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Modern concepts in hand orthotics[1]

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This paper attempts to describe some of the principles and objectives in the orthotic treatment of hand disabilities. The author's experience over many years has been used in the design of a variety of orthotic devices while considering the following criteria:

Function

The device should place the hand in a functional position, thus permitting immediate use of any residual capability and also placing the hand in the optimal position to promote recovery.

Effectiveness

The device should be capable of effecting relief of the symptoms.

Adaptability

The device should be capable of adaptation to fit a reasonable range of patients.

Adjustability

It should be possible to adjust the device to compensate for the changing condition of the hand during treatment.

Comfort

The patient is more likely to co-operate in a comfortable splint.

Aesthetic Appearance

These points will be illustrated in the following series of figures.

Boutonnière injury orthosis (1)

This orthosis (Figure 1) may be formed by direct application using Prenyl. This material has the advantage of being easily adjusted after immersion in hot water and then setting in cold. The attitude of 40 degrees of flexion of the distal end portion prevents the orthosis from slipping.

Vitrathene and polypropylene may also be used; however, both require a former for the moulding process. Experience with this orthosis to date has proved it very effective in reducing the final deformity, but further evaluation is required.

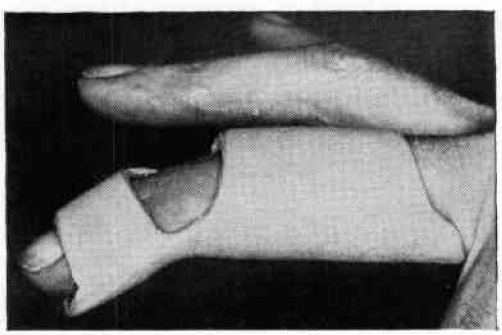

Fig. 1. For Boutonnière injury (1) Type: passive. Material: Prenyl. Function: PIP joint in extension, DIP joint in flexion, 40 degrees approximately.

Boutonnière injury orthosis (2)

The distal and proximal volar plastic troughs are linked by parallel spring steel rods of 18 SWG wire. The dorsal trough is positioned distally for ease of application of the orthosis. Once the finger has been introduced the dorsal trough slides into position over the proximal interphalangeal joint, completing a three-point pressure system (Figure 2).

A full Celadex ring is required distally if a position of 40 degrees of flexion of the distal segment of the finger is required. When the orthosis is applied to the lateral aspect of the finger it corrects deviation. It has also been used in the treatment of a mallet finger.

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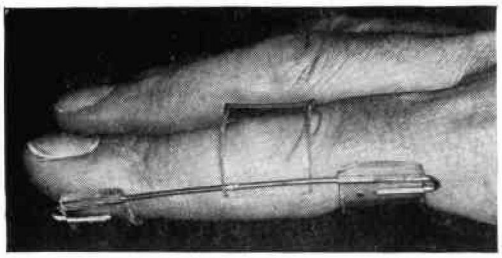

Fig. 2. For Boutonnière injury (2) Type: passive. Material: Celadex-spring steel. Description: slide-lock. Function: extends IP joints.

Ulnar deviation orthosis

This simple type of orthosis is easily fabricated. The orthosis functions by using the ring finger as a stabiliser, thus checking the ulnar drift of the little finger (Figure 3). The open-ended configuration is adopted to aid application and removal. The orthosis can be used for an ulnar nerve lesion or for an injury of the metacarpal joint, rather than in the rheumatoid arthritic.

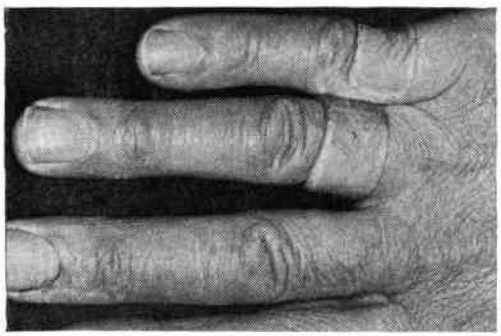

Fig. 3. For ulnar deviation. Type: passive. Material: Celadex. Function: adducts to mid-line (positioned by adjacent finger).

Minor flexion contracture orthosis

The transparent Celadex plastic saddle is found to be cosmetically acceptable (Figure 4). For some patients, especially female, this factor is of great importance and, if it results in increased co-operation on the part of the patient, it will undoubtedly assist recovery from the injury. Once the patient's confidence has been gained, further treatment may be embarked upon if the contracture requires a stronger dynamic device. This orthosis can be used on social occasions and also during work to maintain some degree of extension when more active splintage is inconvenient or impracticable.

