

Custom moulded plastic spinal orthoses

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Abstract

A review of fifty patients with wide ranging clinical conditions who had been fitted with one-piece moulded plastic spinal orthoses was carried out to determine prescription criteria for these orthoses. The review showed that patients with scoliosis (idiopathic and paralytic), kyphoscoliosis, as well as a selected number of patients with low back pain derive benefit. Patients with kyphosis and localized vertebral body disease are unlikely to gain benefit since they commonly cannot tolerate the excessive skin pressures which occur as a consequence of the corrective and distractive forces applied by the devices.

Introduction

Spinal orthoses are one of the most commonly prescribed types of orthoses delivered in the United Kingdom. A review of prescription practices in Dundee during one year showed that a total of 520 spinal orthoses had been prescribed and subsequently fabricated representing 17 per cent of the total orthotic supply for a district with a population of 180,000 people. Ninety one per cent of these orthoses were fabric supports but the remainder were rigid devices. These devices have traditionally been fabricated from metal and leather but in recent years it has been the practice in Dundee to make increased use of moulded plastic jackets (McDougall and Condie, 1982).

Between 1979 and 1982, a total of 56 patients with a wide range of clinical conditions had been supplied with 66 moulded jackets. Eight of these patients had undergone spinal surgery and 34 had previously worn conventional orthoses such

as fabric supports, Taylor braces and Milwaukee braces. Referring clinicians had considered that these conventional orthoses had been inadequate for a variety of reasons and had decided that alternative orthotic provision should be attempted even though the plastic orthoses were often considered to be a 'last resort'. The success of their fittings and the consequent increased clinical demand prompted the authors to undertake a review of 50 consecutively fitted patients in order to improve our understanding of prescription criteria and to assess the benefits of this type of orthotic care.

Description of orthosis

One-piece plastic spinal orthoses are commonly fabricated using vitrathene (Paul, 1970), a derivative of polyethylene*, although polypropylene can also be used (Zamosky, 1978). The fabrication process involves taking a plaster-of-Paris wrap cast of the patient's trunk, from which a plaster model is produced. The force distribution required to be applied by the orthosis upon the trunk is achieved through the rectification of the model (the addition or removal of plaster). A heated sheet of vitrathene is draped by hand around the rectified model and its edges are trimmed when it has cooled. Particular attention is given to the axilla and groin areas. The plastic is flexible in its opened state allowing the patient to don it, but becomes rigid when secured with velcro straps around the trunk. The plastic overlaps over the abdomen (Fig. 1). Sheets of various thicknesses are used depending upon the desired rigidity.

The orthosis is light in weight (typically 0.5 to 1 kg) and is more cosmetically acceptable than

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'Vitrathene' is manufactured by Stanley Smith and Co., Isleforth, England and supplied through North Sea Plastics, Dumbarton, Scotland.

the conventional metal and leather devices (Fig. 2). It is easy to clean and does not absorb perspiration. Vitrathene possesses excellent fatigue properties and its durability typically gives many years of useful function.

Review method

The 50 patients selected for the review were taken from a list of sequential deliveries. The mean follow-up time was 25 months following delivery with a minimum period of four months. The review was conducted by interviewing 47 patients and recording the answers to pie-set questions using a specially developed proforma. Relevant personal details, diagnoses, previous forms of treatment, orthotic objectives and results of clinical reviews were noted. The details of a further three patients who had died since delivery of their orthoses were taken from case notes. Decisions on the success or otherwise of the orthoses were made from an assessment of a number of criteria, including the provision of postural support and the relief of persistent pain.

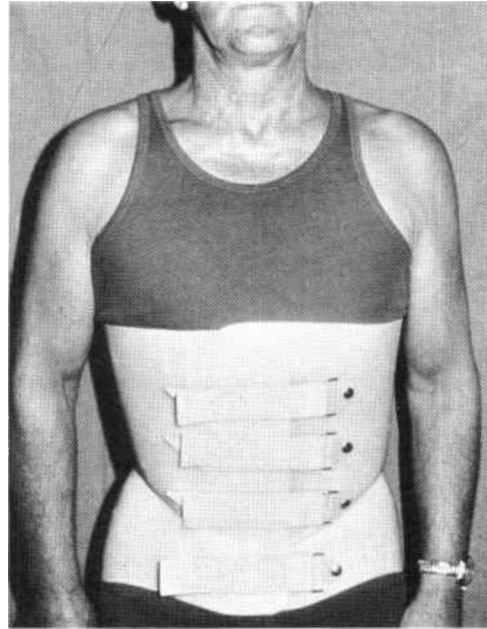


Fig 1. A one-piece plastic spinal orthosis with the proximal edges overlapping on the abdomen.

