

## Multi-adjustable post-operative orthosis for congenital muscular torticollis

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### Abstract

A multi-adjustable torticollis orthosis is described for the post-operative bracing of patients after surgical correction of congenital muscular torticollis. The orthosis can be put on in the early post-operative period and the head and neck position can be maintained in the corrected, and later over-corrected position by the built-in multi-adjustable joint-mechanism. The details of the manufacturing are described. Twenty-five patients (13 girls and 12 boys) from age 1 to 22 with congenital muscular torticollis were fitted with the orthosis post-operatively for an average duration of 10 weeks. Satisfactory compliance with the orthosis was found in 23 cases. Complications were minimal (3 cases) and were related to scalp irritation which improved after minor adjustments of the halo.

### Introduction

Congenital muscular torticollis, a common and distinct clinical condition found in the newborn and infants, has been well recognised since antiquity. Controversies still exist in regard to the underlying etiology, pathogenesis and treatment (Canale *et al.*, 1982; Coventry and Harris, 1959; Hulbert, 1965; Kasai, 1980; Licht, 1965). However, for children having persistent torticollis after the age of one it has been well recognised that spontaneous resolution is no longer considered possible and that surgical treatment is most helpful in improving the range of neck movement,

cosmesis and skull and facial asymmetry (Canale *et al.*, 1982; Coventry and Harris, 1959; Lee, 1986; Ling, 1976). Surgery can be in the form of subcutaneous tenotomy; open unipolar tenotomy; bipolar tenotomy; Z-lengthening of the sternomastoid muscle; simple to radical excision of the fibrotic mass etc. (Itoi *et al.*, 1990; McDaniel *et al.*, 1984; Minamitani *et al.*, 1990; Oh and Nowacek, 1978). Post-operatively, additional to a lengthy course of physiotherapy involving active and passive neck stretching, control of the head and neck in the corrected position by use of Halter traction, neck collar, splint, plaster or bracing has been advocated. From the literature and the authors' experience, well controlled positioning of the neck post-operatively in the over-corrected position can offer improved long-term results with less recurrences (Funayama, 1977; Itoi *et al.*, 1990; Oh and Nowacek, 1978; Staheli, 1971; Tachdjian, 1967; Tse *et al.*, 1987).

Many conventional cervical orthoses are however, static and often limited in their adjustability, comfort, and ease of use. These orthoses can therefore only maintain the head and neck in the same position throughout the entire period of immobilisation.

The required features of an improved orthosis are that it must be light, less cumbersome, dynamic, and easily adjustable in all planes, so that it not only maintains the head and neck in a corrected position but is also capable of exerting corrective forces to thereby achieve further correction, or over-correction.

This paper describes such a multi-adjustable cervical orthosis for application in post-operative bracing of torticollis patients.

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### Fabrication procedures

The orthosis consists of:

- 1) head piece with cross-bar;
- 2) Y-shaped chin support with elastic strap;
- 3) multi-functional joints;
- 4) upright and horizontal rods with baseplate;
- 5) upper thoracic plate with upright holder;
- 6) body jacket.

The head piece, cross-bar, Y-shaped chin support and body jacket are made of Synergy, 0.3cm thickness low temperature thermoplastic which was selected because of its strength and the ease with which it can be adjusted by the application of heat. To enhance comfort, a 0.3cm self-adhesive polycushion liner is used (Fig. 1).

The head piece, width 2.5cm, encircles the skull and opens posteriorly and is fastened to the head with a 2.5cm Velcro strap which is trimmed to avoid pressing on the ears. A diagonal cross-bar is added to prevent downward displacement of the head piece.

The Y-shaped chin section which utilises double layers of Synergy material for reinforcement is used to support the chin and control alignment of the head and neck within the orthosis and is attached to the head piece on the side opposite the affected muscle and moulded along the chin to push onto the zygomatic arch of the bulged side.

The elastic strap is attached to the chin support and head piece in criss-cross fashion. The upper fixed attachment point is located on the affected side in front of the ear. The lower end of this strap is attached to a buckle or fixed over the chin support. The strap is made of a 2.5cm strong elastic material and thus by exerting the appropriate pull on them, the head, neck and chin can be maintained in a corrected position post-operatively.

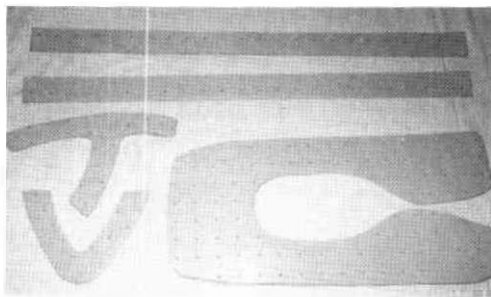


Fig. 1. Head piece, cross-bar and Y-shape chin support sections.

