Working document to be used in relation with the "Ergonomic requirements for dental equipment"

In this working document the ergonomic requirements elaborated in the "Ergonomic requirements for dental equipment" have been listed without the extensive explanations in the original document. The different chapters regarding the general requirements and dimensions concerning the patient chair are largely brought together. So that a well usable survey of requirements with an indication of the aim of this came into existence.
This working document can be used for discussion of the application of the ergonomic requirements while the original document attains now the function of a reference book, in relation with the comprehensive explanations and the many graphics used for illustration.
For a easy consultation of the original document the relevant paragraph(s) are mentioned after each item in this document.

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1. Working stool dentists. (Chapter 10 Ergonomic requirements).

1. The minimum angle between upper and lower leg of the sitting dentist has to be 110°. (10.1).
2. This requires a seat design that differs from the usually nearly horizontal seat. The dimensions of the seat have to make it possible to sit without pressure on either the backside or thighs. The seat is therefore divided in two parts for obtaining a balanced sitting posture: a horizontal part at the rear for supporting the buttocks with a minimum length of 15 cm and an oblique part declining 20° for an equal support of the sloping down thighs. With a movable front part, an angle of more than 110° between lower and upper legs is possible. (10.2).
3. A slight inclination forward of the seat of maximally 6-8° can be used. (10.3).
4. The sides of the seat should not go up, because by doing so, the sides of the buttocks with their muscles are lifted upwards and this reduces the fixing of the pelvis. (10.4).
5. The maximum depth of the seat shall be 40 cm and the width 40 cm with a maximum of 43 cm. (10.5).
6. The minimum sitting height of the (impressed) seat for a dentist of 156 cm ($P_{(F)}5$)* is 47 cm. (10.6).
7. The maximum sitting height of the (impressed) seat for a dentist of 196 cm ($P_{(M)}95$)* is 63 cm. (10.9).
8. The range of height adjustment of the seat should be between 47 and 63 cm. (10.8).
9. In order to support the vertebral column a backrest with a lumbar or pelvic support of 10 to 12 cm high is needed at the top of the backside of the pelvis that is adjustable vertically from 17-22 cm and for very tall dentists to 24 cm. (10.9).
10. The backrest with lumbar or pelvic support needs also to be horizontally adjustable to maintain the more or less hollow curve (lordosis) of the back so that it is impossible for the back to adopt a C-shape, that is a backwards rounded back.
    One may sit upright in an active sitting position without support of the pelvis but as soon as the back muscles are tired a rounded back is created, so that support of the pelvis is needed to remain seated upright. (10.10 and 10.13).
11. While sitting in a working posture, there should be no contact between the backrest and the back musculature on either side of the pelvic/lumbar support because this disturbs a good sitting posture. But for stretching, relaxing or leaning backward the backrest may continue upward, and also a little backward, so that contact may be brought about with the back by leaning backwards. (10.14).
12. The backrest with pelvic support should not exceed a width of 30 cm. (10.11).
13. The backrest is elastic over a short distance of 1-2 cm and can rotate around a horizontal axis with an angle of 25° upwards and downwards; while the upholstery should be flexible enough to tolerate being depressed for adaptation to the individual curvature of the back. (10.12).
14. The upholstery of the seat has to be sufficiently hard with a roughened surface. It has to be firm, depressing only slightly. A too soft upholster allows the pelvis to move into an incorrect and unstable position and is tiring. A smooth surface stimulates slipping away. (10.15).
15. If armrests are desirable, 2 armrests are needed, continuously adjustable. (10.16).

* In the “Ergonomic requirements for dental equipment” the data regarding P5 female dentists ($P_{(F)}5$) with a length of 156 cm and P95 male dentists ($P_{(M)}95$) with a length of 196

cm are used as limiting values. That means that female dentists shorter than 156 cm and dentists taller than 196 cm are not yet considered within the requirements for the construction of dental equipment.

2. **Patient chair. General requirements.** (Chapter 11 Ergonomic requirements and also following chapters).

