Evidence Based
Static Progressive Splinting

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Learning Objectives:

- Gain understanding of the indications, precautions and contraindications.
- Gain understanding of the evidence supporting static progressive splinting.
- Appreciate the mechanical principles.
- Appreciate the anatomical knowledge base.
- Learn some tips and tricks for splinting.
Static Progressive Splinting

Definition:

“Splints that incorporate inelastic components to apply torque to a joint to statically hold it in its end range position in order to increase passive range of motion”

“creates static mobilizing force on segment, resulting in passive motion of joint or successive joints”

Mobilization Splinting

- Dynamic Splinting
- Static Progressive Splinting
- Serial Splinting
# Mobilization Splinting

<table>
<thead>
<tr>
<th>Static Progressive Splinting</th>
<th>Dynamic Splinting</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Base</td>
<td>- Base</td>
</tr>
<tr>
<td>- Outrigger</td>
<td>- Outrigger</td>
</tr>
<tr>
<td>- Static components for force application</td>
<td>- Dynamic components for force application</td>
</tr>
<tr>
<td>Velcro, static line, screws</td>
<td>Rubber bands, elastic, coils, springs</td>
</tr>
<tr>
<td>gears, turnbuckles</td>
<td></td>
</tr>
<tr>
<td>- Used to increase passive joint range</td>
<td>- Mobilize joints</td>
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Static Progressive Splinting

As tissue length changes, patient is able to readjust tension to new maximum tolerable length.
Indications/ Contraindications

Indications:
Loss of joint motion

Contraindications:
Stage of Healing
Diagnosis
Protocol
Knowledge of Anatomy

• Bony Structures

• Nerve Pathways

• Arches

• Blood Supply

• Stages of Healing

Remodeling of Tissue

The biologic rationale for using splints to increase range of motion..... peri-articular connective tissues remodel over time in response to the type and amount of physical stress they receive.....

Applying the Principles of Splinting

- Wider longer splints distribute pressure better
- Flared edges cause less pressure than straight edges
- Avoid pressure on bony prominences
- Allow full motion at non-involved joints

Applying the Principles of Splinting

- Prevent distal migration
- Maintain proper angle of pull
- Secure attachments
- Stabilize proximal joints

Applying the Principles of Splinting

- Low Load Prolonged Stress = LLPS
- 90° angle of pull.
- If angle is less than or greater than 90°, the force can damage the joint or the articular cartilage.

How to measure a 90° angle of pull?
Total End Range Time

The amount of increase in passive range of motion (PROM) at a stiff joint is proportional to the amount of time the joint is held at its end range or “TERT“ (Total End Range Time)

$$TERT = \text{frequency} \times \text{duration}$$

Questions for the Splint Maker

Questions

- What is the goal?
- What type of mobilization splinting?
- What structures are affected?
- What is the pathology?
- What are the precautions?
- How can I measure progress?
How to Decide Which Type of Splint?

Dynamic, Static Progressive, or Serial Static Splinting—How to decide?
Modified Weeks Test

- 20 degree increase in ROM - no splint
- 15 degree increase in ROM - static splint
- 10 degree increase in ROM - dynamic splint
- 5 degree increase in ROM - static progressive splint


Journal of Hand Therapy, 17(3), 158-162.
Torque Angle Range of Motion

Quantifies the amount of torque forces required to gain a certain amount of passive range of motion at a joint - helps us decide which type of mobilization splint is needed.
# Consider Force and Control of Force

<table>
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<tr>
<th></th>
<th>Dynamic</th>
<th>Serial Static</th>
<th>Static Progressive</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Force</strong></td>
<td>Elastic/ given force/ doesn’t hold tissue at max. length</td>
<td>Constant tension– end range position maintained</td>
<td>Constant tension– end range maintained–</td>
</tr>
<tr>
<td><strong>Force Control</strong></td>
<td>Springs/ rubber bands deform over time– no one has control</td>
<td>Clinician has control</td>
<td>Clinician and / or patient have control</td>
</tr>
</tbody>
</table>


Application of Force

Proper tension: How much is correct amount?

