



# EFFECTIVENESS OF INDIGENOUSLY DEVELOPED STATIC AND DYNAMIC HAND SPLINT IN PATIENTS WITH CLAW HAND: A COMPARATIVE STUDY

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**Abstract : Background/Introduction:** Claw hand deformity is a condition where fingers are bent into a position that looks like a claw. It may affect all of the fingers or some of them. A splint is a rigid support made from metal, plaster, or plastic. It's used to protect, support, or immobilize an injured or inflamed part of the body. A static splint has no moving parts. It can be used for support, protection, or correction. Whereas a dynamic splint has a static base onto which levels, springs, or pulleys can be attached. This allows the therapist to adjust the tension to apply a low-level long-duration load to help slowly improve range of motion.

**Objective:** To assess the effects of both static and dynamic claw hand splints on lumbrical muscles, in which, patients had flexor tendon injuries along with both ulnar and median nerve injury involvement.

**Participants:** 10 patients with unilateral claw hand deformity.

**Intervention:** Application of both static and dynamic claw hand splint. (8 weeks interval)

**Main Outcome Measure:** Book hold Test, FIM Score

**Result:** The result of the study shows book hold test increased from not able to perform to moderate in static hand splint whereas it was mild to good with dynamic splint. And FIM Score improved in both the splints but it was 44 with dynamic hand splints. It shows that the patient gradually improved on his precision work by the end of the 8 weeks use of dynamic hand splint due to increase in strength of his lumbrical muscles.

**Conclusion:** According to results of this study, it has been concluded that after using dynamic claw hand splint, the power of lumbrical muscles increased in all patients and reduction of clawing in fingers visible.

**Key words:** - Indigenous, Book hold test, FIM Score, Static, Dynamic, Claw hand.

## INTRODUCTION

Claw hand deformity refers to a condition where the fingers are bent into a position resembling a claw, with the fingers curled inwards and the knuckles protruding. This can occur due to nerve damage, muscle imbalance, or other underlying conditions. The most common cause is damage to the **ulnar nerve**, which controls some of the muscles in the hand that are responsible for finger movement.

In a typical case of claw hand deformity, the **fourth** and **fifth** fingers are most affected, showing signs of hyperextension at the knuckle joint and flexion at the finger joints. This is often associated with muscle weakness, especially in the intrinsic hand muscles. Common causes:

- Ulnar nerve injury or compression (such as from trauma, prolonged pressure, or conditions like cubital tunnel syndrome)
- Leprosy, which affects nerve function and leads to deformities like claw hand
- Stroke or neurological conditions, where motor control is impaired
- Arthritis or other musculoskeletal disorders

Treatment options:

- Physical therapy: To improve strength and flexibility
- Splints: To help maintain the fingers in a more functional position
- Surgical intervention: In some cases, nerve repair or tendon surgery may be necessary to improve function
- Medications: To manage pain or inflammation, depending on the underlying cause

A static claw hand splint: It is a type of orthopaedic device designed to help manage and correct the positioning of the hand in cases of claw hand deformity. The splint is intended to hold the fingers in a more functional and neutral position, preventing further deformity and promoting recovery. Unlike dynamic splints, which involve moving parts, a static splint holds the hand in a fixed position.

**Key Features of a Static Claw Hand Splint:**

- **Fingers in extension:** The splint keeps the affected fingers (typically the 4th and 5th) in an extended position to prevent them from staying curled.
- **Wrist support:** It may also provide support to the wrist, maintaining it in a neutral position to reduce tension on the tendons and muscles.
- **Comfort:** Made from materials like thermoplastic, soft padding, or foam, the splint is designed to fit comfortably around the hand while offering firm support.
- **Prevention of contracture:** By keeping the hand in a functional position, the splint can help reduce the risk of permanent contracture (permanent tightening of the muscles or tendons).

**Uses:**

1. **Resting splint:** Often used at night to help relax and stretch the muscles that may be affected by the deformity.
2. **Post-surgery or injury:** After a nerve injury or surgical correction, it can help maintain the hand in an optimal position during the healing process.
3. **Preventive care:** For conditions that may lead to claw hand deformity, a static splint can provide support and prevent worsening of symptoms.

