STABILISATION OF THE CERVICAL SPINE USING A BIO-CON COLLAR

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Abstract. The Bio-Con collar is described. The collar is fully adjustable and the head and cervical spine may be immobilised to any degree of flexion or extension desired. The head is held in position by means of a rigid head frame fitted with a chin and two occipital pads. By the virtue of the fact that this is attached to a firm base by means of adjustable metal pads the cervical spine is effectively immobilised.

Key words: Spinal injury; Spinal cord injury; Cervical spine; Cervical collar.

Introduction

THE treatment of cervical spine injuries with cord involvement at the Conradie Hospital is conservative, with patients remaining on traction on the pack bed for twelve weeks. The Orthopaedic Consultant decided to decrease the period of immobilisation in bed in selected cases, if a cervical collar which provided complete immobilisation of the cervical spine could be provided. Since no collar available to us fulfilled these criteria the Bio-Con collar was developed (Figs 1 and 2).

Description of Collar

The collar consists of a one-piece base made of $\frac{1}{4}$ -inch (6 mm) round stainless steel which is shaped on specially developed jigs to fit the average shoulder (Fig. 3). When applying the collar this allows for minimal adjustment to provide a firm but comfortable base for the individual patient. To the base on either side at clavicle level are attached the adjustable side supports (Fig. 3). They consist of a 14-gauge stainless steel attachment plate $1\frac{1}{2}$ inches (38.1 mm) wide which is first drilled by means of a jig to provide an *adjustable joint for flexion and extension at the base of the collar* (Fig. 2). The attachment plate is then shaped and low-temperature brazed onto the base. A round 146 disc on the inside of the attachment plate forms the other half of the joint. To this disc is brazed a $\frac{1}{4}$ -inch (6 mm) tube by means of a short right-angled connector rod (Fig. 5). The tube receives the $\frac{1}{4}$ -inch (6 mm) threaded rod which by means of two nuts on either side of the tube provide the height adjustment, at the same time providing a firm lock for this adjustment (Fig. 5). A similar adjustable joint is used to connect the side supports to the head piece, *thus making provision to alter and control the amount of flexion/extension of the head at the upper cervical joints* (Fig. 4).

The head-piece itself consists of two half frames (Fig. 6) made of $\frac{1}{4}$ -inch (6 mm) round stainless steel, once again being formed by the use of a jig. These two frames slide into the $\frac{3}{8}$ -inch (10 mm) thick nylon blocks to which the upper side support joints are attached and held in position by two cap and two thumb-screws (Fig. 4).

FIG. 1
Bio-Con collar, oblique view.

FIG. 2
Bio-Con collar, lateral view.

FIG. 3
Collar on shoulder jig (shoulder bust): (a) bust, (b) side supports attached to base.

FIG. 4
Side supports of collar: (a) lower adjustable joint, (b) upper adjustable joint, (c) nylon block to hold frames of head piece, (d) thumbscrew.

FIG. 5

Inside view of lower side support joint: (a) inner half of lower joint, (b) connector rod, (c) tube, (d) threaded rod, (e) lock nuts.

FIG. 6

Head piece: (a) anterior frame with chin piece, (b) posterior frame with occipital pads.

On the anterior frame is mounted a contoured adjustable chin piece. The adjustment of this is provided by means of a $\frac{3}{16}$ -inch (5 mm) grub screw (on the underside of the chin piece) which locks the chin piece in position once the desired angle has been obtained (Fig. 7).

Mounted on the posterior frame are two butterfly shaped occipital pads. Their adjustment is provided by a specially developed attachment joint which allows for anterior/posterior and lateral rotation (Fig. 7). It also allows the pad to be shifted laterally (either inwards or outwards) along the frame in order to position the pad in the optimum position and angle under the occipital bone. The pad is locked in position by means of two $\frac{1}{8}$ -inch (3 mm) cap-screws and a $\frac{3}{16}$ -inch (5 mm) grub screw. (Only one size Allen key is necessary to set and lock all the adjustments on the collar.) One-quarter-inch (6 mm) thick pelite is used to pad the occipitals, and a softer $\frac{3}{8}$ -inch (10 mm) pelite is preferred as padding for the chin-piece, both being attached by means of a good quality contact glue.

