



P3 Report

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Flexo

*Designing for Improved Care;
Physiotherapy Equipment for Parkinson's Patient*


Approval form

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Thank you.

Sincerely,
Athira

Abstract

Parkinson's disease (PD) is a chronic neurodegenerative disorder that affects the central nervous system. It is characterized by the loss of dopamine-producing cells in a specific region of the brain called the substantia nigra. Dopamine is a neurotransmitter responsible for transmitting signals that regulate movement and coordination. As dopamine levels decrease, individuals with PD experience a range of motor and non-motor symptoms. The primary motor symptoms of PD include tremors, bradykinesia (slowness of movement), rigidity (muscle stiffness), and postural instability (balance problems). Non-motor symptoms may include cognitive impairment, depression, anxiety, sleep disturbances, and autonomic dysfunction. PD is a progressive disease, meaning symptoms worsen over time. While there is no cure for Parkinson's disease, various treatments, including medication, physiotherapy, and lifestyle modifications, aim to manage symptoms and improve quality of life for patients. However, there is a need for innovative equipment that targets the specific challenges faced by PD patients.

This project aims to fill that gap by designing an advanced personal physiotherapy equipment that addresses the unique needs of PD patients, focusing on improving motor function, balance, and mobility. The report outlines the design process, technical specifications, functionality, and potential benefits of the developed equipment, along with recommendations for future improvements and implementation. Through this project, I hope to contribute to the advancement of physiotherapy interventions for Parkinson's disease, ultimately enhancing the well-being and functional abilities of affected individuals.

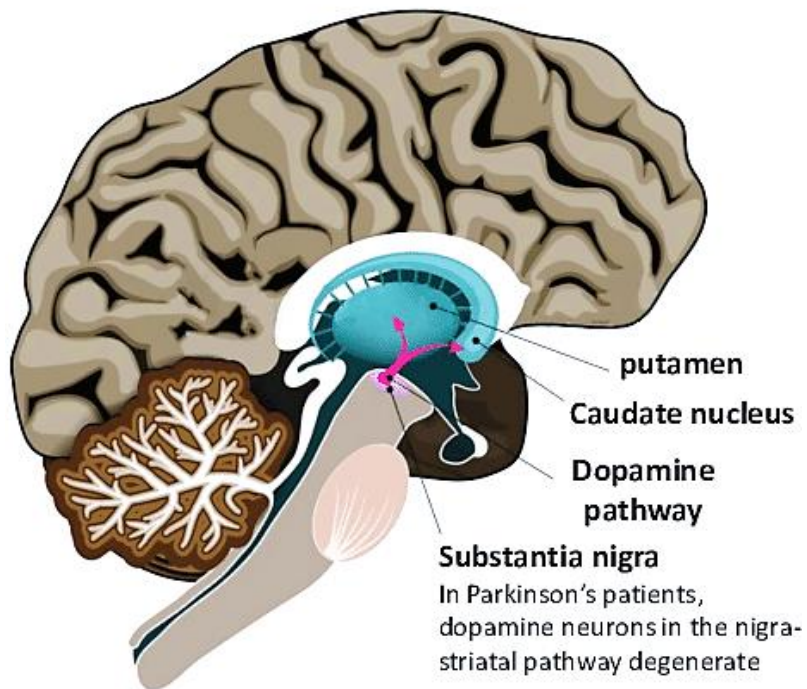
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1. Parkinson's disease

Parkinson's disease is a chronic neurodegenerative disorder characterized by the loss of dopamine-producing cells in the brain. This results in motor symptoms such as tremors, slowness of movement, muscle stiffness, and balance problems. Non-motor symptoms can include cognitive impairments, mood disorders, sleep disturbances, and sensory problems. While the exact cause is unknown and there is no cure, treatments like medication and physiotherapy help manage symptoms and improve quality of life. Ongoing research drives advancements in understanding the disease, leading to new treatment approaches and strategies. Multidisciplinary care and support enable individuals with Parkinson's to achieve better functioning, independence, and an improved quality of life.



1.2 Cause of Parkinson's disease

Reduced dopamine levels in the brain are a key factor in Parkinson's disease. Dopamine is a neurotransmitter involved in regulating movement. In Parkinson's, the cells that produce dopamine in the brain degenerate and die. This leads to a significant decrease in dopamine levels. Without adequate dopamine, the brain's motor regions have disrupted communication.