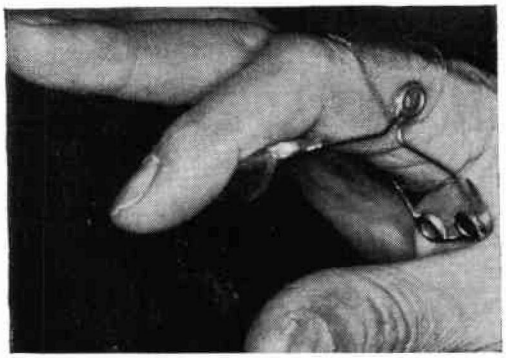

Fig. 4. For recovery phase of minor finger injury. Type: dynamic. Material: Celadex-spring steel. Function: resists flexion IP joints, assists extension IP joints.

Orthoses for thumb opposition

A three stage orthotic approach to the treatment of the hemiparetic child is demonstrated.

The long opposition orthosis (Figure 5 left).

The long opposition orthosis incorporates the wrist and metacarpals and can be fabricated in the clinic. The thumb portion may be omitted while the main wrist unit is positioned manually then immersed in cold water to set. A cap unit to abduct the thumb may be added later. If preferred the two components may be formed in the reverse order.

Alternatively, the orthosis may be fabricated on a positive cast and on some occasions a master cast may be used. The production of a plaster of Paris negative can present some difficulties with the small child.

The short opponens orthosis (Figure 5 centre).

This orthosis incorporates the metacarpals. It is important to maintain the seating on the entire lateral aspect of the distal palmar crease extending proximally. This provides increased comfort to the wearer. The Velcro fixation should be placed at the angle which provides the most effective fixation.

The thumb-cap opposition orthosis (Figure 5 right).

The thumb-cap opposition orthosis is the final stage of this orthotic treatment programme. An open-thumb unit can be used which gives

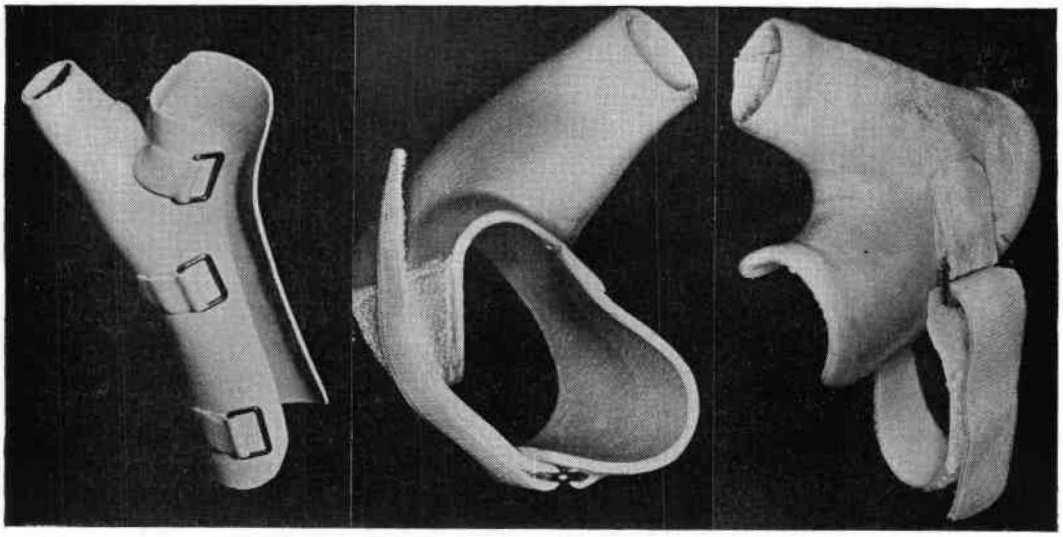

Fig. 5. For thumb opposition. Three stage orthotic approach. Left, long-incorporating wrist. Centre, short-incorporating metacarpals. Right, thumb cap. Type: passive. Material: Prenyl. Function: maintains opposition of thumb.

additional freedom; however, this can also cause difficulty with pressure. The choice will depend on the type of patient. This unit is normally acceptable to the patient as it is small and permits an increased range of movement.

Orthosis for injuries of ulnar nerve

In the production of this device (Figure 6) it is necessary to measure and cast the hand and to fabricate the orthosis on a former since the cemented joints require time to set. Once again the properties of Prenyl make it extremely easy to make adjustments in the clinic. If the orthosis is being used for an extended period, however, a more rigid plastic is used.

This piece of apparatus has been found aesthetically pleasing to the patient. It assists those who grasp objects, such as sacks, to perform their daily tasks. It has been used in

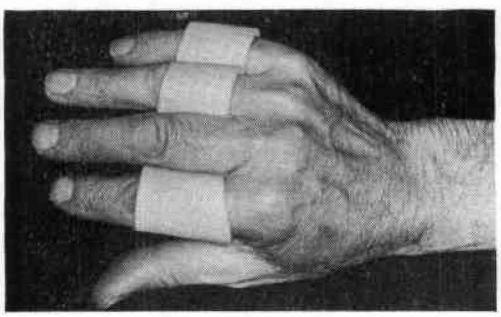

Fig. 6. For injuries of ulnar nerve. Type: passive. Material: Prenyl. Description: knuckle-duster. Function: prevents clawing, harmonises movement. Control by middle and index fingers.

