



6th International Conference on Applied Human Factors and Ergonomics (AHFE 2015) and the
Affiliated Conferences, AHFE 2015

Automated decompression table for the individual and targeted treatment of disc herniation

Ulf Müller, Kim-Hoa Huynh*, Nico Feller, Michael Schiffmann, Sebastian Kamp

Laboratory of Manufacturing Systems, Cologne University of Applied Sciences, 50679 Cologne, Germany

Abstract

Traction therapy is a common and effective non-surgical treatment of low back pain caused by degenerated or herniated intervertebral disc or other disc deformities. While lying on specially designed treatment tables and fixated on the pelvis, axial traction is applied to the patient's spine to separate the vertebrae and release pressure on the disc. Targeted traction of specific segments instead of pulling the whole spine can increase the efficacy of the traction therapy and reduces side effects due to less application of traction force. This paper presents a design approach of a traction table, which allows the targeted and accurate repeatable treatment of any specific intervertebral disc. Furthermore the treatment of malformations like scoliosis is possible due to the special design of the traction table. The automated measuring of the patient's back on the traction table enables the accurate and effective resp. ergonomic treatment of the patient by the comparison of MRI images and the measured spine shape.

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Peer-review under responsibility of AHFE Conference

Keywords: Decompression table; Disc herniation; Low-back pain; Non-surgical treatment

1. Introduction

Back pain is one of the most common health complaints nowadays. Especially high physical stress such as lifting and carrying of heavy loads, frequent bent-over work or other posture harming activities cause painful complaints in the lower back region. This low back pain is often attributed to degenerated or herniated intervertebral disks due to the overstress of the spine.

* Corresponding author.
E-mail address: kim-hoa.huynh@fh-koeln.de

The treatment of chronic low back pain can either happen through a surgery of the damaged spine segment, e.g. by open discectomy of the intervertebral disc, or by non-surgical methods like spinal manipulation. Chiropractors and physical therapist perform adjustments to the spine with the goal of correcting alignment problems what leads to alleviation of the patient's back pain. A common non-invasive method to treat low back pain is the stretching of the spine to separate the patient's vertebrae. By this means pressure on the disc is released and an elongation of the degenerated disc is performed. The herniated disc moves back to its normal position between the vertebrae and whereby pressure is taken off the nerves what alleviates the pain.

Physical therapists perform traction of the spine with specially designed and sectioned traction tables. The patient, who lies in supine or prone position on the treatment table, is harnessed on the pelvis while the movable part of the table slowly moves in linear direction. That way axial traction force is applied to the patient's spine what separates the vertebrae.

The application of dynamic, intermittent traction to the spine by pulling and releasing the vertebrae creates pressure differentials in the disc. This reduces the intradiscal pressure [1] and stimulates the diffusion of fluid and nutrients what helps the disc to heal and reshape to its natural height [2]. Distraction of the spine leads to decompression of the degenerated disc. Spinal decompression by distraction is a common and effective and approved type of spinal treatment and is performed by many practitioners to relieve low back pain.

Spine therapy on traction tables requires the manually adjustment of the patient's treatment position by the physical therapist. The therapist has to locate the exact position of the damaged disc to adjust the patient accurately on the traction table and perform an effective traction treatment. Due to differences in body shape such as height and formation of the spine, sufficient efficacy is only achieved through individual and adequate treatment of the spine. Therefore back pain therapy by the use of a traction table has to be individual and ergonomic to get the best benefit of spinal manipulation.

2. Objective

Spine therapy with current traction tables does not fulfill the requirements of an individual and ergonomic treatment due to the patient's differences in body shape. Most traction and distraction tables only allow the treatment of patients of an average population, i.e. only patients with ordinary spine shape are treated properly. Patients with different spine shape in the coronal and sagittal plane, e.g. kyphosis or scoliosis cannot be treated adequately with usual traction tables.

An individually adjustable distraction table for the treatment of back pain due to degenerated disc or spinal malformation increases the efficacy and ergonomics of the distraction therapy. By the targeted treatment of a spinal segment, traction force is only applied on the affected part of the spine instead of pulling the whole spine. As a result side effects are reduced.

For that reason a new design of a distraction table is developed that enables the treatment of the spine in the coronal and in the sagittal plane of diseases like scoliosis. To perform a targeted treatment of the specific spinal segment, the position of the affected disc has to be located. Current distraction tables require the manually localization of the damaged disc by the physical therapist to adjust the distraction table to perform targeted treatment. With the help of an automated measurement of the patient's spine the physical and data processing by the traction apparatus the therapist is capable to adjust the distraction table on the basis of the measuring data and find the optimal treatment posture. By this means, sufficient efficacy of the traction therapy is achieved.

3. Design approach

In this paper a design approach of a patient-individual and ergonomic distraction table is presented.

The new developed distraction table comprises the automated measuring of the patient's spine by the means of an integrated measuring system together with a multi-dimensionally adjustable lying surface to perform patient-individual treatment. While lying in supine position on the distraction table the patient's back is measured by a tactile measuring device, which moves along the vertebrae and records the curvature of the spine. The measurement data is processed by the software, which creates a curve of the spine. With the help of the image of the particular

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