**How It Works:**

The splint works by keeping the fingers extended, which can help prevent further deformity, encourage proper alignment, and reduce muscle imbalances in the hand. It also reduces stress on the joints and tendons, which is particularly important for people recovering from nerve damage or surgical procedures.

A dynamic claw hand splint is a type of splint designed to not only support the hand but also facilitate movement, offering more flexibility than a static splint. This splint is typically used to help with claw hand deformity by allowing controlled motion, which can aid in improving function and preventing further deformities while encouraging muscle activity and range of motion.

**Key Features of a Dynamic Claw Hand Splint:**

- **Active joint movement:** Unlike a static splint, a dynamic splint has components (like springs, elastic bands, or adjustable straps) that allow for some degree of movement in the fingers and wrist while still providing support.
- **Flexion and extension control:** It may be designed to assist with both finger extension and flexion, allowing the hand to move in a more functional way.
- **Wrist and finger positioning:** It helps position the hand in a more neutral or functional posture, typically extending the fingers and keeping the wrist stable.
- **Adjustability:** Some dynamic splints are adjustable, allowing the therapist or wearer to change the level of assistance depending on the stage of recovery or specific needs of the patient.

**Uses:**

1. **Post-surgery rehabilitation:** After nerve repair or tendon surgery, dynamic splints help facilitate the rehabilitation process by allowing for controlled movement during recovery.
2. **Neurological conditions:** Conditions like ulnar nerve palsy or stroke that cause claw hand deformities can benefit from a dynamic splint to prevent contracture and assist in regaining hand function.
3. **Joint mobilization:** If the hand has tightness or limited movement due to injury or nerve damage, dynamic splints can gently mobilize the joints to restore some range of motion.
4. **Assist in muscle strengthening:** In cases where the intrinsic muscles of the hand are weakened (as with nerve damage), dynamic splints can provide support for movement while promoting strengthening.

**How It Works:**

- The dynamic splint utilizes springs or rubber bands to help provide gentle resistance for the hand to extend or flex, depending on the specific needs of the patient.
- The tension applied can be adjusted, and over time, the spring tension can be reduced as the patient's strength and hand function improve.
- By encouraging active motion, dynamic splints can assist in reducing the stiffness or muscle imbalances that are common with claw hand deformity.

**Benefits of Dynamic Splints:**

- **Encourages muscle activity:** By allowing for movement, it helps prevent muscle atrophy (weakening) and joint stiffness.
- **Improves hand function:** Dynamic splints assist in regaining a more functional hand position, which is critical for activities of daily living.
- **Prevents further deformity:** They can help realign the fingers and hand to prevent the progression of the deformity, especially when combined with physical therapy.

## NEED OF THE STUDY

Usually both the static and dynamic splints are used for the correction of claw hand deformity. But the main objective of this study is to assess the effects of both static and dynamic claw hand splints on lumbrical muscles, in which, patients had flexor tendon

injuries along with both ulnar and median nerve injury involvement. The Indigenously developed dynamic splint has spring mechanism which helps to improve the grasp pattern in case of claw hand deformity.

## RESEARCH METHODOLOGY

### 3.1 Population and Sample

10 patients (7 males and 3 females) with unilateral claw hand deformity were selected for the study. All patients were recruited from IIPPO, Chennai. The Name, Age, Gender and Other anthropometric data were collected from the patients. A detailed explanation of the study was given to individual patient, after took the signature of the patient on an informed consent form.

Static Claw hand splint:

A Static custom-made splint, made up of 5 polypropylene sheets (as per fingers length and width), placed on the all four fingers of right hand and thumb, covered with an elastic tape on the ventral aspect of the hand. The splint was worn for short intermittent periods during the day while performing functional tasks as well as in the exercise program.

Dynamic Claw hand splint:

The best part of this design is that it provides long lever arm. It covers up to forearm and it was fabricated with the spring mechanism. Both orthotic splint options were custom fabricated.