The reduction in dopamine levels primarily affects the basal ganglia, a set of structures in the brain responsible for coordinating and refining movements. Without adequate dopamine, the basal ganglia struggles to regulate and control movement, leading to the characteristic motor symptoms of Parkinson's, including tremors, bradykinesia (slowness of movement), rigidity, and postural instability. This results in motor symptoms such as tremors, slowness of movement, rigidity, and postural instability.

The exact cause of dopamine cell degeneration in Parkinson's is not fully understood, but genetic and environmental factors may contribute. Other factors, such as oxidative stress and inflammation, may also play a role. Researchers are actively studying Parkinson's disease to deepen our understanding and develop better treatments.



Substantia nigra

Regulates movement and motor skills

Dopamine

Transmit signals to brain and body that supports motor skills

Norepinephrine

Communicates signals between nerve cells and controls critical functions such as heart rate



1.3 Who does it effect?

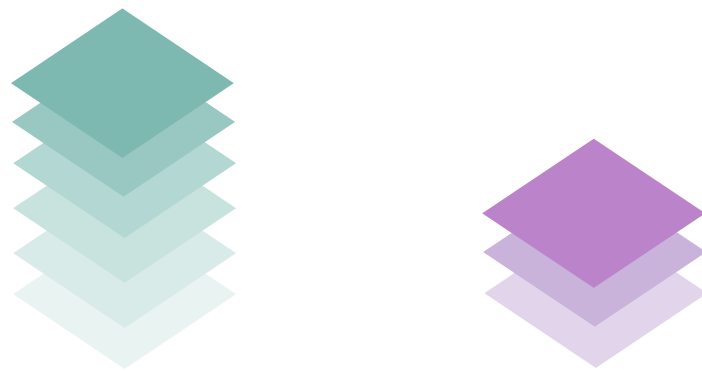
Parkinson's disease can affect individuals of all genders and races, although it is more commonly diagnosed in older adults. The risk of developing Parkinson's increases with age, and the majority of cases are diagnosed in people over the age of 60. However, early-onset Parkinson's can also occur in individuals younger than 50, although it is relatively rare.

Parkinson's disease affects both men and women, although some studies suggest a slightly higher prevalence in men. It is a global condition, impacting people from all regions and backgrounds.

While Parkinson's is more commonly associated with older adults, it is important to note that it can affect individuals at any age. The impact of the disease extends not only to the individuals diagnosed but also to their families and caregivers who provide support throughout the management of the condition.

1.4 Onset of Parkinson's disease

The onset of Parkinson's disease before 40 years is rare and termed as early onset of PD (EOPD). The onset between 21 and 40 years is termed as 'young onset PD' (YOPD), while those with onset before 21 years are termed 'juvenile parkinsonism' (JP): These terms classify the age at which Parkinson's disease manifests. Early onset of PD refers to the rare cases where symptoms appear before the age of 40. Young onset PD refers to cases with onset between 21 and 40 years, while juvenile parkinsonism describes the even rarer cases where symptoms emerge before the age of 21.



Parkinson's Disease is 2X more likely to affect men than in women

1.5 Gender distribution of Parkinson's disease

Particularly in those older than 50 years, the highest male-to-female ratio was observed for age intervals 40–49 years and 50–59 years. It decreases for the age intervals 60–69 years (2.03) and 70–72 years: This observation suggests that the male-to-female ratio in Parkinson's disease is highest in the age groups of 40–49 and 50–59. However, as age progresses, the ratio begins to decrease, with a lower male-to-female ratio observed in the age intervals of 60–69 and 70–72. This indicates that the gender distribution of Parkinson's disease may vary across different age groups.



1.6 Symptoms of Parkinson's disease

Parkinson's disease (PD) presents a wide range of motor and non-motor symptoms that can significantly impact an individual's daily functioning and quality of life. Motor symptoms are the primary hallmark of PD and include tremors, which are involuntary shaking or trembling of the limbs, most commonly observed at rest. Bradykinesia, or slowness of movement, makes it challenging to initiate and execute voluntary movements. Rigidity, characterized by muscle stiffness and resistance, can cause discomfort and limit mobility. Postural instability, another motor symptom, leads to impaired balance and coordination, increasing the risk of falls.

