The Effect of Corset on Walking Time in Lumbar Spinal Stenosis

Lomber Spinal Stenozda Korsenin Yürüme Süresi Üzerine Etkisi

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ABSTRACT Objective: To investigate the quantitative effects of lumbar corset used in lumbar spinal stenosis (LSS) on walking time. **Material and Methods:** The study population comprised 70 LSS patients with a mean age (±SD) of 59.23 ± 5.90 years. The equipment included a treadmill, unloading station and lumbar corsets. All patients were made to walk on a treadmill with 0-degree inclination at a speed of 1.2 km/h. During this walk, a system was available that could reduce the body weight by 20 or 25%. The patients walked five times as follows: without corset, with elastic woolen corset, with lumbar corset and with either 20 or 25% reduction in body weight. Symptom initiation time (SIT), and total walking time (TWT) were recorded. Statistical evaluations were performed with the software program SPSS 11.0. **Results:** As a result of walking with lumbar corset SIT and TWT were significantly longer compared to walking without corset ($p< 0.001$). The use of lumbar corset had a similar effect to that of 20% body weight reduction and lengthened the total walking time by reducing mechanical weight bearing. **Conclusion:** Lumbar corset increases SIT and TWT in patients with lumbar spinal stenosis. It is beneficial for symptoms similar to that obtained by 20% body weight reduction.

Key Words: Spinal stenoz; walking

ÖZET Amaç: Bu çalışma ile lomber spinal stenoz (LSS) durumunda kullanılan lomber korsenin, hastaların yürüme süreleri üzerine olan etkisinin kantitatif olarak değerlendirilmesi amaçlanmıştır. **Gereç ve Yöntemler:** Çalışmaya yaş ortalaması (±SD) 59.23 ± 5.90 yıl olan 70 LSS'li hasta alındı. Çalışma araçları yürüme bandı, yük alma istasyonu ve lomber korse idi. Tüm hastalar 0 derecelik eğimde, 1.2 km/sa hızda yürüme bandında yürütüldü. Yürüme sırasında vücut ağırlığını %20 ve %25 oranında azaltabilecek bir sistem mevcuttu. Hastalar; korsesiz, elastik yün korseyle, lomber korseyle ve vücut ağırlığının %20 veya %25'i azaltılarak beş kez yürütüldü. Çalışma sırasında semptom başlama zamanı (SBZ) ve toplam yürüme zamanı (TYZ) kaydedildi. Bulguların istatistiksel değerlendirilmesi SPSS Windows 11.0 versiyonu paket programı ile yapıldı **Bulgular:** Lomber korse ile yürüme sonucunda SBZ ve TYZ, korsesiz yürüme ile elde edilenden anlamlı derecede daha uzun bulundu ($p< 0.001$). Lomber korse kullanımı, vücut ağırlığının %20'sinin azaltılmasıyla elde edilen etkiye benzer bir değerde mekanik yüklenmeyi azaltarak yürüme süresini artırdı. **Sonuç:** Lomber korse, lomber spinal stenozlu hastalarda SBZ ve TYZ'leri artırmaktadır. Lomber korse, semptomlar üzerinde, vücut ağırlığının %20'sinin azaltılmasıyla elde edilen etkiye benzer bir fayda sağlamaktadır.

Anahtar Kelimeler: Spinal stenosis; yürüme

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Degenerative lumbar spinal stenosis (LSS) is the narrowing of the lumbar spinal canal, nerve root canal or intervertebral foramen due to different causes.[1] Most frequently observed classical clinical sign of LSS is neurogenic claudication (NC).[2,3] Congenital malformations,

developmental defects, degenerative changes, spondylolisthesis, postoperative scars, lumbar disc hernia or any possible combination of these factors can all play a role in the etiology of LSS.[1-6] In LSS pathology, there are dynamic components as well as structural factors.[7] Such dynamic factors are extension posture resulting in the narrowing of the spinal canal and axial weight bearing. A study has demonstrated that narrowing due to axial weight bearing is more common than narrowing due to extension posture.[8]

In the treatment of patients with back pain, there is no single form of therapy or an ideal one. This is also true for patients with LSS. Whether several techniques that are in use change the natural course of the disease or whether they are superior to each other by any means are yet to be determined.[9-12] For conservative treatment, spinal ortheses are also being used.[13,14] However, there are only a limited number of studies on the use of corset in patients with LSS.[14] Due to the limitation in the number of studies, it is unclear whether the use of corset is effective in the treatment of LSS.

In this study, we aimed to investigate the quantitative effects of lumbar corset used in LSS on walking time.

