

The “One-80° Pronosupinator”: Regaining forearm rotation

The One-80° Pronosupinator is a new and versatile orthosis that is helping patients regain supination and pronation range of motion. We were driven to design the One-80° Pronosupinator through our experience as hand therapists, working with patients following wrist and elbow injuries. We know that regaining forearm rotation can be a challenge for patients and therapists alike, that traditional therapies are often not as effective as we hope, and that rotation is key to function. Research demonstrates that orthoses remain effective in these cases, despite therapy plateau, the presence of some malunion or hard end-feel. In practice, however, there are barriers to implementing orthoses to address forearm rotation. The One-80° Pronosupinator design aims to reduce these barriers and allow more patients to achieve optimal outcomes.

Forearm rotation is a key movement that allows positioning of the hand for both fine and gross motor tasks. Functional range is commonly reported as 50 degrees of each supination and pronation⁽¹⁾. However, more recent studies report greater range is required for day-to-day functional tasks, with means as high as 65 degrees of pronation (keyboard use) and 77 degrees of supination⁽²⁾. The relationship of rotation and function is demonstrated in patient populations, with rotation being a predictor of Disabilities of the Shoulder and Hand (DASH) questionnaire score^(3,4). Rotational gains of 34 degrees, which were

achieved using orthoses, have resulted in a 24 point improvement in DASH score⁽³⁾, well above a minimal clinically important difference⁽⁵⁾.

Forearm rotation is a compound movement involving both the proximal and distal radioulnar joints. As a result, pronation and supination can be affected by injuries involving the elbow, forearm and/or wrist. Limitations of joint motion are often considered in relation to bony malunion and/or soft tissue contractures^(6,7). At the wrist, osseous malunion which alters the articulation of the sigmoid notch or ulnar head may contribute to stiffness in rotation.

However, cadaveric studies examining the effect of malunion on rotation demonstrate only a modest amount of limitation until severe malalignment is present^(8,9). Soft tissue contracture is the greater contributor to movement loss in many cases⁽¹⁰⁾. What this means for us in the clinical setting is a patient's movement restriction may be due to malunion, soft tissue contracture or a combination. And unless malunion is severe, patients still have potential to improve their range of motion through addressing the soft tissue contracture component. When malunion is determined to be the main contributor to stiffness, surgical intervention may be indicated⁽¹¹⁾.

Early, protected motion is recommended where possible to prevent the development of soft tissue contracture and fibrosis⁽¹²⁾. Once stiffness develops,

it can be challenging to resolve. Traditional hand and physical therapy techniques, such as heat modalities, manual stretching and joint mobilisation, are often the first line treatment for subsequent soft tissue contracture. This can be effective for those with mild to moderate stiffness in early stages of treatment. In cases where stiffness persists, these techniques are often ineffective⁽¹³⁾. There is the misconception that when traditional hand therapy fails, or when there is a hard end-feel, malunion, chronicity or plateau, that two options remain. One is for the patient to compensate for any lack of movement, potentially resulting in further injury up the kinetic chain⁽¹²⁾; and the other is more invasive treatment⁽¹⁰⁾. However, research involving sustained stretching with orthoses shows substantial change can be achieved despite these factors^(14,15).

“...regaining forearm rotation can be a challenge for patients and therapists alike”

Researchers have investigated the effect of sustained stretching via mobilisation orthoses on forearm rotation range. The results demonstrate significant gains in supination and/or pronation using a variety of orthosis designs. Mean improvements range from 25.8 degrees (pronation)⁽¹⁶⁾ to 48.3 degrees (supination)⁽¹⁴⁾. These gains were made despite participants plateauing with standard treatment and despite time since injury. In practice, these features may have historically justified a cessation of rehabilitation efforts, but this research demonstrates a potential for substantial movement gains.

There are two key components when considering the success of these orthoses: 1) forearm position within the orthosis (is the orthosis providing adequate stretch?) and 2) duration of wear (is the stretch sustained long enough to allow tissue adaptation?). When applying a mobilisation orthosis, it is critical to assess whether it is holding the patient in a position of stretch. These studies achieved this by advising regular progression of stretch whilst wearing the orthosis⁽¹⁵⁾, or by comparing maximum active range within the orthosis⁽¹⁴⁾. Alternative options, such as neoprene rotation straps or taping are never sufficiently levered for the stiff wrist or elbow. This results in limited movement gains.

Another commonly chosen orthosis is a static wrist orthosis strapped to a static elbow orthosis in either pronation or supination. This often fails to be applied by patients in a way to reliably hold the position at end-of-range, so it commonly fails to stretch a truly stiff forearm. If orthoses are not effectively holding the forearm at end-of-range, they are not going to provide an efficient and effective stretch.

