dental assistant can sit alongside, straight across from the dentist, there being room to sit with her left thigh beneath the back of the patient chair;
3. to be able to position the teeth in the mouth of the patient (working field) within the shortest possible distance from the dentist, especially important for small dentists and to place the opening of the mouth as much as possible directed toward the dentist. In this way the dentist avoids bending forward in the direction of the mouth.

Only when it is not possible to obtain good sight of the lower incisors and the premolars by moving the chin towards the breast and/or the head upwards by pillow or headrest, is the back of the patient chair positioned slightly obliquely.



Dentist with posture symmetrically upright, with the arms alongside the upper body, the patient positioned horizontally and the dental assistant—for carrying out four handed dentistry- straight across from the dentist, being able to sit sufficiently with her left thigh beneath the back of the patient chair. The dentist is able to move with his legs below the back in all positions between 8.30 – 13.30 o'clock, while the dental assistant is able to follow.

11 Starting position for the majority of treatment: about 11.00 o'clock position.

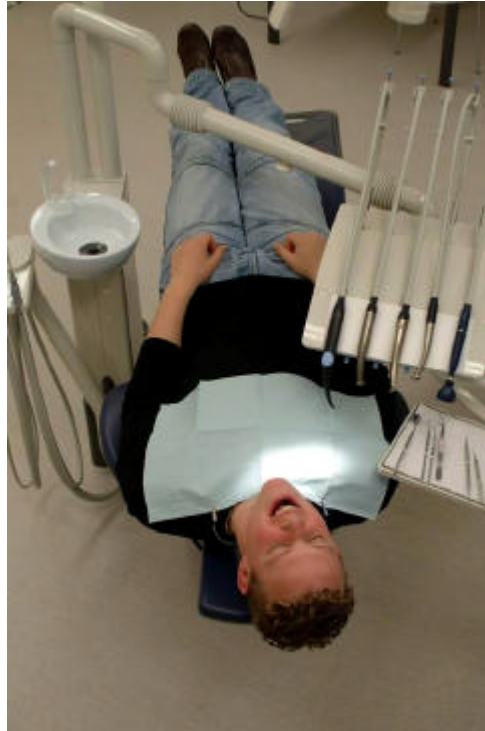
It appears that the right handed dentist sits most frequently in or around the 11.00 o'clock position. (left handed dentists around the 13.00 o'clock position). The 12.00 o'clock position is not used much and often only temporarily (not more than 10 % of the time). The 11 o'clock position also has the advantage that the dental assistant can then sit with a correct posture straight across from the dentist and is then able to sit sufficiently close to the patient. The dentist who sits in this way is also nearer to his instruments and will pull in instruments over the face of the patient less often.

When using the 11.00 o'clock position as starting position e.g. for examinations and occlusal oriented treatments, the space between 11.00-12.00/12.30 o'clock can be used when treating surfaces of teeth oriented to the left, whilst remaining in the correct posture, without bending.



For working in the 11.00 o'clock position the patient's head is turned in lateroflexion to the right (for left handed dentist to the left) with the crown of the head of the patient directed toward the symmetrical plane of the dentist. The pillow below the neck is placed obliquely, approximately 30°, and pushed a few cm sideways in the direction in which the head is turned sideward.

N.B. When using a shell shaped headrest it is possible to put a tempor® pillow on it to improve the limitation experienced when turning the patient's head.



The lateroflexion of the head then has to be followed by a small movement of the patient's body in the same direction to make this position of the head more comfortable for the patient. Ensure that there is sufficient good support for the neck of the patient.

In the 11.00 o'clock or 13.00 o'clock position of the body the 12.00 o'clock position is imitated. But when appropriate one may also work in the 12.00 o'clock position.

Explanation.

By the oblique position of the head of the patient to the right (or to the left for left handed dentists) the dentist is able to work in a symmetrical posture upright with his arms alongside the upper body. As soon as the working field is positioned outside the symmetrical plane of his upper body he will lift his arms and bend sideward and rotate his spinal column and head into an unfavourable, burdening posture.

