The Saddle, in the Riding School and in the Dental Practice- An Analysis of Motion-Sequence and Function

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Abstract

Actually the use of a saddle seat seems of increasing popularity as working stool in dental practice and training in dental schools as well. Its advantages in comparison to usual stools are communicated with the suggested comfort of a horse saddle. The critical question is whether these are true. A closer look on the various aspects of sitting on a horse saddle and a dental saddle will give answers. Our analysis shows how a saddle is used on horseback and that the design is meant to enable the horseman or horsewoman to ride. Sitting on a horseback and riding dressage is a very active and dynamic sport, constantly demanding physical adaptation of the bodies of both rider and horse. Practising dentistry should be done in an as dynamic posture as possible also. However, a static working posture cannot be avoided during lasting fine neuro-motor movements of the practitioner during patient treatment. Prolonged use of a saddle chair promotes the unfavourable consequences of this static working posture. Therefore the few advantages of a saddle chair are overshadowed by its disadvantages and these are very likely causing musculoskeletal disorders: Introducing a saddle chair in the dental office is as inviting a Trojan horse to come in.

Key Words: Micro-osteoperforations, Canine movement, Accelerated tooth movement

Introduction

The introduction of the saddle-chair in dentistry during the nineteen-eighties and nineteen-nineties was an instant hit.

The chair is easily adjustable and creates the possibility to sit in a higher position (especially beneficial for the smaller dentist/ dental assistant) and sitting higher than the length of the lower-legs. Another advantage is to be able to sit with sloping-down lower-legs.

The traditional working-chair did not have these advantages: one simply had to sit on the edge of the seat to create a higher sitting level.

An adequate working-chair is simply a must, because the design of the patient-chair did not change much in the last fifty years.

The patient-chair is equipped with i.e. a fixed backrest, a ditto seating- and leg-area and an adjustable headrest. Underneath the patient-chair's backrest is a certain amount of plating, from its centre sloping upwards to the sides and the upperpart of the chair.

If the patient-chair is in a flat position, there will be no room for the legs of the dental team and even the highest position of most of the patient-chairs will be too low for a long dentist.

This design, in combination with the position of the headrest, will not facilitate the working posture of the dentist and the dental assistant. And if/ when the dental team is sitting in a 9h/11h position on a traditional working-chair, reaching the mouth of the patient will be at least an effort (the working-chair being one with a horizontal or slightly forward tilting seat) [1].

This problem can be solved up to a certain degree by sitting higher than the length of the lower-legs.

Sitting on a higher level is facilitated by the saddle-chair, and is probably an or one explanation for its' popularity.

Problem Analysis

What is required of a working-chair - given a healthy, correct working posture of the dentist- to facilitate working without physical complaints in a sitting position, and in what way will the saddle-chair contribute to this?

For this purpose, an analysis is made of the human posture and movement(s) when one is sitting in a saddle on horseback as taught in riding-school, and the dentist's working posture and freedom of movement whilst sitting on a saddle-chair executing his fine motor skills.

Starting-Point: The Correct Way of Sitting

An incorrect working-posture is the main cause of muscular-skeletal disorder{s} [2-7] {Muscular-skeletal disorders caused by congenital and/or psychological problems are no subject matter of this article).

A tenable physiological working-posture in sitting position is never fully worked out in literature.

Desk-chairs are equipped with seats and backs facilitating leaning backwards per the consensual aim of avoiding physical overload. However, in dentistry it is impossible to work whilst leaning backwards. The consequences of static labour in sitting position are described in the ISO 11226 [8] Standard with directives concerning the maximal raising and bending of the head, trunk and limbs.

In 1981 Hokwerda et al. [9] already declared the necessity of upright sitting to maintain a symmetrical working position. During the many ESDE congresses, via the first version of the Ergonomic Requirements of Dental Equipment 1and in information papers for students, an explanation has been given why the optimal physiologic posture when standing [10] is transferred or better superimposed upon sitting [11-13].

The research concerning the prism-glasses is also based on this symmetric working-posture [14,15]

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The picture below shows us the principles of a symmetric posture: the central axis (vertical) is the reference for the horizontal lines such as the pupil-, shoulder-, nipple-, hip-, and knee-line (*Figure 1*).