Fig 1: Dynamic Splint

### 3.2 Assessment

The Functional Independence Measure (FIM) is an instrument that was developed as a measure of disability for a variety of populations and is not specific to any diagnosis. The FIM instrument

- Includes measures of independence for self-care, including sphincter control, transfers, locomotion, communication, and social cognition<sup>[1]</sup>.
- Is an 18-item, seven-level, ordinal scale intended to be sensitive to changes over the course of a comprehensive inpatient medical rehabilitation program.
- Uses the level of assistance an individual needs to grade functional status from total independence to total assistance).
- This tool measures the activities of Daily Living (ADLS)
- Each item on the FIM is scored on a 7-point Likert scale, and the score indicates the amount of assistance required to perform each item (1 = total assistance in all areas, 7 = total independence in all areas). The ratings are based on performance rather than capacity and can be acquired by observation, patient interview, telephone interview or medical records. The developers of the FIM recommend that the scoring be derived by consensus with a multi-disciplinary team.
- A final summed score is created and ranges from 18 – 126, where 18 represents complete dependence/total assistance and 126 represents complete independence.

### 3.3 Data Analysis

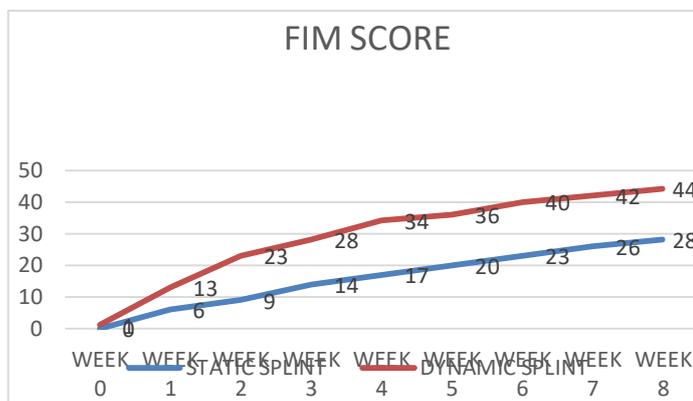


Fig 2: Graphical representation of FIM score after using static and dynamic splint.

## IV. RESULTS AND DISCUSSION

Table 1: Performance of Book hold Test in static and dynamic splint.

TEST	WEEK 0	WEEK 2	WEEK 4	WEEK 6	WEEK 8
BOOK HOLD TEST IN STATIC SPLINT	Not able to perform	mild	mild	moderate	moderate
BOOK HOLD TEST IN DYNAMIC SPLINT	mild	mild	moderate	moderate	good

The result of the study shows book hold test increased from not able to perform to moderate in static hand splint whereas it was mild to good with dynamic splint. And FIM Score improved in both the splints but it was 44 with dynamic hand splints. It shows that the patient gradually improved on his precision work by the end of the 8 weeks use of dynamic hand splint due to increase in strength of his lumbrical muscles.

In our study we made two different splints for patient which shows a great improvement and at the end of the 8th week lumbrical grip improves and activity of self-care also able to perform. Sterling Bunnell considered the father of hand surgery wrote in the classic book about hand surgery, in a chapter which was dedicated to intrinsic muscles of the hand, "the intrinsic muscles of the hand though tiny are important because with the long flexor's long extensors, they complete the muscle balance in the hand. The limitations of this study were that we do not know how long the patient have to wear the splint and limitations of the sample size.

## V. CONCLUSION

According to results of this study, it has been concluded that after using dynamic claw hand splint, the power of lumbrical muscles increased in all patients and reduction of clawing in fingers visible. So, dynamic hand splint is more effective for the treatment of claw hand deformity.

## REFERENCES

1. Neiman R, Maiocco B, Deeney VF (1998). "Ulnar nerve injury after closed forearm fractures in children". J Pediatr Orthop. 18 (5): 683–5. doi:10.1097/00004694-199809000-00026. PMID 9746426.
2. Ramage JL, Varacallo M, Anatomy, Shoulder and Upper Limb, Hand Guyon Canal null. 2018 Jan [PubMed PMID: 30521235].
3. Valenzuela M, Varacallo M, Anatomy, Shoulder and Upper Limb, Hand Interossei Muscles null. 2018 Jan [PubMed PMID: 30521193].
4. Schuppe V. Ulnar claw: A kinder, gentler solution. J Hand Ther. 2019 Mar 08; [PubMed]