Test instrument for predicting the effect of rigid braces in cases with low back pain

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Abstract

The difficulty of predicting the acceptance and the result of wearing rigid braces has been identified before and is reported in the literature. Therefore a test instrument has been developed and tested. The intention is that the test instrument can imitate a rigid brace. Furthermore, different attributes of the rigid brace can be altered. Thus the range of the lordosis, the level of maximal dorsal support and the amount of abdominal support can be altered. By changing these parameters the maximal pain relief is sought. A good correlation between the result in the test instrument and the rigid brace manufactured according to the information from the former was seen (93%). No false negative results were seen. Thus, if no acceptance or pain relief was seen in the test instrument no pain relief could be expected in a rigid brace.

Another purpose of this test instrument is to simplify the manufacture of the brace and to transfer easily the information gained from the test instrument to the brace with the aid of a so called measuring device.

Introduction

Outer spinal supports are among the most frequently prescribed types of orthoses. There is no doubt that in many cases with different types of low back pain (LBP) they have a good effect.

However, sometimes braces are prescribed on nonspecific indications and patients do not experience the expected relief. It is therefore very important to make sure that the indication

for wearing the brace is correct before it is manufactured.

The failure or brace treatment in LBP is caused mainly by a lack of knowledge of the pathomechanism of the spinal disorder and how the brace influences the pain.

In a Swedish study (Willner, 1985) the acceptance of wearing a rigid brace (Flexaform brace) varied between different diagnoses of the LBP. But on the average only 51% of all patients included in this study with low back pain accepted wearing a rigid brace and reported pain relief. That means that about half of the cases were not affected by a rigid brace and consequently had been prescribed braces with no effect.

To be able to predict the result of treatment with a rigid brace before it is manufactured and delivered to the patient, a special test instrument has been developed and tested. The main purpose of this test instrument is to imitate a rigid brace and to see whether this type of orthosis can be accepted by the patient and, if so, how it should be fitted. This instrument estimates the degree of the lordosis and the level of the maximal dorsal support to achieve optimal pain relief and acceptance. If no pain relief is achieved—there is, according to the author's experience, no indication for prescribing a rigid brace.

Another purpose of this test instrument is to make the fitting of the brace easier and more accurate by using a special measuring device for transferring the information from the test instrument directly to the brace module to be fitted.

The aim of this paper is to present this test instrument and describe its use in a group of patients with LBP.

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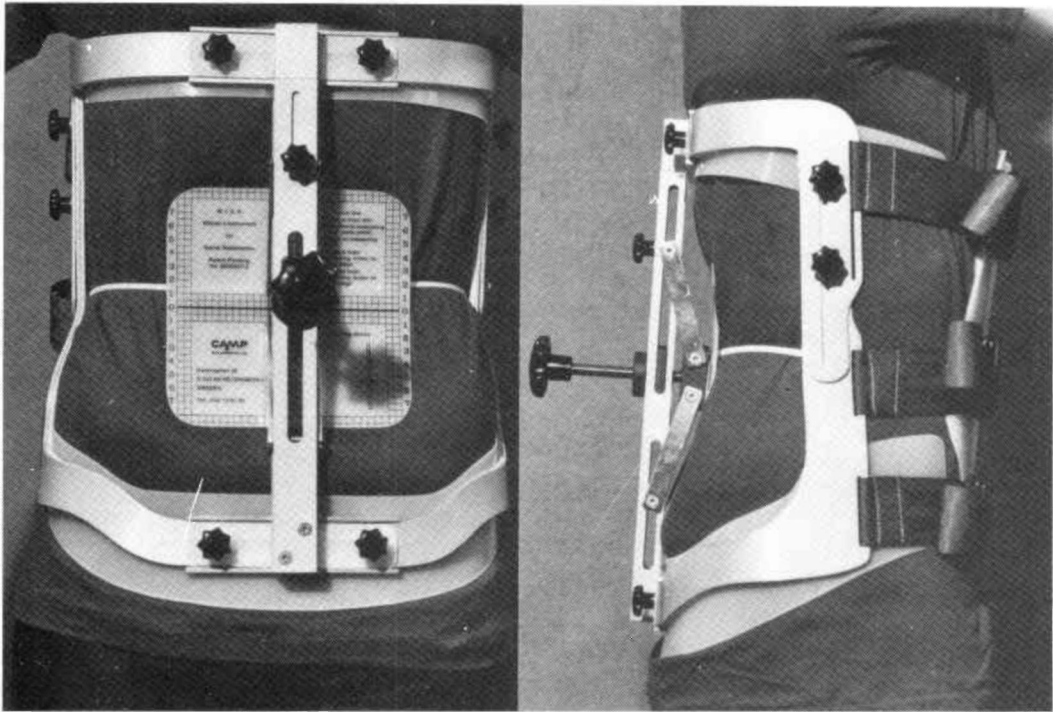
Fig. 1. Test instrument. Left, posterior view. Right, lateral view.