By the lateroflexion to the right the patient's head is also turned in a better direction for the dental assistant.

Head and body of the patient have to be brought into a more or less straight line in connection with the lateroflexion of the head to make this position comfortable for the patient. It requires an adjusted form of back and seat of the patient chair to achieve this end easier. So that the patient is able to lie comfortably in as straight a line as possible in the 11.00, 12.00 and 13.00 o'clock positions without being bothered by the design of the patient chair.

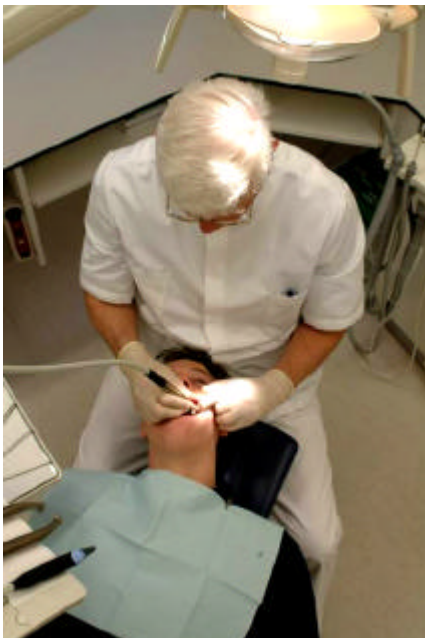
It is also important because a comfortable lying position for the patient is a condition for obtaining a relaxed patient and correct position of the patient's head.

The sort of treatment carried out from around the 11.00 clock position include examination, involving charting the teeth and carrying out a full periodontal examination, scaling and



Application upper jaw, left, preparation 26 MO, with indirect vision:

- occlusal surface upper jaw 20-25° backward;
- lateroflexion to the right;
- turning patient's head round the long axis to the right to obtain a proper position of the working field (fine tuning);
- light beam about parallel with the viewing direction.



Application upper jaw, left, buccal preparation for crown, with direct vision:

- occlusal surface upper jaw 20-25° backward;
- lateroflexion to the right;
- turning patient's head round the long axis to the right to obtain a proper position of the working field (fine tuning);
- light beam about parallel with the viewing direction.



Application lower jaw, lingual to the right, scaling and polishing teeth:

- occlusal surface lower jaw about 40-45° obliquely backwards;
- lateroflexion to the right;
- turning patient's head round the long axis, dependent on the position of the tooth, to obtain a proper position of the working field (fine tuning);
- light beam about parallel with the viewing direction.

13 Sitting beside the patient, in the 8.30-10.00 o'clock position, for treatment in the lower jaw

For working from the 8.30-10.00 o'clock position in the lower jaw the back of the chair is placed a little obliquely and the head of the patient is turned forward with headrest or pillow and finally the chin is directed toward the patient's chest so that the occlusal plane of the lower jaw is positioned horizontally as much as possible.



Application for preparations from occlusal 46:

- occlusal surface lower jaw approximately horizontally;
- lateroflexion to the right;
- turning patient's head round the long axis to the right to obtain a proper position of the working field (fine tuning);
- light beam about parallel with the viewing direction.



Application for preparations lower jaw to the right, buccal or to the left, lingual.

Here preparation lingual surface 36:

- occlusal surface lower jaw approximately horizontally;
- lateroflexion to the left;
- turning the patient's head round the long axis to the left to obtain a proper position of the working field (fine tuning);
- light beam about parallel with the line of vision.

14 Sitting beside the patient, in the 8.30-10.00 o'clock position, for treatment in the upper jaw



Application for particular preparations from the buccal surface in the upper jaw, scaling and polishing buccally, endodontic treatments with direct vision right and left and further treatments from the palatal surface, left in the upper jaw, e.g. crown preparations etc. provided that it is possible to work in a symmetrical upright position.

