### Let’s rethink dental ergonomics

#### How to set up a workstation that works for you

**S**cientific literature shows that musculoskeletal disorders (MSD) are a major problem for dental health workers. A systematic review of MSD among dental professionals by Hayes et al. in 2009 suggested that the prevalence of general musculoskeletal pain ranges between 64% and 93%. Pain is reported mainly in the back, neck and shoulder.

These statistics are much higher than for many other healthcare professionals. Rambabu et al. showed in 2014 that musculoskeletal pain was most prevalent among dentists (61%), followed by surgeons (37%) and physicians (20%).

We must therefore look at our workstations with new eyes and new tools. A variety of techniques are available to assess the health of skeletal muscles, and combined with a sound knowledge of anatomy and biomechanics are essential tools to help us enter into evidence-based ergonomics. Blanc et al. in 2013 showed that there is a high degree of variability depending on the workstation, and that clinicians can adapt their position accordingly to drastically reduce physical strain.

The origin of this line of research can be traced back to the work carried out by Dr Daryl Beach in the 1950s. He determined a new concept in ergonomics for dental care workers – his theory of proprioception. This theory can now be explained and expanded upon by biomechanics.

The problem is finding a position which works for the practitioner as well as the patient. Because our position is mainly or fully determined by the patient’s position. The patient’s position, which affects the dentist’s spine, should be considered separately from how we handle instruments, which affects our shoulders.

**The patient’s position**

We usually ask the patient to sit in our dental chair, and tilt the backrest until they tell us to stop. However, it is becoming increasingly standard practice to set the patient in a fully lying position to allow for ergonomic access to their oral cavity. This position is commonly used by physiotherapists and massage therapists, and is also used for sleeping. So why is it so difficult to achieve in a dental chair? Based on human biomechanics, we can identify three reasons:

1. **The backrest is often not aligned with the seat.** This creates a painful lumbar lordosis and spine curvature.

2. **Knees are bent.** While this makes the chair more comfortable in a seated position, it also increases lumbar lordosis in a lying position (Figure 1).

3. **When the chair is tilted backwards, there is no indication of when it will stop.** This can be especially uncomfortable for elderly patients, who have a lower threshold for proprioception.

There are a few measures we can take to help with this. When your backrest is set horizontally, ensure the entire surface, from headrest to footrest completely flat. You can then ask your patient to lie down on the unit and put their head on the headrest. Don’t worry about whether they will miss the headrest; when someone lies on their bed, they don’t miss the pillow. Once the patient is lying down, you can place a cylindrical cushion under their knees to reduce lumbar lordosis (Figure 2).

Furthermore, if the unit is flat it will fit any patient size, and you won’t be dependent on the shape of the dental seat. The patient’s mouth is the reference point (Figure 3). When a patient is sitting in a dental chair, their ischial point is always at the same place, but their mouth is not. This requires continuous adjustment and adaptation. Surgery has been performed on a flat operating table for many years; there is no reason why oral surgery cannot be performed in a similar manner.

In fact, there may be an argument for replacing our dental chairs with operating tables. The dental unit was originally created based on the design of a
barber’s chair. It is clear, however, that today many dental procedures are much more akin to operations than haircuts.

**Location of instruments**

The use of instruments is governed by upper-limb movement. When referring to instruments, we should not only distinguish between the ‘chair-side cart’ and the ‘over the patient tray’. We should categorise them based on their location in relation to our articular physiology, and how easy it is to reach them. This is where an understanding of basic anatomy and the average range of motion is essential.

Extreme movements and high muscular strain due to the lever effect cause MSD. So it’s important to recognise these movements and avoid them.

The full range of a joint can be divided into three areas: internal, intermediate and external (Figure 4). The intermediate range is the only one which can be maintained comfortably, especially for postures which are adopted for long periods of time. Average human articular ranges are listed since decades, so it’s very easy to isolate the intermediate range for each movement, and establish which posture is suitable for each individual.

For instance, in the shoulder the maximum range of the scapulohumeral joint is 50° extension and 90° flexion (Kapandji. 2007). The intermediate range is 5° extension and 45° flexion. This indicates the area where our hand is able to reach comfortably, and therefore where our instruments should be. As a rule in ergonomics, the machine should be adapted to the user, not the other way round. Having instruments out of reach is not an option.

If we consider the position of the instrument tray which comes over the patient, it is clear that it brings the hand much too high in respect to the shoulder. The tray may seem useful, but if it causes shoulder pain it is not an ideal solution. Instead, we could consider using a side tray, and asking the assistant to hand us more instruments.

There are two ranges of movement in the elbow: flexion/extension, and pronation/supination. Biomechanically, however, elbow movements are often a combination of these two. There are two physiological associations: the ‘strength elbow’, which combines flexion supination and extension pronation when we need power, and the ‘finesse elbow’ which combines flexion pronation and extension supination when precision is required (Werner et al. 1994; Galloway et al. 2002). An example of the latter is taking a pencil from a chest pocket and handing it to someone.

‘Finesse elbow’ (flexion pronation) is most often required in our line of work. So when we need to place instruments back on the tray, it should be done with this physiological movement. The rotary instrument holder should be in an appropriate position to facilitate this, where our hand goes naturally. We shouldn’t bring our hand to the instrument; the instrument should come to our hand.

**Five steps to make sure your workstation is ergonomically optimal:**

- sit comfortably on your stool without a patient
- bring your hands to your minimum field of view
- ensure the dental chair is fully horizontal
- ask your patient to lie down and lift the chair to this height
- practise the ‘finesse elbow’ movement to see where your hand goes naturally, and bring the tray to this position

Now, you are ready to work! Once your dental chair has been adjusted correctly, you will never have to change its settings; they are suitable for all patients, whatever their size. Their head will always be at the same location on the headrest. The centre of your workstation is their mouth, so this should be the point around which everything revolves.

These rules can be applied to all of our joints and all parts of our body, to obtain a fully comfortable, MSD free, pain-free, and more efficient daily practice.

**References**


