

Technical note

Mechanical efficacy of the mobilising cervical support device (Mbrace)

J. ZAPLETAL* and M. A. VAN DUIJN**

**Radiology Department, St Antonius Hospital, Nieuwegein, The Netherlands*

***Physical Therapy Department, IJmuiden, The Netherlands*

Abstract

This study evaluated the mechanical efficacy of a new "mobilising" cervical support device. This device has been developed in response to the requirements of whiplash patients to overcome the problems of heat and immobilisation which can occur in patients wearing conventional wrap-around cervical collars.

All planes of cervical range of motion of 21 volunteer subjects without current or past cervical dysfunction were measured actively and passively under two conditions (no support and with cervical support) using the cervical range of motion (CROM) instrument.

The results show that the mobilising cervical support device restricts hyperextension effectively while allowing substantial movement in other planes of motion (flexion, rotation and lateral bending). This potential mobility keeps nearly all muscles in the neck fit and problems of muscle atrophy, weakness and contraction, which can occur in patients using conventional cervical wrap around collars, can be avoided.

Regarding mechanical efficacy, the mobilising cervical support device can be useful in the (early) mobilisation phase in patients needing gentle neck support after a soft tissue hyperextension or whiplash injury.

Introduction

Recently, a cervical support device (Mbrace), especially designed for patients with a soft tissue hyperextension injury or a soft tissue whiplash associated disorder (WAD), has been introduced

All correspondence to be addressed to Dr. Jiri Zapletal, Radiology Department, Koekoekslaan 1, 3435 CM Nieuwegein, The Netherlands. Tel: (+31) 306099111; e-mail: j.mail@wxs.nl

in the Netherlands. This cervical device differs from a conventional "wrap-around" cervical collar due to its "open" form, mechanical function and (front) fastening system (Fig 1).

The purpose of the cervical support device in patients with a soft tissue WAD is to provide gentle neck support, to eliminate a hyperextension re-injury and to offer substantial mobility in order to avoid the harmful effect of disuse. Up to now, the mechanical efficacy of this so called "mobilising" cervical support device has not been demonstrated. It was the authors' goal to evaluate the mechanically restrictive effect of this device in normal healthy volunteers.



Fig 1. The mobilising cervical support device.

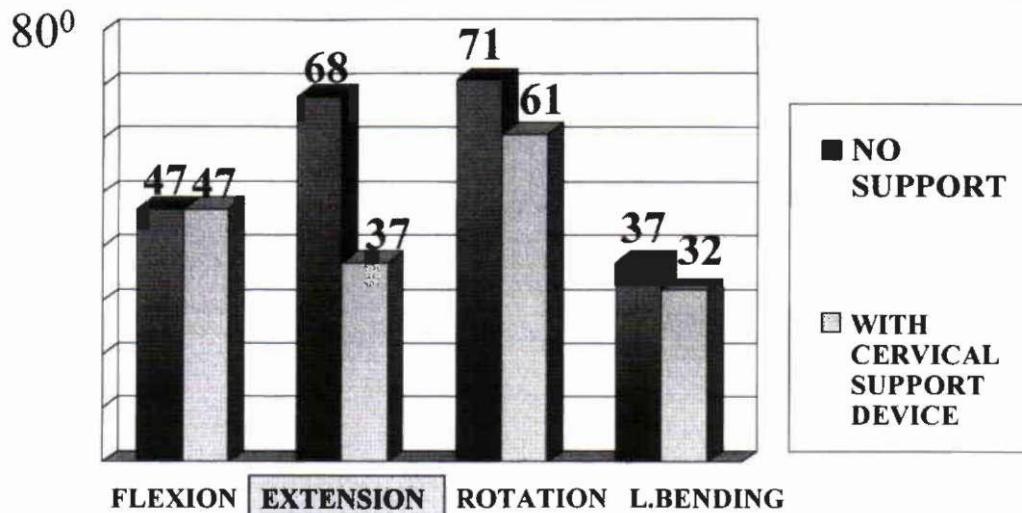


Fig 2. The mechanical efficacy of the device (active).

Material and methods

Twenty one (21) volunteer subjects (age range 15-61 years, mean age 36 years) with no history of neck abnormality were tested for neck range of motion (overall motion) using the CROM instrument. This instrument allows the collection of reliable three-dimensional motion information on the head and neck (Capuano-Pucci *et al.*, 1991). The thorax was fixed in a high chair that blocks shoulder and thoracic motion. An appropriate support (small, medium or large) was applied and properly fixed. Each volunteer was tested in and out of the cervical support device in three planes of motion. The following motion parameters were measured by the same examiner: 1) flexion, 2) extension, 3) axial rotation, and 4) lateral bending.

