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Clinical Biomechanics of Posteroanterior Pressure to the Spine

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Abstract. Posteroanterior pressure is a common manual technique used for the clinical assessment and treatment of vertebral column disorders. The purpose of this article is to describe the clinical biomechanics of the posteroanterior pressure to the spine. To establish the biomechanical effect of the posteroanterior pressure on the vertebral column, the applied load is defined by two components of force and the moment produced by that force. The clinical implications are also described in terms of the componenents of force and the moment produced by the posteroanterior pressure.
Key words: Clinical biomechanics, Posteroanterior pressure, Mannual therapy, Spine.

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INTRODUCTION

Posteroanterior pressure applied to the spine is a common manual technique used for the clinical assessment and treatment of vertebral column disorders. Posteroanterior pressure is a force applied by the therapist's thumb or hypothenar eminence in the posteroanterior direction to the spinous process of a vertebra. Information from the posteroanterior pressure is interpreted in terms of the pain response and spinal mobility.

Although the procedure for the application of the posteroanterior pressure has been described[1)], the clinical biomechanics of this technique has not been described. The purpose of this article is to describe the clinical biomechanics of the posteroanterior pressure to the spine.

LOAD PRODUCED BY POSTEROANTERIOR PRESSURE

To establish the biomechanical effect of the posteroanterior pressure on the vertebral column, the applied load must be defined. The applied load is defined by the two components of the force and the moment produced by that force.

Two components of the force

The force applied to the spine can be divided into two components (Fig. 1). One is the longitudinal component in relation to the vertebral body and the other is the transverse (shear) component in relation to the vertebral body. Relative sizes of these components depend on how the force is applied and the orientation of the vertebra.

a) Methods of application

There are many possibilities for the method of application, such as vertical force in relation to the bed surface, force applied perpendicular to the spinal bony curvature, force directed towards the center of the vertebral body, and force perpendicular to the skin surface (Fig. 2). The two components of force vary depending on the direction of application.

b) Orientation of the vertebra

The other important variable is the orientation of the vertebra in relation to the force we apply. Depending on the curvature of the spine, we have different effects. For instance, if we apply the

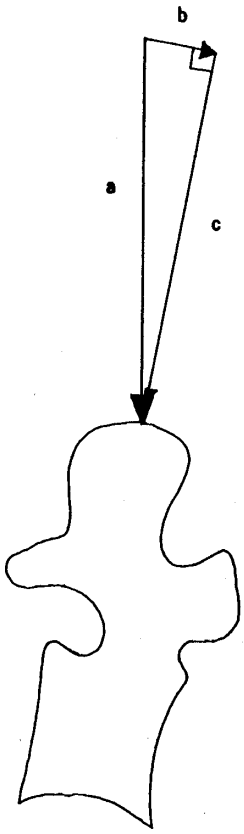

Fig. 1. Two components of the posteroanterior force applied to the spine.
a: Posteroanterior force.
b: Longitudinal component in relation to the vertebral body.
c: Transverse (shear) component in relation to the vertebral body.

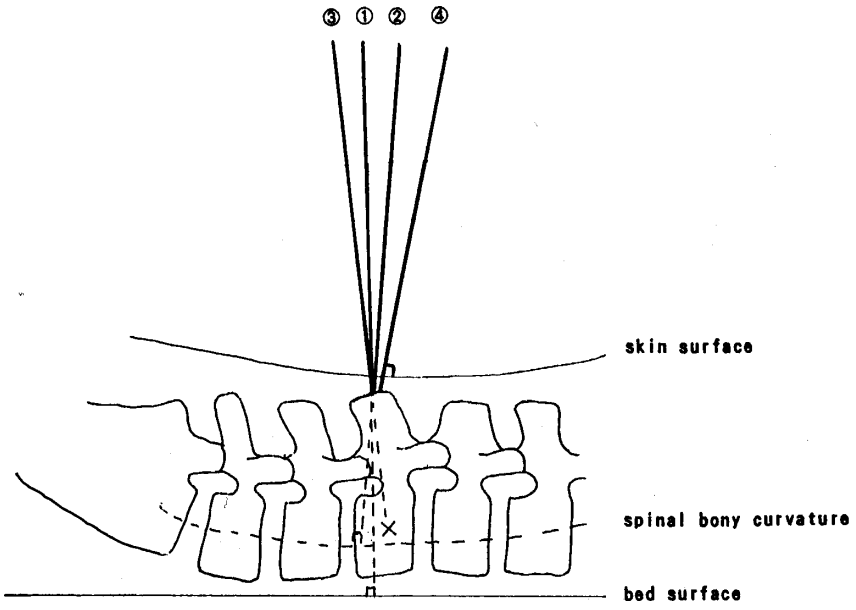

Fig. 2. Variation of the posteroanterior pressure
① Vertical force in relation to the bed surface.
② Force applied perpendicular to the spinal bony curvature.
③ Force directed towards the center of the vertebral body.
④ Force perpendicular to the skin surface.
x: Center of the vertebral body.