Method

The instrument consists of an aluminium frame, adjustable in width and length, which is to be applied to the back of the patient (Fig. 1).

At the back of the frame there is a back stay with an adjustable back support. This back support is adjustable in height and the lumbar lordosis can be increased or decreased by using an adjustment screw. At the front there is an abdominal support with six pull straps and adjustable fix locks.

A measuring device for the instrument is seen in Figure 2. This instrument can be adjusted in height, has a locking control and a measuring screw. The device allows the transfer of the observed information to the brace module and simplifies the construction of the brace.

The dorsal frame is adjusted to fit the trunk. For this purpose, the curve of the frame must be placed just above the iliac crest to permit the transfer of information between the trunk of the patient, the test instrument and the brace to be fitted. The height of the instrument must correspond to the planned height of the brace to be fitted, that is, the upper edge of the frame should be just below the lower border of the scapula. Thereafter an abdominal support is
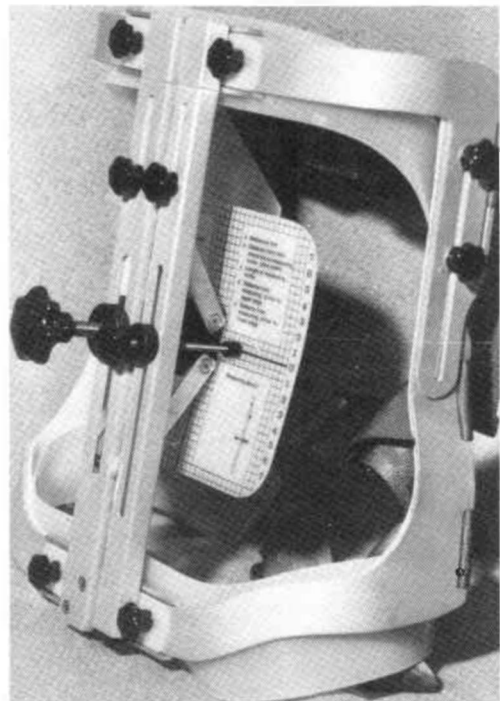

Fig. 2. The measuring device fixed on the test instrument.

applied and fixed to the frame with fix locks. The strips must be tightened to stabilize the instrument to the trunk. The lower border of the abdominal support is placed above the pubis.

The back support is now loosened and placed at the level at which the patient needs the maximal support. Thereafter the main dorsal screw (initially unscrewed as far back as possible) is adjusted to increase the range of the lordosis and the immobilization of the spine, until the patient reports optimal pain relief.

If the patient in this position can now move his back away from the back support, an abdominal pad is added under the abdominal support until a complete stabilization in the test instrument is attained. Two different sizes of pads are available (with a thickness of one and two cm).

The observed positions and the range of the back and abdominal support can be transferred to the brace by a measuring device.

However, to be able to transfer the information from the test instrument to the brace to be fabricated via the measuring stick, the following defined lines must be taken into consideration (Fig. 3).

(a) The reference line—the line joining the upper palpable corners of the iliac crest.
(b) The null line—the horizontal line on the back support marking the level of the maximal dorsal support.
(c) The central line—the horizontal line marked on the abdominal pad, the level for the maximal thickness of the pad.

With the aid of the measuring stick the following parameters are registered: (Fig. 2).

(1) The height of the brace to be fabricated.
(2) The level of the null line in relation to the upper and lower edges of the brace.
(3) The range of lordosis. This is measured by screwing the screw of the measuring stick until the top of the screw touches the back support at the level of the null line. The distance from the top of the screw to the measuring stick is recorded.

