

Explanation.

This checklist has been drawn up for dentists to assess whether a dental unit is ergonomically acceptable for her/his individual use. Unfortunately there is no dental unit available that fulfils the ergonomic requirements in particular with respect to the different dimensions of dental operators. Regarding ergonomic features considerable differences exist between units as well.

Information about an ergonomic method of working can be found in the document "Adopting a healthy sitting working posture during patient treatment". This document is accessible on website www.esde.org under the button "publications".

Every dentist has the right to choose the kind of dental unit she/he wants to use, based on her/his own arguments. However, when a unit has to be assessed in terms of ergonomic analysis methods (*e.g. positioning the instruments in the field of vision, placing instruments on working height, minimizing the movements of the upper arms, avoiding sideward bending and rotations of the upper body and extreme movements of the hands*) only the front delivery system with balanced whip arms, above the patient chair, forms the best base for an ergonomic approach. Also in relation with the concept of four-handed dentistry. Therefore the checklist is primarily related to a front delivery system; however it can be used for different units as well.

On the website of ESDE under the button "publications", the related document "Ergonomic considerations regarding cart and instrument console with hanging down hoses" can be consulted to check the restrictions of these types of units. Dentists who want to study more details are advised to consult the website of ESDE and this particular document: "Work document to be used in relation with the ergonomic requirements for dental equipment".

Chapters of the checklist are:

I	working stool of the dental operator
II	patient chair
III	arrangement of instruments with tubed dynamic instruments
IV	foot control
V	operating light
VI	use of matt surfaces and colours
VII	position of hand instruments for the dental operator
VIII	position of instruments for the dental assistant
IX	spittoon
X	infection prevention

All topics are presented in the format of questions one has to answer for each individual situation. Handling of the checklist is made easy by marking the respective boxes. After filling in the checklist one has to assess the outcome in relation with the possibilities to create healthy working conditions.

To support the design of ergonomic equipment for dentists ranging from $P_{(F)5} = 1.56$ m for female dentists to $P_{(M)95} = 1.96$ m for male dentists the document "Ergonomic Requirements for Dental Equipment - Guidelines and Recommendations for Designing, Constructing and Selecting Dental Equipment" has been elaborated. This document is accessible on the website of ESDE under the button 'publications'.

I Working Stool of the Dental Operator

Manufacturer	
Type	

CRITERIA	YES	NO	NOTES
1. Is there a seat with a horizontal course below the bottom (sitting bone tubercles) and a sloping down course below the upper legs to be able to sit with an angle of about 110° or more between upper and lower legs?	<input type="checkbox"/>	<input type="checkbox"/>	
2. Is it possible to use the back rest as a kind of pelvic support that can be positioned against the upper backside of the pelvis? <i>In this way the pelvis- support may not only enable one to sit upright without support, but also support the back when back muscles are tight, to avoid sitting with an unfavourably backward bent back (C-back).</i>	<input type="checkbox"/>	<input type="checkbox"/>	
3. If sitting, is there no pressure between the back- support and back muscles below and above the upper side of the pelvic bone? <i>This pressure is hampering free movement of the body and contributes to an unfavourable static posture.</i>	<input type="checkbox"/>	<input type="checkbox"/>	
4. Is the upholstery of the seat sufficiently hard, necessary for sitting upright, and furnished with a roughened surface to avoid slipping away?	<input type="checkbox"/>	<input type="checkbox"/>	
5. Is the base of the working stool no hindrance to the dental operator or the dental assistant?	<input type="checkbox"/>	<input type="checkbox"/>	