In addition to motor symptoms, Parkinson's disease also manifests various non-motor symptoms. Cognitive impairments, such as difficulties with memory, attention, and executive functions, can impact thinking and decision-making abilities. Mood disorders, including depression and anxiety, are common in PD and can significantly affect emotional well-being. Sleep disturbances, such as insomnia and rapid eye movement (REM) sleep behavior disorder, disrupt normal sleep patterns and can lead to excessive daytime sleepiness. Loss of sense of smell (anosmia), constipation, urinary problems, and sexual dysfunction are also frequently observed non-motor symptoms.

It is important to recognize both motor and non-motor symptoms in Parkinson's disease, as they can significantly impact a person's overall well-being and quality of life. A comprehensive treatment approach, addressing both motor and non-motor symptoms, is crucial to effectively manage the condition and provide optimal care for individuals living with Parkinson's disease.

MOTOR SYMPTOMS



WALKING



SLOWED
MOVEMENT



RIGID
MUSCLES



FROZEN FACIAL
EXPRESSIONS



GAIT & BALANCE
PROBLEMS



TREMOR

NON-MOTOR SYMPTOMS



LOSS OF
SENSE OF SMELL



ANXIETY &
DEPRESSION



VISION
PROBLEMS



CONSTIPATION



COGNITIVE
IMPAIRMENT



SLEEP
DISTURBANCE



DIFFICULTY
SWALLOWING



APATHY &
FATIGUE

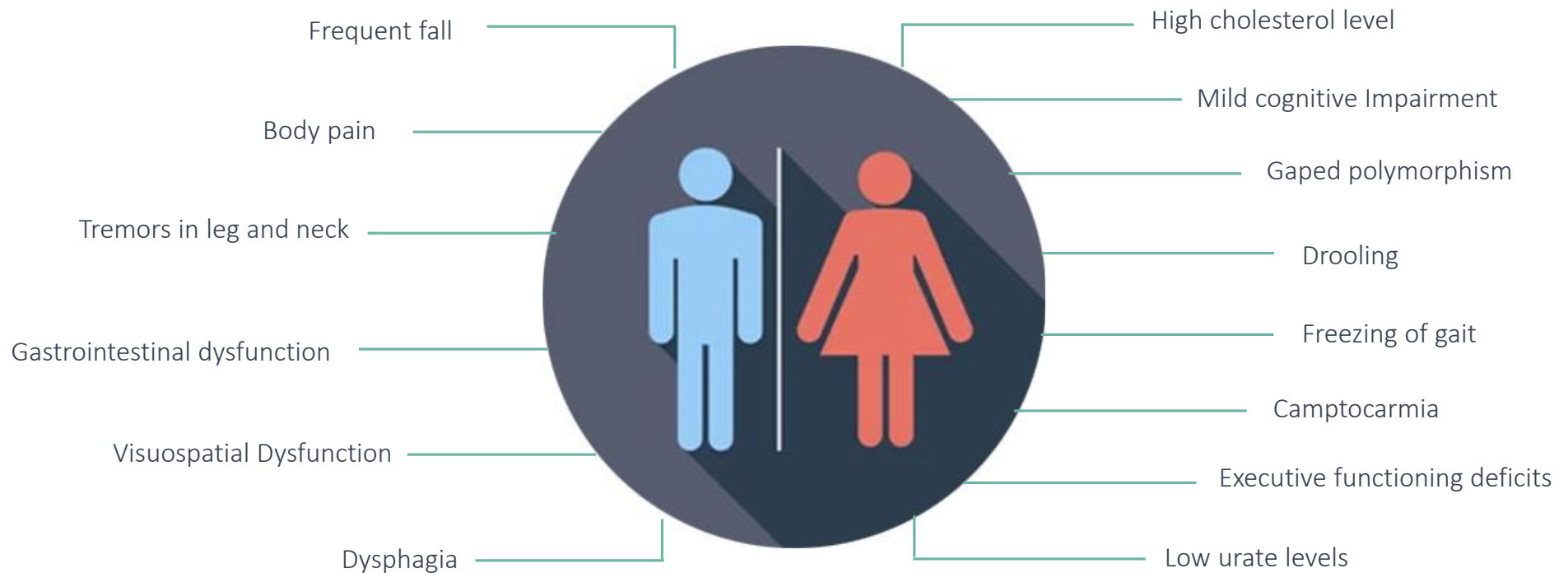


SPEECH
PROBLEMS

1.7 Prominent symptoms Male Vs Female

Women show distinctive symptoms as well as differences in the reasons to pharmacological therapies and deep brain stimulation procedure, and in the personal evaluation of the quality of the life compared with men.

