



— Home Therapy Kit —

Occupational Therapy Kit

for patients suffering from ALS/MND

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Project Guide

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अभिकल्प विद्यालय



On the afternoon of Feb 16th 2023...

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... a single statement set my project in motion

“ Main kal se nahi aaungi ”

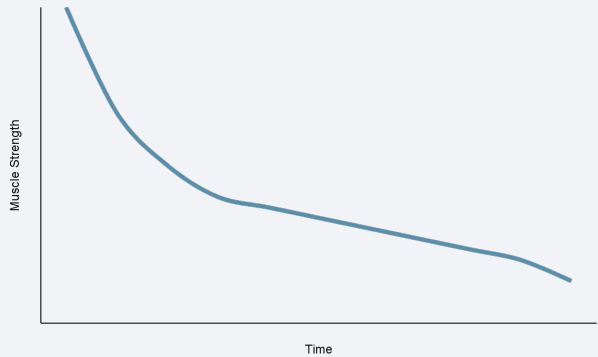
Meet Rita Rodriguez

- She is a homemaker, teacher and a mother
- She value being able to teach children
- She values being a mother
- She enjoys cooking and cleaning



But...

- She was diagnosed with ALS
- She's worried about losing the ability to work and move around the house
- She wants to be able to make *chapatis* again
- But as ALS is a progressive disease, her strength is deteriorating day by day



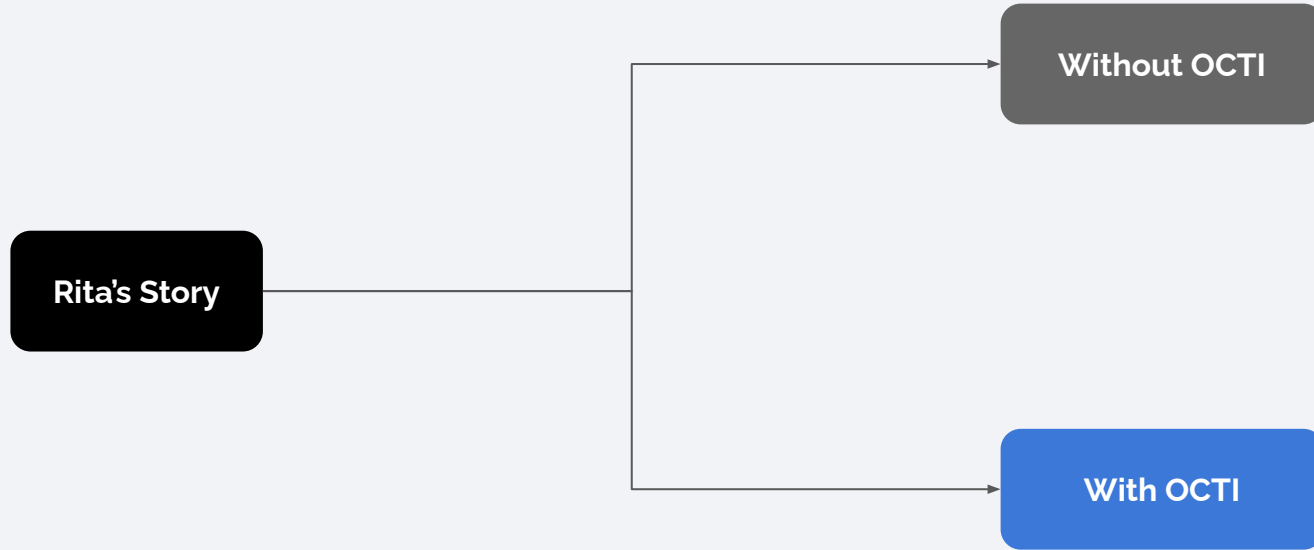
16th Feb 2023

**It was her last day of therapy session at
Neurogen Hospital when she said...**

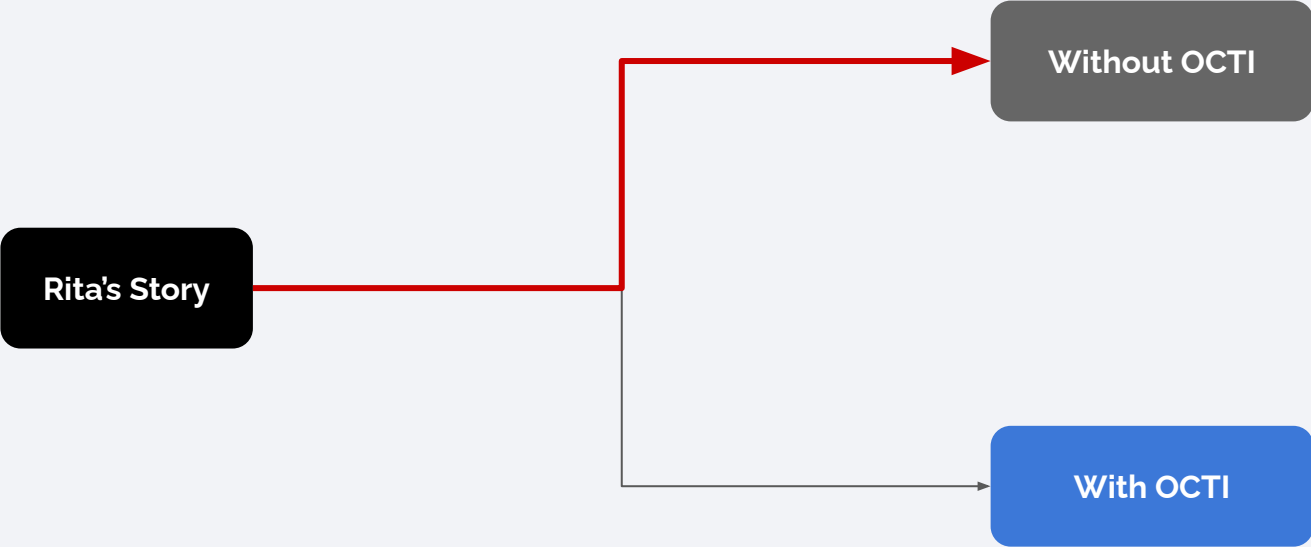
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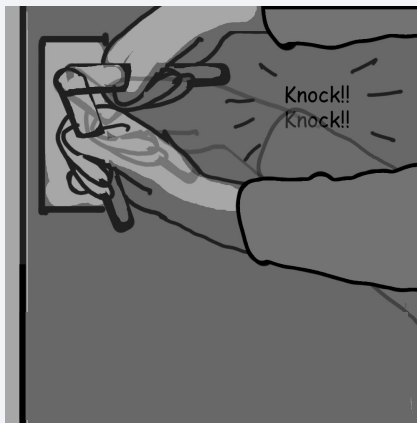
There could be 2 ways this story can progress...



Scenario 1

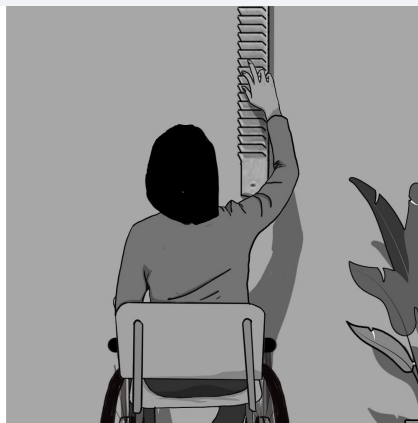


Rita at home **without OCTI**



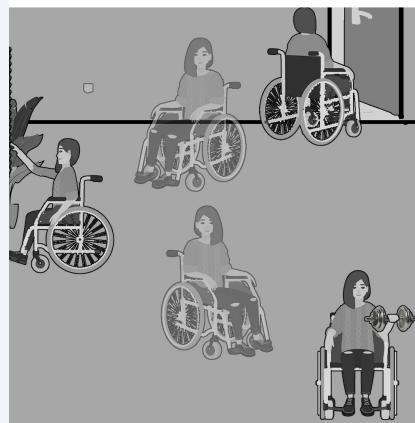
Disturbance

"Everytime I start doing exercise on the door some or the other person needs to pass through the door."



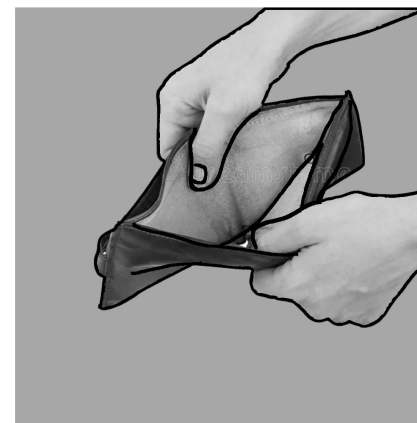
Loneliness

"Being here facing a blank wall and doing the exercise makes me feel lonely."



Inconvenience

"I need to roam all around the house to do different kinds of exercises. It is exhausting and inconvenient for me."