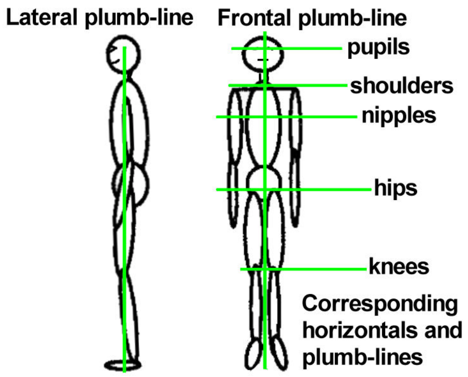


Figure 1. *This implies, that in lateral view there is a plumb-line as well, practically coinciding with the central axis.*

This lateral plumb-line starts from the middle of the skull (sella turcica), through the centre of the shoulder-joint, the centre of the hip-joint and the same of the ankle. The gravitation in relation to the weight of the distinguished parts of the human body leads to the fact that the axial axis ideally ends in the centre of the foot. Transferred to sitting: the seat of a chair always should be a horizontal exactly underneath the seat-bones to reach the line of balance, and to stabilize the seat-bones in a straight line. This starting point puts the feet firmly on the floor, contributing to the stability of the whole body.

Form and Function of a Riding-Saddle

The saddle-chair is based on a riding-saddle and many of its qualities.

The fact that dressage riders are sitting on horseback in such a correct(ed) and fully balanced posture probably initiated the idea for a saddle-chair in the dental surgery, to enable the dentist to sit as upright and balanced as a dressage rider.

This takes us to the heart of the problem, because this supposition requires a certain understanding of the dressage-sport and its expedient; the saddle.

Important parts of the saddle are (*Figure 2*):

The important thing for a rider is a correct posture; straight and stretched, with the breastbone slightly raised to come to the position in which both arms can move independently and separately from each other [16].

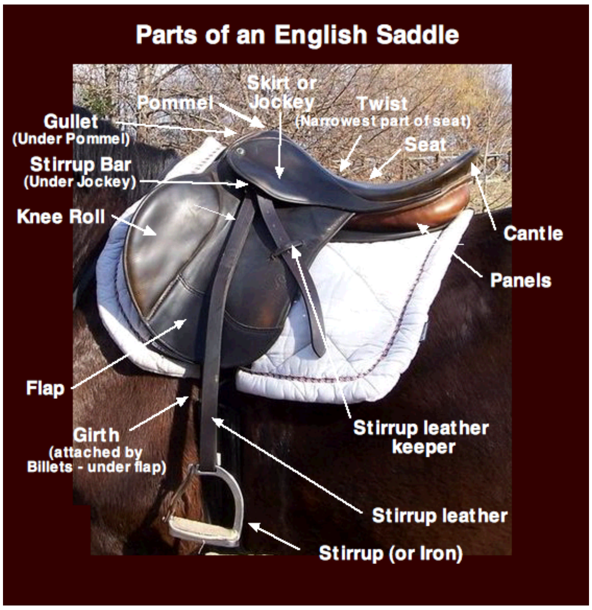


Figure 2. *Parts of a multi-purpose saddle.*

With a protracted shoulder girdle, however, forward circling movement of the shoulders will be impossible because in case of protraction the head-equilibrium muscles are involved, resulting in a connected movement of both arms.

In the first-mentioned correct posture of the rider the spinal column is fully stretched to be able to benefit from its flexible ability.

The legs are leaning against the saddle in such a way, that the upper legs can move freely, while the contact with the horse is taking place via the calves of the rider.

The feet are placed with the ball of the feet on the stirrups and can move freely up and downward (*Figure 3*).

Figure 3. *Variations in foot positions.*

The plumb-line of the posture on horseback is essentially the same as the lateral plumb- or balance line; from the centre of the skull through the middle of the shoulder- and hip-joints and finally through the middle of the foot [17] (*Figure 4*).

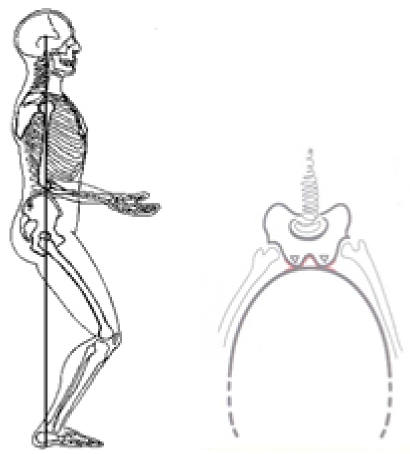


Figure 4. *Balance on horseback.*

The big difference with the standing position is, that one sits on horseback in a straddle with bended knees. The feet are in line with the hip joints [3,17].

When sitting on a horse, the pelvis of the horseman is slightly tilted forward, because of the shape of the saddle. The rolls on the front-rim of the saddle are restraining the upper legs, so the tilting of the pelvis is limited to secure the shock-absorbing and flexible abilities of the spine.