II Patient Chair

Manufacturer

Type

CRITERIA	YES	NO	NOTES
<p>1. Is it possible for the patient to lie adequately horizontally on the patient chair? <i>A horizontal position of the patient with the knees lifted in an angle of not more than 15° is necessary to be able to position the patient sufficiently horizontal. Because the nose should not be lower than the knees for that may cause a damming up of the blood circulation in the head of the patient. When the angle between the seat of the patient chair and the support of the lower legs is more than 15° the upper body of the patient has to be placed in an oblique position to avoid a too low position of the nose. But then the dental operator will be forced to work with an unwanted bent body and head.</i></p>	<input type="checkbox"/>	<input type="checkbox"/>	
<p>2. Is the back of the patient chair flat without an upward curving of the sides at the upper side of the back? <i>This prevents the sides of the upper body of the patient with the shoulder blades uncomfortably pressed upwards as a consequence of a curved back of the patient chair. The difference in length of adult patients can be more than 50 cm. with their curves on different places. A patient chair has to accommodate to all these differences to offer a comfortable support to the body of the patient.</i></p>	<input type="checkbox"/>	<input type="checkbox"/>	
<p>3. Are back, shoulders and neck of the patient as much as possible supported to arrive at a relaxed patient and an optimal opening of the mouth? <i>If back, shoulders and lower part of the neck of a patient are not as much as possible supported the muscles of shoulders, neck and mouth will get strained so that the patient feels less relaxed. The taller the patient the less the top of the back and the lower part of the neck is supported making her/him feel uncomfortable.</i></p>	<input type="checkbox"/>	<input type="checkbox"/>	
<p>4. Is the transition between seat and back equal without height differences when seat and back are placed horizontally? <i>This is important because the underside of the back lies with the lowest 13 cm on the seat and an uneven transition of seat and back feels uncomfortable and makes the patient less relaxed. The deepening of the seat is often too distinct, leading to pressure below the thighs.</i></p>	<input type="checkbox"/>	<input type="checkbox"/>	
<p>5. Is the back of the patient chair as thin as possible? <i>When the back is thin, about 4 cm at the sides and 6 cm in the middle, the dental operator and dental assistant are able to sit well with the legs beneath the back and to move their legs freely. When the sides of the back of the patient chair are curved upwards, the small dental operator will have to lift his/her arms and shoulders too high when working at the side of the patient chair. This is also uncomfortable for the patient. (See item II.2) Thick upholstery contributes to this as well.</i></p>	<input type="checkbox"/>	<input type="checkbox"/>	

CRITERIA	YES	NO	NOTES
<p>6. Is it possible to position the headrest for the lying patient in such a way that the back of the head lies about in the same plane as the upper side of the back, corresponding with the plane of the back of the patient?</p> <p><i>This is necessary to support the patient in an as horizontal as possible position. When the back of the head lies lower than the plane of the back of the patient this is uncomfortable.</i></p>	<input type="checkbox"/>	<input type="checkbox"/>	
<p>7. Is the headrest, when positioned horizontally, not too high (in vertical direction)?</p> <p><i>If the headrest itself is too high or this is positioned too high the shoulders of the dental operator have to be lifted during instrument manipulation in the mouth and possibly the upper arms are spread sideward, depending on the height of the headrest. Both effects are causing postural problems.</i></p> <p><i>Therefore also rising sides of the backrest of the dental chair (see also item II,2) or a too thick backrest / too thick upholstery have to be avoided (see also item II 5).</i></p> <p><i>This is particularly important for small dental operators and dental operators with long upper arms.</i></p>	<input type="checkbox"/>	<input type="checkbox"/>	
<p>8. Is the support for head and neck constructed in such a way that sufficient turning of the head of the patient is possible in 3 directions?</p> <p><i>The working-field in the mouth of the patient has to be orientated to the viewing direction of the upright sitting dental operator, so that she/he is able to look perpendicularly as well as possible onto the working-field without bending and rotating his/her upper body and head. This occurs when the work-area is not oriented towards the viewing direction, and when the 3 turnings are insufficient:</i></p> <p><i>It should be possible to turn the head of the patient that much forwards or backwards, further lateral to the right or left and finally around the longitudinal axis to the right or left so that</i></p> <ul style="list-style-type: none"> <i>– the occlusal plane of the lower jaw is placed obliquely backwards for treatment in the lower jaw, in the so-called “book –reading- position”, about 35-45°obliquely or sometimes more , when/if the treatment is in the back of the mouth,</i> <i>– the occlusal plane of the upper jaw is placed 20-25°backwards (in relation with a vertical plane) for treatments in the upper jaw,</i> <i>– the head can be placed obliquely aside, in lateral flexion, until about 30°and</i> <i>– finally the head is turned aside around the longitudinal axis until maximally 45°</i> <i>– sometimes it is necessary to place the occlusal plane of the lower jaw about horizontally for treatment in the lower jaw, sitting in the 9.00-10.00 o’clock position.</i> <p><i>The combination of these turnings should make it possible for the dental operator to look perpendicularly – in an upright work-position - onto the working-field. If the working-field can not be turned sufficiently in the proper position, the dental operator is forced to bend her/his upper body and keep her/his head obliquely, leading to problems of the spine, neck and muscles. Essential is the indicated position of the occlusal plane of as well the lower and the upper jaw, with the patient in a horizontal position.</i></p>	<input type="checkbox"/>	<input type="checkbox"/>	