The maximum possible range of motion was tested using passive and active methods. For the passive test the volunteer allowed the tester to move the head and neck through the maximum range of motions without resisting. For the active tests, the volunteer was instructed to move head and neck as far as possible in all planes of motion.

The results were recorded as degrees of motion. Average range of motion using passive and active methods was then calculated for the group. The standard deviation for the four directions of motion was measured. Statistical analysis using the paired *t*-test was undertaken to assess statistical significant motion reduction.

Results

The mobilising cervical support device was fixed properly for optimal efficacy. Average unrestrained passive and active extension was respectively 70.8 ± 9.6 and 67.9 ± 9.6 (mean \pm standard deviation). Restrained passive and active extension was 40.9 ± 6.1 and 36.7 ± 6.6 .

The average reduction in motion was 29.9 ± 9.1 and 31.2 ± 9.9 . Both passive and active extension was significantly restricted by the open collar ($p < 0.05$).

Flexion, rotation and lateral bending (active and passive) were not substantially restricted.

The data are plotted in Figures 2 and 3, giving an indication of the efficacy of the mobilising cervical support device in restricting extension in normal force conditions. The performance of the device under substantial force application has not been evaluated in this study.

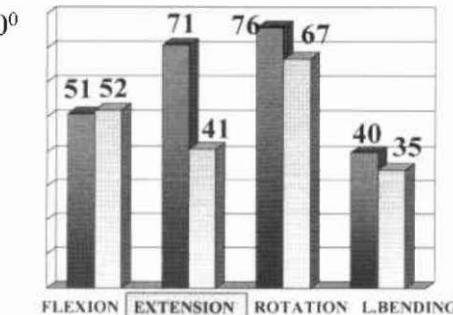


Fig 3. The mechanical efficacy of the device (passive).

Discussion

Cervical collars are often prescribed in the treatment of neck disorders of both traumatic and non-traumatic aetiology (Johnson *et al.*, 1977; Sandler *et al.*, 1996). A traumatic neck disorder that frequently occurs after a rear-end car collision is "whiplash". This term, becoming so general in contemporary society, is often described as a non-contact acceleration/deceleration injury of the neck. Although no consensus about the exact patho-physiological mechanism of whiplash exists it is postulated that hyperextension plays an important role in soft tissue damage (McKenzie and Williams 1971; MacNab, 1964). The injury frequently causes myofascial soft tissue damage with stretching and bruising of the muscles and supporting ligaments of the neck (Newman, 1990). Most neck pain developing shortly after the accident is due to myofascial soft tissue injury (Newman, 1990; Gargan and Bannister, 1990; Yeung, 1996). In many cases the patient experiences pain within a few minutes that increases progressively and is markedly aggravated by movements, especially in (hyper)extension. Consequently, patients with such an injury usually require neck support to relieve pain and to allow soft tissue healing. To provide this support, "immobilising" cervical wrap-around collars are frequently recommended.

There are a variety of cervical wrap-around collars available. Their continued widespread usage would suggest a beneficial effect. In a study on surgical collars, Naylor and Mulley (1991) found that pain was a symptom that frequently improved by wearing a soft or hard (firm) cervical collar. However, hard wrap-around collars were frequently found uncomfortable and tended to cause various problems and difficulty in daily life. Whilst soft collars were better tolerated than hard collars and caused less interference to daily activities, they were frequently found uncomfortable, too hot and irritating. Putting a wrap-around cervical collar on and fastening it at the back of the neck was sometimes also a problem, especially in patients with rheumatoid arthritis.

A well known side effect in the use of immobilising collars is that muscle atrophy, weakness and contraction may result from the use of these collars due to reduced muscular activity. In this context, previous studies show

that cervical spine immobilisation after a whiplash-type distortion gives rise to prolonged symptoms whereas more rapid improvement can be achieved by early active management and early (home) mobilisation (McKinney, 1989; McKinney *et al.*, 1989; Mealy *et al.*, 1986). Furthermore, it has recently been observed that the outcome is better for patients who are encouraged to continue their normal, pre-injury activities as usual than for patients who take sick leave from work and are immobilised in the early phase after the neck sprain injury (Borchgrevink *et al.*, 1998).