The pommel is the rounded, foremost part of the saddle and is in fact the edge of twist and seat: this is the part of the saddle closest to the horses back, following its contour and thus securing the horses freedom of movement. The height of the saddle is also important in relation to the width to prevent from an end position in the hip joint. A correctly contiguous saddle also secures the freedom of movement of the horseman, and on this freedom of movement the whole art of dressage-riding is based.

If/when the rider tilts his/her pelvis backwards; the horse is given a forward impulse and will move accordingly. This forward impulse given by the rider is combined with a certain amount of pressure from the riders' calves. To keep the horse going these impulses must be given continually.

In this way, there is a rhythmic forward- and backwards tilting of the riders, pelvis. And so, setting aside the use of the reins, a teamwork between man and horse is developing; the horseman, based on sitting and driving (positioning his legs and moving them up-, down-, and forwards) will be able to spur on the horse into step, canter, gallop, and accomplishing complicated man oeuvres.

In case of an even pressure on both seat-bones of the rider, the horse will go straight on; if the pressure on the seat-bones is unequal, the horse will move to the right or the left.

During dressage, the virtual plumb-line of the horseman's body does not vary, and the horseman will never lean forward when on horseback. A slight rotation of the spine is possible, as well as a slight lateral flexion [3].

In equestrianism, the saddle is finely tuned to the functionality of the human body to endorse the dynamics of the sport. A well fitted saddle (made to measure if necessary) enables the horseman as well as the horse to influence each other dynamically based on movement.

The Saddle-Chair in the Dental Surgery

The application of a saddle-shaped seat on a working-chair in the dental surgery is based on a different principle. Setting aside the compressibility of the gas piston when sitting down and the softness of the upholstery, the working-chair is a static basis. This is a necessity to be able to work with precision and cannot be compared to the dynamics of sitting on a horse in motion.

Sitting on a saddle-chair in a dental surgery implies the direct fixation of the human body on the saddle-seat by means of the upper legs. During horse-riding, however, contact with the horse is ado with the calves, enabling the upper legs to move freely. In this dynamic situation, the starting point (origo) of a muscle is the invariable point where the action originates of; namely by shortening the muscle in question. This action has its point of impact on the attachment (insertion) of the muscle.

An important example in this case is the Mm. Iliopsoas-group; with the origo on the pelvis and the lumbar spine, and the insertion on the trochanter minor of the femur, the upper-leg. The most important function of this muscle-group is lifting the upper-leg [18] (*Figure 5*).

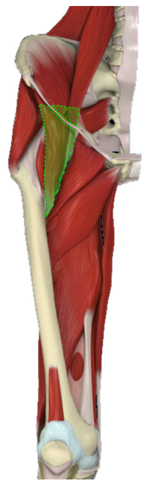


Figure 5. *Conjoined muscle and tendon of Psoas Major and Iliacus.*

But, when sitting in a static position on a saddle-chair, the upper legs are fixed against the seat of the chair, so the origo and insertion – from a biomechanical point of view- will turn around.

The result is that the tractive forces, pulling the upper-leg when sitting in a saddle on horseback, are now pulling the origo, in this case the pelvis and the lumbar spine. This will explain the often-visible hyper-lordosis of the lumbar spine, because the pelvis is pulled forward, causing a high pressure on the vertebral discs at the back of the spine [12,17,19] (*Figure 6*).

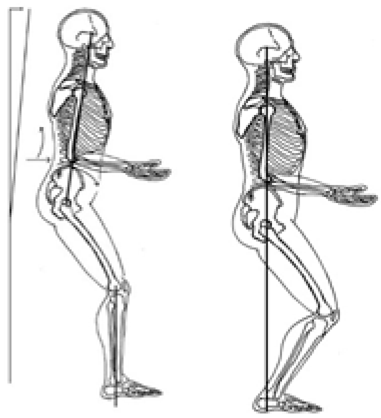


Figure 6. *Left: the posture on a saddle-chair, with the pelvis tilting forward, causing a hyper-lordotic lumbar spine, a forward tilted trunk and legs placed forward. Right: the upright sitting horseman with virtual plumb-line.*

Moreover, when both lower-legs are in a fixed, non-flexible contact with the floor there is no possibility to relatively shorten or lengthen the bended legs. On horseback, this is no problem at all: by using the stirrup one can pull up the heels or press them downwards.

Constant dynamic movement is not possible on a saddle-chair because of the static working-situation, so, the distance between the seat-bones and the slightly raised frontal rim of the seat (a vague derivative of the pommel) in relation to the depth, length and height of the seat, is of the greatest importance. As mentioned before: in professional dressage, the use of a bespoke saddle is a necessity to facilitate the constant dynamic movement [17].

The saddle-chair is standardized however, so the person sitting on it may experience too much or not enough freedom of movement on the seat, depending on the shape and size of his / her body.