The level of the maximal thickness of the abdominal pad (if any) is decided by measuring the distance between the central line on the back of the pad and the lower edge of the abdominal plate, which should be placed over the pubis (Fig. 3). Before taking the test instrument off, the null line on the back support

A = REFERENCE LINE
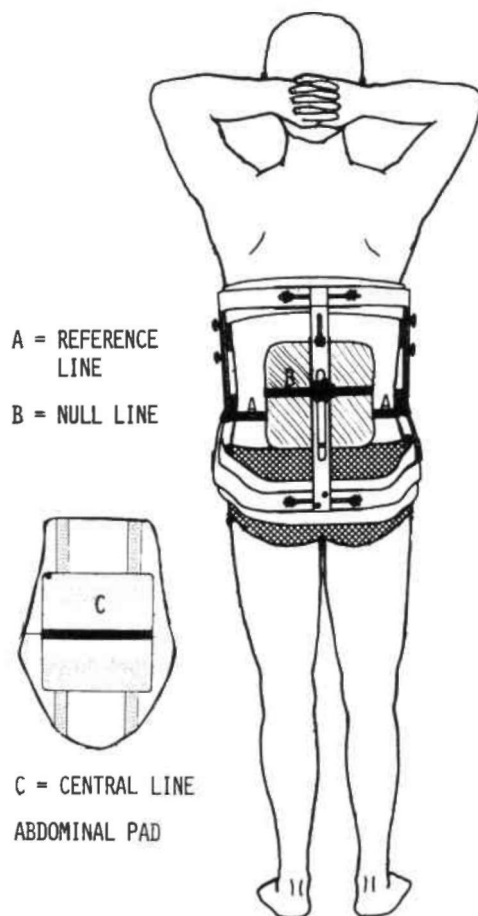
B = NULL LINE

C = CENTRAL LINE

ABDOMINAL PAD

Fig. 3. Reference lines to allow the information observed in the test instrument to be transferred to the brace to be manufactured.

in relation to the reference line of the patient is measured expressed in cm above or below this reference line (Fig. 3).

All this information is recorded on a special form. At the workshop this information and another measuring device are sufficient for the manufacture of a well fitted brace. The reference line is easily identified on the brace module and is marked (Fig. 4, top). A hole in the mid line of the brace is drilled at the level of the null line.

Thereafter the measuring stick, adjusted according to the information on the form, is placed vertically on the module. The upper and lower borders of the brace are now easily decided. If the measuring screw comes through the brace and protrudes on the inner side, a pad of the same thickness must be made and placed in the brace (Fig. 4, bottom). If an abdominal
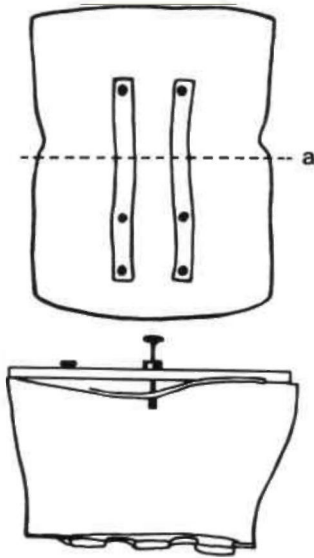
Fig. 4. Top, marking of the reference line (a) on the prefabricated module of a rigid brace. A hole is drilled at the level of the null line. Bottom, measuring device is placed on the module and the screw passes through the hole at the level of the null line.

pad has been seen used in the test instrument, a similar pad or bend in the anterior reinforcement is made with its maximal thickness or bending at the level of the central line.

The examination with this test instrument can be made at the doctor's surgery, the physiotherapy department, or if suitable, at the workshop. The test should go on for at least half an hour, during which time the patient tests the status in the standing, walking, bending forward and sitting positions. If there is any doubt concerning the test results these should be repeated twice or even three times.

Patient tests

Between 1986-87, 88 consecutive cases which had been referred to the Spinal Unit in Malmö with the question "Indication for a rigid brace?" were investigated with the test instrument.

In this test material 42 cases were females and 46 males. The mean age at the time of the test was 43.6 years (range 20–70) in the men and mean age 44.4 (range 20–68) in the women.

Of these 88 cases 59 had received a rigid brace either before this test in 27 cases, or after the test in 32 cases. Of these 59 cases 12 had a spondylolisthesis, 5 spinal stenosis (all operated

Table 1. Correlation between the result of the test instrument and of the rigid brace

		Result of brace treatment (Number of cases)	
		Good	Poor
Result in test instrument	Good	40	4
	Poor	0	15

on and with failures) and 42 unspecified LBP with negative myelographies.