A recent study in United states disclosed that women are also less likely than men to have informal caregiver support. As a result more women use paid caregiver services than men. linked to the longer average lifespan of women and their inclination toward being caregivers rather than receivers of care.



1.8 Stages of Parkinson's disease

Parkinson's disease is generally classified into five stages based on the progression and severity of symptoms. It's important to note that the progression of Parkinson's can vary widely among individuals, and not everyone will experience the exact same symptoms or progress through the stages at the same rate. These stages are a general framework to understand the typical progression of the disease:

Stage 1: Initial Stage

This is the mildest stage, characterized by mild symptoms that typically affect one side of the body. Tremors or other movement abnormalities may be present, but they are generally mild and do not significantly interfere with daily activities. Changes in posture, gait, and facial expression may also be subtle or unnoticeable.

Stage 2: Mild Stage

In stage 2, symptoms become bilateral, affecting both sides of the body. Tremors, rigidity, and bradykinesia become more pronounced, making daily tasks more challenging. Balance problems and coordination difficulties may also emerge, leading to a higher risk of falls.

Stage 3: Moderate stage

Symptoms become more severe, and there is a marked impairment in mobility and balance. While individuals can still manage daily tasks independently, they may experience a significant slowing of movements and require more time and effort to complete activities. Falls become more frequent, and there may be a noticeable decline in reflexes and reaction times.

Stage 4: Intermediate Stage

At this stage, symptoms are severely disabling, and individuals may require assistance with daily activities. Walking becomes challenging, and they may need a walker or assistance to move around. Tremors and rigidity are prominent, and bradykinesia is severe, making it difficult to perform tasks independently. However, individuals can still stand and walk without assistance.

Stage 5: Mild Stage

Individuals in stage 5 are often unable to walk or stand independently and may require a wheelchair or be bedridden. They may experience significant motor fluctuations, including freezing of movements. Non-motor symptoms such as cognitive impairment, hallucinations, and severe mood changes may also be present. Around-the-clock assistance is typically required for daily activities, and quality of life is greatly impacted.

1.9 Impact on Social interaction of the patient

As the disease progresses and symptoms worsen, individuals with Parkinson's may experience various challenges that affect their ability to engage in social activities and maintain relationships. Addressing these challenges and maintaining social connections is crucial for the overall well-being of individuals with Parkinson's disease. Supportive environments, understanding from family and friends, involvement in support groups, and access to rehabilitation services can all play a role in facilitating social interactions and reducing the impact of Parkinson's on social life.

Fatigue and energy levels:

Parkinson's disease can cause fatigue, which can limit a person's energy and stamina for social interactions and socializing. Fatigue may make it more challenging for individuals to participate in social events or maintain regular social contact.

Communication difficulties:

Due to softening of the voice, slurred speech, or monotone speech it becomes harder for patients to communicate effectively, leading to misunderstandings and frustration in conversations. As a result, individuals with Parkinson's may become more hesitant to engage in social interactions, leading to social isolation.

Motor symptoms:

Due to visible motor symptoms it may make it challenging for patients to participate in activities that involve physical movement, leading to reduced participation in social events.



Emotional changes:

Being accompanied by mood disorders, including depression and anxiety it effects the person's motivation, enjoyment, and interest in social interactions. Patients feel withdrawn, irritable, or experience a loss of interest in previously enjoyed social activities.

Social stigma:

Due to visible motor symptoms like tremors or stiffness, individuals with Parkinson's may face social stigma or misconceptions about their condition. This can result in feelings of embarrassment, self-consciousness, or being treated differently by others, which may discourage social engagement.