CRITERIA	YES	NO	NOTES
9. Can the head and neck rest be easily adjusted and provides it a stable support, without uncomfortable pressure against the underside of the skull or top of the neck?	<input type="checkbox"/>	<input type="checkbox"/>	
10. Is a shell-shaped headrest constructed in such a way that the lower part, which has contact with the neck, runs downwards instead of upwards to avoid an uncomfortable pressure against the upper side of the neck? <i>The head of the patient cannot be turned sufficiently backwards (20-25°) during treatments in the upper jaw when/ if there is an uncomfortable pressure is against the neck.</i>	<input type="checkbox"/>	<input type="checkbox"/>	
11. Is when working sitting the extension of the basis of the patient chair in backward direction causing no obstruction to positioning the feet of the dental team (dental operator and dental assistant) in combination with a foot control? <i>Otherwise the dentist will have to sit in an unfavourable, unbalanced posture.</i>	<input type="checkbox"/>	<input type="checkbox"/>	
12. Is it possible to position a horizontally placed patient at a proper height to enable a correct sitting posture of the dental operator? <i>A small dental operator of 156 cm (P_(F)5) needs a minimum height of the seat of the patient chair of 53 cm. A tall dental operator of 196 cm (P_(M)95), up to 200 cm, needs a height of 90 cm. Otherwise she/he will not be able to position the patient high enough for being seated upright, for which the patient has to be positioned horizontally, as well for treating the lower and the upper jaw.</i>	<input type="checkbox"/>	<input type="checkbox"/>	
13. Is operating the adjustments of the patient chair - by foot or hand - within easy reach of both dental operator and dental assistant? <i>Operation of a foot control attached to the backside of the basis of the patient chair causes an unwanted, unfavourable posture.</i>	<input type="checkbox"/>	<input type="checkbox"/>	
14. Allows the width of the back of the patient chair for working in an upright standing posture with the mouth of the patient straight (symmetrically) before the operator enabling to work without far forward reaching arms? <i>The condition for working in a standing posture is more favourable when a foldaway elbow arm rest is available at the side of the back that can be moved downward when the dentist is working standing.</i>	<input type="checkbox"/>	<input type="checkbox"/>	
15. Is it possible for the dental operator, when she/he works standing, to place her/his feet beside the patient chair without hindrance of a too wide basis?	<input type="checkbox"/>	<input type="checkbox"/>	
16. Can the patient chair be positioned sufficiently straight up for prosthodontics and registration methods and sufficiently horizontal for surgical procedures? <i>In relation with the right individual working height.</i>	<input type="checkbox"/>	<input type="checkbox"/>	

III Arrangement of Instruments with Tubed Dynamic Instruments

It has already been explained before that in order to be able to apply the basic principles of ergonomics a front delivery system is desired for an ergonomic method of working for the dental operator. And most favourably also for four-handed dentistry so that the dental assistant is able to hand over and replace dynamic instruments.