Too much freedom of movement may lead to shearing forces; a tight seating space will cause constant pressure on the os pubis and surrounding structures (perineum) [20-23]. These problems and the fixation of the upper-leg plus the stable position of the feet on the floor, when sitting on a saddle-chair will have compensatory consequences for the spine. In addition to this; the extent of exorotation and lateroflexion of the upper-legs (also facilitated by the Mm. Iliopsoas-group) will consequently determine to what extent the hip-joint will attain an overloaded end-position. In other words; the design of the saddle-chairs' seating area leads to a fixation of the legs when in raised- and exorotated position, consequently more and more obstructing the movement of the upper body in the lower back region (*Figure 7*).

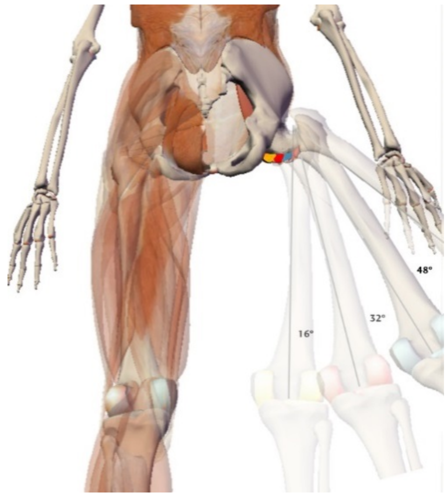


Figure 7. *Visible body.*

The extent of this obstruction is also defined by the degree of dispersion of both legs. The wider the angle, the greater the tension in the muscles of the Iliopsoas-group, and the lesser the possibility of movement of the lumbar spine. Yet this situation is often experienced as being a stable one; a phenomenon in orthopaedics described as a "paradoxical feeling".

From an anatomical point of view, all joints have a maximal "range of motion "(ROM). The ISO 11226 standard indicates the maximal allowance of the ROMs during a static working position: these ROMs are rather limited because the static muscle tension will increase rapidly with the increase range of movement during static actions in sitting position; these are rather limited because the static muscle tension will increase rapidly with the increase of biochemical tissue reactions as acidification.

To maintain a neutral pelvic position, comparable with the physiologic ideal posture while standing upright, is also necessary when being seated. The sum of all posterior and anterior muscular forces of the sagittal plane in sitting position should be nil as well [7,8,12,24] (*Figure 8)*.

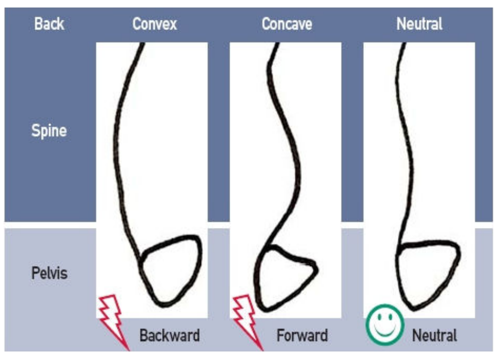


Figure 8. *Illustration.*

This is only possible when / if sitting upright. Because of the specific design of the saddle-chair, the pelvis is stimulated to tilt forward, inducing a concave shape of the lumbar spine, consequently disturbing its balance and significantly changing the forces on the spine.

A constant forward tilting, coupled with bending the trunk forward will often cause overloading of the vascular-rich perineum and pubic area (a well-known phenomenon in the cycling sport; after intensive cycling for several days, temporary impotence is accepted as being normal) [20-23,25] (*Figure 9*).