1.10 Impact on family and caregivers

Parkinson's disease not only affects individuals diagnosed with the condition but also has a significant impact on their families and caregivers. Here are some key points on how Parkinson's disease affects families and caregiver



Increasing caregiving responsibilities:

As Parkinson's progresses, patients require increasing levels of assistance with daily activities placing additional caregiving responsibilities on family members or designated caregivers, which can be physically and emotionally demanding.

Emotional strain:

Caring for someone with Parkinson's can lead to caregiver stress, frustration, and sadness as they witness the decline in their loved one's health. Coping with these emotions while providing care can lead to burnout and impact the caregiver's well-being.

Lifestyle adjustments:

Parkinson's requires lifestyle adjustments, including modifying the home for safety. These changes disrupt normal routines and may necessitate personal and professional sacrifices for the patient and their family.

Financial implications:

Families may need to navigate insurance coverage, seek financial assistance, or make budgetary adjustments to manage the financial impact of the disease.

Social and recreational abilities:

Parkinson's limits social and recreational activities, reducing family outings and social interactions. This loss of connections and enjoyment has an emotional impact on patients and their families.



11th APRIL
PARKINSON'S
DISEASE
WORLD DAY

1.11 Did you know?

Red Tulip: A Symbol of Strength and Resilience in Parkinson's Fight

The most recognized symbol for Parkinson's disease is a red tulip itself. The red tulip is used to represent hope and is often used as a symbol of support for people living with Parkinson's disease. It is used in various awareness campaigns and events related to the disease. The red tulip symbolizes optimism and serves as a reminder that despite the challenges of Parkinson's disease, there is always hope for a better future.

April 11th, World Parkinson's Day

World Parkinson's Day was established to commemorate the birthday of Dr. James Parkinson, the British physician who first identified the condition in 1817. The day provides an opportunity for organizations, healthcare professionals, caregivers, and individuals affected by Parkinson's disease to come together, share information, and advocate for better research, treatment, and support services.



2. Prevalence of Parkinson's disease worldwide

Globally, disability and death due to PD are increasing faster than for any other neurological disorder. The prevalence of PD has doubled in the past 25 years. Global estimates in 2019 showed over 8.5 million individuals with PD. Current estimates suggest that, in 2019, PD resulted in 5.8 million disability-adjusted life years, an increase of 81% since 2000, and caused 329 000 deaths, an increase of over 100% since 2000.