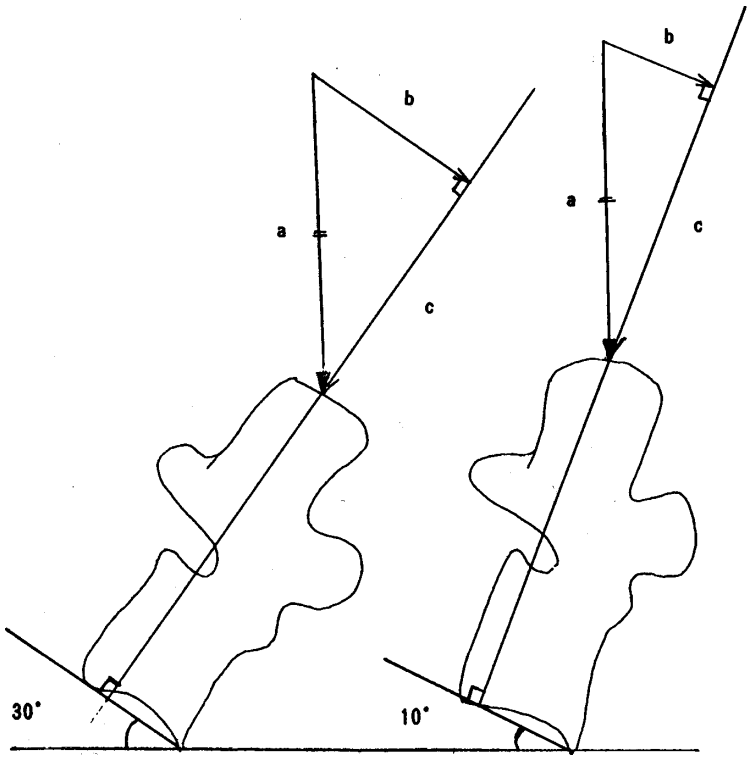

Fig. 3. Effect of the orientation of the vertebra in relation to the vertical force.
a: Vertical force (Posteroanterior pressure).
b: Longitudinal component.
c: Transverse component.

force vertically and vertebra is tilted at 10 degrees, we have a different effect compared with applying the same force to the same vertebra tilted at 30 degrees (Fig. 3). The former has a relatively small longitudinal component and a large transverse component.

Another example is that if we take a particular strategy, say vertical force, then the longitudinal force varies depending on which part of spine we are applying it to. For example, we would be applying a compressive force to L1/L2 intervertebral joint and a traction force to L4/L5 intervertebral joint (Fig. 4).

Therefore, the significance of the force for a particular vertebra depends on the orientation of the force in relation to that vertebra. The direction of the force applied to the spine determines the nature of the actual force applied to the vertebra.

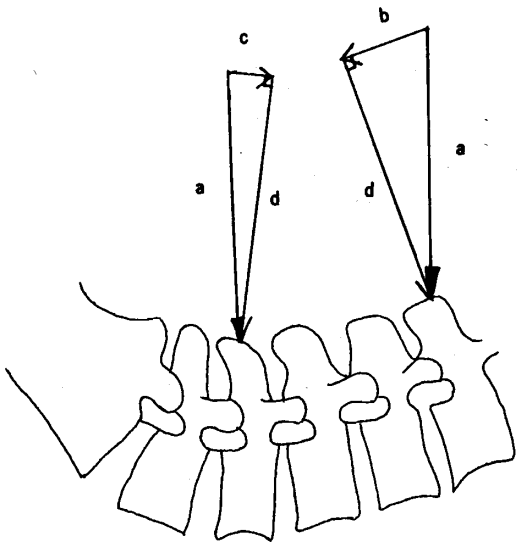

Fig. 4. Variation of the longitudinal force in case of Posteroanterior pressure on L4 and L1 spinous processes.
a: Vertical force.
b: Compressive force to L1/L2 intervertebral joint.
c: Traction force to L4/L5 intervertebral joint.
d: Transverse force.