MATERIAL AND METHODS

CLINICAL EVALUATION

All patients had degenerative central LSS confirmed by magnetic resonance imaging (MRI) with intractable NC defined as leg pain or paresthesias precipitated by walking and relieved by sitting or lying down.[3] The patient group was homogenous and NC was the only symptom. Each subject underwent a standardized examination including an assessment of subjective complaints and relevant medical history, active range of motion in the lumbar spine, lower-extremity flexibility, neurological status, gait abnormalities, condition of soft tissues and articulations of the spine. The patients underwent a detailed questioning together with systemic, leukomotor and neurological examinations. Patients were excluded if they presented with LSS secondary to neoplastic or metabolic causes, had lumbar spine or lower extremity surgery within the last year, or were candidates for urgent low back or lower extremity surgery. Patients with peripheral vascular disease were excluded by means of clinical examination of peripheral pulses and noninvasive vascular studies, as indicated. No patient had a cardiopulmonary condition that would limit exercise capacity during the treadmill examination. The arthritis of the hip and knee limiting walking and the presence of diabetes mellitus were also among the exclusion criteria. Ethics committee approved the study protocol. The patients were informed before being enrolled in the study and written consents were obtained.

RADIOLOGICAL EXAMINATION

Direct anteroposterior and lateral lumbosacral X-rays of the patients were obtained. MRI was carried out with Picker EDGE 1.5 Tesla MRI device. T2 weighted sequences that allowed for better discrimination of dural tube space and soft tissues were used to measure the dural tube area passing through intervertebral discs at levels L2-3, L3-4, L4-5, and L5-S1.

TEST PROCEDURE

All patients were made to walk on a treadmill with 0-degree inclination at a speed of 1.2 km/h. During this walk, a system was available that could reduce the body weight by 20 or 25% (Figure 1). The patients were not allowed to hold the sidebars during walking. The patients walked five times as follows: without corset, with elastic woolen corset, with lumbar corset and with either 20 or 25% reduction in body weight. An examiner recorded the walking

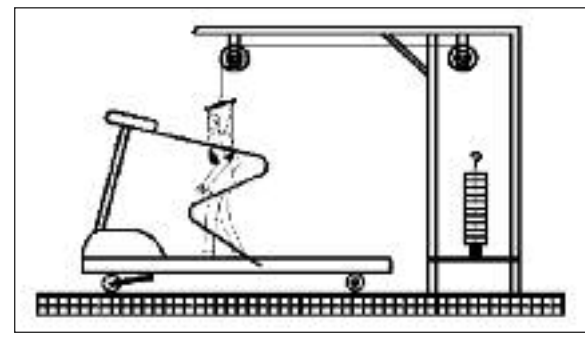

FIGURE 1: Line drawing of treadmill device and its equipments.

time. There was 30 minutes of rest between each walk. The elastic woolen corset provided almost no support to the waist and the lumbar corset was designed to support the waist. Lumbar corsets were supported with two steel rods that were placed posteriorly on paravertebral muscles together with two plastic rods placed laterally to these. Steel rods were adjusted in a manner to have full contact to the waist. When the patients started experiencing leg pain, this was recorded as symptom initiation time. When the patients stopped walking because of increased complaints this moment was recorded as total walking time.

STATISTICAL EVALUATION

Statistical assessment of the data was carried out with SPSS Windows 11.0 version package program. The evaluation of the parameters for patient groups was carried out by calculating arithmetic mean±standard deviation and median (min-max) values. In order to delineate the difference between the groups Friedman test was utilized; Bonferroni corrected Wilcoxon test was employed to find which group was the cause of this difference. P value of <0.05 was considered statistically significant; for Bonferroni corrected evaluations p< 0.01 was accepted as significant.

RESULTS

A total of 70 LSS patients participated in the study (59 female and 11 male). Mean age for LSS patients was 59.23 ± 5.90 years and mean body mass index (BMI) was 30.65 ± 3.06. All LSS patients had neurogenic claudication. The duration of complaints for the patients was 8.62 ± 8.04 (1-30) years. When all types of walk were compared in LSS patients, walking without a corset and walking with elastic woolen corset did not differ in terms of SIT and TWT (p> 0.05). There was no increase in total walking time when elastic woolen corset was used (Table 1).

When considered in terms of SIT and TWT,

SIT and TWT were significantly longer when walking with lumbar corset compared to walking without corset (p< 0.001).

When patients were made to walk after 20% reduction in their body weight, SIT and TWT were significantly longer than those observed when walking without corset (p< 0.001).

Similarly, when patients were made to walk after 25% reduction in their body weight they walked longer distances than they walked without a corset (p< 0.001). This difference could be observed both in SIT and TWT (p< 0.001 and p< 0.001).

Total walking time measured with the use of lumbar corset and the total walking time measured with 20% reduction in body weight were not significantly different from each other (p> 0.05). The use of lumbar corset had a similar effect to that of 20% body weight reduction and lengthened the total walking time by reducing mechanical weight bearing (Table 1).

DISCUSSION

Lumbar corset and reduction of body weight resulted in significant increases in walking time. TWT

TABLE 1: Symptom initiation time and total walking time of patients with lumbar spinal stenosis (LSS).

	SIT (s)		TWT (s)	
	Mean ± SD	Madian (min-max)	Mean ± SD	Madian (min-max)
Walking without corset	68.0 ± 40.5	55 (15-200)	112.0 ± 66.0	93 (30-375)
Walking with woolen corset	67.4 ± 39.6	60 (14-189)	112.1 ± 66.5	95 (25-355)
Walking with lumbar corset	97.5 ± 56.4	78 (22-290)	163.3 ± 100.7	129 (40-450)
Walking with 1/5 of body weight unloaded	101.5 ± 73.6	77 (20-360)	163.7 ± 110.3	125 (30-480)
Walking with 1/4 of body weight unloaded	126.8 ± 76.7	106 (30-390)	197.0 ± 120.7	157 (40-530)

Symptom initiation time (SIT): (s;second).

