

# An Attempt to Improve the Sitting Posture of Children in the Classrooms

Keiko Ishihara, Kazuo Dake, Tomoki Kashihara and Shigekazu Ishihara

**Abstract**—We sought to improve the sitting postures of children studying in the classrooms of a primary school. We made the seat of a standard chair lower and attached a cushion designed by one of the authors. The cushion is cut at a 25° downward angle toward the legs to allow the users to support their weight with their feet and alleviate pressure on the underside of the thighs. We also lowered the desktop to below the height of children’s elbows. Eighty-three children were given the new chairs and desks, and they were observed over 7 months. Around 10 % of them voluntarily maintained good sitting postures; others straightened their postures when the teachers reminded them to do so.

**Index Terms**—Chair, Observation, Schoolchildren, Sitting posture.

## I. INTRODUCTION

The authors consider that it is important that school children sit in a good posture during their classes. Reasons include that good sitting posture encourage a good pencil grip leading to efficient writing. Additionally, acquiring the habit of a proper sitting position can prevent lower back pain and health problem in the adult life. Thus, we reexamined desks and chairs in school classrooms.

Since March 2008, we have confirmed that using a cushion placed on the flat seat of an inexpensive chair is effective in making adult users improve their sitting posture. The cushion, named the “Zen Cushion,” was designed by Dake, one of the authors from an idea that arose when using a cushion during *Zen* meditation. Here, we report our attempts to improve the sitting postures of schoolchildren during classes using Zen Cushions.

## II. EFFECTS OF THE ZEN CUSHION ON IMPROVING SITTING POSTURE

The Zen Cushion has a unique shape to encourage a novel

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manner of maintaining the user’s sitting posture. The cushion is cut at a 25° downward angle toward the legs to let the users use their feet to support their weight and to alleviate pressure on the underside of the thighs (Fig. 1). The sides of the top are rounded to allow the user to sway his or her hips to either side to relax the lower back.



Figure 1. Zen Cushion.

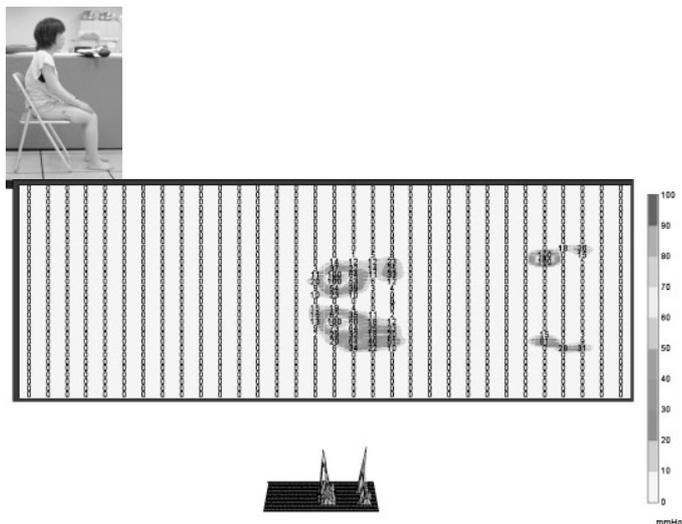
Ishihara *et al.* (2009) studied its effect from the perspective of body pressure distribution and simulated loading of the lower back lumbar spine using a human biomechanics model based on sitting posture measurements in participants who were university students [1].

### A. Distribution of Body Pressure

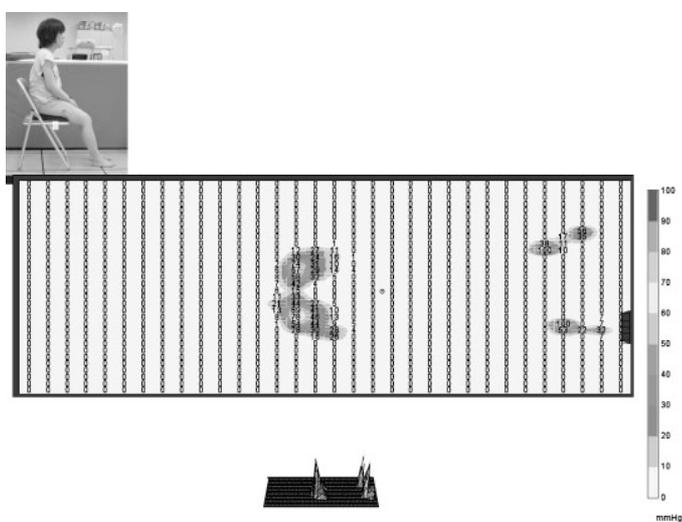
The participant was a 21-year-old woman, 148 cm tall, weighting 44 kg. Three chairs were used to compare the pressure mapping of the participant’s lower body with and without the cushion. A simple stool, a folding chair, and a standard office chair were used. Pressure-mapping sensor sheets (FSA 4.0; Vista Medical) were placed on the seat and on the floor. Pressure was measured for each type of chair while the participant sat on the seat wearing no shoes.