1. The patient must be positioned horizontally without damming of the blood circulation in order for the dentist to adopt a correct posture. (11.1).
2. The chair needs to have a flat surface in order to achieve a relaxed horizontal position of the patient, without feeling pressure from the form of the back or seat of the patient chair. Making it possible to place the patient also in a more diagonal position and to avoid interference with the movement of the arm of small dentists by a sideward rising back. Curvatures and a lordosis support are often uncomfortable because they frequently, and mostly unintentionally, interfere with the anatomical characteristics of the patients. These have differences of length of about 50-60 cm, together with all the differences in anatomy, i.e. the individual roundings so that it is not possible to use a patient chair with a number of curvatures to accommodate all these patients. (11.2 and 11.5).
3. Therefore the angle between the seat and support for the lower legs should be restricted to a smooth transition of not more than 15°. A greater angle will result in the knees/legs of the patient being positioned too high causing damming of the circulation of the horizontally placed patient. (11.4).
4. Also a smooth transition between the upholstery of the back and the seat is necessary because the lowest part of the back of the patient, on average 13 cm, lies before the back of the seat (SRP, the Seat Reference Point*) A continuous surface is necessary to avoid an uncomfortable overstretching of the back of the patient. (11.5).
   * The Seat Reference Point, SRP, is the crossing of the tangent lines of seat and vertically placed back of the patient chair.
5. Just before the rear of the seat a sunken area , with only a small deepening of the seat by 3 cm for the buttocks of the patient, has to be present. A further deepening causes an overstretching. (11.3).
6. The lower legs have to be positioned in line with the body to prevent them hanging down and interfering with the blood circulation.(11.6).
7. The patient should lie with the shoulders completely supported in order to avoid strain in the muscles of his shoulders, neck and mouth, which in turn hampers a relaxed position of the patient, opening of the mouth and flexible turnings of the head. (11.8).
8. The lower part of the neck (C4-C7) has to be supported in direct contact with the support of the shoulders. This support has to match the individual height of the neck curvature varying normally from about 4 until 8 cm. (11.9).
9. Positioning the upper body of the patient in a proper relation with the back together with the headrest, should be attained by shortening and lengthening of the back of the patient chair. (12.11).
10. The upper part of the neck (C1-C3) has to be left free for movements of the neck and head. (11.9).
11. The patient must be able to lie in a straight line on the seat and back of the chair in the 11.00, 12.00 and 13.00 o'clock positions to fit the positions of the right handed and left handed dentists and turning the head of the patient around 3 axes for fulfilling the conditions for sitting symmetrically upright. (The patient may be positioned parallel with the longitudinal axis of the patient chair and diagonally). (11.10)
12. The 3 movements of the head, to orient the working field in the mouth of the patient towards the viewing direction of the upright sitting dentist, are the following. (11.11).

- forward with the occlusal plane of the lower jaw from about 0° (horizontally), sitting next to the patient, up to 45° when the dentist is sitting more or less behind the patient; and backward with the occlusal plane of the upper jaw 20-25 obliquely backwards in relation with a vertical plane.
- lateroflexion that means turning the head obliquely sideward, about 30°, to the right or the left, This movement is always combined with a movement of the upper body in the same direction.
- around the length axis of the head, maximally about 45°, to the right or the left.

13. The upholstery must be firm but not hard and allow a certain adaptation to the anatomical shape of the patient (pressure mapping). (11.12).
14. The width of the back of the patient chair has to be as small as possible for the standing dentist in order to work in a correct posture (12.13 and 16.13)
15. Armrests have to be minimal in connection with the hindrance of the dentist, when standing to carry out treatments. (11.13). For this Foldaway armrests can be used for this so that these can be put aside when the dentist works standing. (12.13).
16. A sitting dentist with a length of 196 cm ($P_{(M)}95$) needs a free space for his feet and foot control behind and on the side of the basis of the chair. (15.1 and 16.14)
17. A distinct or fixed lordosis support is unwanted but a lordosis support that can be adjusted individually could be a solution. (11.14).
18. The upper body of the patient rotates around an axis below the underside of the pelvis at about 13 cm from the rear of the seat, when the patient is positioned in a horizontal or vertical position in the patient chair. This is an important aspect which needs to be considered when designing the mechanism for the movement of the back. (11.15).