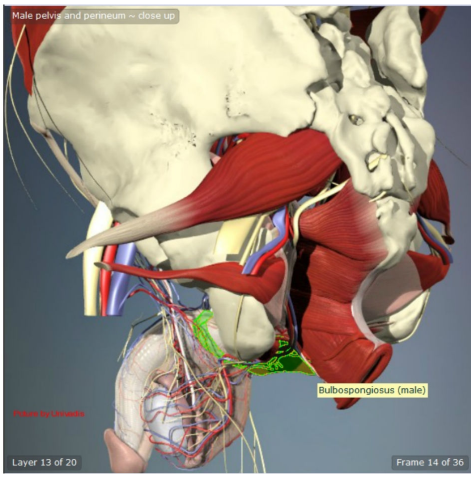


Figure 9*. Perineum highlighted in green.*

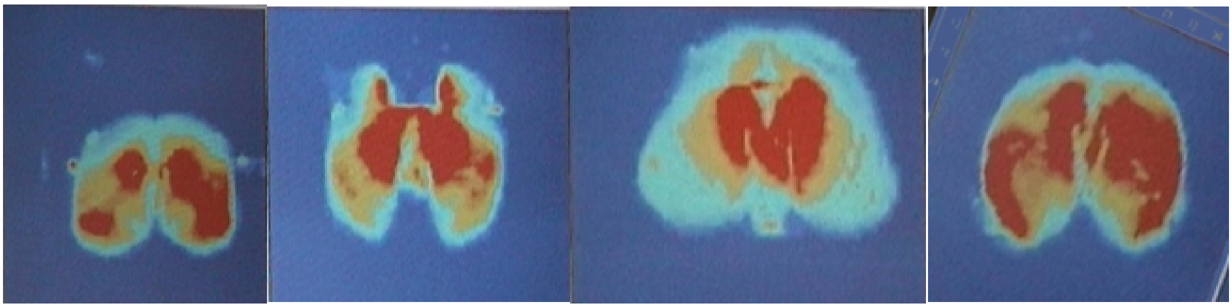
It is possible to relieve the forces in and on the area by compensating leaning backwards with the thoracic spine; the pelvis will tilt backwards and the spine is going to adapt a C (=concave) shape.

This manner of leaning backwards with the thoracic spine will consequently force the dentist to bend his head forward (more than 25 degrees) to be able to look into the patient's mouth.

This concave shape is noticeable after a long working-period (hours, days, months) in sitting position on a saddle-chair, when posture-decline is taking its' toll, leading to sitting in a slouching way. Evidence of the perineal overloading and the overloading of the muscles in the upper-leg was found in a video survey by Engels and Hokwerda, when a pressure-mat was placed on the seat of several different working-chairs [12].

The following pictures were extracted from the video to give an impression of the findings (*Figures 10-12*):

Figure 10*. The red area represents the bony pressure, the yellow the acceptable muscular pressure and the blue-grey area soft tissue contacts. So, the red dots represent the sitting bone tubercles. Note the free soft tissue space between the legs.*



Figs: 11 a 11 b 11 c 11 d

Figure 11*. (a) Dental chair with a slightly forward tilted seat, too much pressure on all areas. (b) A modified saddle chair with very soft upholstery, extended areas of bony pressure. (c) A traditional saddle chair, seating bones area cannot be defined, note the pressure in the pubic region. (d) A traditional 90/90/90° chair with too soft upholstery, not allowing for sitting in a higher position.*

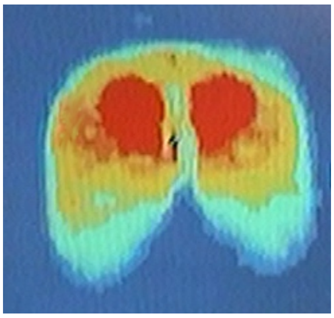


Figure 12. Represents the Ghopec chair in a high sitting position (125°). The shortness of the blue grey area is caused by the fact that the frontal part of the seat is sloping down.

Consequences of the Sitting Posture/Working Method during Patient- Treatment

The condition for executing micro-mechanical operations in the mouth of a patient, is to work with a minimal as possible overload of the postural muscles, and thus reducing the overload on the whole body.

To achieve this, the dentist must sit symmetrically upright [1,8]. The positioning of the body during the micro-mechanical work will increase the static muscle-tension. If one can work in an upright position there will be hardly any problem, because there are no displacements in the head / neck area. If the head is bent forward however, the necessary muscular strength will increase because of the actual weight of the head and the influence of the moment of force.

Actual weight of the human skull? The weight of the skull doesn't increase when moving. But moving the head can increase the load of the back, neck muscles and the glutes. The load is caused by a moment of force that must be compensated *(Figure 13)*:

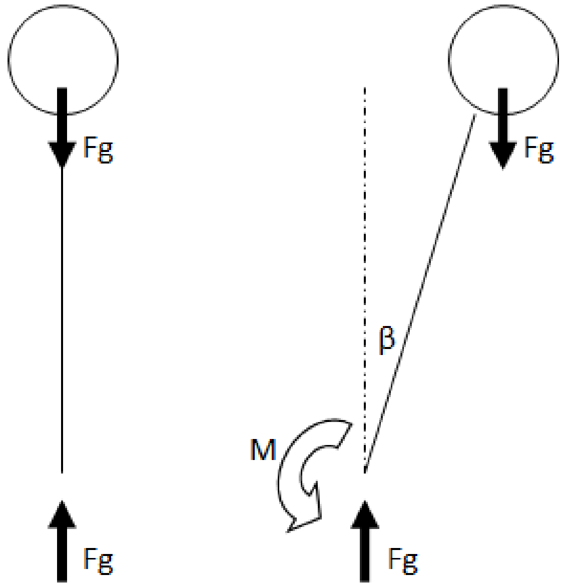


Figure 13. The mass of the head downwards is as big as the force of the seat upward.

