THE “SITTING” POSITION AND ITS IMPLICATIONS IN DENTAL TECHNOLOGY. GENERAL ASPECTS OF IMPROVING THE QUALITY OF LIFE - PART I

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Abstract: Specifically, maintaining a prolonged sitting position is considered to be associated with an increased risk of musculoskeletal disorders in the back, neck, shoulders, arms, hands, hips, knees and legs. The purpose of this study is to generate data, which can be used to support decisions on improving the health of dental technicians, whose basic activity is carried out in a sitting position at the work table, in order to improve the quality of life. Implementation of ergonomic measures, in the area where professional activities directly affect the physical and mental health of the employee, is of great importance.

INTRODUCTION

As we mentioned in two other articles published in 2015, also in Acta Medica Transilvanica journal, dental technology is a liberal profession, in which over 95% of daily activity is performed in the “sitting” position. At that time, we conducted two preliminary studies also published in this prestigious journal with a medical profile which is Acta Medica Transilvanica, on both musculoskeletal disorders and other occupational diseases that dental technicians can acquire at work, in terms of the toxic factors existing at this level (vibration, noise, insufficient light, infectious agents, incorrect posture etc.), but also the means and possibilities by which this category of staff can improve their working conditions in the dental laboratory.(1,2) Starting from these studies published in 2015, we expanded our research in this extremely interesting field of ergonomics, conducting a study structured in two parts on dental technicians much more extensive and better documented, in the context of implementation in 2016-2019 of solid ergonomic principles among this category of staff, either through well-documented specialization courses held within professional organizations, or through up-to-date literature.

Thus, the correct posture, given by the biomechanical alignment of the body, is maintained by the coordinated action of the elements of the neuro-myo-arthro-kinetic system. Regardless the position of the body (orthostatic, sitting, lying down), it is of major importance to maintain a correct posture, a proper alignment of body segments. But, one of the most frequently adopted positions by all individuals is the seated position.

Specifically, maintaining a prolonged sitting position is considered to be associated with an increased risk of musculoskeletal disorders in the back, neck, shoulders, arms, hands, hips, knees and legs.(3-8)

But, before moving on to the description of the study we have conducted, it is necessary to clarify very briefly some of the basic notions that we have used in this article.

As it is well known, conditions affecting the muscles, bones and joints, tendons and ligaments are called musculoskeletal disorders. These lesions cause pain, weakness, discomfort, numbness, sensitivity disorders and swelling.(9)

Occupational musculoskeletal disorders are among the workplace health problems from industrialized and developing countries. They are caused by cumulative trauma disorders during exposure to stressful biomechanical, social, and psychological agents, for a long period of time.(10) In the category of staff affected by these musculoskeletal disorders, there are also dental technicians.

However, prolonging the activity at the work table in the sitting position can lead to prolonged static muscle contraction, increased pressure on the intervertebral discs and tension on ligaments and muscles, decreased tissue flexibility, changes in the curvature of the spine and weakened paravertebral muscles, changes that may increase the risk of musculoskeletal injury.(11)

AIM

The purpose of this study is to generate data, which can be used to support decisions on improving the health of dental technicians, whose basic activity is carried out in a sitting position at the work table, in order to improve the quality of life, prevention of specific pathologies and increase performance at work.

MATERIALS AND METHODS

In general, musculoskeletal disorders, due to sitting position, begin with symptoms of pain located in one or more

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areas of the body, the level of its intensity may differ depending on the individual.(12-14)

The sitting position has a wide support base, there are no problems of stability, balance, the centre of gravity having a low projection. Maintaining balance, achieved both by the information received from the exteroceptors of the gluteal area, the posterior face of the thigh and the plant, and by the intervention of proprioceptors from the ischial tuberosities, is easily ensured, especially if the subject is seated on a chair with backrest.(15-24) However, during the professional activity, the positioning of the body segments may be differently maintained from individual to individual, respectively:

- The head/neck may be in a neutral position, tilted forward (flexed) or backward (hyperextension), tilted sideways, rotated (twisted) or tilted sideways and rotated;
- The torso can be located upright (straight), anteriorly inclined (flexed), laterally inclined, rotated (twisted), inclined and rotated or supported posteriorly (on the backrest);
- The thighs may have different flexion amplitudes on the pelvis ($< 90^\circ$, 90° - 100° , $> 100^\circ$);
- The legs can have different flexion amplitudes on the thighs ($< 90^\circ$, 90° - 100° , $> 100^\circ$);
- The legs can be extended differently on the legs ($< 90^\circ$, 90° - 100° , $> 100^\circ$), depending on the plantar support on the ground (support).