3. Dimensions patient chair, except the head and neck support. (Chapters 12, 15 and 16 Ergonomic requirements).

1. The minimum height of the seat is 35 cm and the maximum height is 90 cm (12.4 through 12.7.
2. The minimal length of the back for supporting the shoulders of the $P_{(F)}5$ patient with a length of 156 cm is 41 cm on the sides of the top of the back; and in the middle of the top of the back, where the shoulders are about 3 cm higher: 44 cm. (12.8).
3. The maximal length of the back for supporting the shoulders of the $P_{(M)}95$ patient with a length of 196 cm is 56 cm on the sides of the top of the back; and in the middle of the top of the back: 56 cm. (12.10).
4. The length of the headrest above the shoulder line in the middle is 25 cm. (13.3)
   The total length of back and headrest together is minimally 69 and maximally 84 cm from the SRP. (16.6)
5. The resulting range for adjusting the length of the back is 15 cm. This should be attained by shortening and lengthening the back (preferably with the mouth of the patient kept in the same place in relation to the position of the dentists). (12.11).
6. The width of the back at the top of the side of the back for supporting the shoulders is 42 cm (12.12).
7. The width in the part of the back where the elbows need support is 48 cm for being as small as possible for the standing dentist (12.13 and 16.13).
8. The underside of the back can narrow to 43 cm, the width of the seat (12.13).
9. The elbows of the patients can be supported on foldaway elbow rests. Both supports can be 11cm broad so that the elbows can be supported at some distance from the upper body without gliding away.
   For the elbow of the $P_{(F)}$ 5 patient (156 cm) the support must be available 34 cm below the top of the back and for the $P_{(M)}95$ patient (196 cm) 49 cm below the top.

The support must therefore be more than 15 cm long in order to enclose the elbows. (12.13).

10. The total thickness of the back has to be very small: 4 cm ; and in the middle part of the back not more than 6 cm over a distance of about 50 from the top of the headrest, to allow the dentist and dental assistant to sit with the legs underneath the headrest and chair. This is specially important for small dentists so that they are able to position the head of the patient and headrest plus back of the chair between thighs and lower arms. (12.14).
11. The width of the seat is 43 cm but where the support for the lower legs starts, this widens so that at the end of the leg support it becomes 55 cm. This allows a diagonal position of the patient on the chair. (11.10 en 12.15)
12. The deepening of the sunken area in the seat for the buttocks of the patient is approximately 3 cm, about 13 cm from the rear of the seat, which is on average the place where the undersides of the sitting bones of the pelvis (tuberosities ischii) are placed. The width of the deepening corresponds with the width between the external limits of both of the tuberosities ischii, this being about 15 cm. (12.3).
13. The total length of the seat and support has to be 122 cm, with a length of the seat of 58 cm and a length of the support of the lower legs of 64 cm. (16.5).
14. For the vertical sitting position of the patient, the back should be placed vertically, the seat horizontally and the leg support at an angle of 60°, in relation with a vertical plane. (16.7)
    (For higher sitting positions the support for lower legs could positioned vertically).
15. For sitting down and getting off the back should be positioned with an angle of 70-80° backward, in relation with a horizontal plane, with the seat declining 10° backward and the support for the lower legs at an angle of 60°. (16.8)
16. Patients have to be positioned horizontally with the lower legs in a straight line with the body and at an angle of maximally 15° between lower and upper legs (16.4 and 16.9).
17. A sitting dentists needs a free space of 81 cm for his feet and foot control behind the basis of the patient chair, between the basis of the chair and the backside of the headrest, of a horizontally positioned back and headrest of the patient chair for treating a $P_{(F)}5$ patient, with a length of 156 cm. (15.1)
    Also enough space is needed for the feet of a standing dentists. This can presumably be achieved by rounding off the base of the chair (if present), bearing in mind that dentists sometimes stand against the seat or back of the patient chair so that space is made available for the width of an obliquely placed foot, i.e. 13 cm. (16.14).
18. It is impossible to obtain an acceptable solution for a separate foot control attached to the basis of the patient chair for operation of the movements of the patient chair, as a result of the free space necessary for feet and foot control.