The mass of the head downwards is as big as the force of the seat upward (for this example the trunk is left out of consideration) (Fg) The moment is M, M= sin(β) * y *Fg (y is the coordinate distance on the x and y axes). This means that an increasing angle β the more load on the musculature. This load of the extensor muscles leads to a certain muscle force Fs in the formula: M= Fs * a.

The arm a is the distance between the insertion on the skull and the pivot point of the last vertebra or the middle point between the hips. Because a is always smaller the sin (β)*y it is obvious that the muscle has and can provide great forces. The more the head is bent forward, the more the force increases (*Table 1*). In the next example, we use a P95 Man.

Table 1. There is no actual increase of weight of the skull, but moving the skull in a forward direction and keeping it there in a static position causes forces in the extensor muscles to such an extent that they carry a burden of 23 kg when bending 10° forward, 46 kg – 20° and further.

Weight body	100.7		Kg							
Weight skull	7.6	i.e. 7.5%	Kg							
Fg	76	N								
Y	0.893 m	P95 man	When seated eye height							
β	0	10	20	30	40	50	60	70	80	90
M (Nm)	0	12	23	34	43	52	58	63	66	67
suppose										
a										
Fs (N)	5	cm								
Weight Increase(kg)	0	234	461	674	867	1033	1168	1268	1328	1349
	0	23	46	67	87	103	117	127	133	135

In dentistry, the above described biomechanical explanation of increase of the weight of the skull is even worse, because as an extra there is the necessary skull inclination to look into the mouth of the patient (*Figure 14)*.

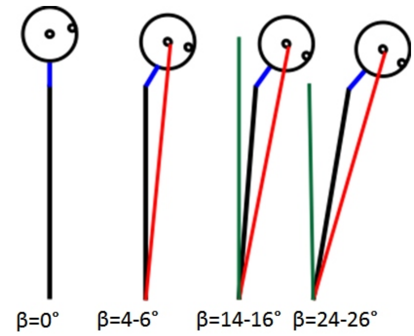


Figure 14*. Compensatory reactions.*

There are two types of compensatory reactions on this combined manner of bending forward:

- The trunk is bent forward from the pelvis onwards to a maximum of 10 degrees, without changing the position of the individual vertebrae. The head is bent forward to a maximum of 25 degrees by means of a reflectory movement in the upper part of the cervical spine. In this way, the relative increase in weight of the trunk and head, and the reactive forces of the muscles involved, will be reduced to a minimum.
- The whole upperpart of the body is bent forward from the lumbar spine onwards. In this case lumbar spine flattens and / or will bend into a C – shape (see picture) with in addition to this, a neck-flexion, starting off from high up the thoracic spine, progressing into the lower cervical spine. All displacements of the vertebrae are contributing to larger displacements of the upper - body (>10 degrees) in combination with a neck-flexion of more than 25 degrees. This will lead to a relative great increase in weight of the head and subsequently to great reactive forces of the back- and neck musculature.

Only when the movement described in section 1, above, is originating from the pelvis, it will be possible to maintain the normal position of shoulders and arms.

In case of the movement as described in section 2, above, an immediate protraction of the shoulder-girdle will develop, preventing the arms from moving independently from each other [6,7,19,24].

As mentioned in the ISO standard 11226 1 the curve of the upper body during static activities is maximally 20 degrees; this 20 degree-curve however, is relating to a standing working position.

Hokwerda and de Ruijter have reduced this 20 degree-curve already to a maximum of 10 degrees in their document: “Adopting a healthy sitting posture during patient-treatment” [3].

This implies that the dentist should sit as close as possible to his working-area. Seated on a saddle-chair however, it is hardly possible, if not impossible to get to the 10 degrees-curve because of the sitting position behind the pommel of the saddle-seat. (note; the distance between os pubis and the edge of the seat.) Because one must bend the body forward over this pommel to be able to consider the mouth of the patient, the curve is noticeably more than 20 degrees, inducing an increase in relative weight and subsequently an inacceptable raised muscle-tension [6,7].

Bending the upper-body forward as mentioned above, displacing the centre of gravity forward as well, in combination with the straddle-legged way of sitting on the saddle-chair, diminishing the stability of the upper-body, will cause a dis-balance of the body and consequently an overloaded musculature. In addition to this (as mentioned before) there will be an increase of pressure in the region of perineum and genitals [25].

Consequences of an Incorrect Sitting–Posture

An incorrect sitting-posture will bring several factors in its wake, that will not solely have an impact on the body-posture.