In the context of maintaining a correct body position at the work table, on an ergonomic chair, this involves several features:(13,14)

- The head is upright or slightly inclined forward;
- Shoulders should be relaxed;
- The arms should be next to the sides of the body;
- The back should be fully supported, with adequate lumbar support;
- Elbows should be close to the body, bent at about 90° - 100° (not less than 90°);
- The hands, wrists and forearms should be on the same line and approximately parallel to the floor, in an anatomically neutral position (possibly the wrists should be in a slightly extended position);
- The hips should be bent at about 90° - 100° ;
- The thighs are supported on a chair, preferably lined and parallel to the floor;
- The knees should be on the same line as the hips, flexed at about 90° - 100° ;
- Feet should be fully supported on the floor or on a footrest, in dorsiflexion of approximately 90° - 100° .

Thus, for conducting this study we chose the questionnaire method. Starting from the previously mentioned information, we made an extremely rigorous questionnaire, which we split into 2 parts. This questionnaire was applied to a number of 61 dental technicians aged between 31 and 67, between August and September 2019. The study group came mainly from Bucharest, but there were also subjects working in Braşov, Constanţa, Sibiu, Piteşti, Alexandria and Râmnicu Vâlcea. 37 of the subjects were females (60.66%), while 24 of the subjects were males (39.34%) (figure no. 1).

Figure no. 1. Gender distribution of study group

Next, we will present the first part of the questionnaire that we developed:

1. What is the seniority in work? **a.** < 5 years; **b.** 5-10 years; **c.** 11-15 years; **d.** 16-20 years; **e.** 21-25 years; **f.** 26-30 years; **g.** > 31 years.
2. Have you followed in the period 2016-2019, in your professional training, courses in ergonomics and/or occupational disease prevention or have you studied up-to-date literature? **a.** Yes; **b.** No.
3. How many hours do you work per day? **a.** > 8 hours; **b.** 8 hours; **c.** < 8 hours.
4. How many days do you work per week?: **a.** > 5 days; **b.** 5 days; **c.** < 5 days.
5. How do you assess the height of the work table? **a.** Low; **b.** Good; **c.** Too high; **d.** I can't appreciate.
6. How do you assess the height of the work chair? **a.** Low; **b.** Adjustable so that the feet rest on the floor; **c.** Too high; **d.** I can't appreciate.
7. How do you appreciate the ergonomics of the work chair? **a.** It has support for the natural curvature of the back/spine (lumbar support); **b.** It does not have support for the natural curvature of the back/spine (lumbar support); **c.** It has forearm support; **d.** It has no forearm support; **e.** I can't appreciate.
8. How do you assess the position of the head/neck during the work schedule? **a.** In neutral position; **b.** Tilted forward (bent); **c.** Tilted backwards (hyperextension); **d.** Tilted laterally; **e.** Rotated (twisted); **f.** Tilted and rotated; **g.** I can't appreciate.
9. How do you assess the position of the body (torso) during the work schedule? **a.** Straight; **b.** Tilted forward; **c.** Tilted laterally; **d.** Rotated (twisted); **e.** Tilted and rotated; **f.** I can't appreciate.
10. How do you appreciate the position of the shoulders during the work schedule? **a.** Relaxed; **b.** Brought forward; **c.** One is higher; **d.** I can't appreciate.
11. How do you assess the position of the forearms and elbows during the work schedule? **a.** Leaned on the work table; **b.** Unsupported on the work table; **c.** The elbows are close to the body, flexed at about 90° - 100° ; **d.** The elbows are away from the body; **e.** I can't appreciate.
12. How do you assess the position of the hands during the work schedule? **a.** In a straight line with the forearm; **b.** In a line other than the one of the forearm; **c.** I can't appreciate.
13. How do you appreciate the angles of the hips (formed between the trunk and the thighs) during the work schedule? **a.** $< 90^\circ$; **b.** 90° - 100° ; **c.** $> 100^\circ$; **d.** I can't appreciate?
14. How do you appreciate the angles of the knees (formed between the thighs and legs) during work schedule? **a.** $< 90^\circ$; **b.** 90° - 100° ; **c.** $> 100^\circ$; **d.** I can't appreciate.
15. How do you appreciate the angles of the ankles (formed between the legs and feet) during the work schedule? **a.** $< 90^\circ$; **b.** 90° - 100° ; **c.** $> 100^\circ$; **d.** I can't appreciate?
16. How do you assess the position of the feet during the work schedule? **a.** With the whole sole on the ground, the contact with the floor being made on the same line with the knees; **b.** The contact with the floor is made forward; **c.** The contact with the floor is made backward; **d.** The contact with the floor is made on the inner edge; **e.** The contact with the floor is made on the outer edge; **f.** I can't appreciate.
17. How do you appreciate the posture of the body during the work schedule? **a.** Correct; **b.** Incorrect; **c.** I can't appreciate.