4. Support of head and neck by headrest and neck support. (Chapter 13 Ergonomic requirements).

1. The width of the headrest above the shoulder line is on the sides of the neck 24 cm and declines then upward until 20 cm where the backside of the head is positioned, about 17 cm above the shoulder line. Above this contact area (with the back of the head) the width of the headrest can decline and follow the rounding of the head of the patient. (13.1)
2. The length of the headrest above the shoulder line in the middle is 25 cm. (13.3).

3. The thickness of the headrest should be about 3 cm, towards the top dropping to 0.5 cm to attain as much space as possible around the head of the patient for an easy reach to the patient's mouth. (13.4).
4. The upper part of the neck (C1-C3) remains unsupported to have free space for movements of neck and head. The neck support underneath the lower part of the neck (C4-C7) needs a small bent ring-shaped support, with a width of 16 cm and a basis of 5-6 cm for supporting the neck. This should also be provided with the means to adapt the height of the neck support to the dimension of the individual neck curve, ranging from about 4-8 cm in normal situations. (13.5).
5. The headrest should be able to be turned backward 20° so that it e.g. can be used when treating patients on medical grounds with the back in a 30° position. For patients with kyphosis (with a rounded back) it must be possible to bring the neck support about 15° forward

NB Above mentioned guidelines can not yet be considered as well rounded requirements as it needs further study to find good solutions for a head and neck support. By which it is possible to turn the head of the patient in 3 directions, oriented on the viewing direction of the dentist sitting in a correct posture.

Observation 1.
For very small dentists limitations exist for working in a healthy posture when sitting and standing. The conditions required to reduce these limitations include: the availability of proper ergonomic equipment, the existence of reasonable circumstances and ensuring that the working field in the mouth of the patient is turned towards the viewing direction of the dentists.
Observation 2.
A new design of the patient chair is necessary to enable dentists to work in a healthy posture (dictated by the way the body and the head of the patient have to be positioned) and for the convenience of the patient (support of the legs, the buttocks and back, head and neck and finally the elbows). Technically a movement of the back of the patient chair is necessary:

- to match the length of the back of patient – by adjusting the height of the back of the patient chair with a range of 15 cm - in relation to the height of the back of the patient;
- for the movement of the body backward and in a position upright via a rotation around an axis formed by the connecting line along the underside of the sitting bones of the pelvis, the tuberosities ischii.

5. Foot control dental unit. (Chapter 17 Ergonomic requirements).

1. A foot control can be designed with a pedal on which the foot is placed either entirely or partly. Placing the whole foot on the pedal causes an unfavourable load, particularly an asymmetrical, harmful strain on pelvis and vertebral column. Therefore it is necessary to place the heel on the floor so that it can support the foot, while the front part is placed on the pedal. The foot should be raised from the heel by an angle of between 5 and 15°. (17.1).
2. The length of the pedal should be 22 cm for a dentist with a length of 196 cm ($P_{(M)}95$), taking into account the fact that about 15 cm of the back of the shoe is not placed on the pedal. In practice a shorter length would be preferred. (17.2).
3. The width of the pedal should be 12,7 cm taking into account the width of the shoe for a $P_{(M)}95$ dentist (196 cm). In practice a smaller pedal will be sufficient so 7 cm may be used. (17.3).
4. A foot control can also be designed with a pedal operated by pressing on the side by movements to the right or the left. (17.4)
5. Preference has to be given to this mode of operation of the pedal, since the heel rests completely on the floor and only small movements of maximally 15°, which require little strength, are needed. (17.5)
6. A combination also exists where the pedal is placed in a certain position in relation to the desired speed and then the foot is placed on the pedal for operation. This is slightly more complicated.
7. The support for moving the foot control with the foot should be 8 cm high and 13 cm broad. No higher because then the foot and the leg have to be lifted too high; 13 cm corresponds with the width of the foot and shoe of the $P_{(M)}95$ dentists (196 cm). A half open support works differently for the right and the left foot and is therefore less advisable. (17.7).
8. The weight of the foot control should be designed so that the foot control can easily be repositioned, without it sliding away. In the case of a light foot control, non-slip material can be attached to it. (17.8).
9. The foot control should be designed as simply as possible, there should be no more functions than necessary and it should be simple to operate. The different functions must be identifiable by easily recognizable colours and symbols. Because of hygienic requirements, more functions are being transferred onto the foot control. This should not be at the expense of practicability, particularly because the foot control is normally not visible during treatment. This results in high requirements for the positioning of the various control parts and their mode of operation. (17.9).
10. A quite different design is the tube controller: a bent hose that is placed on the floor in such a way that it is possible to maintain contact when changing from one position to another. The tube control can be set up for operation with either the right or left foot so that it is not necessary to pivot the foot sideward in order to operate it. (17.10).