Prefabricated orthoses such as the JAS Sup/Pro^(3,15) or the custom-moulded design by Parent-Weiss and King⁽¹⁶⁾ provide a reliable force and results. Thermoplastic orthoses, such as the Colello orthosis⁽¹⁷⁾, and designs described by Shah, Lopez et al⁽¹⁸⁾, and Lee and LaStayo⁽¹⁴⁾ also provide reliable stretch, holding people at end-of-range.

The proposed mechanism of sustained stretch via mobilisation orthoses allows lengthening adaptation of the soft tissues. Consequently, duration of stretch is critical. Flowers and LaStayo⁽¹⁹⁾ and Glasgow, Fleming, et al⁽²⁰⁾ have examined this in detail relating to the proximal interphalangeal joint and total end range time (TERT). Most hand therapists and surgeons would be very familiar with Capener and other mobilisation orthoses for the PIP joint.

The same principles apply to forearm rotation. In many upper limb joints, the most efficacious stretch by far, is one which lasts for hours, giving tissues a stimulus and time to adapt.

Despite the evidence supporting their use, our clinical experience tells us that these orthoses are under-utilised. So, what are the barriers? A reliable orthosis is often not easily accessible, and custom-making one in the clinic that reliably holds a firm stretch at end-of-range is technically demanding and time consuming. These are especially barriers for clinicians who may be inexperienced with these orthoses. Fabricating a reliable design, such as a Colello orthosis⁽¹⁷⁾, remains time consuming for even the most experienced therapist.

From a patient's perspective, cumbersome designs are often not well tolerated. Patients report they don't like to wear them or that they find it difficult to fit in the required time in order to achieve gains in range. The bulk and position make most orthoses hard to wear and usually prevents function of the entire limb. If patients are unable to achieve a sufficient number of hours per day, the tissues do not adapt⁽²¹⁾.

We set about designing a patient-friendly option which also provides a reliable stretching force, to achieve optimal outcomes. The result is the One-80° Pronosupinator. The hinged elbow articulation allows free elbow flexion and extension. The wearer's digits are free, allowing them to hold items in their hand and briefly perform tasks whilst wearing the One-80° Pronosupinator (Fig. 1).

When the task is complete, it promptly and firmly stretches them back to end-of-range (Fig. 2). The soft wrist cuff allows some wrist flexion and extension, making function easier. The light-weight aluminium frame allows it to apply ample stretching torque, while weighing under 400g (0.9lbs). This means the

patient can wear the One-80° Pronosupinator for hours of their day, while still using their hand for brief function. They can go about their activities and only have the discomfort of constant stretch. From a therapist perspective, the One-80° Pronosupinator is ready-to-go and easy to adjust. One size can be adjusted to fit most people (Fig. 3). And it is easily adaptable for use on either left or right; for pronation or supination. A single orthosis can be in the clinic cupboard ready for a 2-3 minute customisation for the next patient who presents with stiffness. Patients are happy to wear it, finding they get the best result for the least effort and inconvenience (Fig. 4). Clinicians are reporting their patients typically achieve improvements in keeping with the 40° to 50° suggested in the literature^(14, 15, 18).

We have been further encouraged by recognition of the One-80° Pronosupinator as a finalist in IFSHT Cristina Alegri Award for Innovation in Hand Therapy in 2019. It was also the winner of the Physiotherapy Research Foundation's inaugural Pitchfest in 2019.



Figure 1: The One-80° Pronosupinator is a dynamic mobilisation orthosis for forearm rotation. It applies a dynamic stretch for supination or pronation whilst allowing free elbow flexion and extension, and free use of the digits.



Figure 2: Whilst wearing the One-80° Pronosupinator, patients can actively move out of a stretched position (eg from supination to pronation) and are then dynamically stretched back into position when they relax. The orthosis can be applied in either a supinated (pictured) or a pronated position.



Figure 3: One size fits most people. The distal length of the orthosis can easily be adjusted to the desired forearm length.



Figure 4: The wearer can briefly move out of a stretch position for function. This makes it easier for patients to achieve the required total end range time for soft tissue adaptation.

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NEW! IFSHT MEMBER-TO-MEMBER MENTORING PROJECT

The IFSHT is excited to announce the IFSHT Member-to-Member Mentoring Project. Purpose: IFSHT has seen significant growth in the Associate and Corresponding Member categories, who demonstrate a passion for hand therapy. The IFSHT mission to develop and enhance the practice of hand therapy recognizes the need to address issues that these countries face in forming a national hand therapy society comprised of OT and PT hand therapists. Survey: All IFSHT delegates were invited to participate in a survey regarding hand therapy development in their country. Full Member countries shared how their society was formed and its current scope of activity.

Associate and Corresponding member delegates shared their opportunities and issues for growth of a professional society. Based on the survey responses, one or two full member countries have been paired with associate or corresponding member countries to foster a mentoring relationship. Guidelines, outcome and timelines: each participating country has been given a guideline for the mentoring relationship and IFSHT will be asking for feedback every six months. We hope this initiative helps to further the development of hand therapy around the world as per the IFSHT mission.

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