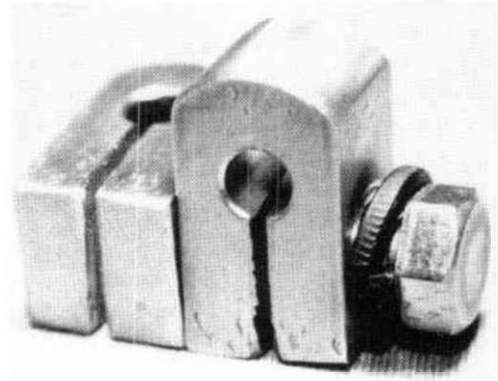


Fig. 2. Multifunctional joint.

The anterior upright arises from an upper thoracic plate, extends upwards and is attached to the horizontal rod by means of a multifunctional joint (Fig. 2).

The multi-functional joint consists of two solid brass connector blocks measuring 2.5cm x 1.2cm x 1.2cm with a hole of diameter 0.5cm and an 0.1cm slot. They are locked together using an M6 bolt and spring washer to form a simple hinge joint and clamping mechanism.

The joints control lateral flexion of the neck, flexion/extension, and horizontal rotation in the transverse plane. The motion of the joints together act to more closely approximate normal neck motions.

The two horizontal rods, diameter 0.5cm are welded to the stainless steel baseplate, 3cm x 1.5cm x 0.1cm. This is riveted on to the head piece just above the ear (Fig. 3).

The uprights are anchored by brass upright holders (4cm x 12cm x 12cm) which are riveted onto the upper thoracic plate. The holders are drilled and tapped M4 to accept

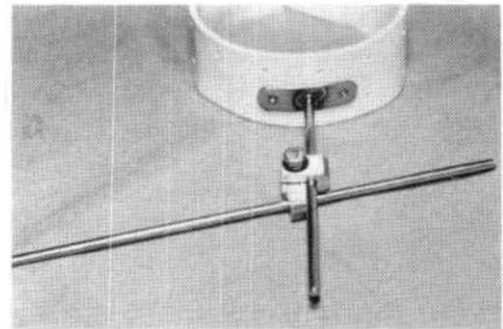


Fig. 3. Multifunctional joint with rods and steel plate riveted onto the head piece.

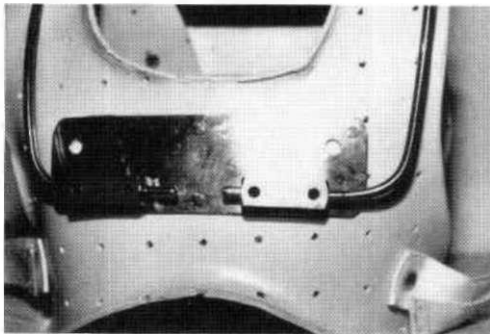


Fig. 4. Upright with the upright holder attached to the body jacket.

socket head type grub screws which when tightened effect locking of the uprights (Fig. 4).

The upper thoracic plate, 15cm × 4cm 2024-T2 aluminium, is attached to the body jacket by two M6 screws and butterfly nuts (Figs. 4 and 5).

### Clinical applications

Prospective patients were measured for the multi-adjustable cervical orthosis before operation and were fitted two to three days post-surgery. The head and neck were put into the orthosis and positioned in the maximally corrected while still tolerable position — i.e. with the neck laterally tilted to the opposite side, and also rotated to the side of the muscular torticollis with the neck in approximately about 20° of extension. The orthosis was only removed for the purpose of an intensive active mobilisation and passive stretching physiotherapy programme which was begun once the surgical wound had healed (five to seven days). For the rest of the time, the orthosis was kept on.

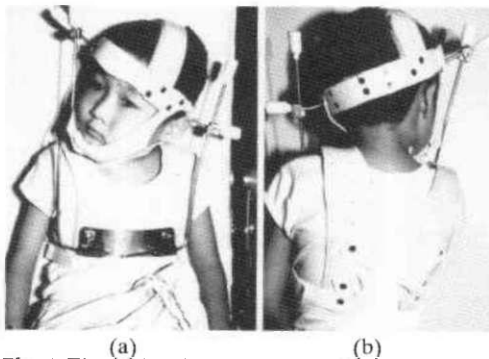


Fig. 5. The multiadjustable cervical orthosis applied post-operatively on a patient.

a) Frontal view  
b) Posterior view

Regular adjustment of position and checking of compliance being done by the orthotist, physiotherapist and surgeon at a special follow-up clinic. The total period of orthosis wear ranged from 8 to 12 weeks.