6. Dental operating light. (Chapter 18 Ergonomic requirements).

1. A dental operating light must be able to be positioned around the head of the dentists, before and sideward so that the light beam is running parallel to the viewing direction, with a maximal deviation of approximately 15°. In all positions around the patient chair from which a dentists treats patient (between 8.30-15.30 o'clock). In order to achieve this, the reach of the foreside of the dental operating light has to be so great that it can be positioned in the vertical plane of the back of the dentist. (18.1).
2. A dental operating light needs 3 orthogonal axes for:
   - placing a dental operating light in a adequate position near by and just above the level of the head of the dentist; on the right or left side of the head;
   - to ensure that the rectangle of the lighting field is always, and in all positions of the dental operating light around the head of the patient, parallel with the bi-pupillary line of the eyes of the patient. (18.2)
3. By the third axis the lamp can be positioned obliquely with an angle of minimally about 45° for placing it in a manageable position on the side of the head of the dentists which is only possible with a third axis. This is necessary to have shadow free lighting in the mouth of the patient. Otherwise the dentist is forced to place the lamp above the breast of the patient. This causes fatigue producing shadows below the hands of the dentist, in the mouth of the patient(behind teeth, lips and cheek) and on the working field. Furthermore, the dentist then directs the opening of the mouth of the patient toward the light beam which forces him to bend forward with both head and upper body. (18.2).
4. The adjustment of the lamp around 3 axes has to be made in such a way that it can easily be carried out with a balanced movement, preferably with one handle in an as low a position as possible. (18.3).
5. The maximal height of the dental operating light for the sitting $P_{(M)}95$ dentist (196 cm) is 177 cm. (18.4).
6. The minimal height of the dental operating light for the sitting $P_{(F)}5$ dentist (156 cm) is 140 cm. (18.5).
7. The maximal height of the dental operating light for the standing $P_{(M)}95$ dentist (196 cm) is 214 cm. (18.6)
8. The maximum reach for the lamp behind the headrest from the Seat Reference Point (transition seat and back patient chair) for the $P_{(M)}95$ dentist (196 cm), for the range of heights, is 125 cm. (18.7).
9. The reach of the lamp for a dentist standing before the patient is 95 cm before the SRP. (18.8).
10. The illumination should be continuously adjustable from 8000-25000 lx. (18.9)
11. The colour rendering index should be 85, but if the operating light can be used for colour matching it must be more than 90. With this in mind, a reduced light level, appropriate for colour matching, has to be used. (18.10).
12. The colour temperature should be 5500 K. If the lamp is to be usable for colour matching, the colour temperature has to be maintained with the lower lighting levels needed for colour matching. (18.11)

7. Using matt surface. (Chapter 19 Ergonomic requirements).

1. The surfaces of dental equipment and instruments have to be matt, to avoid fatiguing glittering effects on the eyes of the dentists. (19.1)

2. The colours used for dental equipment should be light for an optimal contrast, that means an optimal illuminance pattern to avoid more adaptation of the eyes than necessary and so prevent eye fatigue. (19.2).

