



Optimized work posture and dynamic sitting induced by a work chair equipped with separated twin backs

Dynamic Sitting

Humans are dynamic beings. Originally, they led active lives as hunters or gatherers. However, they had to undergo a fundamental change in their way of life as their anatomical structure was not able to fully adapt to the activity pattern brought up by the emergence of our advanced state of civilization.

Rough patterns of activities as hunters or gatherers changed gradually to precise activities as skills and technical abilities were required for handicrafts. As society became complex, necessitating the emergence of new jobs, some people engaging in a particular group of jobs were exposed to a burden that was difficult to carry. This burden existed in a variety of forms as illustrated by the motions of the workers engaging in carpentry, pottery, smithy, goldsmithery and silversmithery.

In particular, office workers and those engaging in commerce and trade increased gradually. Presently, two thirds of all workers are performing their duties while maintaining a sitting position. Consequently, many of these workers have complained of pain in their heads, necks or backs caused by monotonous work postures.

However, it is impossible to perform the daily routine of office work in a standing position, and working in a standing position will not be a practical way to fundamentally change the sitting-down working environment. For this reason, optimizing the sitting position can be the best way to cope with problems arising due to sitting posture. To develop a sitting position based on a fixed sitting pattern, conventional rigid chairs should no longer be used. Observing people's sitting posture revealed that they frequently change their positions in order to

Duoback satisfies the DIN 4551 requirements in their entirety. It is a revolving chair composed of 6 bases with or without wheels and a height-adjustable middle shaft

The seat of the chair is similar to that of conventional office chairs and slopes gently toward the back.

The striking thing about the chair at first sight is that it has separated twin backs with a cushion made in the shape of a half dish, which hangs flexibly at the adjustable T-shape fixing rod.

The twin backs in the shape of a half dish are about 38.5 cm long and 20 cm wide and have rounded corners. The twin

prevent fatigue.

The rigid bench found in the church seemed to serve the purpose in its own way. However, it would be beyond imagination that workers working in a sitting position for more than 8 hours per day should be provided with that kind of chair. Conversely, sitting on a sofa might look comfortable, but you may imagine how uncomfortable it would be if the person in it has to lean forward just to take hold of a cup.

Sitting in an optimized posture in the workplace should vary depending on the working environment. Numerous chairs have already been on the market with the slogan 'We provide the optimized posture'. However, most of the people using that chair, despite their slogans and attractive chair design, complain of neck and back pain when they sit in it for long hours. Using the wrong chair and the resulting muscle stress and fatigue after work are likely to cause long-lasting loss of work ability.

For this reason, the minimum requirements for office chairs should be as follows:

1. The back of the office chairs should be able to comfortably support the user for a long time while sitting in them.
2. The user should be able to lean forward or backward while sitting in them, ensuring sufficient support and safety in all circumstances.
3. Office chairs should ensure safety in all circumstances.

Duoback, a new type of office chair with separated twin backs, was evaluated for a period between May and September, 1990.

The evaluation results are as follows:

backs curve outwards in the middle when seen from the vertical axis, and they curve inwards in the middle when seen from the horizontal axis. Metal and the material combined with rubber were used to fasten the twin backs to the T-shape fixing rod. Such fastening allows motions just like the condyloid joint motion. The twin backs automatically return to the original position if the load is eliminated. The height of the T-shape rod for fixing twin backs can be adjusted or fixed.

Also, the fixing rod's angle can be adjusted or fixed as well. If necessary, this fixing rod can be flexibly fixed using the basic angle set individually beforehand. All knobs enabling

such mode adjustment are easily accessible to the users while sitting on the chair.

Equipped with separated new twin backs, is Duoback providing a safe, relaxed and comfortable work environment?

To answer this question, we have examined all the standards employed by the research lab.

Research lab's testing of Duoback

Test standards applied are as follows:

1. Supporting of the pelvis when leaning forward or backward
2. Supporting of the back when sitting in a upright posture and leaning backward
3. Supporting of the chest when sitting in a upright posture and leaning backward
4. The extent of the twin backs' adaptation to changes in posture

Those tested were the patients being treated by me with the physical build ranging from a height of 150cm and a weight of 40kg to a height of 190cm and a weight of 129kg. Consequently, it was possible to perform the test on people with varying physical builds.

Modern office chairs should allow the user to comfortably lean forward or backward. Supporting of the pelvis should be sufficiently accomplished when leaning forward or backward so that such supporting prevents the lumbar vertebra from being too upright.

