Mechanics of Spinal Bracing

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The problems involved in spinal bracing have been the subject of considerable study at Northwestern University during the past year. In this time it has been found that there are several hundred braces for the spine. Each has at least one proper name, many totally unpronounceable; and most have few or no specifications. Generally there is no concise indication of their particular value other than a suggestion that the author or designer liked one brace better than any other he had been able to make.

The proper use of braces must not be based upon descriptive literature or the intentions of the original designer. The choice should be derived from and related to the configuration and physiology of the part to be treated, and based on a knowledge of the disease process which is occurring—and hopefully on the knowledge that a given mechanical therapeutic technique is helpful for this specific disease. The resultant choice should be presented to the orthotist as a prescription embodying the specific structural components desired in the brace.

The spine functions as a semi-flexible rod resting on the sacrum which is an integral part of the pelvic ring. It consists of a column of articulated vertebral bodies cushioned from each other by the intervertebral discs, and held in place by a series of ligaments anterior and posterior to the vertebral bodies. The attitude of the pelvis is the basic determinant of the posture of the spine. The ligaments and discs together limit the amount and direction of motion of the vertebrae on each other, and of the spine as a whole. This flexible rod will buckle to the side when a certain critical load is applied to the top. If the base of the rod is fixed, and the top is free to move as the spine is within the body, the critical load which will cause buckling is approximately four and one-half pounds. The weight of the head-arms-trunk complex is considerably greater than four and one-half pounds in the erect position.[1] Therefore, it is not the inherent stability of the spine which prevents collapse; it is, rather, the action of the muscles.

It is common to think of the back muscles, specifically the para-spinal muscles, as the sole group of muscles active in normal posture control. Certainly this group of muscles would seem to be solely responsible for the ability to pick up weights. The electromyograph does show that these muscles are active in bending forward and returning to the erect position. However, simple consideration of the bulk of these muscles and their placement close to the spine itself suggests that this group is not sufficiently bulky nor advantageously placed to do the whole job unaided.

Electromyograph studies show considerable activity of the flank and anterior abdominal muscles. Measurement of intra-abdominal pressure during the return to the erect position after bending shows that there is an increase during this effort in proportion to the load.[2]

The abdominal cavity is balloon-shaped. The diaphragm above forms the dome. The abdominal and flank muscles form the sides. There is a pelvic diaphragm below which completes the balloon. It is common experience to hold the breath while lifting a heavy load. This maneuver increases intrathoracic and intra-abdominal pressures. Increased intra-abdominal pressure will relieve the paraspinal muscles of much work in returning the spine to the erect position because the spine lies over the balloon on bending forward.[3] This also reduces the pressure on the lower lumbar discs since the force is active on the same side of the lumbosacral fulcrum as the weight to be lifted. Therefore, it seems apparent that when functional or structural weakness of the lumbar or dorsal spine occurs, a specific component of the prescribed brace or garment should usually be a firm abdominal support. This can be incorporated in the brace along with suitable "three-point pressure" systems.[4]

The general principles of dealing with people apply to the treatment of the back, as well as to other parts, and it is necessary to treat the individual in his individual situation and not to become an idolator of a modality.

Currently progress is being made in the identification and standardization of basic types of braces. An understanding of the complex functions of the back is developing. Careful analysis of these functions of the back, a thorough understanding of the causes of certain diseases of the spine, and analysis of the characteristics of basic brace types should allow us to prescribe a brace that will be most beneficial to the patient with a spinal condition.

References—

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