Financial Problems

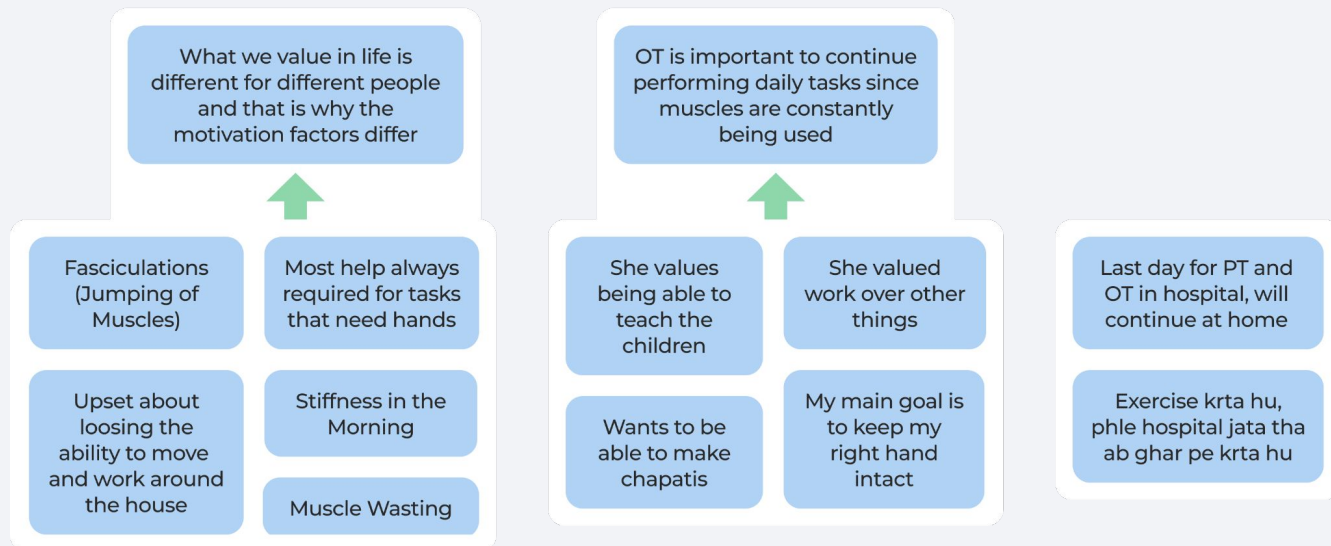
"Regular therapy sessions are expensive and time consuming. And the OT kit available in market are not ALS specific, also only target one exercise at a time."



**Just like Rita, there are many other
ALS patients in India facing similar problems.**

Inferences from the interviews

Need for a OT kit for therapy at home



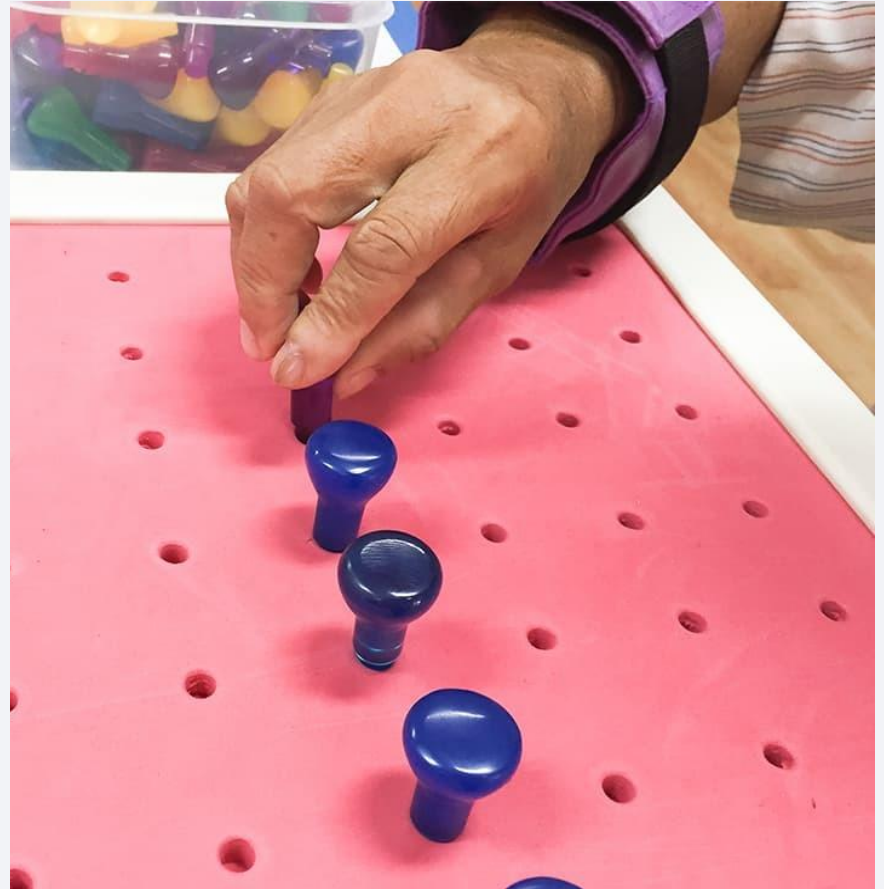
**To better understand their
problems and find solutions
to it, we need to do an
extensive research.**



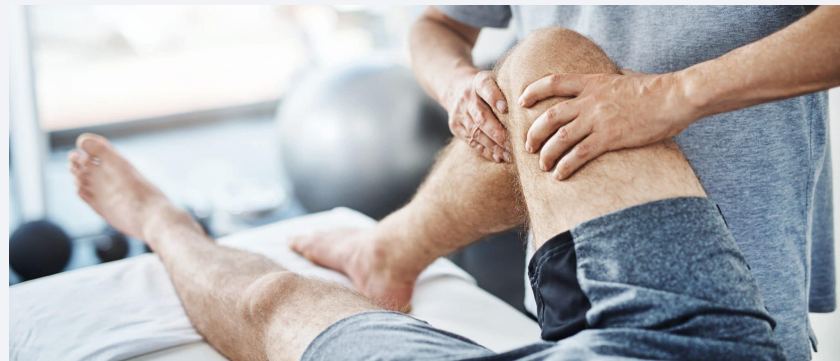
What is Occupational Therapy?

Occupational therapy is a field of healthcare that aids people in adjusting to daily life. Therapists work in a variety of settings throughout society, such as clinics and classrooms, and their sole goal is to make people's lives simpler.

Giving someone assistance after a stroke so they can recover at home is one example. This person can have restricted dexterity or range of motion. They could need home modifications and assistive technology to live independently.



Difference between Occupational Therapy and Physiotherapy



Occupational Therapy	Physical Therapy
<ul style="list-style-type: none">● Improve motor skills to perform everyday functions	<ul style="list-style-type: none">● Prevent long term pain through exercise and treatment
<ul style="list-style-type: none">● Regain a sense of independence	<ul style="list-style-type: none">● Gain full range of mobility from damaged areas
<ul style="list-style-type: none">● Gain a sense of confidence and happiness	<ul style="list-style-type: none">● Ability to perform everyday activities

Role of Occupational Therapists for ALS Patients

The degenerative disease ALS gradually kills the body's neurons. This can entail having trouble doing something as straightforward as trying to button a shirt or put on a pair of shoes in the early stages of the illness. Eventually, when the illness gets worse, problems with feeding, breathing, and nutrition may arise.

ALS patients may be able to improve their condition with the support of an occupational therapist by making healthy food and exercise choices, for instance, or by utilising specialised assistive technology that promotes independence



ALS Functional Rating Scale

As ALS progresses patients' functions and independence reduces. ALS Functional Rating Scale is a standard scale used extensively for the evaluation of ALS patients' degree of functional impairment.

It is a 12 item scale which measures functions of various muscles. Each item is scored from 0 to 4, where 4 stands for no involvement by the disease and 0 stands for maximal involvement. The 12 items are summed up to obtain a final score.

Table 1. Amyotrophic Lateral Sclerosis Functional Rating Scale (ALSFRS)

The evaluated finding	Score	The evaluated finding	Score
1- Speech		Needs attendant for self-care	1
Normal speech processes	4	Total dependence	0
Detectable speech disturbance	3	7- Turning in bed	
Intelligible with repeating	2	Normal	4
Speech combined with nonvocal communication	1	Somewhat slow and clumsy, but no help needed	3
Loss of useful speech	0	Can turn alone or adjust sheets, but with great difficulty	2
2- Salivation		Can initiate, but not turn or adjust sheets alone	1
Normal	4	Helpless	0
Slight but definite excess of saliva in mouth; may have nighttime drooling	3	8- Walking	
Moderately excessive saliva; may have minimal drooling	2	Normal	4
Marked excess of saliva with some drooling	1	Early ambulation difficulties	3
Marked drooling requires constant tissue or handkerchief	0	Walks with assistance	2
3- Swallowing		Nonambulatory functional movement only	1
Normal	4	No purposeful leg movement	0
Early eating problems, occasional choking	3	9- Climbing stairs	
Dietary consistency changes	2	Normal	4
Needs supplemental tube feeding	1	Slow	3
Exclusively parenteral or enteral feeding	0	Mild unsteadiness or fatigue	2
4- Handwriting		Needs assistance	1
Normal	4	Cannot do	0
Slow or sloppy; all words are legible	3	10- Dyspnea	
Not all words are legible	2	None	4
Able to grip pen but unable to write	1	Occurs when walking	3
Unable to grip pen	0	Occurs with one or more of the following: eating, bathing, dressing	2
5A- Cutting food without gastrostomy		Occurs at rest, difficulty in breathing when either sitting or lying	1
Normal	4	Significant difficulty, considering using mechanical respiratory support	0
Somewhat slow and clumsy, but no help needed	3	11 - Orthopnea	
Can eat most foods, although clumsy and slow; some help needed	2	None	4
Needs to be fed	0	Some difficulty in sleeping at night due to shortness of breath. Does not routinely use more than two pillows	3
5B- Cutting food with gastrostomy		Needs extra pillow in order to sleep (more than two)	2
Normal	4	Can only sleep sitting up	1
Clumsy but able to perform all manipulations independently	3	Unable to sleep	0
Some help needed with closures and fasteners	2	12- Respiratory insufficiency	
Provides minimal assistance to caregiver	1	None	4
Unable to perform any aspect of task	0	Intermittent use of BiPAP	3
6- Dressing and hygiene		Continuous use of BiPAP during the night	2
Normal	4	Continuous use of BiPAP during the night and day	1
Independent and complete self-care with effort or decreased efficiency	3	Invasive mechanical ventilation by intubation or tracheostomy	0
Intermittent assistance or substitute methods	2	Total score/48

ALS Functional Rating Scale

The score is calculated by measuring functions of :