Depends on:

• individual
• diagnosis
• severity of problem
• chronicity of problem
• degree of contracture

An Algorithm for Making Clinical Decisions For Patients with Limited Range of Motion

Add splint to interventions

If splint causes increased pain, Discontinue splint use

No Change in ROM

Reevaluate ROM

If splint wear is tolerated well

Reevaluate TERT

If TERT is maximum

Increase intensity of force

Patient Instructions/ Precautions

- Wearing schedule - frequency and duration
- Caregivers instructions / photos
- Care of splint
- Precautions
- How to know when splint adjustments are necessary
Benefits of Static Progressive Splinting

- Improve range of motion
- without pain

- Patient able to
- adjust force
- gradually
Benefits of Static Progressive Splinting

- Takes advantage of small incremental changes in tissue length
- Splint design allows for small changes without remolding splint each time
- gains are accomplished.
Don’t Forget to Measure Progress!
How to Find The Evidence for Static Progressive Splinting?

Database Searches on:
Pub Med
Ovid, Google Scholar
OT Seeker
PEDro, EBSCO

Key Words: “splinting, dynamic splinting, static progressive splinting, splinting the upper extremity, splinting and hand therapy”
The Evidence: Optimal TERT: Randomized Clinical Trial

Glasgow et al looked at 43 patients and the use of splints to correct joint contractures.

Group A - TERT of 6 hours per day
Group B - TERT of 6-12 hours per day

Patients included PIP and MCP contractures, and used both dynamic and static progressive splints.

Overall conclusion favored longer TERT time for contracture resolution.

Use of Low Load Prolonged Stretch: Retrospective Study

Nuismer et al looked at the use of Low Load Prolonged Stress with neurologically involved and orthopedically involved caseloads.

- Splint use 10 weeks (average)
- Improved function, ADL’s
- Improved range, comfort, ability to RTW, leisure


American Journal of Occupational Therapy, 51 (7), 538-543.
Doornberg et al conducted a study:
29 consecutive patients with elbow stiffness
• Increase of 51° elbow flexion
• Use of splints for average of 4 months
• ½ hour each direction, 3 x / day
Results in ROM pre-splinting versus post splinting show statistically significant increases.

Gelinas, Farber, Patterson and King looked at 22 patients:

- Average splint use- 15 hours / day
- Increased of 24 ° after an average use of 4.5 months.
- 11 patients regained functional arc (30-130°)

McGrath et al conducted a clinical trial of 38 patients:

- Increased arc of motion
- Increased supination
- Increased patient satisfaction

Lucado et al looked at static progressive splinting after distal radius fractures.

- Increased supination (mean of 14.5°)
- Increased wrist extension (mean of 18.6°)
- Improved grip
- Improved DASH

McGrath et al also looked at 47 patients with limitations of wrist motion. Patients wore a SPS wrist splint for an average of 3 hours per day for ten weeks. Average gains were an increase of 35 degrees of total arc of motion. Patient satisfaction scores were on average 8.2 out of 10.

Michlovitz et al conducted a systematic review of treatments to improve range of motion.
9 studies on splinting- 8 case series & 1 RCT
- Static progressive splinting
- Dynamic splinting
- Serial casting

Farmer and James conducted a systematic review of all treatments for contractures,

- Passive stretching
- Serial casting
- Splinting (Dynamic and Static Progressive)
- E-stimulation
- Surgery
- Botox

Farmer, SE., James, M. (2001). Contractures in orthopaedic and neurological conditions; a review of causes and treatment. Disability and Rehabilitation. 23(13); 549-558.
Today’s Program

• Static Progressive Orthosis for a stiff finger
The hand based SPS orthosis:
- Maintains MCP joint in extension
- Pulls PIP and DIP into flexion
- Needs pulley to direct angle of pull

*Orfit Colors NS 1/12”* is a lightweight, conforming elastic based product, perfect for circumferential and hand based orthoses.
Static Progressive Finger Flexion

Orthosis

Use scraps of material to make a finger cap over the finger tip.
References


Thank you for your attention!

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