

The dental foot controller— The devil is in the detail

TEXT: Dr. Caroline Gerhard

Ergonomics and usability have gained a lot of momentum in the last years. Employees and Employers in many industries started to spend time and money to think about how the workplace and its environment could be enhanced and how long-term damage to the dentists musculoskeletal system can be avoided. One possible answer: Change the dental foot controller.

The best thing about my thesis is the fact that I get to deal with the object of interest on a daily basis. The foot controller is, frankly, just an “input device” and probably the least expensive element that ships with a dental unit. But let's start with the full picture:

Everyone working in dentistry knows how demanding this kind of job can be. Not only in a psychological way, but also—and sometimes even more—in a physiological way. Mostly, the dentist's work posture leads to a typical cluster of symptoms, mainly in the musculoskeletal system. These are influenced by a number of factors, such as patient, oral work area, dental unit and dentist with his professional training,^{1, 2, 3, 5, 6} Beginning with Schön & Kimmel^{5, 6} in the late 1960s to Rohmert⁴ in the 1980s,

a lot of experiments and studies have been conducted, aiming to enhance the dental working environment. Albeit many product innovations came up in the last years, many dentists still suffer from painful problems with their musculoskeletal system.

The fact that the whole situation has barely changed has been the core motivation for me to write my thesis and continue to develop a solution. I started with dissecting the dental workplace, taking the aforementioned elements into account. The dental foot controller has, surprisingly, never been element of a scientific study and can't be found on an explaining picture.

That's interesting, because the dentist can not drill any cavity without the dental foot controller.

Study design

The aim of this study was to determine how the operating principles of the foot controller affect spinal position (Sonosens® monitor) and foot pressure distribution (medilogic) of a dental professional. For this purpose, a total of 63 participants were monitored.

They were divided into three groups of 21 participants each, based on their

profession (dentist yes/no) and their professional working years (<10 years, >10 years). For the study, four dental foot controllers were chosen, comparable in their functionality, but differing in control concepts. The controllers used were the universal-pedal controller (*A-dec*) the combined sliding-pedal controller (*KaVo*), the pedal controller (*Sirona*), and the sliding wheel controller (*XO CARE*).



Fig. 1: Universal-pedal controller (firm A-dec; pictures 1–5)



Fig. 2: Combined sliding-pedal controller (firm KaVo; pictures 1–6)

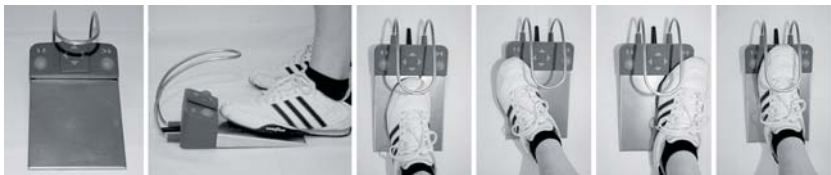


Fig. 3: Pedal controller (firm Sirona; pictures 1–6)



Fig. 4: *Sliding-wheel controller (firm XO CARE; pictures 1–6)*

Results and conclusion

The spinal position

As far as the effects on the spinal position are concerned, we can assume that they are in direct relation to the operating principle of the respective dental foot controller. In order to be able to use most dental foot controllers effectively, the human body is forced into a posture not physiologically natural and originating from the following compensatory reactions:

- dorsal tilt of the pelvis (*universal-pedal controller, combined sliding-pedal controller, pedal controller*)
- kyphosis and right lateral flexion in the lumbar spine (*universal-pedal controller, combined sliding-pedal controller, pedal controller, sliding wheel controller*)
- lordosis, right-sided lateral flexion and right-sided torsion in the thoracic spine area (*universal-pedal controller, combined sliding-pedal controller, pedal controller, sliding wheel controller*)
- hyperextension of the head in dorsal, right lateral flexion and right-sided torsion in cervical spine (*universal-pedal controller, combined sliding-pedal controller, pedal controller, sliding wheel controller*).

Foot pressure

In order to operate the foot controller, a number of movement sequences are essential and the consequences diverse. For example,

during the operation of the universal controller and pedal controller, as opposed to the combined sliding-pedal controller and sliding wheel controller, an increased application of pressure on the working foot causes a flexion extension movement. This initiates muscular compensatory reactions such as a weight shift that leads to a decrease of pressure on the standing leg.