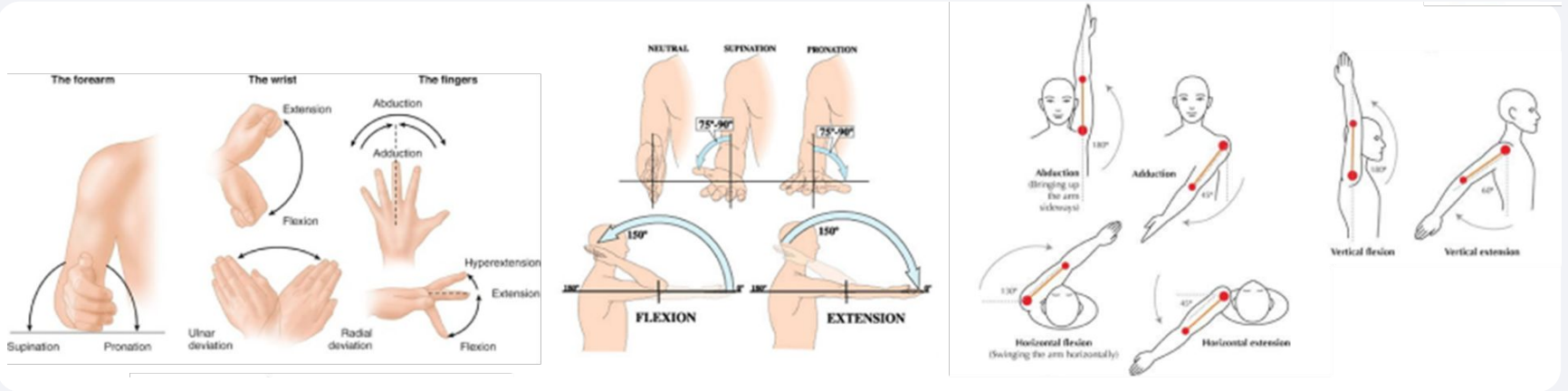
Speech	Turning in bed and adjusting bed clothes
Salivation	Walking
Swallowing	Climbing Stairs
Handwriting	Dyspnea
Does subject have gastrostomy?	Orthopnea
Dressing and Hygiene	Respiratory Insufficiency

Total ALS-FRS score indicates severity of ALS as follows:

- >40 (Minimal to Mild) (**Stage 1**)
- 39 - 30 (Mild to Moderate) (**Stage 2**)
- <30 (Moderate to Severe) (**Stage 3**)
- <20 (Advanced disease) (**Stage 4**)

Range of Motion

To understand the exercises better, I studied various range of motion of Wrist, fingers, forearm, shoulder and elbow.



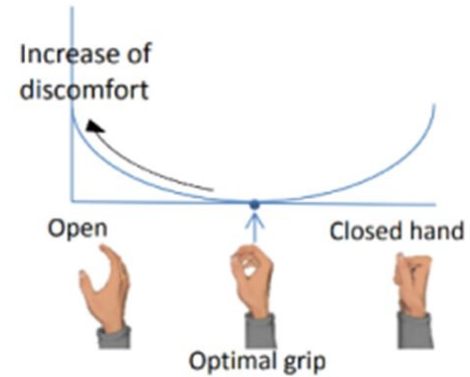
Range of Motion

As ALS progresses, most people gradually lose their ability to use their hands and their arms as their muscles weaken.

So, one area of focus in occupational therapy is the development of exercises that target various grips.



(a)



(b)

Muscle Wasting and Wrist Drop



Muscle Wasting generally happens when you don't exercise the muscles and it loses its strength eventually.



As the disease progresses the muscle responsible for wrist extension and finger movement weaken and lose their function.

Task Analysis

To study daily tasks that people do during their entire day, right from waking up to going back to bed for sleeping. A self observation was done to understand all the micro activities and what body parts are involved while performing those activities. In this observation the tasks that are associated with hand moments, were considered.

Daily Tasks	Fingers	Hand	Wrist	Elbow	Shoulder
Operating Phone					
Getting up from bed					
Setting up the bed					
Brushing Teeth					
Combing Hair					

Task Analysis

Daily Tasks	Fingers	Hand	Wrist	Elbow	Shoulder
Opening/Closing Water Tap	Blue	Blue	Blue	White	Light Gray
Wear Clothes	Blue	White	Blue	Blue	Blue
Bathing (Lifting & Pouring Mug)	White	Blue	Blue	White	Light Gray
Picking Soap	Blue	Blue	Blue	White	Light Gray
Taking Medicines	Blue	Blue	Blue	Blue	Light Gray
Drinking Water/Tea	Blue	White	Blue	Blue	White
Turning Keys to Lock	Blue	White	Blue	White	White
Money Transaction	Blue	Blue	Blue	Blue	Light Gray

Task Analysis

Work Tasks	Fingers	Hand	Wrist	Elbow	Shoulder
Cooking					
Writing					
Opening/Closing Laptop/Book					
Typing					
Writing					

Task Analysis

Tasks	Fingers	Hand	Wrist	Elbow	Shoulder
Playing Musical Instruments	Blue	Blue	Blue	Blue	Blue
Playing Games	Blue	Blue	Blue	White	White
Drawing	Blue	White	Blue	Blue	Blue
Tinkering	Blue	Blue	Blue	Blue	Blue
Using TV Remote	Blue	Blue	Blue	White	White
Itching	Blue	Blue	Blue	Blue	Blue
Swimming	White	Blue	Blue	Blue	Blue
	White	White	White	White	White
	White	White	White	White	White

Product Analysis

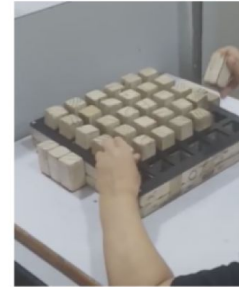
Market Products



Opportunities

1. A kit which is economical and have multiple exercises in one.
2. A portable tool / product which can be used in homes, while watching TV.
3. A game based exercise kit to make exercise more fun and engaging.
4. Occupational Therapy kit catering to the needs of ALS patients.

Hospital Products



Design Brief

To design an **occupational therapy kit** that could be used by patients suffering from **ALS/MND in stage 1 and 2**, at the convenience of their own house. The therapy kit will include various **tools for exercise** that target muscles of the **fingers, palms, wrist, elbow, and shoulder**. It should help maintain their range of motion and grip strength, and reduce muscle wasting of their upper limbs.

The kit should be **economical, accessible and portable**. The tools inside the kit should be intuitive and exercises done with the help of the tool could also be personalized by the occupational therapist according to the patient's condition

Design Directions

Direction 1

DIY Kit made from already existing materials so that it is easily available and replaceable when lost or broken

Direction 2

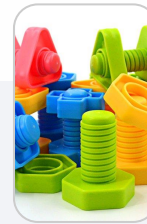
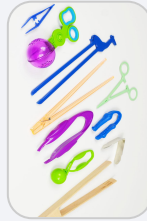
A Toy or Product that can be interacted in various ways to facilitate different exercises.

Direction 3

A Kit containing exercise tools that are made to target specific muscle group at a time

Ideation 1

A Kit containing various intuitive products available in market along with the instructions on how to use them, which targets fine motor skills of a person while having fun doing those exercises.



Ideation 1



Play Dough



Nuts and Bolts



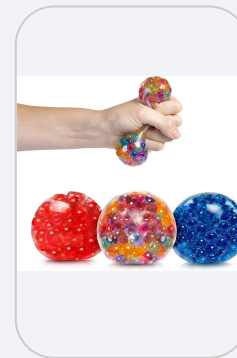
Clothes Pin



Tweezers and Tongs



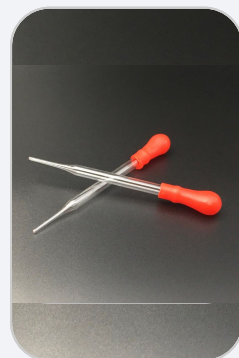
Wikki Stix



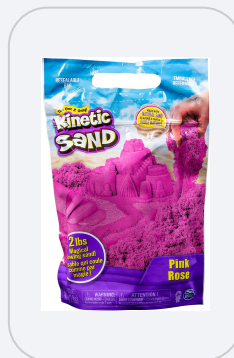
Squeeze Ball



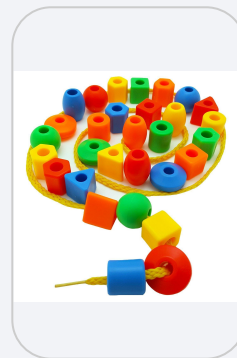
Peg Game



Water Dropper



Kinetic Sand



Beads and Strings



Building Blocks



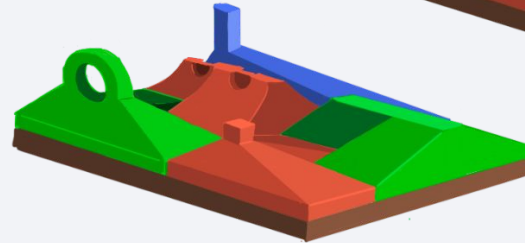
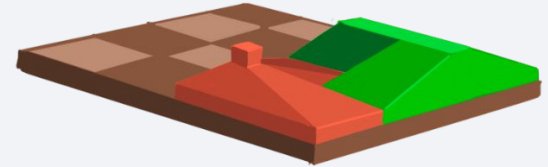
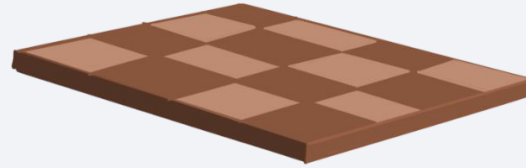
Popsicles with Velcro Dots

Ideation 2

A game of puzzles with uniquely shaped puzzle pieces which facilitates different types of finger grips.

Features

- Magnetic board and puzzle pieces for grip strength training.
- Uniquely shaped puzzle pieces to train muscles used for different types of grips.
- Task Card with different challenges to complete.