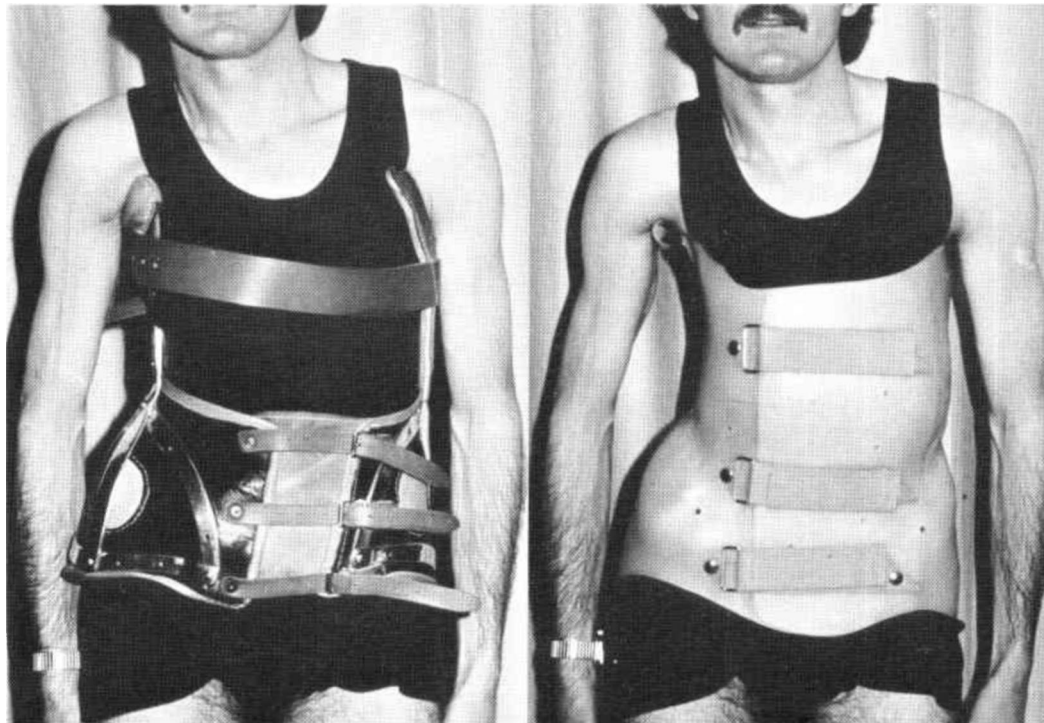


Fig. 2. Left, conventional block leather orthosis. Right, same patient wearing a lightweight Vitrathene orthosis.

Table I. Review summary

Group	Condition	Number of patients in group	Number of successful fittings
1	Spinal deformities		
(a)	Paralytic scoliosis	11	8
(b)	Scoliosis-kyphoscoliosis	10	8
(c)	Kyphosis	6	2
2	Localized vertebral body disease	4	0
3	Low back pain	19	10
Total:		50	28

Results

The patients were divided into three groups for the purposes of analysis.

The first group consisting of patients with spinal deformities was further sub-divided into three sub-groups (a) paralytic scoliosis, (b) non-paralytic scoliosis and kyphoscoliosis and (c) kyphosis.

The second group consisted of patients with localized vertebral body disease caused by tumours or infection.

The third group consisted of patients with low back pain from various causes and whose orthoses were prescribed principally to reduce pain.

Table 1 summarizes the number of patients in each group, with the results of the review.

Spinal deformity (Group 1)

Paralytic scoliosis (Group IA — II patients)

The application of a three point force system in the coronal plane for patients with scoliosis, typically requires forces laterally on the rib cage under the axilla, contra-laterally on the distal end of the rib cage and thirdly at a point on the lateral aspect of the pelvis immediately proximal to the hip joint. To achieve this force system, it is essential that the orthosis fits closely around the pelvis.

These 11 patients suffered from osteogenesis imperfecta, congenital spastic paraplegia, Werding Hoffmann disease, Duchenne muscular dystrophy, pseudohypertrophic muscular dystrophy, poliomyelitis or spina bifida (Fig. 3).

Eight patients continued to wear their orthoses at the time of the review. Of the three which had been withdrawn, one had been prescribed for a two year old child with spina bifida whom the surgeon subsequently considered no longer needed an orthosis. The second had been prescribed too late for one of the muscular dystrophy patients who was in the

latter stages of terminal illness. The third patient who had worn a block-leather orthosis since childhood following the onset of poliomyelitis, preferred this to the plastic orthosis.