The goals of cervical bracing vary according to the patient's problem. In the (sub)acute treatment of a myofascial soft tissue WAD, the goals may be simply to provide gentle neck support, eliminate painful hyperextension and lower the risk of re-injury. In addition, one of the key aims in the treatment of soft tissue lesions is to encourage the damaged tissue to regain tensile strength as rapidly as possible (Hunter, 1994). In this study we evaluated the mechanical efficacy of a new device that is especially developed to fulfil these goals and most importantly to overcome the problems due to immobilisation. The shortcoming of the study is that the motions described are probably greater than those experienced by patients treated with the cervical support device. Nevertheless, testing on healthy individuals seems to be the best method of quantifying the ability of a cervical device to restrict cervical motion (Sharpe *et al.*, 1995).

The findings in this study indicate that the mobilising cervical support device is competent in limiting extension of the cervical spine, while allowing substantial movement in other planes of motion in normal force conditions. This implies that, regarding mechanical efficacy, this device can be useful in patients needing neck support in the (early) phase after a myofascial soft tissue WAD or a soft tissue hyperextension injury as it potentially can keep most neck muscles active and prevents hyperextension with possible re-injury. Future research should address clinical effectiveness of the cervical support device in these patients.

Due to the specific mechanical efficacy of this device one can probably use it in the prevention of a hyperextension or whiplash injury. In this context, it is possible that the neck support is capable of preventing or minimising a cervical soft tissue injury as a result of the

hyperextension mechanism in car collisions. However, further studies are needed to show the performance of the device under substantial applied forces.

Acknowledgement

The authors would like to thank Mrs. Stevenhagen for her assistance in the statistical analysis.

REFERENCES

- BORCHGREVINK GE, KAASA A, McDONAGH D, STILES TC, HARALDSETH O, LEREM I (1998). Acute treatment of whiplash neck sprain injuries: randomised trial of treatment during the first 14 days after a car accident. *Spine* **23**, 25-31.
- CAPUANO-PUCCI D, RHEAULT W, AUKAI J, BRACKE M, DAY R, PASTRICK M (1991). Intratester and intertester reliability of the cervical range of motion device. *Arch Phys Med Rehabil* **72**, 338-340.
- GARGAN MF, BANNISTER GC (1990). Long-term prognosis of soft tissue injuries of the neck. *J Bone Joint Surg* **72B**, 901-903.
- HUNTER G (1994). Specific soft tissue mobilisation in the treatment of soft tissue lesions. *Physiotherapy* **80**, 15-21.
- JOHNSON RM, HART DL, SIMMONS EF, RAMSBY GR, HAVEN W, SOUTHWICK WO (1977). Cervical orthoses: a study comparing their effectiveness in restricting cervical motion in normal subjects. *J Bone Joint Surg* **59A**, 332-339.
- MACNAB I (1964). Acceleration injuries of the cervical spine. *J Bone Joint Surg* **46A**, 1797-1799.
- MCKENZIE JA, WILLIAMS JF (1971). The dynamic behaviour of the head and cervical spine during whiplash. *J Biomech* **4**, 477-490.
- MCKINNEY LA (1989). Early mobilisation and outcome in acute sprains of the neck. *Br Med J* **299**, 1006-1008.
- MCKINNEY LA, DORNAN JO, RYAN M (1989). The role of physiotherapy in the management of acute neck sprains following road-traffic accidents. *Arch Emerg Med* **6**, 27-33.
- MEALY K, BRENNAN H, FENELON GCC (1986). Early mobilisation of acute whiplash injuries. *Br Med J* **292**, 656-657.
- NAYLOR JR, MULLEY GP (1991). Surgical collars: a survey of their prescription and use. *Br J Rheumatol* **30**, 282-284.
- NEWMAN PK (1990). Whiplash injury. *Br Med J* **301**, 395-396.
- SANDLER AJ, DVORAK J, HUMKE T, GROB D, DANIELS W (1996). The effectiveness of various cervical orthoses. *Spine* **21**, 1624-1629.
- SHARPE KP, RAO S, ZIOGAS A (1995). Evaluation of the effectiveness of the Minerva cervicothoracic orthosis. *Spine* **20**, 1475-1479.
- YEUNG E (1996). "Whiplash injuries" of the cervical spine. The relationship between the mechanism of injury and neural tissue involvement. *Physiotherapy* **82**, 286-290.