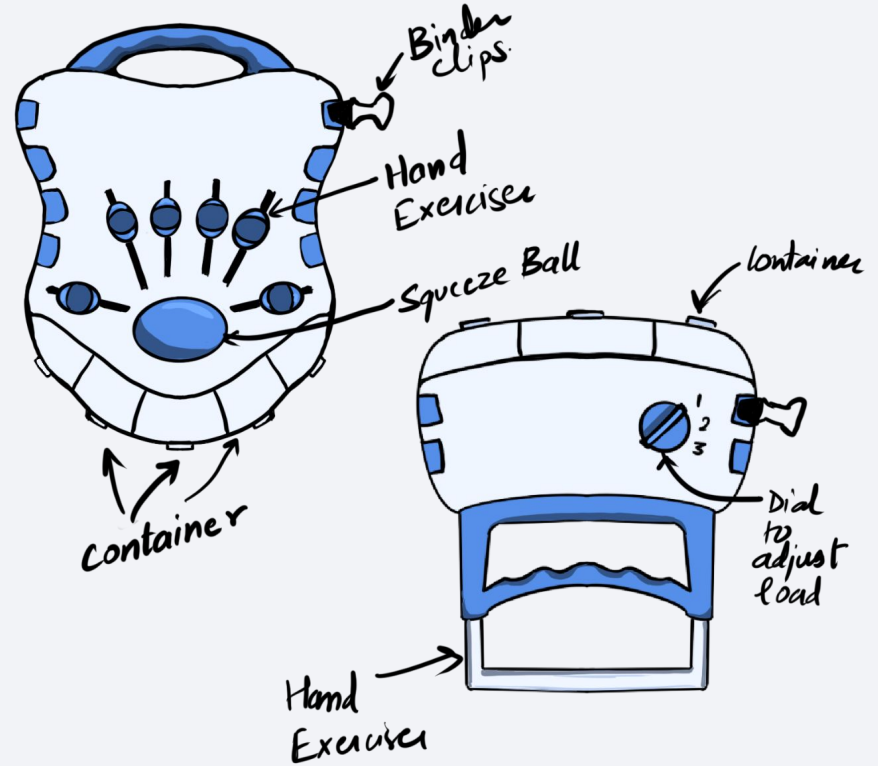


Ideation 3

A product with multiple exercises for hand therapy and strength training.

Features

- One product multiple ways to exercise
- Containers to keep small items like rubber bands and binder clips which can also be used for exercise.

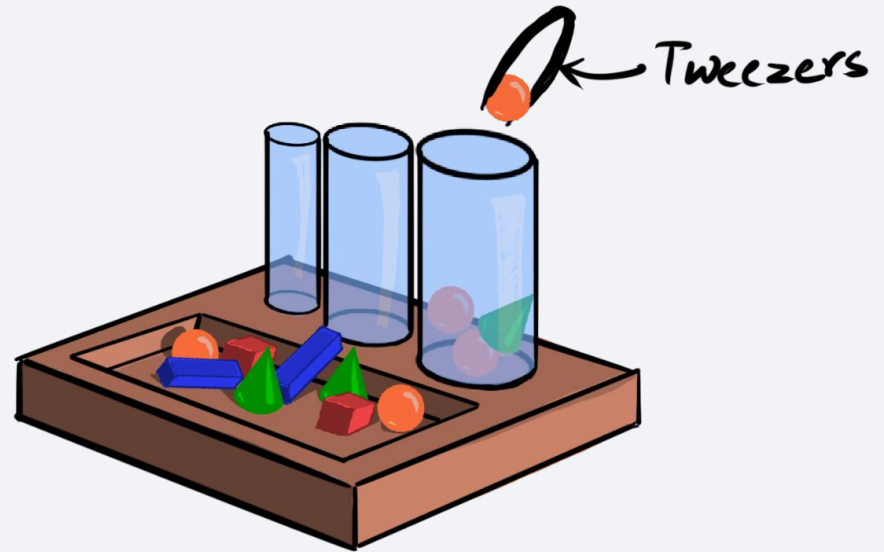


Ideation 4

A Toy which helps in maintaining grip strength with the help of tweezers.

Features

- Grows with as the progression of ALS increases
- Different shapes and different diameter of tube for varied difficulty.
- Different types of fine motor tweezers for different hand grip strength for ALS Patients

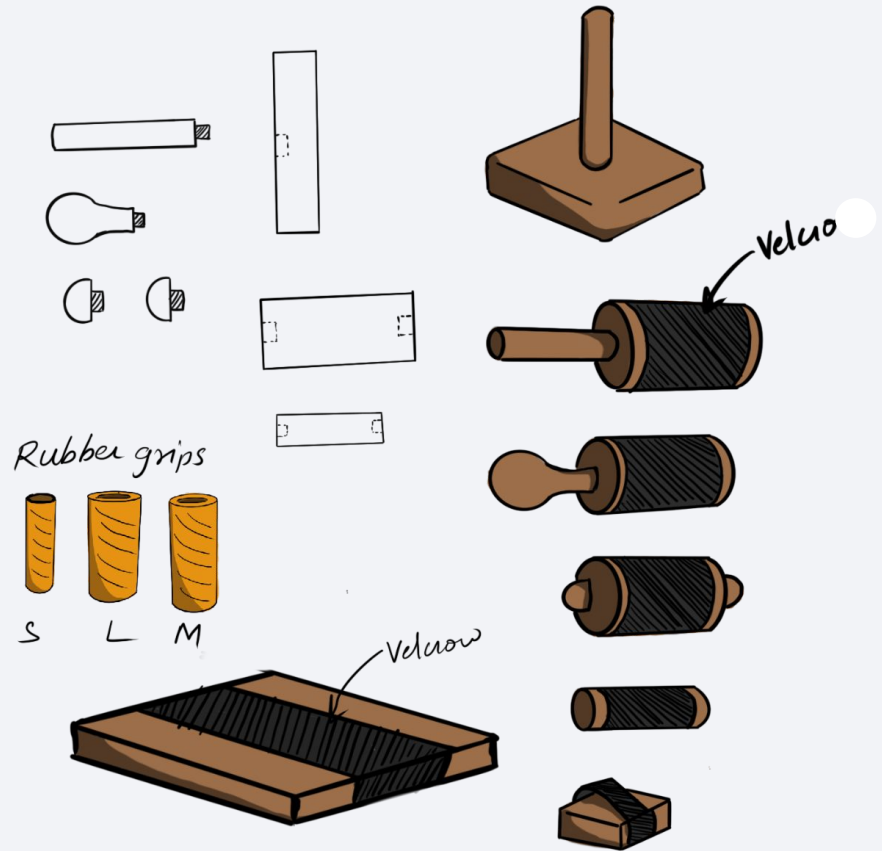


Ideation 5

Exercise kit to target exercises of shoulder, elbow, wrist, hand and fingers.

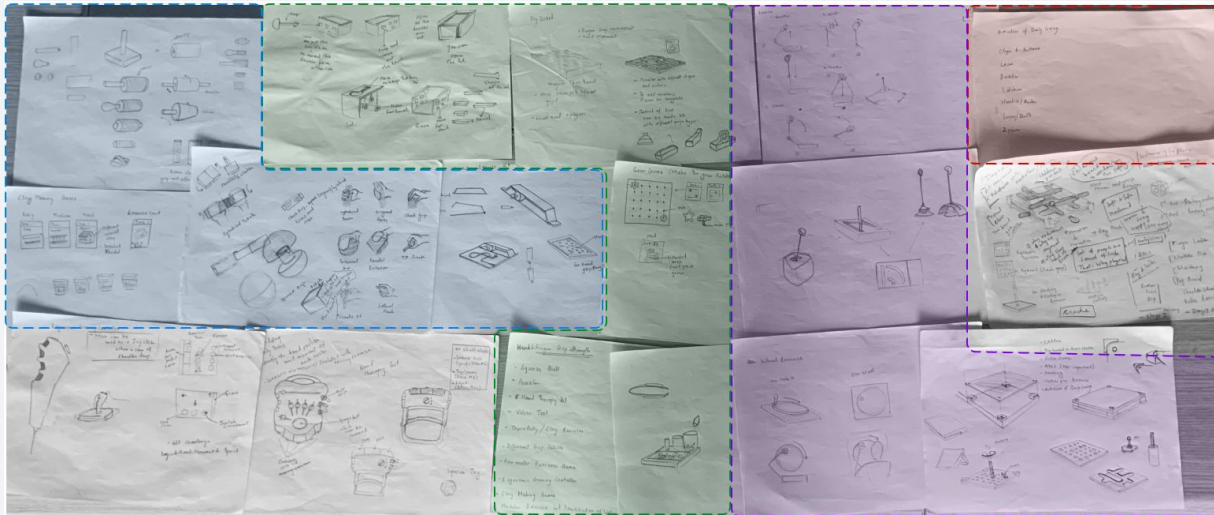
Features

- Velcro attached to increase resistance while performing exercise
- Uniquely shaped handles to train muscles used for different types of grips.
- Different rubber grips to facilitate loss of grip in ALS.
- Modular design to make the kit with minimum tools necessary.



Clustering Ideas

The ideation process involved categorizing exercises for occupational therapy into areas such as **Finger Grip Strengthening, Hand Grip Strength, Movement and Speed, Arm Movement and Strength** and activities of daily living.



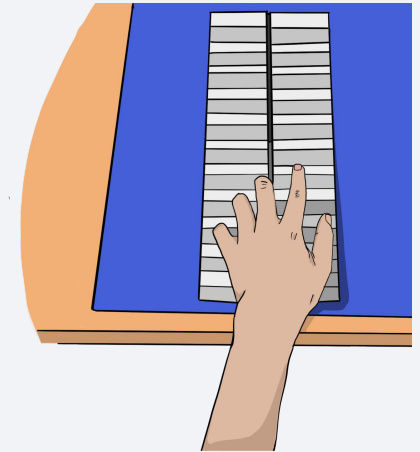
- — — Finger Grip Strengthening, movement and Speed
- — — Hand Grip Strength, movement and Speed
- — — Arm movement and Strength
- — — ADLS

Concept 1

Finger Ladder Exercise

The aid is positioned so that it reaches the furthest reach of the fingers, with the elbow extended. Their centre of gravity is sufficiently in front of them to allow them to lift themselves up

- Positioning on a table:
 - Task involves using the proximal joints, extending the elbow and flexing the shoulder
 - Alternating flexing movements with their fingers and extending them to reach the next step
 - Improves dexterity
- Positioning on a vertical panel:
 - Particularly useful when you wish to get the shoulder to a greater degree of flexing.