The combined sliding-pedal controller, on the other hand, combines the flexion–extension movement and a rotate–slide movement to initiate a balance of pressure between the working and standing leg. Due to the single rotation of the foot necessary to operate the sliding wheel controller, the pressure is more evenly distributed and the working leg relieved slightly as some weight is shifted to the standing leg.

Group comparison

Although the muscular motion sequences of the spine when operating the foot controller are not related to the working years, the effects of a summation of muscular compensatory reactions can be detected in the cervical vertebrae—a direct result of automatized myoreactions along the muscle chains which are produced by known functional principles.

In group comparison, the balance of foot pressure applied on the working and standing leg is almost identical. This indicates that there are no statistical differences identifiable and that work experience or operating knowledge do not play a role in the results.

Comparison of objective and subjective evaluation

It must also be noted that the subjective evaluation of the foot controllers' operating principles in the questionnaire correlates to its assessment in this study as well as to the spinal measurements of the participants. In summary, the assessment and participants' measurements indicate that the sliding-rotation controller is the most recommendable one, followed by the

universal-pedal controller and the combined sliding-pedal controller. The pedal controller causes the most noticeable imbalance in foot pressure, most deviation in spinal position (especially in the cervical spine) and has thus been assessed as least recommendable.

„All the operating principles of the examined dental foot controller have negative effect on the dentist's work posture in the spinal area.“

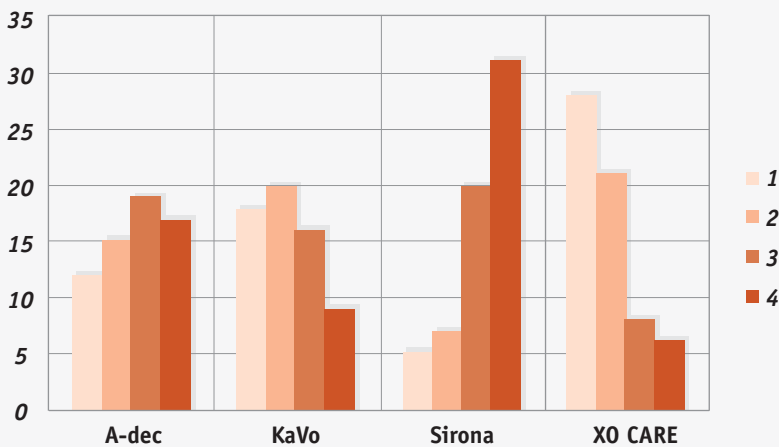


Fig. 5: Assessment of the foot controller by participants, marks 1 (best) – 4 (worst)

An article by Prof. Rotgans follows:

Dental Ergonomics and ESDE

In the 1960s the concept of the patient chair changed dramatically with the introduction of chairs allowing for a more or less horizontal position of the patient, thus enabling the dentist to do his job in a sitting position. Also the development of micro motors and airtors made

big changes in workflow, work speed and efficiency, even enhanced by the introduction of four-handed dentistry. These changes resulted nearly immediately in the well known hazards of dentists. The occurrence of cumulative trauma injuries and repetitive motion disorders, such as chronic back pain and carpal tunnel syndrome, increased dramatically due to sustained awkward working positions and

poorly-designed equipment. Apart from the physical part, efficiency and work under pressure can also lead to too high mental stress levels and eventually to a burn-out syndrome.

Today dentists have many more options to practice in an ergonomic way, not only with products being designed to create a healthy workflow, but also stools allowing them to maintain healthy postures at all times. The ideal is for all products on the market to be manufactured according to prerequisite ergonomic standards. Fortunately, there has been a marked increase in the number of new products being classified as ergonomic and the dental industry has shown its support for the development of this area. The European Society of Dental Ergonomics (ESDE) aims to play an important role in ensuring this growth in interest, and that awareness is sustained and increased.

About ESDE

The European Society of Dental Ergonomics was founded in 1987 by 10 members from different European countries, with the aim to encourage international exchange of experiences and ideas between dental practitioners. After a period of orientation, ESDE has grown in numbers and sharpened its focus: Its influence resulted, among others, in the publication of the document ‘Ergonomic Requirements for Dental Equipment—

Guidelines and Recommendations for Designing, Constructing and Selecting Dental Equipment.’

To get more information have a look at:

• www.esde.org

To get an introduction of the discipline of ergonomics in the ADEE-document ‘Profile and Competences for the Graduating European Dentist—Update 2009’ check the website:

• <http://www.adee.org/cms/uploads/adee>

For the bibliography to this article please contact the editorial office.

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