RESULTS

The results obtained following the application of the questionnaire were:

The structure of the study group based on age is

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represented in figure no. 2.

Figure no. 2. Age distribution of the study group

It is noteworthy that during 2016-2019, all respondents took courses in ergonomics or occupational disease prevention. It is worrying that all participants in the study have a work schedule that exceeds the normal limits of work, namely more than 8 hours a day and this for more than 5 days a week, which involves working on Saturdays and sometimes even Sundays.

Regarding the height of the work table, most technicians (36 - representing 59.02%) considered it a good height, but there were also technicians who opted for the other answer options (figure no. 3). This can be attributed to the different height of the respondents but also to the fact that the work tables generally have a standard height (approximately 89 cm) and do not allow height adjustment.

Figure no. 3. Assessing the height of the work table

Regarding the height of the working chair, an even higher percentage of respondents 46 (representing 75.41%) use chairs with adjustable height (figure no. 4). The answers related to the height of the table and the work chair show that the technicians are aware of the importance of the work position and try to create a work environment that is as friendly as possible.

Figure no. 4. Working chair height assessment

If the options for the working chair are simpler, there is a generous offer on the market in terms of variants and price for height-adjustable chairs, regarding working tables with adjustable height, they appeared more recently on the market and obviously have a higher price than the fixed ones, and those made to order have a higher price. Even so, with a generally high price compared to most dental equipment, upgrading from a standard table to a custom or adjustable table is not one of the first investment options for most dental technicians.

The answers to the 7th question show us a clear picture of the technicians who opted for ergonomic work chairs 39 (representing 63.93%) and the remaining 22 technicians (representing 36.07%) who chose a simpler variant of working chair (figure no. 5).

Figure no. 5. Evaluation of working chair ergonomics

The answers to the following questions are strictly related to the working position and show how technicians spend most of their working time aware or not of the negative effects that non-physiological positions can have over time.

Thus, less than half of the technicians (27 representing 44.26%) work with their head in a neutral position (the most recommended working position), a larger number instead, keep their head in a forward tilted position (29 technicians - representing 47.54%) and only 5 technicians could not assess the working position (figure no. 6).

Figure no. 6. Head position during work

The position of the torso during the work schedule was assessed as follows: 26 respondents (representing 42.62%) work holding their body straight (an ideal working position), 29 respondents (representing 47.54%) are leaning forward and 6 respondents cannot appreciate the position the torso during the working hours (figure no. 7).

Regarding the position of the shoulders during the work schedule, 37 practitioners (representing 60.66%) keep the shoulders relaxed during the work, a variant considered to be correct by the specialists in the field, 16 practitioners (representing 26.23%) keep the shoulders brought forward, and only 8 practitioners cannot appreciate the position in which they work (figure no. 8).