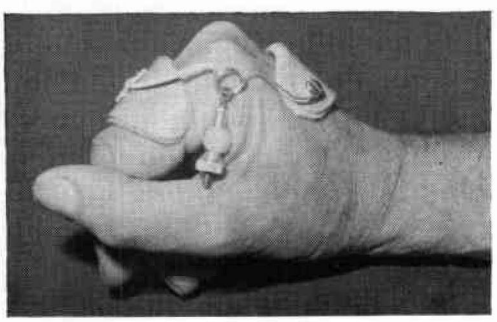

Fig. 7. For injuries of ulnar nerve. Type: dynamic. Material: malleable metal—Plastazote—No. 20 SWG spring steel. Description: ulnar intrinsic. Function: assists flexion MP joints, resists extension IP joints. (Palmar bar adjustable).

the early stage of the treatment of ulnar nerve lesions to be followed by a lively type of orthosis (Figure 7) and also in the reverse sequence.

Orthoses for correction and prevention of flexion deformity

An example of the use of these orthoses is in the treatment of Dupuytren's contracture. The modular design of these orthoses is of considerable value when springs of varying tension are required. The chassis is malleable thus enabling precise fitting at the metacarpophalangeal joint and on the palmar aspect.

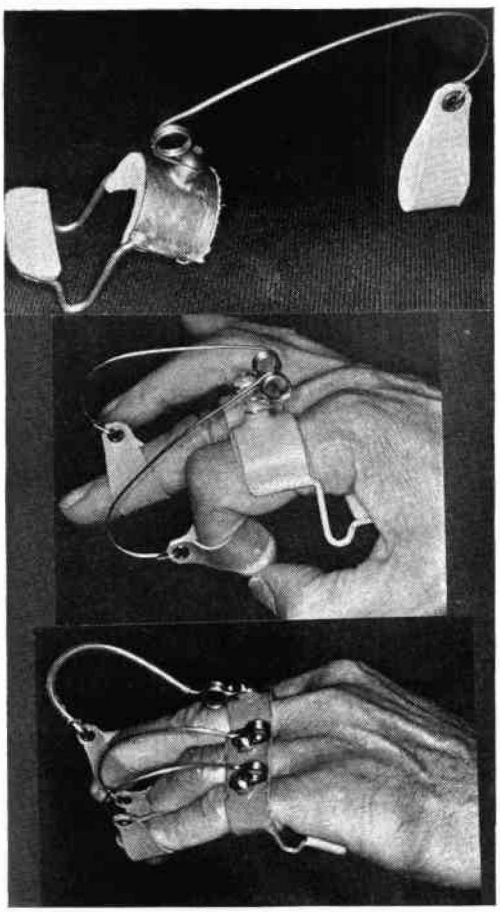

Fig. 8. For correction and prevention of flexion deformity. Top, single finger orthosis. Centre and bottom, multiple finger orthoses. Type: dynamic. Material: malleable metal-Plastazote-spring steel. Description: armchair (modified Exeter). Function: assists extension IP joints, resists flexion IP joints (spring adjustable).

The single-finger orthosis (Figure 8 top) is a modification of the Exeter armchair orthosis. This dynamic device is made in three sizes to cover the adult range. This means that the patient can be fitted in the clinic enabling treatment to commence immediately. A similar range is available for the treatment of children. When difficulty is experienced in maintaining the position of the chassis on the proximal segment it may be necessary to extend the saddle to enclose this segment more completely. This is most commonly encountered with the small finger. This type of device can be produced in multiples for application to two or more fingers (Figure 8 centre and bottom). Other orthoses of a similar design have utilised springs of a shorter length. The end of a spring with a short leg will move in the path of a circle generated by the coil of the spring alone. The natural path of the two distal phalanges moving from flexion into extension is that of an involute. (Figure 9).

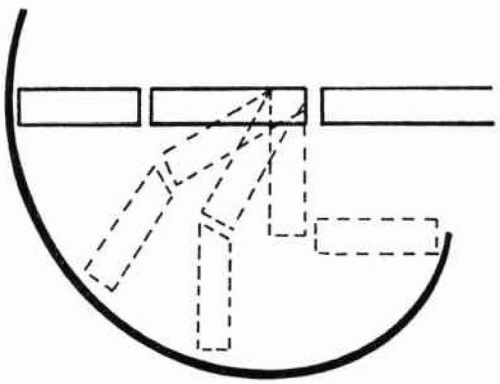

Fig. 9. Involute path of finger tip from flexion to full extension.

If a spring with a longer leg is utilised bending will take place in the leg as well as the spring coils. The combination of the motion occurring in the leg and in the coils of the spring results in a more accurate copy of the actual anatomical motion of the finger.

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