Upon superficial observation, Duoback's twin backs appear very unstable. Fastening of the twin backs in the shape of a half dish allows the condyloid joint to move. The twin backs can lean forward or backward in a large way with the horizontal axis being the center of such movement. Also, the twin backs can rotate in a big way with the vertical axis being the center of rotation.

Such motion can be observed only with empty chairs.

The test subject leaning against the twin back will immediately induce the twin backs' adaptation of sticking fast, conforming to the shape of the test subject's body. All you have to do is to check whether the height of the twin backs is properly adjusted in accordance with the test subject's height. Shoulder blade trouble (resulting from the height of the twin backs being adjusted too high) or lordosis of the lumbar vertebra (resulting from the height of the twin backs being adjusted too low) should be avoided. It is very effective to adjust the capability to conform to various shapes of the upper half of the body. The standards mentioned above were examined with individual work postures considered in the process.

Sitting in an upright posture



The separated twin backs do not directly put pressure on the neural spine. Supporting of the chest and the lumbar vertebra is accomplished by a bulge of the erector spinae muscles, and supporting of the lumbar vertebra is accomplished by the innominate bone underneath the skin. If the chair is properly adjusted, the lower end of the twin backs is placed about 8 to 9 cm above the seat of the chair. The twin backs in the shape of a half dish curve inwards in the middle when seen from the horizontal axis, and they curve outwards in the middle when seen from the vertical axis. For this reason, superb adaptation conforming to the shape of the body can be achieved for sitting in an upright posture. Supporting of the upper end of the rear side of the pelvic bone can be best accomplished by the lower part of the twin backs. There will be no direct pressure working on the sacrum. Consequently, support for the upper part of the pelvis (18 to 24cm above the seat of the chair) as well as support for the upper part of the entire innominate bone can both be accomplished.

In this way, there will be no excessive pressure working on any one part of the body. For the upper part of the pelvis, each of the twin backs in the shape of a half dish rotating around the vertical axis will adapt well to the chest, conforming to the contours of the soft part of the erector spinae muscles. For a very skinny female, sitting on the chair would appear as if her entire chest were wrapped with the twin dishes, and for an athlete with a broad back, the center line for each of the twin backs will get closer to the erector spinae muscles. In this way, whether it be a female or a skinny male, stable support can be ensured. For an athlete with the broad back as, the erector spinae muscles will be effectively stimulated.

Sitting in a leaning backward posture



In the course of performing varied work processes or during a break, sitting in a posture leaning backward is commonly required.

Today, leaning backward is considered a normal work posture for typing work, especially activities involving computer work.

In general, this work posture takes the form of a posture in which you sit leaning backward with your pelvis slightly pushed inward. Here, conventional chairs are not able to provide support for the lower part of the spinal column and the pelvis. Instead, they provide support for the upper part of the lumbar vertebra and part of the thoracic vertebrae, increasing risk factors. Most drivers, from their own experience, are well aware of the pain and discomfort caused by this sitting posture. Usually, placing a cushion onto the sacrum will relieve such pain. Flexibility of the twin backs proved to be an essential strong point when testing the leaning-backward posture in the test laboratory.

The twin backs tend to conform to the inclination of the body. If the upper part of the body leans backward, part of the twin back above the fixing point will lean backward with the lower part of the turning axis rotating in the direction of the abdominal region. In 1914, Lorenz (2) already proposed similar principles, using the 2 lever backs designed to prevent kyphosis, a symptom likely to occur if sitting for a long time. By installing 2 separated twin backs and fixing them separately, the twin backs can move independently from each other, thus optimizing such principles. The twin backs are brought into contact with the upper end of the pelvis as if wrapping up the lower part of the user's back, even when the pelvis is pushed outwards in a big way. The upper end of the twin backs is finished with added softness, and it can serve as an excellent support when leaning backward almost to the limit or stretching your body with raised hands to straighten your backbone.

Enormous nerve stimulation, as when the legs and arms are stretched, takes place in this process, clearing the mind. Because the entire chest is wrapped with dishes, greater safety is provided along with enhanced stability. It is impossible for the back of the body to slip sideways, and this is an important strong point when leaning backward to the limit, i.e. virtually lying down.

Leaning-forward posture



The leaning-forward posture is frequently seen in the office when reading or writing. This sitting posture receives no

help from the back of conventional chairs. However, in the case of the "Duoback" chair, the twin backs automatically conform to the contours of the back of the body, even when the pelvis and the upper body are leaning forward without changing the position of the pelvis. Also, support for the lumbar vertebra and sideways wrapping of the back of the body, not to mention pelvis support, can be retained. If the pelvis is moved backward a little further, pressure working on the innominate bone and the resulting pelvis support, as well as the pressure on the lumbar vertebra resulting from leverage, will increase simultaneously. A sense of safety and stability is provided to the upper part of the lumbar vertebra and the lower part of the thoracic vertebrae through mild stimulation arising from the cushioning effect of the twin backs.