Figure 2 shows the pressure mappings. When the subject sat directly on the seat without the cushion, the body pressure was centered mainly on the ischial bone and spread over the underside of the thighs. Most of the body weight was supported by the buttocks. However, when the subject used the cushion, the body pressure was dispersed over a wider area, and some load was placed on the feet. The effect was most pronounced for the stool and the folding chair.

Concerning the sitting posture, the spine was curved forward when the participant sat directly on the seat; this was extended when using the cushion. This effect was also most pronounced for the stool and the folding chair.



(a) Folding chair with no cushion.



(b) Folding chair with the cushion.

Figure 2. Pressure mapping.

### B. Simulated Loads on the Lower Back (Lumbar Spine)

Twenty-eight people, 19 men and 9 women, aged 20–24 years participated in this test. Their average height was 165.6 cm (SD 7.2 cm) and their average weight was 60.7 kg (SD 11.0 kg). We used the folding chair because it showed a pronounced pressure distribution effect in the first test and because folding chairs are commonly used in meetings and lectures. The participants' sitting postures were compared with and without the cushion on the seat.

The participants were required to sit directly on the seat and then on the cushion on the seat while not wearing shoes. They were asked to adopt the posture they would naturally adopt if attending class or a meeting. A researcher took photos of each participant to measure the joint angles after putting markers on the acromions, knees, and greater trochanters. Front, left, right, and overhead photos were taken of each participant. The horizontal and vertical angles of the forearms, upper arms, wrists, upper and lower legs, ankles, trunk flexion, axial rotation, and lateral bending were measured from the photos.

The simulated load on the lower back (lumbar spine, L4/L5) was reduced for 19 of the 28 participants when they

used the cushion. The simulated load for all participants when using the cushion compared with not using the cushion were normally distributed ( $p = 0.9044$ ,  $W = 0.982450$ , Shapiro-Wilk W-test), and the average value was 93.8%. A histogram of the ratio is shown in Fig. 5. We concluded that the cushion reduced the load on the lower back, as well as the pressure on the ischial bones and the undersides of the thighs.

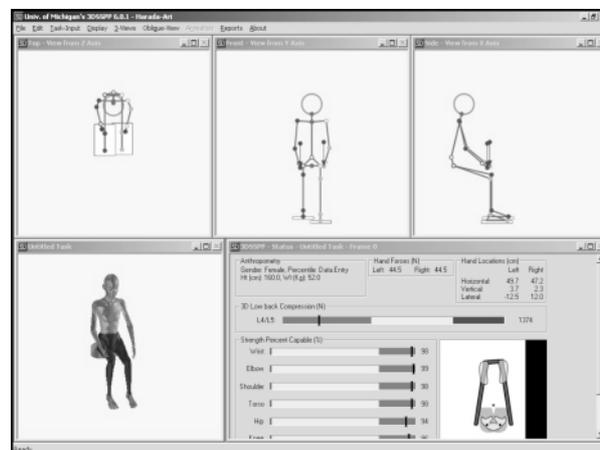


Figure 3. A snapshot of the simulator, 3D SSPP.

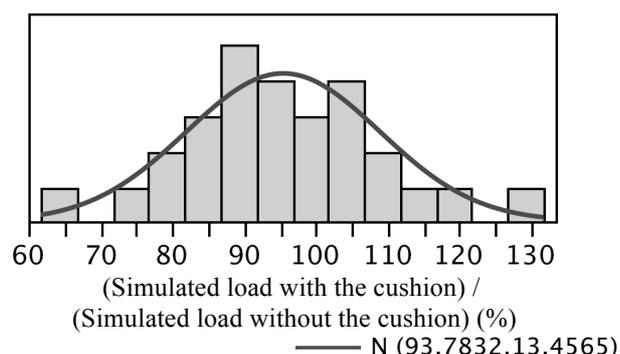


Figure 4. Ratio of the simulated load on L4/L5.

### III. INTRODUCTION OF ZEN CUSHIONS IN CLASSROOMS OF A PRIMARY SCHOOL

Considering the results described above, we expected that schoolchildren could also improve their sitting posture by using Zen Cushions during classes.

#### A. Research Team

Mr. Kashihara, the principal of Tadanoumi-Nishi Primary School in Takehara city, Hiroshima asked teachers and children to cooperate. Mr. Dake, the designer of the Zen Cushion offered the cushions and installed them in three classrooms. The two authors observed and recorded the children's sitting positions. Dr. Ishihara advised and explained the importance of good posture and the aim of this study to teachers and parents at the school.

