

# Ergonomic considerations regarding cart and instrument console with hanging down hoses

## Introduction

In this paper the authors describe the revised ergonomic considerations regarding a dental cart and the instrument console with hanging down hoses. The revision was necessary because in the last 10 years the knowledge about physical ergonomics has taken a considerable flight. Furthermore the technical possibilities of dental equipment often are very ingenious. However in all man-machine systems, including those used in dentistry, the well-being of the dental operator needs to be considered first. This is the base of all national, international and specific laws and directives on labour circumstances. The justification of these principles is extensively dealt with in the *Ergonomic requirements for dental equipment* (see: [www.esde.org](http://www.esde.org) under documents).

It is important to take into account this knowledge.

## 1. Ergonomic considerations regarding a unit/cart right or left of the patient chair\*

When treating patients a dentist is working with a dental unit in a so-called man-machine system, in which to start with the patient chair and the position of the head of the patient affect the working posture and movements of the dental operator. Because both the construction of the chair together with the height adjustment and the position and turning possibilities of the headrest can more or less limit the freedom of movements of the dentist and the possibility to obtain a proper posture. Nevertheless one must consider the possibilities to keep the best possible working posture as described in "Adopting a healthy sitting working posture" (see the article on the website [www.esde.org](http://www.esde.org)). This must be considered to be able to avoid extensive muscle load and gross motoric movements.

The following problems are related with the use of a unit/cart right or left of the patient chair:

- In this arrangement, an unnatural pick-up of instruments is used due to the too strong rotation of the forearm with hand outward, i.e. back from the body (called exorotation), leading to an altered shoulder position and also altered mechanics in an unfavourable way.
- Above-mentioned forearm and hand rotations are also with sideward flexions and rotations of the upper body, resulting in displacement of the body axis and thus leading to imbalance of the body, which has to be avoided.
- Due to the tension of hanging down hoses the muscular strain in hand and arms increases by this. Tension and weight of the dynamic instruments must be as low as possible to limit the static muscular strain caused by this. (By using a front delivery system/over the patient delivery system this can be balanced).
- Adopting a habit to accept a strained posture leads to adaptation of the body to that posture and to a chain of compensational muscle characteristics. This inevitably leads to repression of both proprioception and good physical awareness of a proper posture.  
*NB By firmly enclosing the upper arm with the hand of the other arm, the difference can be felt in muscle strain of the upper arm when using a natural way of instrument pick-up, before the upper body and when picking up an instrument from a unit right/left of the chair.*
- Most of the units placed right or left of the patient chair are not height adjustable so that a reversed man-machine system situation arises: the equipment cannot be adjusted to human characteristics (height of the dentist, natural way of gripping instruments), but the dentist has to adjust himself to the possibilities, i.e. the limitations of the machine. This reinforces the aspects described under previous points. It is most noticeable when working in or around the 9.00 o'clock position, when the instruments of the unit are positioned sideward or behind the dentist's back. Because to perform physiologically acceptable i.e. healthy movements to pick up

and put back instruments these have to be positioned within the field of vision, 30° right and left of the mid-sagittal/symmetrical plane of the upper body of the dental operator, at a short distance and on working height.

- Non-adjustable height of the cart leads to the problem that the taller the dentist the more physical adaptation in regard to the dimensions of the cart is required. This can eventually lead to musculo-skeletal disorders in the upper part of the body.
- The low unit is often, after the treatment, pushed away from a sitting position. A dentist will often do so with a backwards rounded back what leads to an unfavourable load.
- By positioning instruments outside the field of vision there is a higher risk of stick injuries and dropping of instruments.
- Looking up from the operating field when picking up and returning instruments to such a unit, means that the eyes first must accommodate to the different light situation when looking aside and then again, when returning to the operating field. This reinforces eye strain and eye fatigue. *NB If we look at somebody using instruments for particular activities or for do it yourself (DIY) tasks we see that he puts these in front of him, so as to easily grab them.*
- A more dynamic style of working of the dentist requires free space on the right/left side of the patient chair, for movements with the working stool, working when standing and walking of the dentist.
- Sometimes a tray for hand instruments is mounted on top of the unit behind the instruments. This causes an increase in frequency of high-strained movements with arms.
- No four handed dentistry is possible with handing over dynamic instruments.
- After a treatment the console with instruments cannot be moved away toward the side of the dental assistant for cleaning and disinfection.

*Conclusion:* The unit position right/left of the patient chair is not geared to the requirements of an ergonomic working posture and operating mode of the dentist as published in the *Ergonomic requirements for dental equipment*.

## **2. Ergonomic considerations regarding an instrument console with hanging down hoses near the patient chair and with a tray for instruments above the patient**

The following problems are related with the use of an instrument console with hanging down hoses and with a tray for instruments above the patient.

- Positioning of such an instrument console in combination with an instrument tray is practically impossible. Either the tray with hand instruments is positioned within the normal distance for gripping instruments from the tray and putting these back, while the instruments of the instrument console are then positioned too far away. Or the instruments of the instrument console are placed within the normal distance for gripping and replacing these, while the hand instruments are positioned too far away. Sometimes a unit is constructed with a tray that is made swivelling with respect to the console with instruments.
- From an anatomical/physiological point of view it may be clear that an instrument console with hanging down hoses is unfavourable. Even when the distance for reaching the instruments of the instrument console is correct, exorotation of the arm and shoulder is always inevitable, i.e. a considerable sideward rotation of the lower arm for gripping and replacing the instruments. These movements can only be made when the upper body rotates and bends sideward in order to reach for the instruments; the range of movements is of course depending on individual anatomical characteristics.
- The positioning of the instrument console is becoming more unfavourable when sitting more in the direction of the 9.00 o'clock position. This leads to a console position outside the field of vision of the dentist. The field of vision is more or less confined to a maximum angle of 30° to

both right and left of the symmetrical = midsagittal plane of the dentists (dividing the upper body in 2 equal parts).

- More static load of the muscles is necessary for handling the instruments because no balancing of the instruments with hoses is possible.
- The patient is enclosed by the hanging down hoses.
- The patient can get entangled in the hanging down hoses when leaving the patient chair.
- The hoses, contaminated with aerosol, will slide along the clothes of the patient and the dentist.
- No four handed dentistry is possible with handing over dynamic instruments.
- After a treatment the console with instruments cannot be moved away toward the side of the dental assistant for cleaning and disinfection, without hindrance for the patient.

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*\* First publication in "Ergonomic principles in dentistry" distributed to the participants of ESDE's AM, in 2001, in Piestany. The conclusions were derived from a study of the ergonomic working methods of circa 1250 dentists during the Project Sonde and have been published in 2008 on the website of ESDE. The results of the study have been checked with the Ergonomic requirements for dental equipment as starting point. Updates took place in 2011 and 2016.*