Changing posture

Among the postures not observed, the important thing was the conversion of one posture into another and continuous change in a given posture rather than the theoretical basic form of each posture. The twin backs are ideally fastened, enabling perfect support for the necessary back region for all postures.

However, the strongest point is its adaptability to the unbalanced postures originating from the fact that there are left-handed and right-handed people in the world; imbalance is an essential element that forms human motion. Right-handed people differ from left-handed people in the way they sit in chairs, and they have a different working range in their arm movement. In the postures of leaning backward and forward, there can be a kinked thorax, which is accommodated by the twin backs without losing their supporting ability. When you throw an arm over the twin backs to let it hang to rest a while, this will make you sit sideways at an angle of about 45 degrees. Even at such an angle, the twin backs will still be able to provide ideal support. In short, "Duoback" chairs can give you genuine freedom when sitting; you can sit in whatever way you want.

Even when you sit in a posture tilted to one side, the dishes of the twin backs have proved to be capable of accommodating the entire thorax, allowing you to sit in perfect comfort.

If leaning backward to the limit, i.e. placing the feet on the desk to rest for a while or to read computer books, is what you expect from an office chair, you will have no problem with the "Duoback" chair. The same is true even when the pelvis is pushed outwards in a big way.

No sitting posture can give you comfort if it lasts without change for a long time. For this reason, we know humans are made to change their postures continuously for dynamic sitting. Leaning forward, backward, or sideways poses no problem for the "Duoback" chair; its excellent adaptability provides a never-changing support capability. The results of the test performed at the research lab revealed that the "Duoback" chair successfully satisfied all the requirements of modern office chairs set by Schoberth(3). Particularly, this chair fully supports dynamic sitting and allows the conversion of one posture into another with ease. Such strong points serve as the definite reason why "Duoback"

should be the best choice for those engaging in job activities that involve sitting in different postures.

Test performed in the work environment

Upon completion of the test performed in the research lab, testing of the “Duoback” chair was conducted in various work places. Occupations that were the subjects in the test are as follows:

- Nurse
- Novelist
- Electrician
- Designer
- Telephone Operator
- Accountant

My grateful acknowledgment goes to my patients who were willing to serve as subjects in the test, and to Durativ in Hamburg and Vega in Schiltach, who generously offered an opportunity to conduct the test within their workplace.

They accepted the “Duoback” chair promptly and without hesitation, and they felt comfortable when sitting in the chair to work. Briefed on the height/angle-adjustable seat, they willingly used the adjustable seat. However, they seldom used the twin backs’ elasticity control function. All the test subjects unanimously pointed out that a comfortable resting posture and genuine freedom of sitting (you can sit in whatever way you want) were two major strong points. Also sitting in a posture tilted to one side with your legs crossed or leaning backward almost to the limit were the things they liked most about “Duoback”, though they considered such a posture rather weird.

The test posed no problem; subjects experienced no difficulty or pain during the test. Suggestions for improvement were limited to the seat of the chair. In two work places (accounting and electronic assembly), the test was performed with the arm rest L8 installed. The purpose of the arm rest and its special meaning were previously described by Berbuer(1).

This arm rest was used when sitting in an upright posture or leaning slightly backward for computer work, and it received a favorable assessment.

No problem was posed when turning the arm rest for other types of work, nor did it limit Duoback’s capability to convert one posture into another.



Conclusion

Based on the experience in the research lab and the test performed in the workplace, we concluded that Duoback met all the requirements expected from modern office chairs.

With Duoback, users are able to convert from one work posture to another without any problem. Duoback provides safety and support even when users convert one posture into another frequently and unconsciously, enabling dynamic sitting. Duoback provides supporting properly and securely by wrapping the body as if with the dishes and conforming to the contour and the height of the body. Particularly, the pelvis can be properly supported with no discomfort felt by the user in a range of postures, from heavily leaning forward to excessively leaning backward, while preventing the pelvis from becoming excessively inclined or going into an upright position.

Considering the shape of the twin backs, Duoback is suitable for use in all types of offices, including computer rooms, meeting rooms, or directors’ offices. Duoback is able to support extreme movements in all sitting postures and provides perfect support for the body while ensuring freedom for movement of the arms. With the successful development of the Duoback chair, the practicability of dynamic sitting has improved greatly. As a result, Duoback users are able to enjoy comfort and good health in their work environments.



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