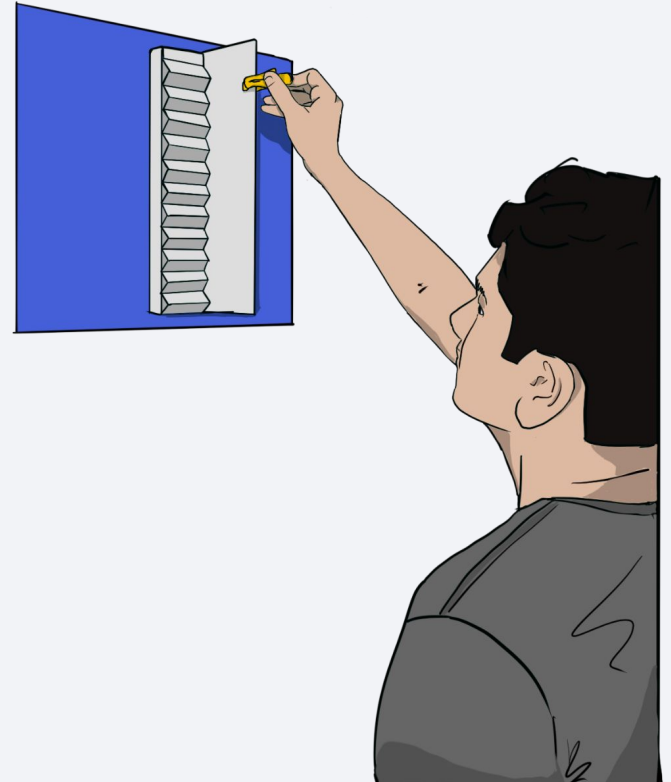


Concept 1

Clothespin Exercise

Useful for improvement of fundamental abilities needed for handling scissors, pencils, and other tools. The application of clothespin tasks and instructional materials would promote the following:

- Enhancement of resistance and strengthening
- Development of the hand's arches
- Proficient control of the radial fingers (thumb, index, and middle fingers)
- Stabilization of the ulnar fingers (ring and little fingers)

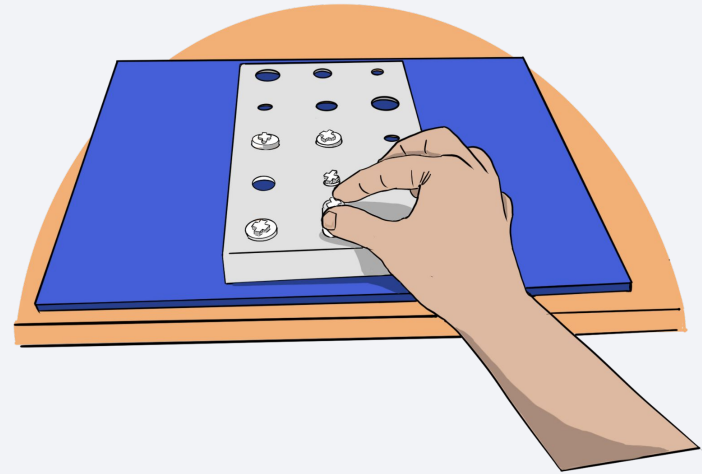


Concept 1

Pegboard Exercise

A rectangular board with circular holes of different diameters- 1 cm, 1.5 cm and 2 cm where cylinders are to be inserted.

- Improves the pinch grip of the patient.
- Gripping difficulty increases with decrease in diameter.



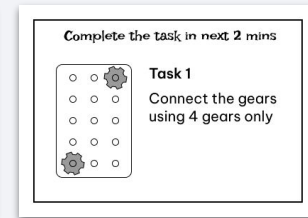
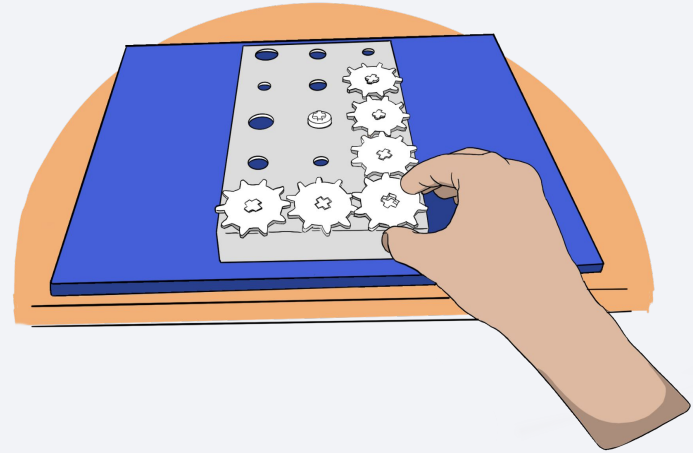
Concept 1

Gear-Game Exercise

The basic aim of this game is to fit the gears into the pegs and form a gear trail.

This has to be done according to the task card given.

- Improves the lateral pinch grip
- Hand-eye coordination
- Gets difficult to fit gears as the diameter of peg decreases
- Inserting the gears into the pegs helps practise the pronosupination of the wrist

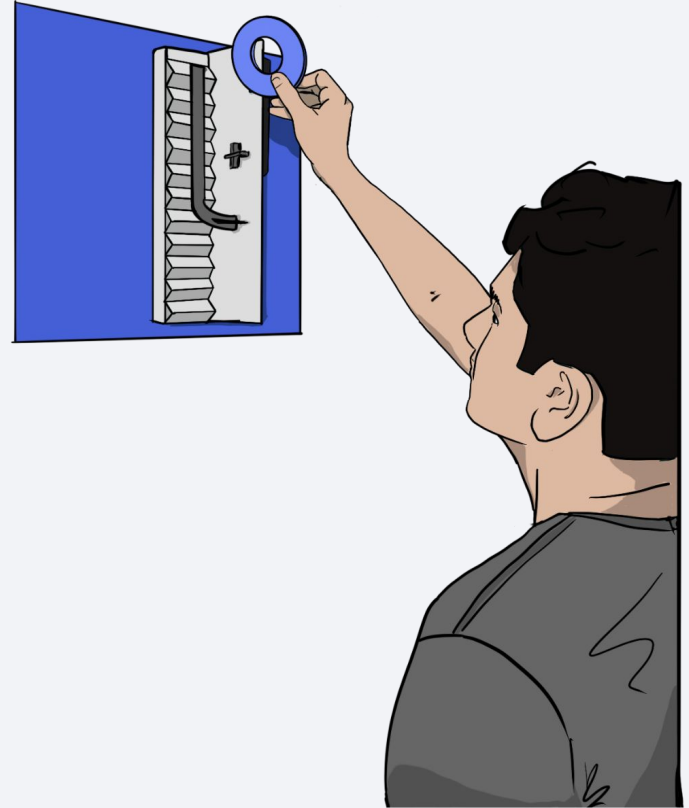


Concept 1

Stacking Exercise

The task is to stack disks into the pole.

- Helps practise the pronosupination of the wrist
- Useful to get the shoulder to a greater degree of flexing

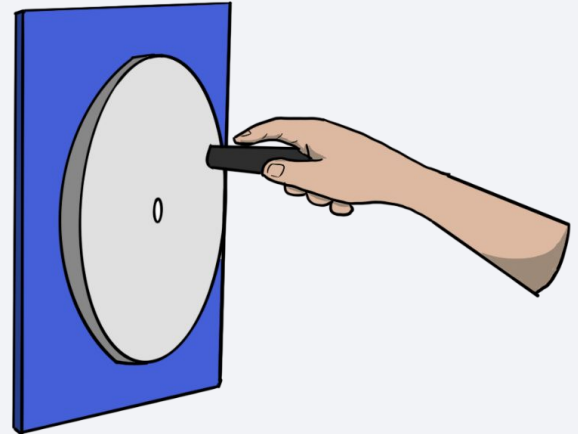
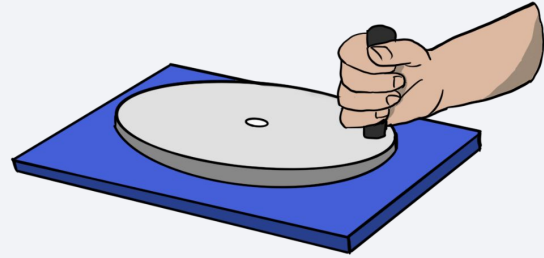


Concept 1

Wheel Exercise

The patient can practise performing a semi-circle or a full circle. The aid can be placed either on table or mounted on the wall.

- Recover mobility in the shoulder.

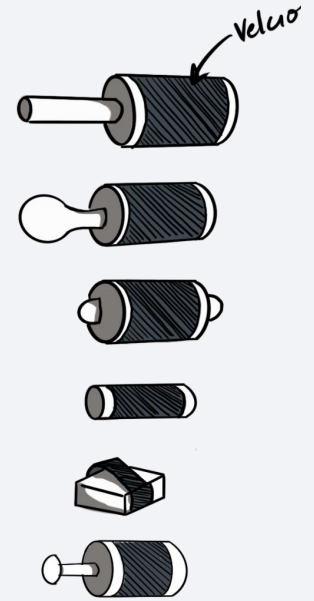
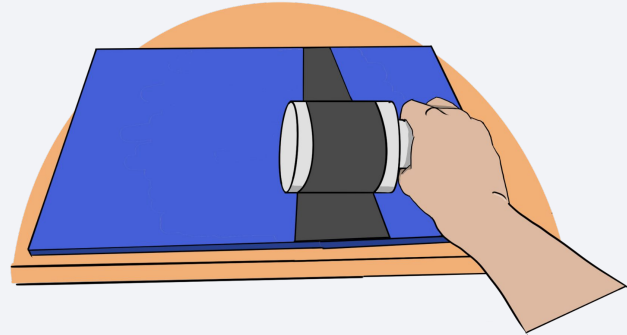