One child with spina bifida used the spinal orthosis within a standing frame to improve posture and balance. The patient with osteogenesis imperfecta was the only one in the review who routinely wore his device in bed to assist breathing. Two patients reported intermittent discomfort with pressure on the rib cage and the anterior iliac spine and the review showed that these are areas requiring considerable care in the cast rectification processes.

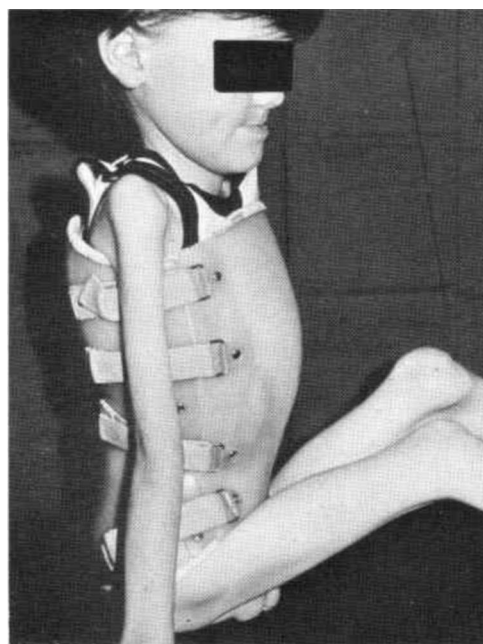


Fig. 3. A one-piece plastic spinal orthosis fitted to a child with muscular dystrophy. Straps have been provided on the lateral side to facilitate donning

Non-paralytic scoliosis-kyphoscoliosis
(Group IB — 10 patients)

The majority of patients in this group were adults with degenerative changes secondary to longstanding idiopathic scoliosis but the group also included patients suffering from osteoporosis, cerebral palsy and neurofibromatosis. Eight of the ten patients demonstrated satisfactory results when the criteria of pain relief and improved ability to undertake functional activities such as standing and walking were considered. Six had previously worn spinal orthoses of other types. Patients in this sub-group generally wore their orthoses intermittently.

The two patients who had discontinued use of their devices had done so because of discomfort. One had complained of discomfort when sitting and a further patient had rib impingement on the side of the scoliosis. Their discomfort could not be alleviated by adjusting their orthoses.

Kyphosis (Group IC — 6 patients)

For kyphosis, forces acting in the sagittal plane require to be applied anteriorly on the sternum and pubis and posteriorly in the dorsal

region. The application of these forces inevitably requires a full-length device which patients find uncomfortable because of high skin pressures on the sternum and pubis.

Patients with kyphosis did least well with this type of orthosis. Of the six patients within this category, only two had gained benefit. Discomfort was commonly reported especially in the sitting position. For the three patients with osteoporotic crush fractures, adequate corrective forces could not be tolerated.

Localized vertebral body disease (Group 2 — 4 patients)

There were four patients in this group and none achieved a satisfactory result. The group consisted of one patient with haemangioendothelioma of T10, one with Paget's disease of LI and two with local but severe deformity following tuberculosis. It was considered that all these patients needed distraction for pain relief which was not obtainable in the spinal orthoses.

Low back pain (Group 3 — 19 patients)

The aim was to restrict spinal movement for these patients rather than to apply any corrective forces. Considerable care was thus taken to locate the orthosis on the pelvis by moulding deeply into the iliac crests (Fig. 4). The orthosis was also flattened over the abdomen in an effort to influence the intra-abdominal pressures (Morris et al, 1961) although it probably helped more by further restricting movements (Nachemson et al, 1983).

There were 19 patients in this, the largest group in the review. Successful fittings were achieved in ten cases. The prevalence of low back pain in the community prompted the investigators to pay particular attention to this group and the results are summarized in Table 2.

It was significant that seven patients gained satisfactory results with these rigid orthoses when fabric supports had failed. Four patients were unable to wear their orthoses for genuine reasons (Table 2b). Of these, one patient was too frail to be a suitable candidate, the second had respiratory problems and could not tolerate anterior pressure and two obtained better relief with medication.