The padding for the base consists of white chrome leather (or equivalent) which is stitched by machine in the form of a 'jacket' over the steel onto a 1-inch (25 mm) wide leather base. To this leather base a $\frac{1}{4}$ -inch (6 mm) thick cordovan (horsehide) covered rubber is glued. This padding is fitted to the base in three sections. The middle section in the front of the collar between the two side supports being a permanent fixture (Fig. 3). The two sections that fit over either shoulder are removable, the stitched leather forming a tight yet sliding fit to facilitate their removal to allow the technician to shape the steel arms with a set of bending irons to the patient's shape.

Application of the Collar

A basic sequence of procedure has been worked out to enable the technician to fit the collar so as to stabilise the head and neck in the desired position and at the same time to provide as much comfort as possible to the patient. The collar as mentioned at the outset is being applied to the patient with a view to getting him

FIG. 7A

Collar viewed from above: (a) chin pad on anterior frame, (b) occipital pads on posterior frame.

FIG. 7B

Inferior view of head frame: (a) chin piece with locking grub screw, (b) occipital pads with attachment joints.

FIG. 8

Sliding the posterior frame out of the nylon block: (a) thumbscrew.

up at an early stage into the sitting position in a wheelchair or ambulant. Both these positions differ from the lying position as regards changes in the position of the head as related to the shoulders as well as the shape of the shoulders and curvature of the spine. This therefore requires that the collar be fitted in the sitting or upright position.

When the patient is off skeletal traction, he is fitted with a 'soft-collar' which gives him some stability while still in bed with his head supported on the mattress. The bed is now 'cranked' up so that the patient is in the sitting position, with a view to allowing him to overcome any initial dizzy spells he may experience when first sitting up. Once the patient has become accustomed to the upright position, then with the aid of trained responsible nursing staff, usually the ward sister with an assistant (the sister stabilising the head in relation to the shoulders and the assistant supplying support to the torso) the patient's legs are swung over the side of the bed. The technician can now fit the collar.

1. The base is the first part to be accurately and comfortably fitted.
2. After this by making use of the various adjustments the chin-piece is settled into the desired position.
3. The posterior frame with the occipital pads are adjusted and slid into position and held in position by two thumb-screws.

Easy removal of the collar is carried out by merely loosening the two thumb-screws which hold the posterior frame in the nylon side pieces, sliding the posterior frame out (Fig. 8) and drawing the rest of the collar anteriorly from under the chin and off the shoulders.

It is customary and good practice for the technician to follow up the fitting of the collar, for the next 3 or 4 days to check if any minor adjustments are needed and to ensure the patient's comfort. In some instances where a patient has very sensitive skin or bony prominences such as over the clavicles, an additional $\frac{3}{8}$ -inch (10 mm) pelite padding is contact glued to the existing padding. This allows for sculpturing out the area over the prominence to provide pressure relief and at the same time provide extra comfort for a sensitive skin. Obviously this necessitates a slight alteration to the height adjustment.

Selected cases, mainly the elderly, hyperextension injuries, spinal fusions for late instability and very incomplete neurological lesions with minimal radiographic evidence of bony involvement, have been successfully fitted with this collar. Once the collar is more readily available its use will be extended to all cases of cervical spine injury in the Spinal Unit.

At the time of writing, further development is being done with a view to producing a fully *adjustable base* which will contribute towards easier fitting and finer adjustments.

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RÉSUMÉ

Le Collier Bio-Con est décrit. Le collier est entièrement ajustable et la tête et l'épine cervicale peuvent être immobilisées au degré de flexion ou d'extension d'un cadre rigide garni de deux coussinets occipitaux et d'un coussinet supportant le menton. En vertu de la fixation de ce cadre à une base fixe à l'aide de joints de métal susceptibles d'ajustement, la colonne cervicale est effectivement immobilisée.

ZUSAMMENFASSUNG

Der 'Bio-Con' Kragen wird beschrieben. Der Kragen ist voll verstellbar sodass der Kopf und Hals in einer gewünschten Lage von Flexion oder Extension gehalten werden kann.

Der Kopf wird in Position gehalten durch einen festen Ramen an dem ein Kinn und zwei Occipitale Kissen befestigt sind. Dieser Ramen wird durch verstellbare Metallplatten an einer stabilen Basis befestigt. Dadurch kann die Halswirbelsäule effektiv immobilisiert werden.