Concept 1

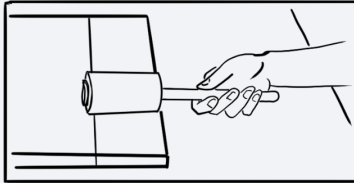
Roller Exercise

Used for improving

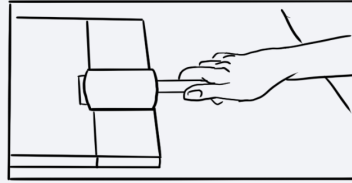
- Manual finger dexterity
- Wrist motions including pronation, supination, flexion, and extension



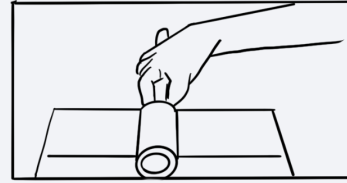
Concept 1



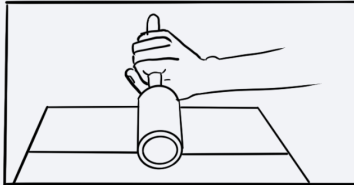
1. Supination



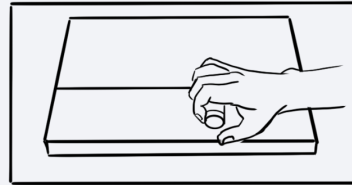
2. Pronation



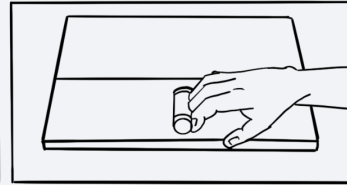
3. Wrist Flexion



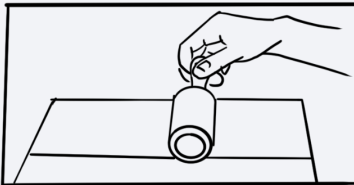
4. Wrist Extension



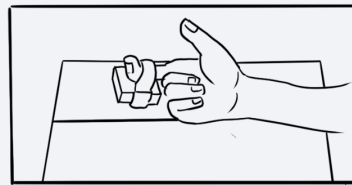
5. Finger Flexion



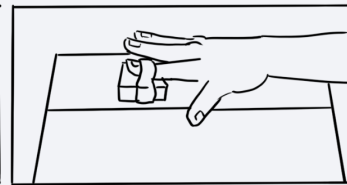
6. Finger Extension



7. Key Pinch

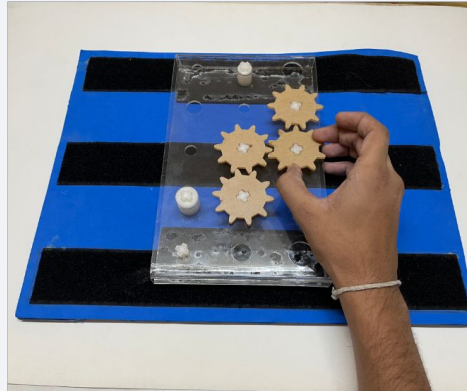
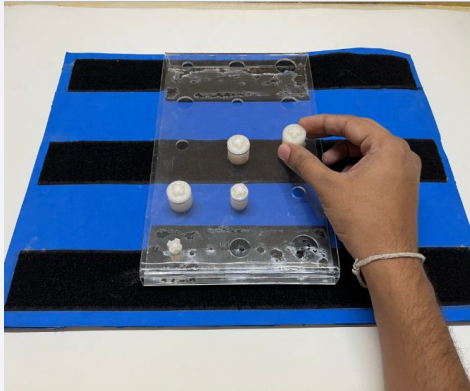
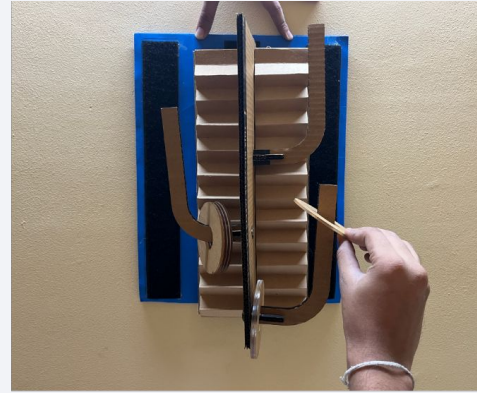
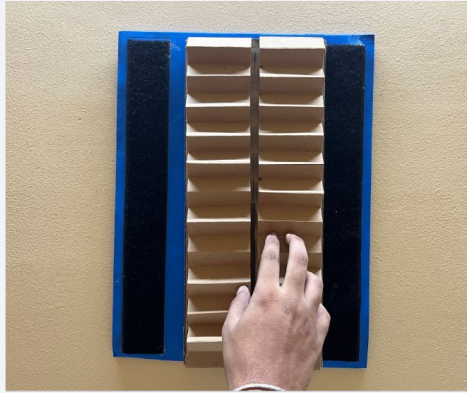
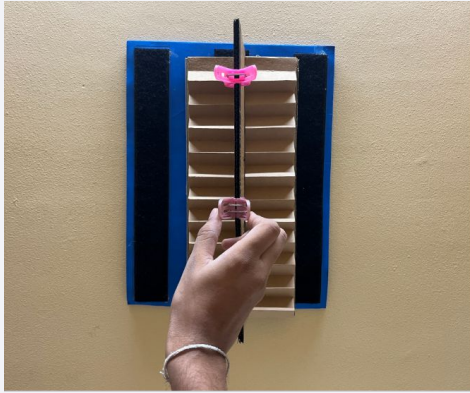


8. Individual Finger Flexion



9. Individual Finger Extension

Concept 1 (Mockup)



Concept 2

Gaming controller for ALS Patients

Games = Motivation

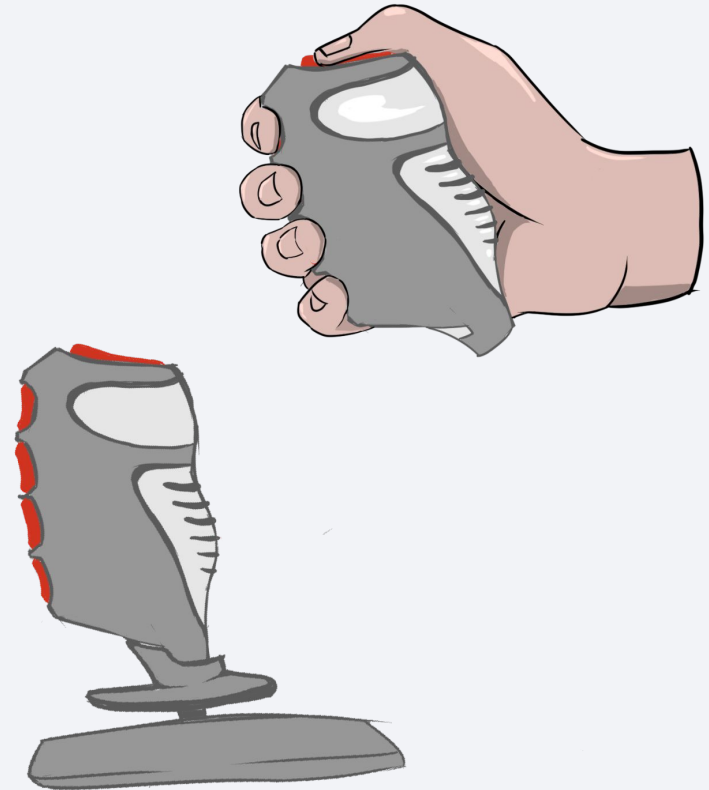
Gamifying the experience of Occupational therapy to motivate the patients to do the exercise regularly.

Customizable Exercise

The exercise/activity can be customised according to the patient's condition.

Controlled Exercise

As sometimes patients tend to exercise more that actually recommended in order to get better quickly, but it ends up being more problematic. So, to prevent this from happening, repetition and difficulty of exercise can be controlled



Concept 2

Game for ALS Patients

Games for motivation and exercise

Different games can be made which will help the patients to exercise daily without getting bored.

Customizable Difficulty

According to the condition of the patient or the stage they are in, we can adjust the difficulty of the game.



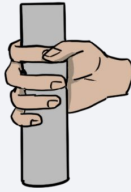
Concept 2 (Mockup)



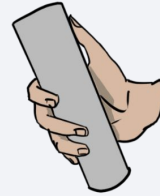
Concept 3

Puzzles

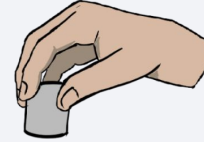
Gamifying the experience of Occupational therapy to motivate the patients to do the exercise regularly.



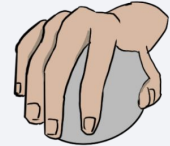
(a)



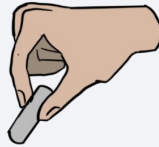
(b)



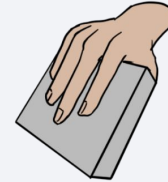
(c)



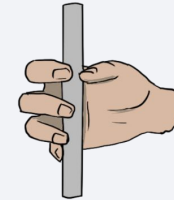
(d)



(e)



(f)



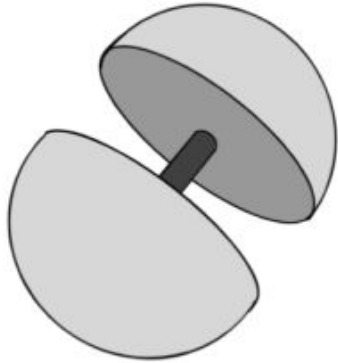
(g)



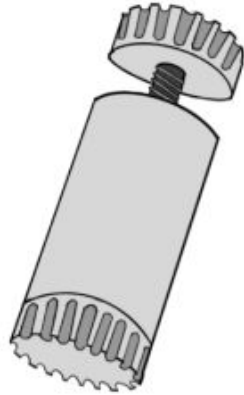
(h)

(a) Cylindrical Power Grip, (b) Diagonal Power Grip, (c) Chuck Grip, (d) Spherical Grip
(e) Tip Pinch Grip, (f) Parallel Extension Grip, (g) Prismatic 4F Grip, (h) Lateral Pinch Grip

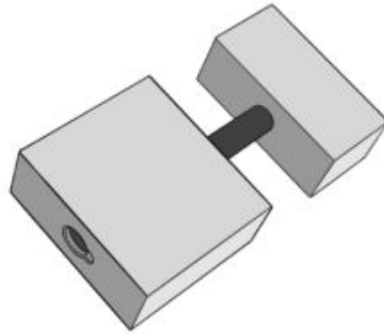
Concept 3



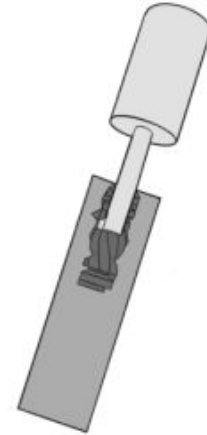
Spherical puzzle for improving spherical type of grip along with wrist improving wrist moment



Puzzle for improving Diagonal and Chuck type of grip by unscrewing the bolts from the cylinder.