The assessment and treatment of some patients with low back pain can be notoriously difficult. In retrospect it should have been

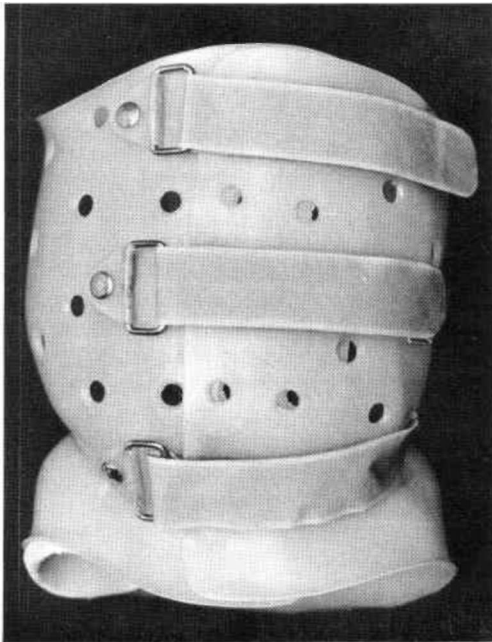


Fig. 4. "Keying-in" of the orthosis around the pelvis is essential for correct fitting. Soft liners may be used for comfort.

Table 2. Results of fitting patients suffering from low back pain

SUCCESES:			
TABLE 2A			
Osteoarthritis with referred pain			— 7 patients
Spondylolisthesis			— 2 patients
Compression fractures awaiting fusion			— 1 patient
			Total: 10 patients
FAILURES:			
TABLE 2B			
Osteo-arthritis with compression fracture	L4		Too elderly and feeble
Osteo-arthritis with spondylolisthesis	L3/4		Respiratory problems
Indefinite investigation but considered connected with artereo-sclerosis	—		Preferred simple analgesia
Prolapsed intervertebral disc	L4		Preferred simple analgesia
			Total: 4 patients
TABLE 2C			
Osteo-arthritis		— 2 patients	L4/5
Indefinite cause			—
Prolapsed intervertebral disc			L3/4
			Anxiety neurosis
			Hypochondriacal
			Hysterical paraplegic
			Total: 4 patients
Minor osteo-arthritis			L4/5
			Malingerer

possible to anticipate failure in four of the remaining five patients (Table 2c). Examination of the complete medical case notes confirmed that four patients had definite psychological problems which directly influenced their low back pain. In all four cases, the diagnoses were made by at least one clinician outside the authors' department. The presence of these adverse psychological factors do not of course exclude the presence of true spinal pathology.

Discussion

The prescription criteria for vitrathene spinal orthoses can be best determined by considering patient groups.

Patients with paralytic scoliosis gain an improved posture, breathing control and outward appearance (Fig. 5) (James, 1977). The results were particularly impressive for four teenagers confined to wheelchairs. All gained more upright positions and were able to use both arms whereas previously they needed the support of an elbow on the wheelchair armrest for support. They reported improved breathing control and increased self-confidence since the presence of the jackets could not be detected under their clothing.

Patients with scoliosis or kyphoscoliosis presenting with secondary degenerative changes, especially the elderly, benefit from using vitrathene jackets for the relief of pain even for part of the day. Intermittent use may be

made by a number of patients for pain relief whilst standing and walking. Patients with kyphosis may also encounter pain as a consequence of secondary degenerative changes but this group does least well and these patients commonly complain of excessive skin pressure.

The second group of patients with localized vertebral body disease did not benefit. The distractive forces which are required for these patients cannot be readily applied by the plastic orthoses since intolerable skin pressures are encountered.

It is less easy to foresee the results for the third group of patients, namely those with low back pain. Most patients needing orthotic care are successfully supplied with a fabric support but there are some patients needing a rigid device. Experience has shown that vitrathene orthoses may be of considerable benefit if applied correctly but very careful assessment is necessary before decisions are taken to initiate fabrication.

Patients' views were sought regarding increases in body temperature and perspiration due to the close proximity of the plastic. Fourteen patients reported no discomfort and were quite satisfied although cotton vests were commonly worn to improve comfort. Patients found their orthoses most beneficial whilst standing, a point on which all (excluding wheelchair users) reported favourably. Eight patients who continued to wear their devices

reported some discomfort under certain situations such as sitting in soft cushioned chairs. It was observed that patient age, per se, is not a contra-indication to the prescription process and patients with ages ranging from 2 to 83 were fitted.

Summary

The review demonstrated that moulded plastic spinal orthoses have an important role in orthotic rehabilitation. The major advantage of this type of orthosis over conventional types is the facility to provide a more precise force system between the orthosis and trunk to meet the particular prescription objectives for each patient though considerable patience may be needed during the fabrication processes. Patients generally find their orthoses lightweight and easy to clean. Those in the series found that their jackets were easy to apply with the exception of the wheelchair users and the elderly and frail.

Prescription practices in Dundee now reflect the results of the review but experience has shown that it is important to show a vitrathene orthosis to a patient before fabrication commences, to ensure that he or she will be prepared to use one. This is necessary to avoid wasted efforts in device fabrication.

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