Application here crown preparation, upper jaw, buccal 16:

- occlusal surface upper jaw 20-25 ° backward;
- lateroflexion to the left;
- turning patient's head round the long axis to the right to obtain a proper position of the working field (fine tuning);
- light beam about parallel with the viewing direction..



Preparations in the upper jaw at which a dentist is not able to sit symmetrically upright have to be carried out with indirect vision using a mirror to be able to work in a proper posture; with the light beam parallel with the viewing direction. With the instruments placed within the field of vision, in a position nearby for a natural way of grasping, without lifting upper arms and shoulders. Handling the instruments in a modified pen grip (with 4 times the strength compared with the normal pen grip); and four handed dentistry for high volume evacuation, blowing dry the mirror with the multi function syringe etc.
Application: preparation, right side, upper jaw.

15 Combination of a stable, active working posture with a dynamic working method

The dentist has to fulfil two conditions to achieve a healthy way of working:

1. **sitting symmetrically upright in an active posture and**
2. **making as many movements as possible during patient treatment.**

The dentist needs to change his static mode of working by constantly altering his sitting position, also to avoid bending his head and upper body and lifting the arms etc. The aim is to always sit in a correct working posture by making movements and turning the head of the patient as described as starting point. As soon as he has to change the instrument position for carrying out activities and starts to work outside the symmetrical plane or when a better view is required or when an arm is lifted etc. the dentist must move around the patient to change his sitting position, instead of bending with body and head. This means that the dentist has to learn to move/swing around the head of the patient as much as possible and to combine this with adjustments of the patient's head. By moving he brings about an alternating contraction and relaxation of the muscles of his body which is necessary for a proper functioning of his posture.

The centre of the working positions a dentist uses is around the 11.00 o'clock position but he may work between 8.30 – 12.30 (or 3.30 – 11.30) o'clock.

When treating or examining surfaces in the mouth of the patient oriented to the left the dentist goes in the direction of the 12.00 o' clock position while the head of the patient is turned to the right.

When treating or examining surfaces in the mouth of the patient oriented to the right he moves to the right in the direction of the 10.00 or 9.00 o'clock position while the head of the patient is turned to the left, when necessary with a lateroflexion to the left as shown by the applications.

In a middle position he treats occlusal oriented surfaces..

Motto: movements replace bending with the head and upper body and prevent static postures.



When treating surfaces in the mouth directed to the left, then:

- a. the dentist moves in the direction of 12.00 o'clock and
- b. the head of the patient is turned in the opposite direction.

Application: e.g. a preparation (or scaling and polishing) buccal, left in the lower jaw:

- occlusal surface lower jaw 40/45° obliquely backward;
- lateroflexion to the right;
- turning patient's head to the right to obtain a proper position of the working field (fine tuning);
- light beam about parallel with the viewing direction.



When treating surfaces in the mouth directed to the right, then:

- a. the dentist moves in the direction of 9.00 o'clock and
- b. the head of the patient is turned in the opposite direction to the left and when necessary also turned in lateroflexion to the left.

Application: e.g. a crown preparation in the upper jaw, buccal 16, in connection with a part of the preparation carried out with indirect vision (or scaling and polishing, buccal in the upper jaw to the right).

- occlusal surface upper jaw 20-25° backward;
- lateroflexion to the left;
- turning patient's head round the long axis to the right to obtain the desired position;
- light beam about parallel with the viewing direction.



When carrying out activities lingual or palatal a position in between, round 11.00 o'clock, is adopted.

Application: e.g. scaling and polishing 36 lingual (or a crown preparation):

- occlusal surface 40-45° obliquely backward;
- lateroflexion to the right;
- turning patient's head more or less to the right for fine tuning;
- light beam about parallel with the viewing direction.

The authors hope that these examples provide enough information to enable dentists to adopt a healthier working style and are willing to answer any further question sent to Prof. Oene Hokwerda, dentist dental ergonomist oene.hokwerda@home.nl, Rolf de Ruijter, dentist r.a.g.de.ruijter@med.umcg.nl, Sandra Shaw, dentist s.shaw@med.umcg.nl.