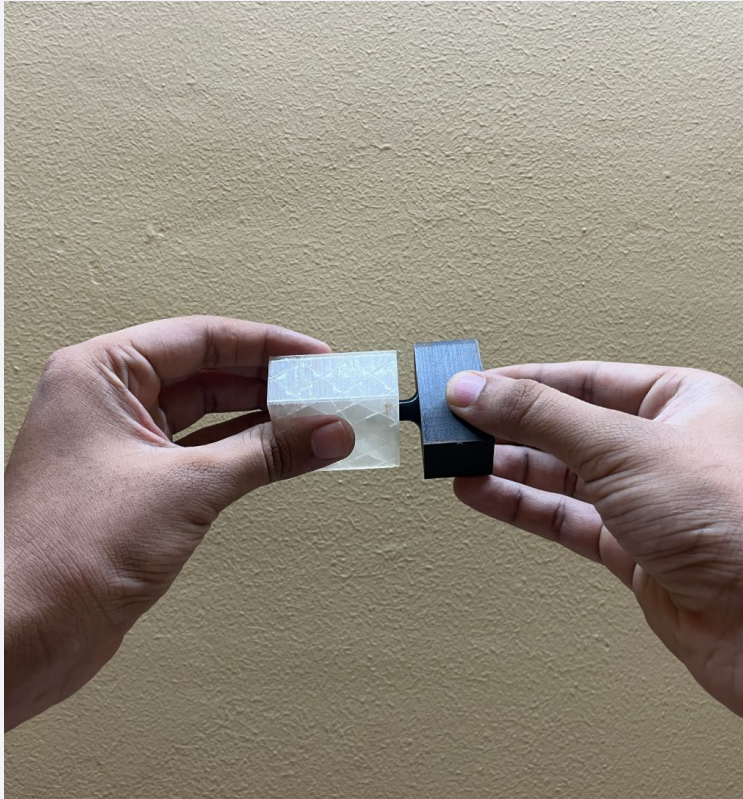


Puzzle to improve parallel extension type of grip



Gamifying the experience of Occupational therapy to motivate the patients to do the exercise regularly.

Concept 3 (Mockup)



Comparison and Evaluation

To test out all three concepts, a criteria matrix was created and then evaluated

Purpose:

To identify the pros and cons of each concept

To see which direction most suited for the user

	Economical	Accessible	Portable	Enjoyable	Customizable	Targeting Multiple Muscles
Concept 1	Medium	Medium	Medium	Medium	Medium	High
Concept 2	Low	Low	High	High	High	High
Concept 3	Medium	Medium	Medium	Low	Low	Low

The evaluations are in terms of preference i.e, High, Medium or Low

Doctor's Insights



Dr. Saurav, an expert in the field, provided valuable insights and feedback when the concepts were demonstrated using mockups.

Observations and Comments

Add **ADLS** to the exercise

Listening to music and doing some activities

In stage I we mostly ask the patient to do ADLS

Make something AR based

Shoulder Wheel is a bit complex exercise

Keys and Locks

Buttons

Some game for exercise

Stage II and III patients do rest exercises

Jitna hath upr ja skta h utna (finger ladder exercise)

Make it fun

Laces

Zip

Make this shape in gear game

Patients generally will do the exercise for a month and then leave it

We can tell the patient to do one exercise in various ways to target different muscles

Patient needs validation that yes this exercise helped to do this work

Final Concept

Based on the proposed design brief, concept 1 checked the most boxes in terms of **being, economical, accessible, portable and Intuitive.**

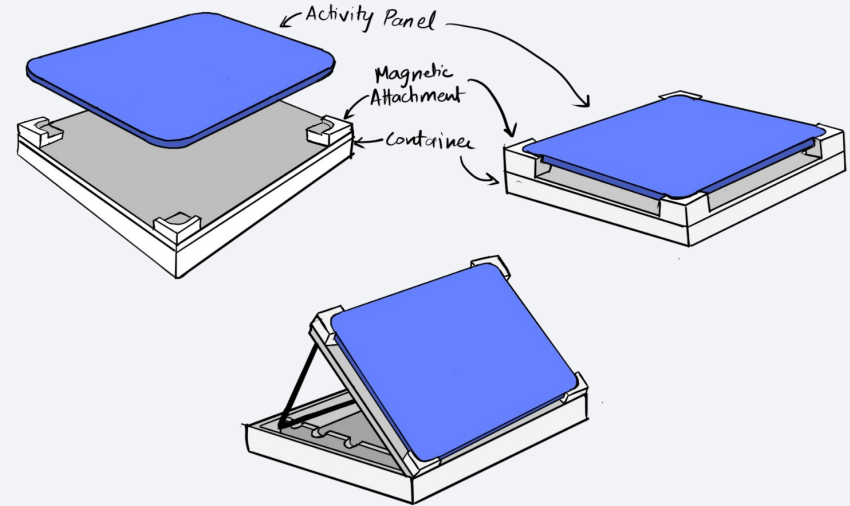
Some modifications were done regarding the **inclusiveness** of the kit. Where the patient can sit and exercise while being around their family and not facing a blank wall.



Final Concept

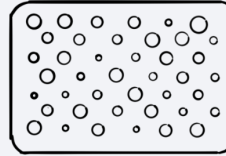
The features of final concept:

- Resembles a board game with different panels for exercises
- Each panel targets specific areas of rehabilitation
- Game-like design for fun and engagement
- Makes therapy enjoyable and interactive
- Promotes adherence and consistency in therapy routine
- Facilitates physical, mental, and emotional well-being of patients.

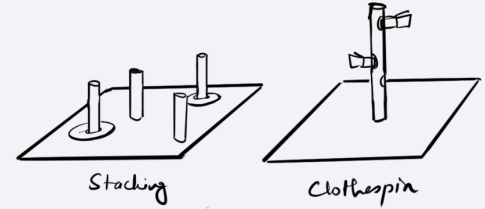


Final Concept

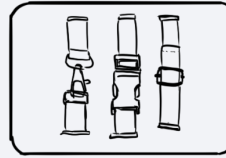
The starter kit includes ADLs, pegboard, stacking, and clothespin exercises that target various aspects of occupational therapy. They provide a comprehensive set of activities to improve daily living tasks and enhance physical abilities.



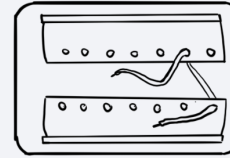
PEGBOARD
GEAR GAME
STACKING
CLOTHES PIN EX



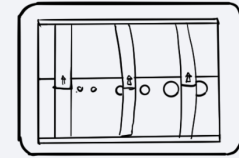
Activities of Daily Living



Belts and Buckles



Shoe Lace, Tie
[Cards with different lace types]



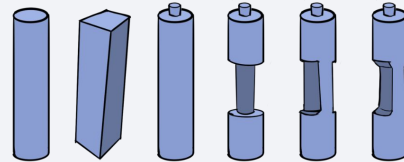
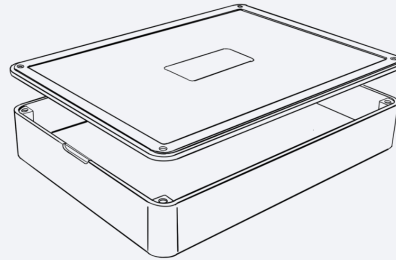
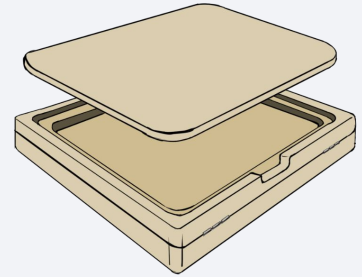
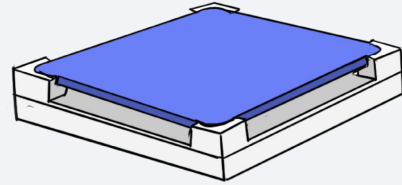
Buttons, Velcrostrap
Snap Buttons, Zip

Moodboard



Form Development

- Inspired by children's toys
- Iterative design process focused on safety and softness
- Rounded edges, with pine wood as a primary choice as a material for it's manufacturing.
- Enhances ease of use and engagement
- Provides an enjoyable and accessible experience for ALS patients in therapy sessions.