8. Positioning instruments with tubing (dynamic instruments). (Chapter 20 Ergonomic requirements).

1. Dynamic instruments should be positioned within:
   - the field of vision, 30° right and left of the mid-sagittal plane of the dentists (dividing the upper body in 2 equal parts) to avoid fatiguing accommodation and adaptation of the eyes outside the field of vision;
   - a reach of 3- 40 cm from the dentist, to avoid undesirable movements of arms and shoulders in the working positions from 8.30 to 12.30 o'clock for right handed dentists; for left handed dentists from 11.30 to 15.30 o'clock. (20.1).
2. The instrument console needs to have an adequate reach so that it is possible to place the tubing with the attached instruments within the direction of grasp, and thereby prevent sideward movement of the tubing which results in traction. (20.2).
3. Dynamic instruments should be positioned within an angle of between 30-60° with regard to the mouth of the patient (or as near to this as possible). If a dental assistant uses the multifunction syringe or transfer instruments to the dentist the positioning of instruments will need to be adjusted. (20.3).
4. The instrument console needs to be able to be moved, with the instruments in the desired position, with little effort and without the console slipping away. (20.4).
5. Dynamic instruments associated with a front delivery system, here the handpiece tubing has to be balanced in such a way that no traction is felt. Length (about 80cm) and height of the tubing have to match the desired reach of the instruments when these are being used. Instead of bolting the handpiece tubing, attachment has to be done in such a way that no traction or other disturbing forces are felt during use or as a result of designing an unbalanced system. (20.5).
6. Dynamic instruments should hang down with an angle of 45° in relation to a vertical plane; and at least 6 cm but preferably 10 cm should be free hanging to enable them to be adequately grasped. (20.6).
7. This means that the vertical distance of the head of the instrument below the instrument console is approximately 7 cm, so as close as possible above the working height, when treating a horizontally place patient. (20.7).
8. When the dentist is seated the dynamic instruments have to be positioned vertically, as close as possible, to the working area. This is about 5 cm above the working height in the mouth, being minimally 78 cm for the $P_{(F)}5$ dentist (156 cm) and maximally 107 cm for the $P_{(M)}95$ dentists (196 cm). (20.8).
9. The working height for a $P_{(M)}95$ standing dentist (196 cm) is 144 cm. (20.9).
10. The distance between dynamic instruments should be minimally about 6 cm, measured from the middle of the instruments and they should be positioned in such a way that damage caused by sharp instruments can be avoided. (20.10).
11. Too broad a range of instruments should be avoided because then the dentists is forced to carry out undesirable movements in order to grasp instruments towards the outer side of the instrument consol. These instruments fall also outside the field of vision, adding to the undesired movements which then have to be carried out in order to use them. An instrument console with a width of about 40 cm appears to be a good solution. (22.11).

12. The underside of the instrument console should be flat so that this can be positioned about 10 cm above the breast of the patient. (20.12). (Rising towards the backside of the console would be better).
13. The control panel for operating different functions, e.g. the patient chair, can be best positioned at the side of the instrument console, nearby the working height, in order to be easily accessible. (20.13).

9. Positioning hand instruments for the dentist. (Chapter21 Ergonomic requirements).

1. It should be possible to position the tray for hand instruments at a distance of 20 to maximally 25 of the body of the dentists at a minimum working height of 78 cm for the $P_{(F)}5$ dentists (156 cm) and a maximum working height of 107 cm for the $P_{(M)}95$ dentists (196 cm). (21.1).
2. The distance from the underside of the instrument console to the tray has to be about 9-10 cm, about 4-5 cm below the dynamic instruments. (21.2 en 21.3).
3. The tray is fixed in the centre below the instrument console with a horizontal arm just below the underside of the instrument console, to avoid contact with the breast of the patient. This arm is bent at the end, nearby the swivelling arm/holder, itself of about 5 cm, for the tray holder attached to this by a mechanism which allows the position of the tray to vary horizontally. The first arm, fixed below the instrument console, can reach up to about 10 cm sideward of the console at both sides, for use of the tray at both sides of the console. Any further handle designed to aid the positioning of the console must not interfere with the placing of the tray and/or its holder. (21.3)
   NB The design of a well to use tray holder with tray is critical.