The spine may be seen as a spring with three curves: the lumbar lordosis, a thoracic kyphosis and a cervical lordosis. This spring is restricted in its kyphotic possibilities for the ribcage is attached to it (*Figure 15)*.

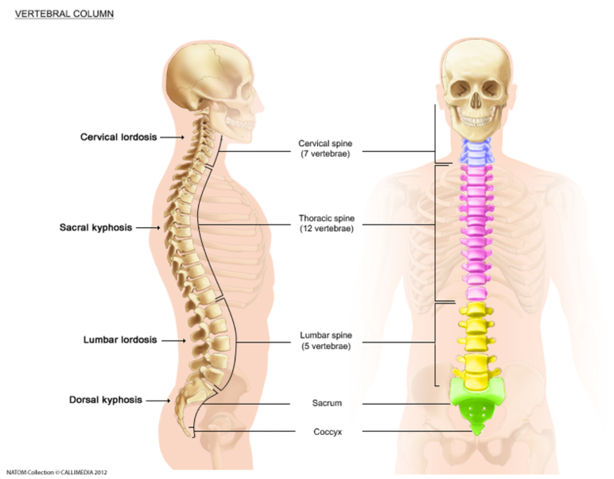


Figure 15*. Vertebral column.*

The facilities of movement from the lumbar to the cervical part of the spring however, are increasing as the thickness and volume of the individual vertebrae are decreasing. This implies, that changes in the position of the lumbar spine will have less compensation in the thoracic spine, and of course more compensation in the cervical part of the spine, causing the head moving backwards to maintain the horizontal gaze. Hyper-lordosis has a significant influence on the degree of force necessary to bend the head forward, to be able to look into the mouth of the patient [17,19,26].

Moving the head forward is working against the lordosis compensatory forces in the cervical spine.

Moreover, by bending the upper-body forward, together with the increasing forward bending of the neck, the head is put in a stable, static position.

In this way, the origo's and insertions of the small, intrinsic neck-musculature are also turned around, and the muscles involved are going to function as co- contractors to keep the head in a stable position [18,24].

This will lead to a fixation of the cervical spine, seriously limiting extension and rotation. If / when the lumbar hyper-lordosis – because loss of physical condition (advancing age, stress, fatigue) – is no longer acceptable to the body, or impossible to maintain, the spine will slouch into a C-shape, causing pressure on the abdomen and its contents. There are also consequences for the position of the diaphragm with a possible restriction of the ability to breathe. In this case the respiration will imperceptibly get more and more sub-optimal, caused by a decreased lung-volume and so negatively affecting the level of oxygen supply to the body [27].

This C-shaped posture will also imply that the distance to the working area will increase, because if this lean-back-posture is slouching more and more backwards, the shoulder-girdle is relatively doing the same, so the arms must come further forwards.

This is called compensatory protraction, when, as mentioned before, it is impossible to move the arms independently of each other. In this case the head-equilibrium- musculature is involved in the action and obstructing the movement of arms and hands. This in its turn will lead to a compensating

Shortening of the most important arm-movement-supporting- muscles (Mm. Pectorales Majores and Minores) and an antero-position of the head. The antero-position of the head may easily cause a diminishing blood-circulation and stimuli-conduction of arms and hands because of the increase of pressure in- and structure of the Scalene muscles (*Figure 16)*.

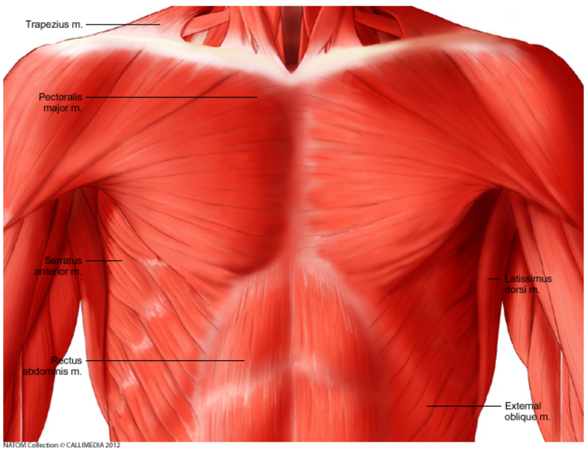


Figure 16. *Increase of pressure in- and structure of the Scalene muscles.*

Several important relations are getting clear; the fixation of the cervical spine will have its repercussions on several functions:

a: The sense of equilibrium or balance of man is accounted for by the information from the nerves of the eyes (orientation on the absolute Horizontal) and the eye-movement system, the balancing organs and the Medulla Oblongata.

This proprioceptive sense of equilibrium is coordinated in the Cerebellum. Nociceptive stimulation of one of these balance-related information influxes may have an influence on all the structures participating in the propriocepsis [27].

b: The fixation of the cervical spine may also have its repercussion on the masticatory system of the dentist.