Moment

Posteroanterior pressure produces a torque as well as producing transverse and longitudinal

forces. The torque tends to rotate the vertebra in a particular direction (Fig. 5). Unless the force goes through the center of a vertebra, posteroanterior pressure causes rotation about the center of the vertebra. The size of the moment is determined by the method of application, the orientation of the vertebra and the vertebral geometry.

a) Method of application

The size of torque depends on the method of application. The torque produced by applying a vertical force is different from the torque produced by a force perpendicular to the vertebral bony curve (Fig. 6). The latter produces a larger moment than the former. Therefore, the method of application determines the amount of torque.

b) Orientation of the vertebra

Orientation of the vertebra also affect the size of the moment produced by posteroanterior pressure. Orientation of the vertebra varies depending on patient's posture, position during treatment, or the treated region in the vertebral column. If the lumbar spine is totally flat, then force applied to the spinous process produces zero torque. On the other hand, if the lordosis is present, the force applied to the spinous process produces some torque (Fig. 7). Therefore, the orientation of the vertebra in relation to the applied force is also important as well as the method of application.

c) Vertebral geometry

Vertebral geometry determines the nature of what we are doing to the patient. The vertebral geometry varies between people and also between regions. Because the lower thoracic spine tends to have a long downward-pointing spinous process, the torque produced in the thoracic region is larger than the torque produced in the mid lumbar spine, which tends to point straight backwards (Fig. 8). Since the perpendicular distance in the thoracic spine is much bigger than that in the lumbar spine, the torque produced is larger when exactly the same force is applied.

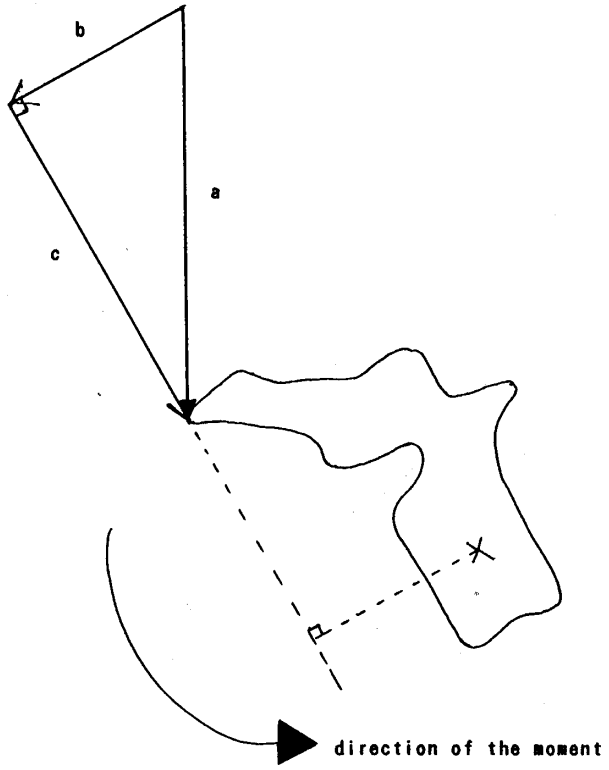

Fig. 5. Torque produced by posteroanterior pressure.
a: Posteroanterior force.
b: Longitudinal component of posteroanterior force.
c: Transverse component of posteroanterior force.
x: Center of the vertebral body.

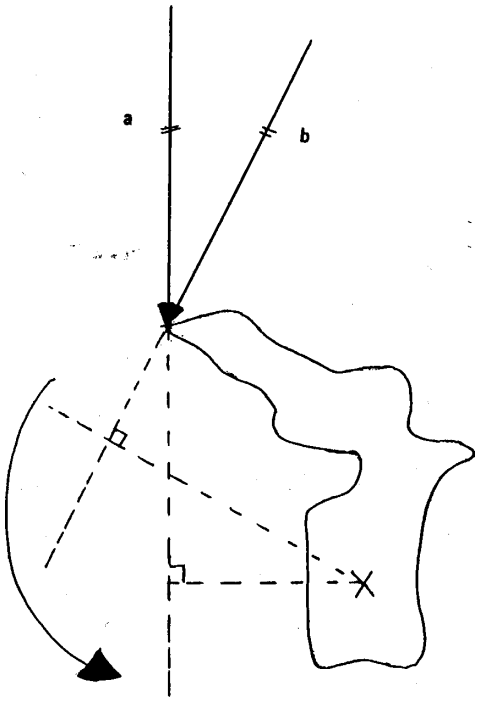

Fig. 6. Effect of the strategies on the size of torque.
a: Vertical force.
b: Force perpendicular to the vertebral bony curve.