Results

Of the 59 cases with prescribed rigid braces either before or after the tests, 40 cases (68%) had positive results in the test instrument as well as in the rigid brace (Table 1). In 15 cases (25%) negative results were seen, i.e. no pain relief was seen either in the test instrument or in the brace. In 4 cases (7%), all in the unspecified LBP group, a false positive finding was seen, i.e. a pain relief in the test instrument while a corresponding pain relief could not be achieved in the brace. No false negative findings were seen in the test instrument, i.e. if no pain relief could be noticed in the test instrument, no pain relief was seen in a rigid brace. As a consequence of this no braces were prescribed in the remaining 29 cases with unspecified LBP.

In 12 cases with spondylolisthesis there was a 100% positive correlation between the results in the test instrument and in the rigid braces which were fabricated according to the information found in the test.

In 5 cases with spinal stenosis operated upon, all with failures postoperatively, no positive results could be seen, either in the brace, or in the test instrument.

A correct prediction of the results of wearing rigid braces was made in 93% when using the test instrument, implying that this is a more accurate method than using different types of clinical estimations only (Willner, 1985) (Table 2).

Table 2. Comparison between the results in rigid braces either with or without using a test instrument.

Result in rigid brace (%)		Good	Poor
With test instrument	Spondylolisthesis	100	0
	LBP unspecified	90	10
Without test instrument	Spondylolisthesis	80	20
	LBP unspecified	35	65

Discussion

According to the literature, the observed frequency of accepting and wearing a brace varies. Ahlgren and Hansen (1978) observed that 75% of the patients with LBP wore their soft braces regularly. McKenzie and Lipscomb (1979) found an acceptance of corset wearing of only 50%. It was also seen that the utilization of brace wearing increased noticeably with increasing age of the patients. Magnusson and Nachemson (1985) reported that of those patients who had been prescribed a soft brace, 16% in the age group under 50 years were permanent brace wearers. Of patients between 60–69 years of age 50% wore their braces permanently and in those over 70 years of age 70%.

Concerning the acceptance of the rigid brace a variation was seen (Willner, 1985). This was especially observed in patients with unspecified LBP. About two thirds of these patients did not report any pain relief, or if they did, could not stand the brace, for example, because of its rigidity or unacceptable abdominal pressure. On the other hand, in cases of spondylolisthesis a high frequency of pain relief and acceptance was seen −85%. Even in cases with spinal stenosis verified by myelography a flexion brace gave pain relief in about 70% of the patients. In the group consisting of unspecified LBP only 15% of the patients experienced complete pain relief in rigid braces, i.e. many rigid braces were prescribed unnecessarily and in 20% only a partial pain relief in a rigid brace was achieved.

This shows that it is difficult to predict the effect of a rigid brace only by clinical estimation, especially in unspecific LBP.

Based on these observations the test instrument described was developed.

By changing the controlled parameters maximal pain relief was aimed at. With this test instrument it is possible to establish: 1) whether wearing a brace will be acceptable to the patient 2) and if so, how the brace should be contoured to give an optimal result.

In the present study this test instrument was studied in 59 cases, in which comparison could be made with a rigid brace already provided. In 93% of all these cases a corrleation was seen between the result of the test instrument and that in the rigid brace, positive as well as negative results.

This showed that if the patient did not experience any pain relief in the test instrument no pain relief could be expected in the rigid brace. That was the reason why braces were not prescribed in 29 of the 88 cases with negative results in the test instrument. In this study a low frequency of false positive findings was seen in the test instrument (7%). On the other hand no false negative findings were observed.

It was noticed that pain relief was experienced related to a very individually specific degree of the lordosis and when the maximal pressure of the dorsal plate was applied at a very specific level. With only a very small change in the degree of the lordosis or the level of maximal pressure of the dorsal plate, the pain returned and the acceptance of wearing the braces deteriorated.

Another reason for developing this test instrument was to be able to simplify the manufacture of the rigid brace. The information gained from the test instrument can easily be transferred to the brace by a measuring device. With this device the height of the brace, the degree of the lordosis and the level of the dorsal support are registered. Also the range of the abdominal support can be estimated.

Conclusion

A test instrument was developed which imitates a rigid brace. This instrument can, with a high degree of accuracy, predict whether a rigid brace will give pain relief in patients with LBP and also show how the brace should be manufactured to give optimal pain relief.

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