Mouth-opening and – closing musculature is innervated by the N. Trigeminus, N. Facialis (Cranial Nervi) and the Ansa Cervicalis, a loop of nerve-bundles emerging ventrally from the first, second and third cervical vertebrae.

The fine motor-movements of the masticatory muscles however, are coordinated in the Cerebellum. Bending too far forwards will cause a changed position of the lower jaw; this will in its turn bring on a change in the effect of the gravitation on the lower jaw and its adjoining structures. This too, is a change of propriocepsis, inducing hyper-activity of the masticatory system, because in most cases one prefers to work with one's mouth closed [11, 17,19,27].

Working symmetrically with one's head in a flexed position may induce fixation of the lower jaw in occlusion (clenching during working). One-sided clenching or gnashing will occur in case of a combination of flexion and rotation of the head [28] (*Figure 17)*.

Figure 17. *Combination of flexion and rotation of the head.*

The description of the implicated problematic swallowing and the possible origin of too short a focus- distance between eyes and working-area, are left out by the authors of this article because of its different subject-matter.

Shifting the saddle- chair when sitting on it is only possible with the aid of the lower- legs and lumbar spine, because the fixed position of the upper -legs are hampering the freedom of movement of the legs. This will lead to overloading the sacro-iliacal joints.

In all descriptions of postural changes symmetrical positions are described, working at the chair can cause asymmetrical influences when using the foot pedal.

By moving about one lower-leg to position the working-chair, and using the other leg to use the foot-pedal, a left-right difference will arise in the fixation of the upper-legs, exerting an influence on the position of the pelvis. In this case the kinetic chain of movements is going to show its compensatory ability, because a -symmetrical position of the seat-bones will impose an a-symmetrical load on the sacro-iliacal- joints, inducing a compensatory rotation of the lumbar spine.

The forces developing on a lumbar level by operating the foot-pedal are described in Caroline Gerhard's thesis [29]. As appears from this thesis, several types of foot-pedals have consequences for the load on the back. The problem of this research is, however, that the sitting-position is not defined and the experimental subjects are sitting on the edge of a traditional working-chair.

Positive and Negative Aspects of the Use of a Saddle-Chair in Dentistry

The positive aspects of the saddle-chair- compared to the traditional, straight working-chairs in the dental surgery are:

- The user cannot slide off the seat.
- It is possible to sit higher than the length of the lower-leg.
- An apparent advantage for the dental assistant is the possibility to make swift, rotating movements, but these are compensated unfavourably in the lower back.

The disadvantages of the saddle-chair however outnumber its benefits. The most important disadvantages are:

- The permanent fixation of the upper-legs and the fixed stabilisation of the feet on the floor, resulting in a hyper-lordotic lumbar change in the position of the spine.
- The shape of the saddle-seat induces the upper-body to bend far more forward than acceptable according to the ISO-standard, resulting in physiological reactive mechanisms. Moreover, the necessary flexion of the head will lead to a second flexion in the spine on a high cervical level, disturbing he sensory information.
- The compensations in the kinetic chain of movements will irrevocably lead to its over-burdening, resulting in complaints in the right - and left-hand side of the upper body. (spine, neck, shoulders, arms, hands).
- The deflection of the lower jaw will lead to serious dysfunction (s) of the masticatory system. Most practitioners fail to recognize these functions as being the result of an incorrect sitting posture.
- The lack of pelvic support; meaning a support with its point of impact on the Crista Iliaca Superior Posterior and thus sparing the back and the back-musculature.
- Operating the foot-pedal induces shifting the seat-bones and in consequence shifting and overloading the sacro-iliacal- joints and the lower back.

In the article "Das perpetuum Mobile der Muskel – Skelett-Beschwerden" Engels and Hokwerda describe the vision on the sitting-posture according to the latest ergonomic viewpoints [2].

The conclusion is, that a working-chair must have a bipartite seating area; a short horizontal part at the back to be able to sit on the seat-bones, and a sloping-down frontal part supporting the upper-legs. In this case the freedom of movement of the upper- as well as the lower- legs is practically fully sustained.

Moreover, a working-chair must be provided with a pelvic rest, exclusively supporting the Crista Iliaca Anterior Superior. This principle differs from that of the backrest put against a bigger part of the back, thus inducing more pressure on the muscles or muscles and spine [30].

The pelvic rest should enable the body continually to get into- and hold the correct (ted) body-posture.

These findings are methodologically confirmed in a survey by Mieke de Bruyne [31,32].

Conclusion

A saddle is to be used on horseback, not in a dental surgery.

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