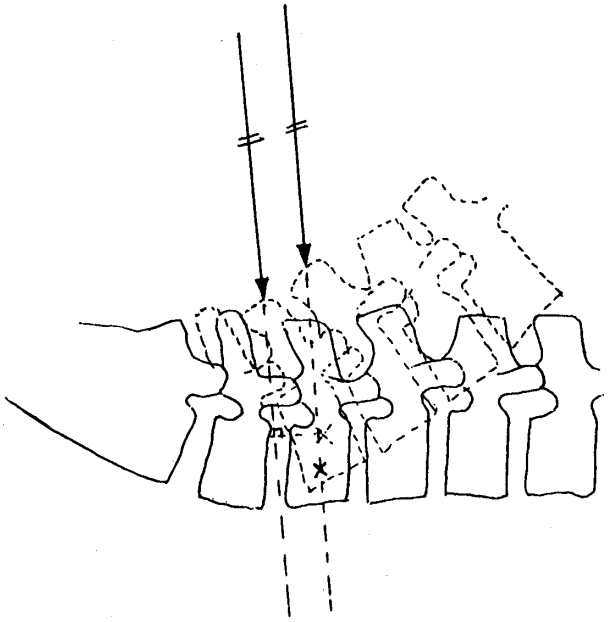

Fig. 7. Effect of lodosis on the moment produced by the same posteroanterior force.

CLINICAL IMPLICATION

Unless the force is applied perpendicular to the spinal bony curvature, the force produced by the posteroanterior pressure has two components. The two components can vary depending on the method of application, where it interacts with the vertebra, and the orientation of the vertebra. The longitudinal component of force causes compression or a distraction type of force at the joint, and to avoid generating longitudinal forces the therapist needs to apply the force perpendicular to the spinal curve.

In addition, the posteroanterior pressure produces some moment unless the force is directed towards the center of the vertebral body. Therefore, the application of force normally to the spinal curve would appear to be most useful, because using this approach, the force has the minimum longitudinal component and the minimum moment.

Clinically, the effect of the posteroanterior force depends on both the load and the movement which

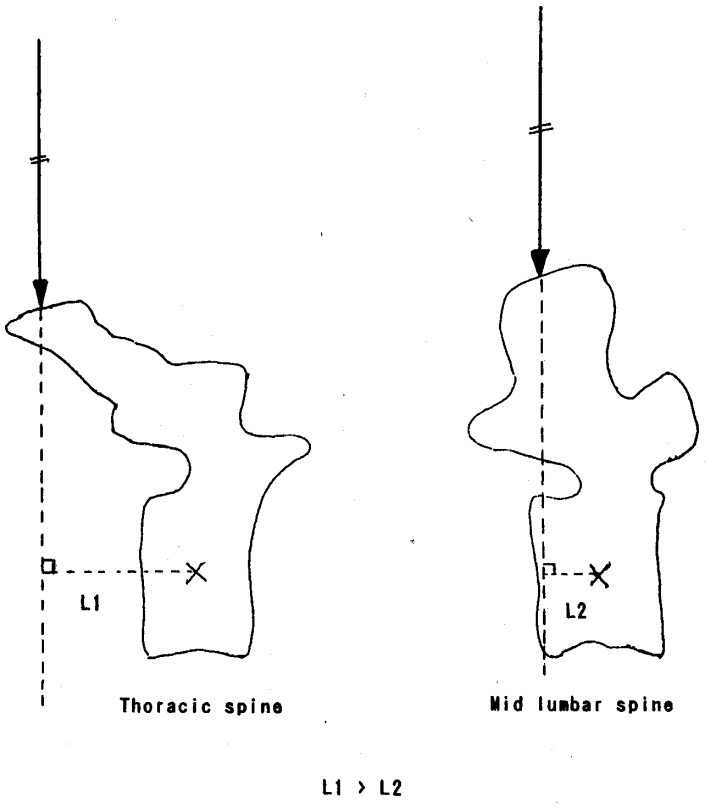

Fig. 8. Effect of vertebral geometry on the moment produced by the same vertical force.

occurs in response to that load. As mentioned before, the load is defined by the size of the moment and by the two components of force. The movement varies at different vertebral levels because of variations in the stiffness of the intervertebral joints, even when the same load components are applied.

When assessing the symptom behaviour of the patient, or the movement of the spine on the application of posteroanterior forces at each vertebral level, perceived variations in patient response may be due to changes in the manner in which the vertebrae experience the applied load. Changes in the longitudinal component of the force or in the moment can alter the proportion of resistance produced by the discs, zygapophyseal joints or other structures. As a result, the symptoms arising from these structures may be altered. Therefore, the magnitude of the longitudinal force component and the sagittal plane moment need to be take into account.

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