CRITERIA		YES	NO	NOTES
1.	Is it possible to place dynamic instruments on working height and largely within the field of vision of the dental operator? <i>The field of vision is within the angles of 30° right and left of the symmetrical plane (that divides the upper body in 2 equal parts). Positioning of instruments in the field of vision is necessary to avoid fatiguing accommodation and adaptation of the eyes just like unfavourable ways of grasping instruments as well.</i>	<input type="checkbox"/>	<input type="checkbox"/>	
2.	Is it possible to position the instrument console in such a way that the dynamic instruments on the console can be placed 30 to maximally 40 cm from the upper body of the dental operator independent of the physical characteristics / dimensions of the individual patient? <i>One has to avoid too far forward and too high reaching because then an unwanted load of the shoulders arises.</i>	<input type="checkbox"/>	<input type="checkbox"/>	
3.	Is it possible to position the instruments with an horizontally placed patient about 5 cm higher than the opening of the mouth in relation with the above mentioned reach of the instruments in order to be able to grasp these without unwanted reaching? <i>The distance between the underside of the instrument console and the breast of the patient is normally about 10 cm to have sufficient room for movements of the hands of the patient. No protuberances should be present underneath the instrument console to avoid unpleasant contacts with the hands of the patient.</i>	<input type="checkbox"/>	<input type="checkbox"/>	
4.	Is it possible to place the instrument console with little effort in the wanted position without the risk of slipping away of it?	<input type="checkbox"/>	<input type="checkbox"/>	
5.	Is it possible to place the instruments as much as possible in an angle of 30-60° in relation to the dental operator?	<input type="checkbox"/>	<input type="checkbox"/>	
6.	Is it possible to position the tubing with the attached instruments largely in the direction of grasping the instruments without tipping over to one side of the tubing which results in traction?	<input type="checkbox"/>	<input type="checkbox"/>	
7.	Is the weight of tubing and instruments balanced in such a way that no traction or other disturbing forces are perceived?	<input type="checkbox"/>	<input type="checkbox"/>	

CRITERIA	YES	NO	NOTES
<p>8. Is it easy to grasp the instruments? <i>These should therefore hang down with an angle of 45° in relation to a vertical plane and at least 6 cm but preferably 10 cm be hanging freely to enable them to be adequately grasped. When the instruments are hanging further downwards in relation with the underside of the instrument console, then this will be an advantage concerning the space thus created between underside of the console and breast of the patient and more space will be available for the arm of the tray holder as well.</i></p>	<input type="checkbox"/>	<input type="checkbox"/>	

IV Foot Control

CRITERIA	YES	NO	NOTES
<p>1. Is it possible to operate the foot control smoothly and unconstrained? <i>This is important with regard to the different constructions of foot controls.</i></p>	<input type="checkbox"/>	<input type="checkbox"/>	
<p>2. Is the heel of the dental operator still on the floor during operating the foot control for its different functions? <i>A foot control where the whole foot is placed on the pedal causes an unequal position of the right and left foot, thus of the legs as well, causing a harmful strain on the pelvis and the vertebral column.</i></p>	<input type="checkbox"/>	<input type="checkbox"/>	
<p>3. Is, in relation with the height of the shoes, the height of the brace for moving the foot control not higher than necessary and sufficiently broad for the shoe? <i>A small height of the brace is wanted because otherwise the upper leg can become in a fixed position against the back of the patient chair during lifting up the foot control.</i></p>	<input type="checkbox"/>	<input type="checkbox"/>	
<p>4. When using a brace can the foot control easily be positioned? <i>Half open braces tend to provide less control when moving the foot and thus may provoke unwanted reactions in the operator's knee, hips and lower back. A half open brace coming from one of the sides works out differently for the right and left foot and is therefore less favourable.</i></p>	<input type="checkbox"/>	<input type="checkbox"/>	
<p>5. Is the weight of the foot control exactly right, to enable easy repositioning of the foot control during patient treatment without sliding away (if necessary with the help of non-slip material)?</p>	<input type="checkbox"/>	<input type="checkbox"/>	
<p>6. Is the design of the foot control simple and are the functions easily recognizable and usable? <i>The foot control is mostly not visible during patient treatment so that one has to turn sideward for observation.</i></p>	<input type="checkbox"/>	<input type="checkbox"/>	