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Figure no. 7. Evaluating the body position during the work schedule

Figure no. 8. Assessing the position of the shoulders during work

Regarding the position of the forearms and elbows, 23 technicians (representing 37.70%) stated that during work they lean with their forearms on the work table. The remaining 38 technicians (representing 62.30%) responded with variant c - elbows close to the body, bent at about 90° – 100°, variant – approved by physiotherapists (figure no. 9).

Figure no. 9. Evaluating the position of the forearms and elbows

Regarding the position of the hands during the work, we must appreciate that all the respondents answered correctly, namely in a straight line with the forearm.

The angles of the hips (formed between the torso and the thighs) during the work were assessed as follows by the respondents to the study: 50 of them (representing 81.97%) answered correctly (variant b) while only 11 of them could not appreciate this aspect (figure no. 10).

A similar result was obtained regarding the appreciation of the angle between the thighs and legs (figure no. 11).

Figure no. 10. Evaluation of the angle between the torso and thighs during work

Figure no. 11. Assessment of the angle between the thighs and legs

Regarding the evaluation of the angle between the legs and feet (ankle angle) during the work schedule, a small number of technicians answered < 90° (6 representing 9.84%), similarly number answered > 100° (7 representing 11.47%). Most technicians answered an angle between 90° and 100° (37 representing 60.66%), while 11 technicians could not accurately assess this angle (figure no. 12).

Figure no. 12. Evaluation of the angle between the legs and feet during the work schedule

Regarding the position of the feet during the work schedule, we found that all respondents keep the whole sole on the ground, the contact with the floor being made on the same line with the knees.

At the last question in the study related to the assessment of posture during the work schedule we have the following results (figure no. 13):

- Correct - 22 technicians (36.06%);
- Incorrect - 20 technicians (32.79%);

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- I can't appreciate - 19 technicians (31.15%).

Figure no. 13. Assessing the correctness of the working position

DISCUSSIONS

Labour at the work table, that involves keeping the body in a vicious / incorrect sitting position for a long period of time, is one of the risk factors responsible for the occurrence of musculoskeletal disorders. Thus, dental technicians are a risk group, for which the working position can have an impact on chronic musculoskeletal health problems.

Although, all subjects stated that during 2016-2019 have attended courses in ergonomics and/or occupational disease prevention or studied up-to-date literature, based on the answers provided, we found major deficiencies in the training of dental technicians involved in the study on standard topics of ergonomics and prevention of occupational diseases (just over 40% offered correct answer options). In this context, we recommend acquiring and deepening the basic notions of ergonomics and occupational disease prevention.(13-15)

Ergonomic risk factors associated with the symptoms of musculoskeletal disorders are individual factors, such as body weight, body height, working posture, working time, rest time. Risk factors for equipment that contribute to the onset of symptoms of musculoskeletal disorders include work table height, chair height, technique/equipment used.(13-15)

Maintaining a correct body position, during the professional activity among people who perform work in a sitting position, contributes to:

- Maintaining balance, during the professional activity;
- Reducing the risk of muscle tension and excessive overload;
- Reducing wear on joints, muscles and ligaments;
- Reduction of physical and mental stress;
- Improving the health of the spine.

Maintaining the anterior inclined position of the spine (flexion) is detrimental to postural health, resulting in unwanted pain and musculoskeletal disorders, the cause being the increasing of the pressure inside the vertebral discs and myoelectric activity in the paraspinal muscles.

CONCLUSIONS

Following the analysis of the answers of the first part of the questionnaire, we can conclude the following aspects:

First, it is observed that musculoskeletal disorders are very common among dental technicians.

All dental technicians involved in the study work on average more than 8 hours a day per week (compared to 5 working days).

All dental technicians involved in the study work more than 5 days a week (compared to one year).

Implementation of ergonomic measures, in the area where professional activities directly affect the physical and mental health of the employee, is of great importance.

The ergonomics of the seats, through the presence of the lumbar support, is an important aspect, for the anterior pelvic tilt and lumbar lordosis, helping to maintain an efficient posture, by combating the flattening of the lumbar curvature.

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