#### B. Installation of Cushions in the Classrooms

In February 2009, the researchers, teachers and parents installed Zen Cushions in three classrooms for first- to third-grade children. We lowered the seat of the standard chair and fixed a cushion to the seat. The top of a standard desk was also lowered so that the user's elbows were higher

than or level with the top. We show the installation in Fig. 5. We found that users could sit firmly with straightened backs by placing their feet on the floor.



(a) Installation of Zen Cushion in the classroom.



(b) Chairs and desks with installation completed.



(c) Users of the new chairs.

Figure 5. Installation of Zen Cushions in classrooms.

### C. Method of Observation

Mr. Kashihara and Mr. Dake observed and took photos of the children sitting in the class about once a month. It was a novelty for the school to admit outside people into classes except for regular parent visits.

The children were not provided with explicit instructions regarding the cushion, because the Principal considered that if the cushion had merit, children would use it appropriately by themselves. Classroom teachers occasionally advised children to maintain a good posture.

## IV. RESULTS

The positions of children who used the cushion are described below.

### A. Day after Installation (February, 2009)

Children sat on the chairs with the cushion with no instruction. We found some of them sat on the front of the seat leaning into the back of the chair, or sat on the rear of the seat with round low backs. Some other children were also found sitting with straightened backs (Fig. 6).



(a) Second-grade children.



(b) Third-grade children.

Figure 6. Positions on day after installation.

### B. Just after Advise about Posture (February, 2009)

On the second day after the installation, the principal advised all children at a meeting to maintain proper postures and to strengthen their bodies. After that, most children were found sitting in their chairs with straightened backs. We found, however that at lunchtime, many children were sitting relaxed with rounded low backs and knees bent under their chairs or leaning against the backs of the chairs (Fig. 7).



(a) Second-grade children.



(b) Third-grade children.

Figure 7. Position of the children just after the principal’s advice on good posture and health.

C. After the New School Year Started (June, 2009)

The new school year started in April. New pupils started to use the cushion from their first day. The new fourth-year children transferred the cushions to the new third-year children and started to use standard chairs without cushions.

The upper-grade children who used to sit on the cushion in a calligraphy class were observed. We found some of them used the writing brushes in proper grips and straightened their backs. Children who improperly used the writing brushes were typically sitting with their backs rounded. They were sitting with their legs stretched out and leaning against the chair-backs, or hanging their feet over the bar on the legs of the desks (Fig. 8).



Figure 8. Children in a calligraphy class.

D. Eight Months after Starting to Use the Cushion (November, 2009)

The first-grade children used the cushion for seven months apart from the summer vacation. We found that children who were sitting in good postures placed both feet on the floor; others with rounded backs stretched their legs forward (Fig. 9).



Figure 9. First-grade children at the end of the eighth month.

V. CONCLUSIONS

The number of children who sat in a proper posture on the Cushion was estimated based on regular observations as described in Table 1. In total, nine (11.0%) of the children usually sat with good posture without any advice; the rest (73 children, 89.0%) could adopt proper postures when reminded by teachers. No child seemed to ignore the advice about maintaining a good sitting posture.

The fact that some children came to adopt good sitting postures by themselves suggests that the Zen Cushion is effective to promoting good posture in children.

Table 1. The number of children who sat in a proper posture on the Zen Cushion.

	Usually sits properly	Sits properly with teacher’s advice	Ignores any advice
First grade (18 children)	3 (16.7%)	15 (83.3%)	0 (0.0%)
Second grade (31 children)	3 (9.7%)	28 (90.3%)	0 (0.0%)
Third grade (33 children)	3 (9.1%)	30 (90.9%)	0 (0.0%)
Total (82 children)	9 (11.0%)	73 (89.0%)	0 (0.0%)

We suggest that the Cushion can contribute to children’s maintaining good sitting postures based on the result that the youngest and most flexible children used the Cushion most effectively by themselves.

Use will likely to be more effective if teachers and families cooperate. At the present time, few children seemed to parley the effect of their good sitting posture into other activities, such as the grip of a pencil or a writing brush.

From our experience, many young people seem to think it inappropriate to sit in a proper posture in a chair. These young people have already adopted habits of leaning against the chair back or rounding their backs and bending their knees; they do not readily accept a tool for maintaining a good posture, such as the Zen Cushion.

In a further case study, we will recommend that children and teachers improve their sitting posture to strengthen their bodies, especially their abdominal muscles, because this may be easier for them to accept. We are now planning to introduce more apparent physical indices, for example, keeping body balance, strength of abdominal muscles, lung capacity and loudness of voice, to enhance their motivation.

REFERENCES

[1] K. Ishihara, K. Dake and S. Ishihara, “A Zen Cushion for better sitting posture,” Proceedings of the 17th World Congress on Ergonomics, IEA 2009 (CD-ROM).