V Operating Light

CRITERIA	YES	NO	NOTES
1. Is the operating light constructed with 3 axes, to be able to turn it in different directions? <i>It must be possible to place the operating light in an oblique position next to the head of the dental operator in all sitting positions around the patient. With the aim to illuminate the mouth as much as possible shadow free and to prevent fatigue of the eyes.</i>	<input type="checkbox"/>	<input type="checkbox"/>	
2. Can the operating light be adjusted smoothly with a balanced movement in order to direct the light beam approximately parallel to the viewing direction? <i>A laborious operation makes positioning of the operating light unnecessarily hard and leads to accepting an insufficient way of illuminating the mouth.</i>	<input type="checkbox"/>	<input type="checkbox"/>	
3. Is the length of the arms of the operating light amply sufficient to enable adequate positioning beside the operator's head in such a way that the operating light reaches until about the plane of the back of the dental operator ? <i>For an easy operation of ergonomic functions the range of operation must always go a little further than the exactly needed range because in the last part of the range of movement there is always some friction leading to avoidance of its use.</i>	<input type="checkbox"/>	<input type="checkbox"/>	
4. Is it possible to adjust the operating light on the correct height for working both sitting and standing?	<input type="checkbox"/>	<input type="checkbox"/>	
5. Is the illumination continuously adjustable from 8.000-25.000 lux? <i>The illumination must be continuously adjustable in connection with age, length of the dental operator, position of the working field in the mouth etc.</i>	<input type="checkbox"/>	<input type="checkbox"/>	
6. Is the colour rendering index 85 (or higher) and the colour temperature 5.500 K or higher?	<input type="checkbox"/>	<input type="checkbox"/>	

VI Use of Matt Surfaces and Colours

CRITERIA	YES	NO	NOTES
1. Do the surfaces of dental equipment, instruments and materials have a matt finish? <i>This is important to avoid fatiguing glittering effects on the eyes of the dentists.</i>	<input type="checkbox"/>	<input type="checkbox"/>	
2. Are light colours used for dental equipment? <i>This is necessary to obtain an optimal contrast, i.e. an optimal illuminance pattern and because of this an optimal pattern of reflection of the light into the direction of the eyes of the dental operator, to avoid more tiring adaptation of the eyes than necessary when looking around, and so to prevent eye fatigue.</i> <i>The same is true for the use of colours in the practice room.</i>	<input type="checkbox"/>	<input type="checkbox"/>	

VII Position of Hand Instruments for the Dental Operator

CRITERIA	YES	NO	NOTES
1. Is it possible to position the tray with hand instruments on working height at a distance of 20-25 cm from the body of the dental operator? <i>This starting point relates to one tray. Using a tray holder for 2 trays means that, as a consequence of the required space, the distance to the dynamic instruments increases too much when the trays are positioned before the dynamic instruments or the tray holder becomes placed - when positioned more sideward - too far away and too far sideward.</i>	<input type="checkbox"/>	<input type="checkbox"/>	
2. Is it possible to move the tray holder smoothly so that the tray with instruments can be placed easily in different positions? <i>This is often not the case or it is not well possible to place the tray in the desired position.</i>	<input type="checkbox"/>	<input type="checkbox"/>	
3. Is it possible to place the tray about 4-5 cm below the dynamic instruments	<input type="checkbox"/>	<input type="checkbox"/>	
4. Is the distance from the underside of the instrument console to the tray about 10 cm so that the hand instruments become placed in relation with the working height? <i>Important is the availability of a flat underside of the instrument console as in this way the chest area of the lying patient and his / her folded hands are not hampered.</i>	<input type="checkbox"/>	<input type="checkbox"/>	
5. Is a correct positioning of the dynamic instruments together with the tray with hand instruments, as indicated earlier, possible?	<input type="checkbox"/>	<input type="checkbox"/>	
6. Can a correct position of the tray be obtained for a right-handed as well as for a left-handed dentist?	<input type="checkbox"/>	<input type="checkbox"/>	