Observation.
It is clear that only a front delivery system enables it to be possible to work fully in a healthy way in accordance with ergonomic requirements developed so far. Other equipment shows limitations.

10. Positioning instruments for the dental assistant. (Chapter 22 Ergonomic requirements).

1. The instruments for suction and, where needed, other instruments with tubing used by the dental assistant, must be positioned as far as possible toward the front of the upper body of the dental assistant, when positioned at the left side(in the situation with a right handed dentist). At a minimum working height of 78 cm and a maximum working height of 116 cm for a $P_{(F)}95$ dental assistant, for use in a sitting and standing position.
   An oblique position of the instruments, about 45°, is desired or when possible, the instruments should hang down to allow a natural way of grasping. (22.1)
2. When these instruments are also used by the dentists the reach must fulfil the requirement of being at a distance of 30-40 cm in the different working positions of the dentist, so positioned next to the head of the dentist. (22.2).
3. The form of holders for the instruments has to be ample funnel-shaped so that the instruments can easily be taken out and replaced. (22.3).
4. Even when the instruments for the dental assistant come from the rear (right side of the dental assistant, in the situation with a right handed dentist) the same requirements as mentioned above apply in principle. (22.3).
5. The best place for a tray with instruments for the dental assistant is as yet not clear. (We believe that, taking into account the requirements for a correct working posture for the dental assistant, the best solutions could be a tray coming from the rear to be placed at the right side before the upper body of the dental assistant or a body tray on

the breast of the patient just before the mouth to be used by not only the dentists but also the dental assistant). (22.5 and 22.6).

11. Positioning spittoon. (Chapter 23 Ergonomic requirements).

1. The spittoon should be placed at the side of the patient chair and should be movable so that the dental assistant has space to sit and so that there is room available for the instruments of the dental assistant's unit, coming from her left side (when working with a right handed dentist). Space for the left upper leg of the dental assistant has to reach to about 15 cm behind the SRP for the $P_{(F)}5$ lying patient (156 cm). (Previous we have calculated that from the rear of the headrest, about 50 cm below the back with headrest is needed for the upper legs of dentists and dental assistant). (23.1)

12. Screen (visual display terminal, VDT) related to equipment. (Chapter 26 Ergonomic requirements).

1. Starting from a correct sitting posture, a horizontal line is drawn from the eyes toward the topmost line of the text on the screen. This determines the height of the screen. The dentists then needs to position the screen in his symmetrical plane, taking into account his working position. So that his mid-sagittal line (dividing his upper body in two equal parts) corresponds with the middle vertical line of the screen. (26.4).
2. The height of the topmost line usually results in a height for the screen of between 119 cm and 152 cm, this being the height of the eyes of the $P_{(F)}5$ (156 cm) and $P_{(M)}95$ (196 cm) dentist respectively, when sitting with an angle of 110° between lower and upper legs. (26.4).
3. Reflection can be avoided by using the right fittings with high frequency neon lamps and turning the screen as vertically as possible. (26.5).
4. In order to provide adequate observation, good contrast is required on the screen. The relation 10 : 1 can be used; below 1: 3 the legibility clearly decreases. The use of colour will never improve the legibility. When using colours it is necessary to optimise the contrasts.

13. Infection prevention. (Chapter 27 Ergonomic requirements).

1. The quality of water within dental equipment has to be guaranteed in relation to disinfection by incorporating good design and using all measures necessary to this end, whilst the dentist is responsible for the quality of the water supply to the unit. (27.1).
2. The system should function (semi)-automatically when the equipment is not in use (thermal/physical disinfection is preferred above chemical disinfection as a consequence of the disadvantages of chemical disinfection). (27.2).
3. Operation of the system must be easy for both dentist and dental assistant. (27.3).
4. The dentist must be informed about how he can monitor water quality with dip slides. (27.4).
5. Surfaces of equipment need to be smooth, without joints, sharp transitions or edges and easily accessible for cleaning and disinfection. (27.5).

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