### Methods of assessment

The results of the patient undergoing surgery and post-operative bracing were assessed functionally and cosmetically according to the same criteria as Canale *et al.*, 1982.

Functionally the results were classified as good when the range of active and passive rotational and side flexion movement was limited by less than 15° as measured by arthroal protractor measurements. The cosmetic evaluation included the surgical scar, the persistence of head tilt, facial asymmetry and the presence of residual bands or tight sternomastoid muscle. The presence of any two or more of these criteria was considered unsatisfactory.

The overall results of treatment were considered good when both functional and cosmetic results were satisfactory, fair when either one was unsatisfactory and poor when both were unsatisfactory.

### Results

Between 1984 and 1991, 25 patients with congenital muscular torticollis were treated surgically in the Prince of Wales Hospital. The age at operation ranged from 14 months to 22 years with an average age of 6.8 years. The detailed breakdown is listed in Table 1. Surgery included either a unipolar tenotomy for the younger patient, or a bipolar release to radical excision in the older patient (over 8 years of age).

Thirteen girls and 12 boys were treated with the orthosis post-operatively for an average of

Table 1. Ages of patients using the orthosis.

No. of patients	Age of operation (years)	Percentage of all patients
3	<2	12%
11	2-6	44%
7	7-11	28%
4	>11	16%
25		100%

10 weeks. The follow-up ranged from 1 to 7 years (average 3.9 years).

No major complications resulted only from the use of orthosis. Minor scalp irritation due to tightness of the halo necessitated readjustment in 3 cases. Orthosis compliance was good except in 2 cases where an earlier removal of the halo was necessary. Both cases were children less than 2 years of age and the parents found the child was not tolerating the orthosis and repeatedly pulling it off.

Follow-up analysis of the improvement in the range of active and passive neck movement, scar, facial asymmetry and head tilt have been analysed showing that 72% achieved a good result, 20% a fair result and 8% a poor result. The age at operation was found to affect the results significantly. Those operated before the age of 6 all showed good results, those between 7-11 of age had 60% good result, 40% fair result and those after 11 had 50% poor and 50% fair result.

### Discussion

There are diverging views regarding the treatment of muscular torticollis in infants less than 1 year old ranging from simple observation, to aggressive manual myotomy in certain centres. Most centres would however recommend surgical treatment for children with persistent torticollis beyond the age of one, in conjunction with some form of post-operative immobilisation together with an appropriate physiotherapy rehabilitation programme (Funayama, 1977; Itoi *et al.*, 1990; Lee, 1986; Oh and Nowacek, 1978; Tse *et al.*, 1987).

The use of Halter's traction, a soft cervical collar, a plastazote or orthoplast collar have all been described. However, the compliance with such orthoses is usually poor and the orthoses cannot effectively maintain the head and neck in the corrected, or over-corrected position. More rigid forms of immobilization using plaster halo-body cast or halo-body vest with skull pins have also been described but these are often neither well tolerated nor accepted by the child or parents, and moreover the essential physiotherapy cannot be instituted appropriately.

The major advantage of the orthosis described here is that it has an adjustable mechanism which facilitates controlling of the head and neck in the most desirable position.

Adjustments can be carried out simply and quickly with good positional control effected by the locking screws. The brace is easily handled, lightweight, offers good compliance, and can be easily removed and reapplied to permit daily rehabilitation physiotherapy. To minimize discomfort at the time of fitting, fabrication is done pre-operatively and the orthosis then only requires application and adjustment post-operatively. As post-operative pain diminishes, the initial correction attained can be gradually increased to an over-corrected position. To avoid compliance problems for children of school age the operation and subsequent bracing period are usually scheduled during the extended summer vacation period. The experience of the authors' also shows that it is difficult and probably not necessary to fit this orthosis for children operated before the age of 2 since the 2 cases who did not tolerate it were found on follow-up to have good results.

With the use of this multi-adjustable torticollis orthosis the authors have been able to maintain good control of surgical correction in 25 patients from age 1 to 22 with a follow-up period of 1 to 7 years, averaging 3.9 years. The results overall have been very satisfactory with 72% of patients fitted attaining good correction and for those treated before the age of 6 all having good results.

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