Total walking time (TWT): (s;second).

with lumbar corset was similar to walking time with 20% reduction in body weight.

External supporting of the lumbar spine with corset is reported to be helpful for patients with LSS.[15] However, it is not clear with which mechanism this support shows its effect.[16] Several theories have been suggested to explain pain relief and harm reduction mechanisms of spinal ortheses.[17] The first one of these is the limitation of movements of this region by the ortheses providing an obstacle to lumbar region movements. Other possible theories are the reduction of the intradiscal pressure by increasing the intraabdominal pressure, the increase in the skin temperature, provision of mechanical support and elimination of pain by increasing proprioception.[18]

During daily life activities, the spine is faced with significant loading with the flexion of the trunk, its extension and rotations. In the absence of severe loads, lumbar region only carries the load of the upper portion of the body.[19] The total load exerted on this lumbar movement segment is mostly calculated by the total amount of flexion, extension or lateral flexion. Thus, total limitation of movement and elimination of loads are not discrete issues.[19] An orthesis limiting the abovementioned movements would have the tendency to reduce the loads in the lumbar region of the body. Yet, there are several structures in the lumbar region. Those structures that are influential during motion and stabilization resist to compression of the lumbar region, to anteroposterior and lateral sliding forces, to flexion, extension and rotation momentums. There is no concise information regarding which of these loads could be eliminated to what extent. It is also controversial to what extent the orthesis counteracts the load exerted on the lumbar region.[19] In studies evaluating the effects of ortheses on spinal weight bearing, patients stood up from crouching position with near maximum weight and reductions were observed in weight bearing with the use of spinal orthesis.[20-22] In our study, the increase obtained in the walking time with the use of lumbar corset, was similar to that obtained with 20% reduction in body weight.

Likewise, spinal orthesis are believed to aid in the transfer of force from the trunk to the pelvis especially during lifting things up thereby reducing the load on the spine. This process is managed directly by the stiffness of the orthesis, while indirectly intraabdominal pressure is increased and abdomen and to some extent chest act like parts with the ability to support the weight of the body.[23-25]

Proprioception is a complex interaction between the afferent and efferent systems that control body movements and position. Lumbar supports provide additional afferent impulses and strengthen proprioception. Patients can perceive their spatial positions and refrain from unfavorable bodily positions. By mechanically preventing bad weight bearing techniques they aid in the cooperation of other muscle groups in the task and increase the safety of weight bearing.[18] Reddell et al examined 272 subjects using lumbar corset for lumbar pain; only five of these were not aware of the presence of the corset while the others were.[26] In our study, all the patients reported being aware of the presence of the corset.

Thoumi et al reported significant reductions in the stress bore by the posterior annulus of the disc and apophyseal joints with the use of orthesis in patients with greater lordosis angles.[27] All the patients with LSS that were recruited in our study had increases in lumbar lordosis. However, we did not measure the lordosis angle of the patients before and after wearing the orthesis.

Most of the studies conducted so far have been carried out only on healthy volunteers and diagnostic standardization of patients with the diagnosis of lumbar pain could not be made.[10,16,20,23,24,27,28] The patients in our study had LSS diagnosed clinically and radiologically. In previous studies, various corsets were used like raney coat, canvas corset, baycast coat, elastic lumbar corset, lumbar corset, weightlifter's belt, Boston brace and thoracolumbosacral orthesis.[19,20,22] However, Nachemson et al reported that in terms of mechanical effect, ortheses were not obviously superior to each other.[19] We used two significantly different corsets

in our study; an elastic woolen corset that nearly provided no support and a lumbar corset that was designed to support the waist. Lumbar corset increased the walking time while elastic woolen corset affected neither the symptom initiation time nor the total walking time.

In LSS patients reduction in body weight by 20% increased walking time by 22% and 25% reduction induced further improvement in walking time up to 55%. In addition, the use of lumbar corset increased walking time by 31%.Under the light of these findings, we can say that with its mechanical effects on the waist lumbar corset may be influential on pain generating mechanisms. Likewise, by increasing proprioception it might have positively contributed to the balanced contraction of the muscles and increasing of walking time. However, we cannot tell whether the weight bore by the lumbar region is reduced by the increase in the intraabdominal pressure or by making a force transfer from the upper part of the body to the pelvis. Since the patients used the corset for a short time, we cannot relate this to the increase in skin temperature. Personal parameters like angle of lordosis are other factors influencing weight bearing.

In conclusion, lumbar corset increases symptom initiation time and total walking time in patients with lumbar spinal stenosis. It is not however possible to tell whether this effect is the result of eliminating the load or increasing the intraabdominal pressure or correcting proprioception or finally decreasing lordosis. However, lumbar corset has a beneficial effect on symptoms similar to that obtained by 20% body weight reduction.

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