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The integration of Ergonomics Ergo-System Framework (EESF) with the product design process in the innovation ergonomic seating support for scoliosis patients

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Abstract

Several researches in medical science have revealed that individuals who have scoliosis experience discomfort while sitting upright, leading to symptoms like leg pain, back pain, and claudication. These symptoms can limit their ability to perform certain tasks in the office. Thus, this paper utilized Ergonomics Ergo-System Framework (EESF) to design a innovative ergonomic seating support for scoliosis patients. Through the interview study conducted with a rehabilitation specialist, a physiotherapy expert, and three scoliosis patients in Malaysia, the EESF was integrated to identify patients design issues and needs. The result of solution components and design criteria obtained from the interview study highlights the parameters for the development of ergonomic seating support. The decision of innovative design of the ergonomic seating support incorporated the modular seating concept for office use, visually aesthetic with emotional design elements, and equipped with adjustable spinal support. To develop the semi-working ergonomic seating supporter concept model for future production, a design process was executed. It is hoped that the outcome of this study will contribute to demonstrating how the EESF can be utilized, integrated with the innovative product design process, and benefit scoliosis patients.

*Keywords: Ergonomics Ergo-System Framework, Design Thinking, Scoliosis, Ergo*nomic, Product Design

1. Introduction

Scoliosis is a condition that occurs in mature patients with a spinal deformity where the Cobb angle in the coronal plane is greater than 10 degrees. Aebi (2005) has classified scoliosis into four major categories. The first type, as shown in **Figure 1**, is primary degenerative scoliosis, which is primarily caused by arthritis in the discs and/or facet joints. This leads to an asymmetrical impact on those structures and typically results in back pain indications. It frequently occurs with or without symptoms associated with spinal stenosis, both central and lateral stenosis. This curvature is referred to as "de novo" scoliosis (Benner & Ehni, 1979; Epstein et al., 1979; Fowles et al., 1978; Grubb et al., 1988; Grubb & Lipscomb, 1992; Korovessis et al., 1994; McKinley et al., 1977).

The second type of scoliosis, as depicted **in Figures 2, 3,** and **4,** is progressive idiopathic scoliosis that occurs during adulthood. The thoracic and/or lumbar spine are commonly affected by this scoliosis, which continues throughout adulthood. It frequently has a connection to secondary degeneration and/or imbalance (Kostuik & Bentivoglio, 1981; Ogilvie, 1992; Sponseller et al., 1987; Winter & Lonstein, 1983).

The third type of scoliosis, illustrated in Figure 5, is secondary degenerative scoliosis. It can develop as follows: (a) It may develop when a person has idiopathic, or another kind of scoliosis, or due to a pelvic obliquity caused by hip pathology, an imbalance in leg length or a lumbosacral transitional malformation. This scoliosis type o is mainly found in the thoracolumbar, lumbar, or lumbosacral spine. (b) Scoliosis can also be caused by metabolic bone disease, such as asymmetric, osteoporosis, arthritic disease, and/or spinal fractures (Bradford et

al., 1999; Deyo et al., 1992; Healey & Lane, 1985; Robin et al., 1982; Velis et al., 1988)

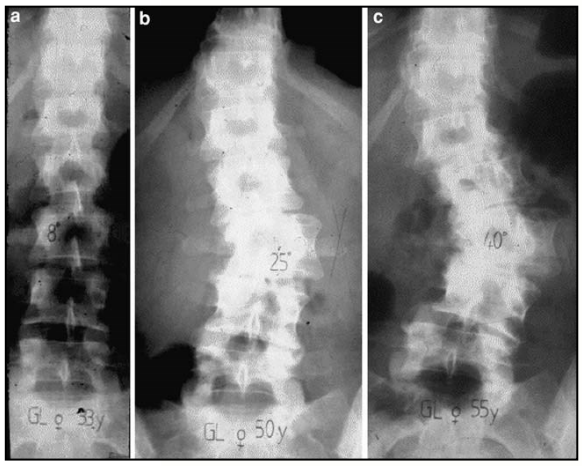

Figure 1. De novo scoliosis (type 1 adult scoliosis). **(a)** age 33 (8 degrees), **(b)** age 50 (25 degrees), and **(c)** age 55 (40 degrees), adopted from Aebi (2005).

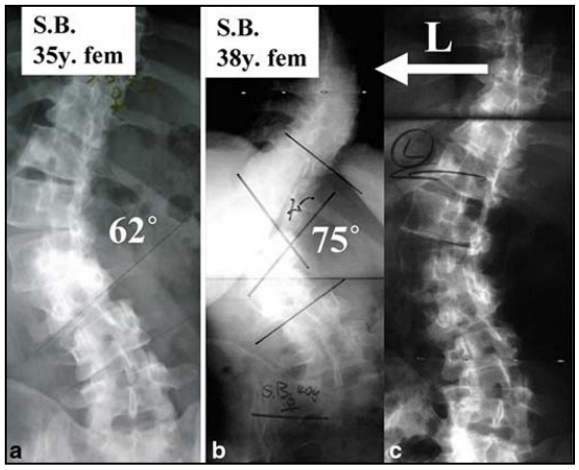

Figure 2. A young female with progressing idiopathic scoliosis occurred in adult life (type 2 scoliosis). **(a)** 62 degrees at age 35 **(b)** advanced to 75 degrees at age 38, and **(c)** left bending with minor correction, adopted from Aebi (2005).

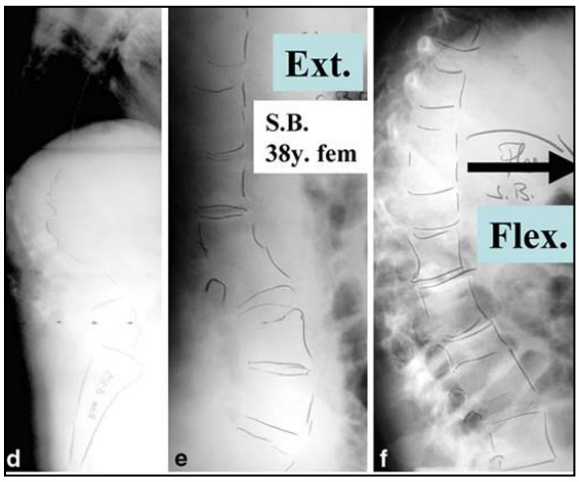

Figure 3. A young female with progressing idiopathic scoliosis occurred in adults. (type 2 scoliosis) **(d)** severe lumbar kyphosis; **(e)** partial extension correction; **(f)** thoracic spine flexion, adopted from Aebi (2005)

Figure 4. A young female with progressive idiopathic scoliosis occurred in adulthood (type 2). **(g) and (h)** 18 months post-operation, adopted from Aebi (2005).