Logo

OCTI

Occupational Therapy Kit

OCTI

Home Therapy Kit

OCTI

Occupational Therapy Kit

OCTI
Home Therapy Kit

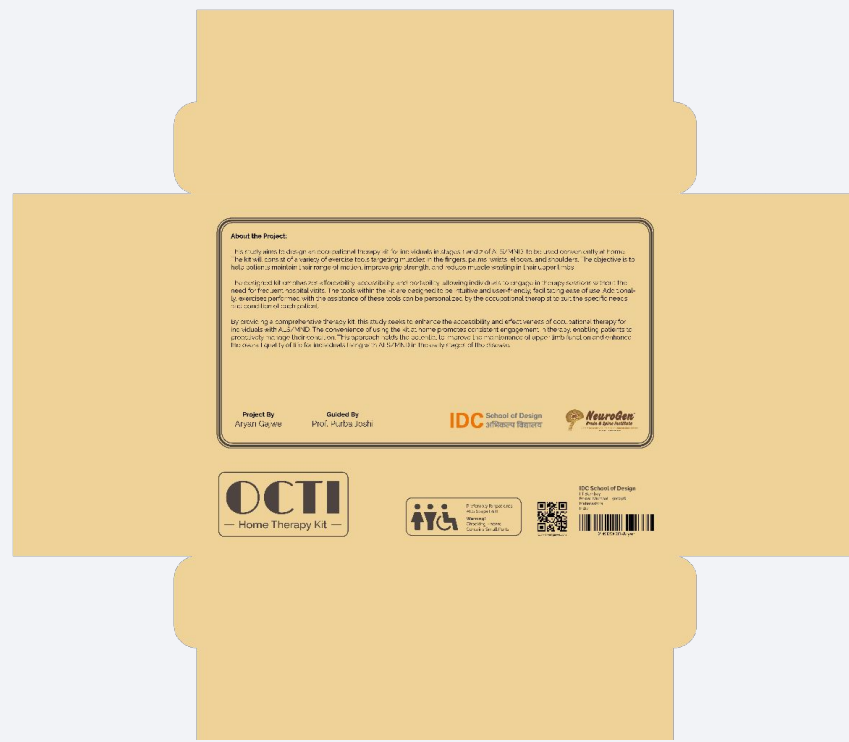
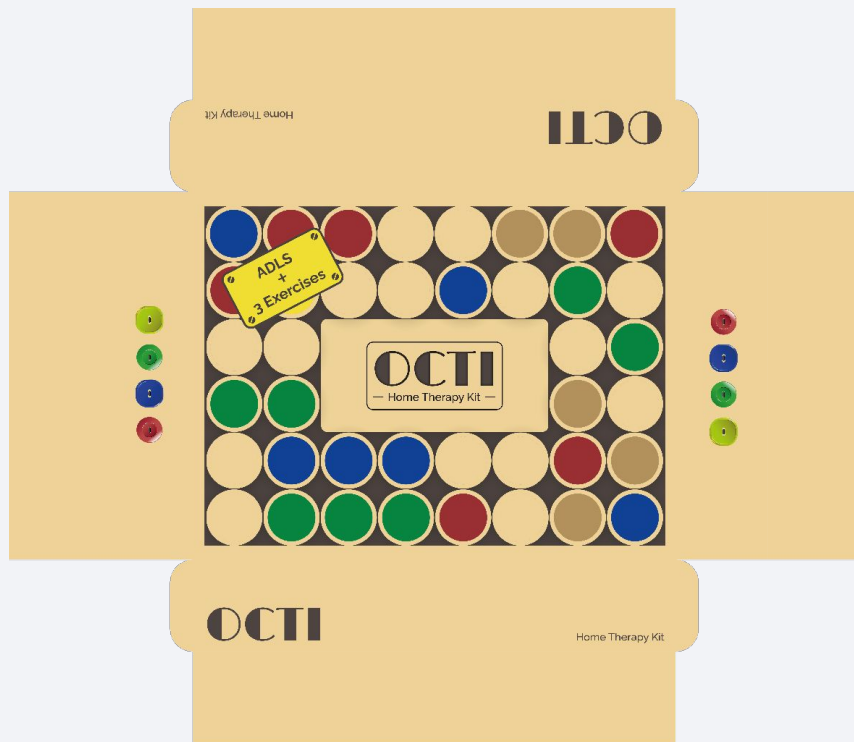
OCTI
Occupational Therapy Kit

OCTI
Home Therapy Kit

OCTI
— Home Therapy Kit —

OCTI
— Home Therapy Kit —

Packaging





ADLS
+
3 Exercises

OCTII
— Home Therapy Kit —

OCTII

Home Therapy Kit





ADLS

ADLS is one of the most important exercise to do everyday and a step forward to do things on your own.

Exercises

1. Zip Unzip - Tic Tac Toe
2. Tie the Lace
3. Free the Panda



Pegboard

A rectangular board with circular holes of different diameters- 1 cm, 1.5 cm and 2 cm where cylinders are to be inserted.

1. Improves the pinch grip of the player.
2. Gripping difficulty increases with decrease in diameter.



Stacking Exercise

The task is to stack discs into the stacked up pegs.

1. Helps practice the pronosupination of the wrist
2. Useful to get the shoulder to a greater degree of flexing

Bonus Game

Now after stacking according to the challenge card you will have to sort the donuts according to the colors. But you can only remove one donut from the stacked pegs at a time.



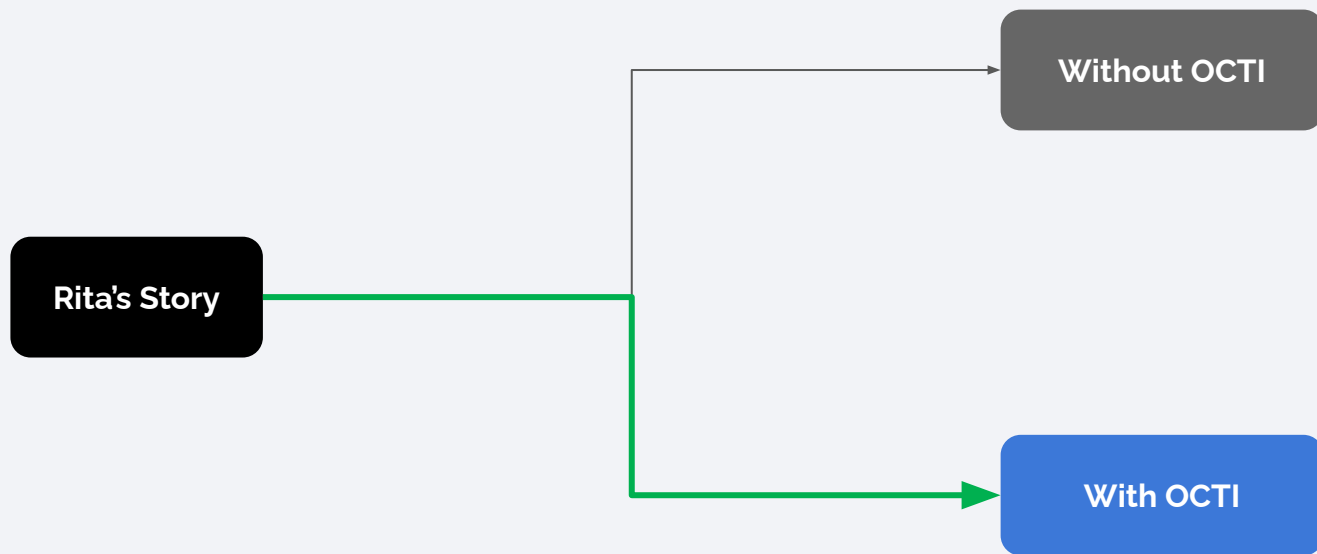
Clothespin Exercise

Useful for improvement of fundamental abilities needed for handling scissors, pencils, and other tools. The application of clothespin tasks and instructional materials would promote the following:

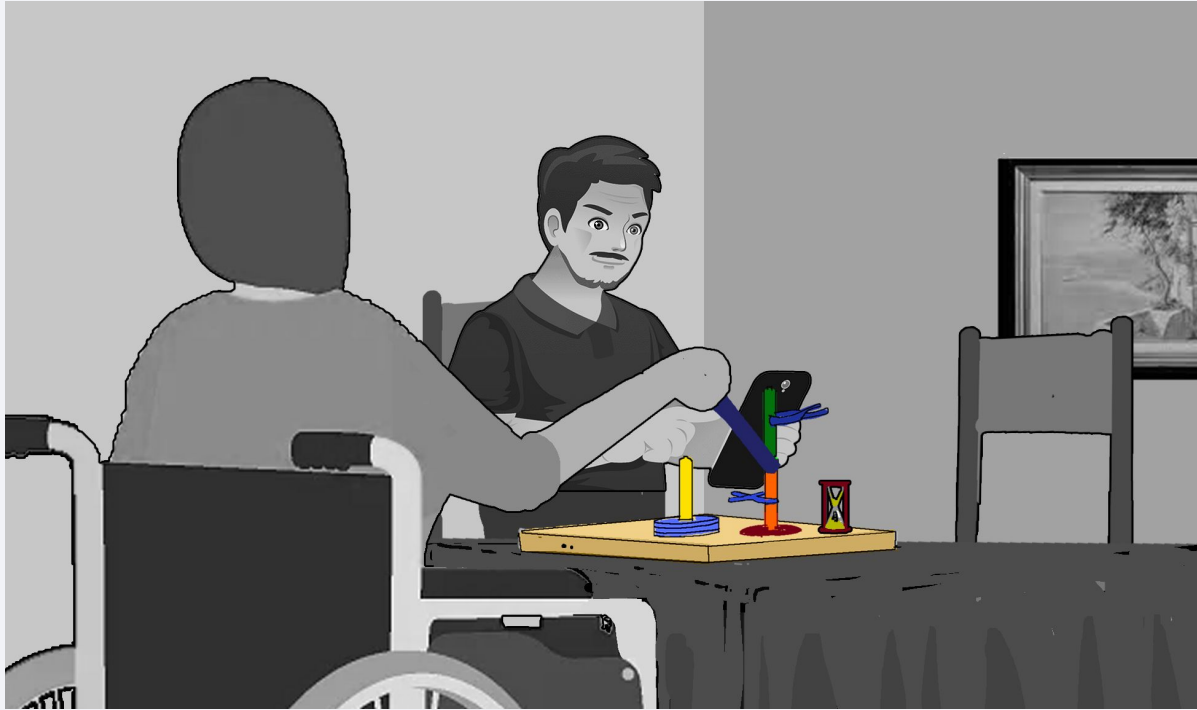
- Enhancement of resistance and strengthening
- Development of the hand's arches
- Proficient control of the radial fingers (thumb, index, and middle fingers)
- Stabilization of the ulnar fingers (ring and little fingers)



Scenario 2



Scenario 2



With a bit of an inclusiveness and gamifying the exercises, Rita doesn't feel lonely and bored anymore.

No one is there to cause any disturbance.

She can have her own time using the kit while watching TV or talking to her friends and family.

Now she doesn't have to move all around the house for doing her exercises.

:)