VIII Position of Instruments for the Dental Assistant

CRITERIA	YES	NO	NOTES
<p>1. Is it possible to place instruments for a suction unit/dental assistant's unit when positioned at her left side and, where needed, other instruments with tubing used by the dental assistant as far as possible toward the front of the upper body of the dental assistant with the aim to handle the instruments without sideward bending and rotations of the upper body? Also without an unfavourable lifting of her shoulders?</p> <p><i>Positioning of these instruments in the rear wall, on the right side of the dental assistant, makes operation with the right hand easier.</i></p>	<input type="checkbox"/>	<input type="checkbox"/>	
<p>2. Is the range of height adjustments sufficiently large to let the dental assistant work also standing?</p>	<input type="checkbox"/>	<input type="checkbox"/>	
<p>3. Are the instruments positioned sufficiently obliquely for reasonably easy grasping?</p> <p><i>The way of grasping must be so that it will not be necessary to bend or turn the hand too far from the neutral / straight position of the wrist in different directions (forward, backward and sideward).</i></p>	<input type="checkbox"/>	<input type="checkbox"/>	
<p>4. Can the instruments of the suction unit/dental assistant's unit be placed also on working height for use by the dental operator, beside the head of the patient at a distance of 30-40 cm from the dental operator?</p>	<input type="checkbox"/>	<input type="checkbox"/>	
<p>5. Is the form of the holders for the instruments sufficiently funnel-shaped so that the instruments can be easily taken out and replaced?</p>	<input type="checkbox"/>	<input type="checkbox"/>	
<p>6. Can the tray with hand instruments for the dental assistant be positioned on working height (being the patients mouth) and so that the instruments can be grasped by the dental assistant without sideward bending and rotations with the upper body and also without lifting the shoulders?</p> <p><i>If the tray is positioned above the patient this is too high for the dental assistant being above the patients mouth. When positioned at the back side of the head of the patient one has to wonder whether it allows for easy access for picking up and replacing instruments, i.e. with the hand with which the instruments are transferred to the dentist, e.g. by turning with the working stool in the direction of the instruments.</i></p> <p><i>Finding a proper place for the tray with hand instruments is still a problem. Possibilities are:</i></p> <ul style="list-style-type: none"> - <i>positioning of the tray more or less between dental assistant and head of the patient or</i> - <i>using a body tray on the breast of the patient just before his mouth.</i> <p><i>These two positions of the tray are the most beneficial from the point of view of a correct working posture.</i></p>	<input type="checkbox"/>	<input type="checkbox"/>	

IX Spittoon

CRITERIA	YES	NO	NOTES
1. Is the position of the spittoon not interfering with the use of the suction unit/dental assistant's unit?	<input type="checkbox"/>	<input type="checkbox"/>	
2. Is the position of the spittoon together with the dental assistant's unit not a hindrance for a proper way of working/sitting by the dental assistant in a correct posture?	<input type="checkbox"/>	<input type="checkbox"/>	

X Infection Prevention

CRITERIA	YES	NO	NOTES
1. Is the quality of water within the dental unit guaranteed in relation to disinfection?	<input type="checkbox"/>	<input type="checkbox"/>	
2. The system should function (semi-)automatically when the equipment is not in use.	<input type="checkbox"/>	<input type="checkbox"/>	
3. Operation of the system must be easy for both dentist and dental assistant.	<input type="checkbox"/>	<input type="checkbox"/>	
4. The dentist must know how she/he can monitor water quality.	<input type="checkbox"/>	<input type="checkbox"/>	
5. The suction system can be cleaned user friendly.	<input type="checkbox"/>	<input type="checkbox"/>	
6. Surfaces of equipment need to be smooth without joints, sharp transitions or edges, and easily accessible for cleaning and disinfection.	<input type="checkbox"/>	<input type="checkbox"/>	

The Authors:

drs. Rolf de Ruijter r.a.g.de.ruijter@umcg.nl
 prof. Oene Hokwerda
 Joseph Wouters

Published by the Center for Dentistry and Oral Hygiene, University Medical Center Groningen