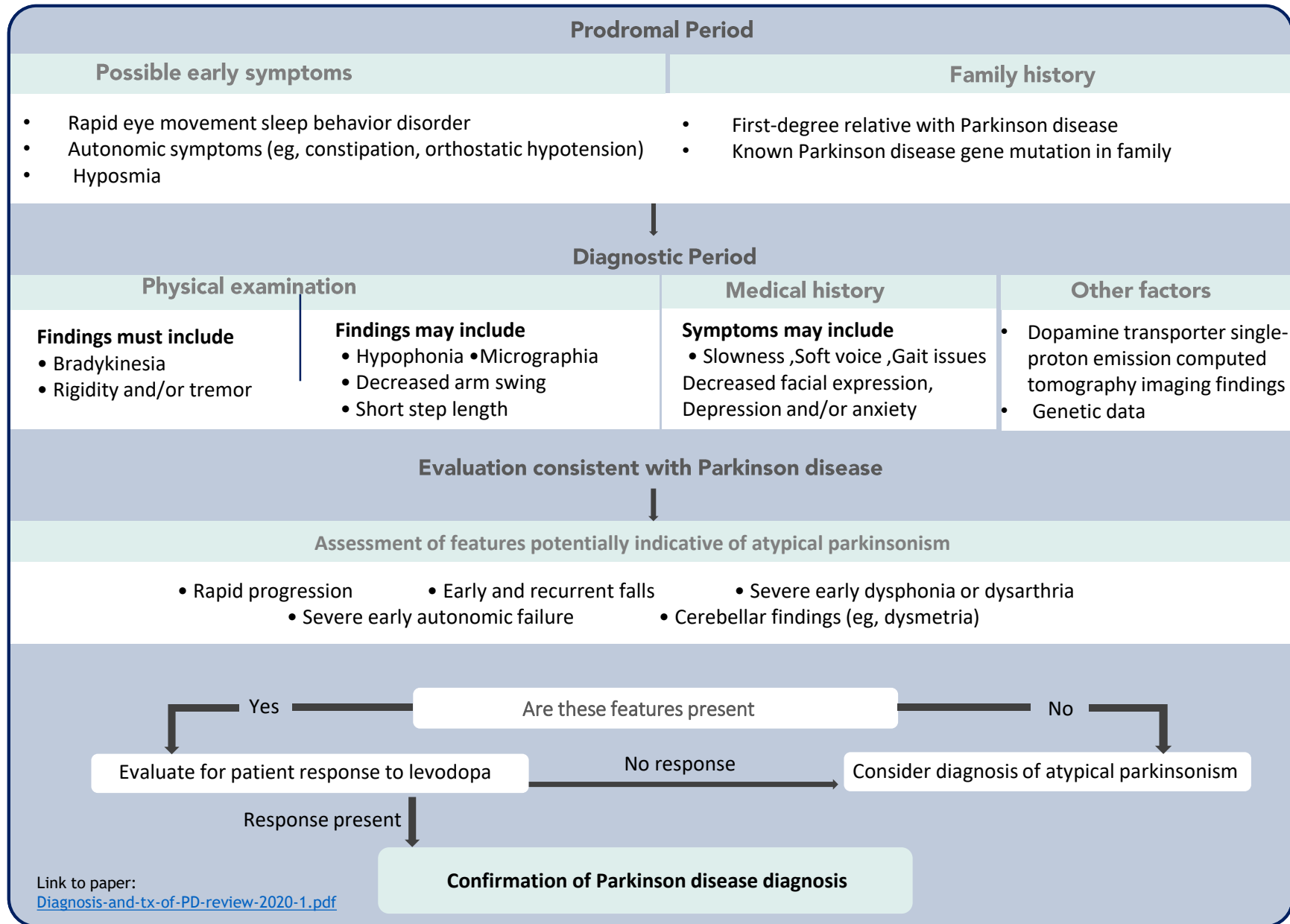
The disease affects both developed and developing countries, with a higher burden observed in aging populations. As life expectancy continues to rise and the global population ages, the number of individuals living with Parkinson's disease is expected to increase significantly. It is crucial to understand the global prevalence of Parkinson's disease to effectively allocate resources, develop targeted interventions, and provide adequate support to individuals and their families affected by this complex condition.

2.1 Parkinson's disease In India

In India in 2019, an estimated 771,000 (95% UI 635,000–919,000) people had Parkinson's disease: This estimate suggests that Parkinson's disease affected a significant number of individuals in India in 2019. It reflects the prevalence of the disease in the country during that year, with the estimated number falling within a range of uncertainty.

An estimated 45,300 (95% UI 38,600–52,800) deaths were due to Parkinson's disease: This statistic highlights the impact of Parkinson's disease on mortality in India. In 2019, Parkinson's disease was rare in young age groups. Prevalence increased notably in the older age groups: This finding highlights that Parkinson's disease was relatively uncommon among younger individuals in India in 2019. However, the prevalence of the disease increased significantly as age advanced. This pattern is consistent with Parkinson's disease being more prevalent in older populations globally, as age is a known risk factor for the disease.

3. Approach to diagnosing Parkinson's disease



4. Literature study

Diagnosis and Treatment of Parkinson Disease A Review

Melissa J. Armstrong, MD, MSc; Michael S. Okun, MD

- Major medication for PD is Levodopa and the resistant towards the medicine also increases as the disease progress - Dosage of the medicine is increased in this case.
- Levodopa is given gradually to avoid negative response to medication which include abnormal involuntary movement.
- With progression, individuals with Parkinson disease will require increasing doses of their initial therapy and the addition of other therapies with complementary mechanisms of action

A review on Parkinson disease treatment , Tori K Lee, Eva L Yankee

Department of Biology, Pacific Union College, Angwin, USA

- Attention strategies and visual clues help in attaining equal stride length
- Rhythmic motion of treadmill helps PD patients to regularize gait also improves step variability and stride length which later becomes major risks for elderly people.

Parkinson disease; The prodromal phase and consequences with respect to work life

Umea University

- More than half of the people who were classified as PD Patients suffered from some other form of parkinsonism
- PD patients had significantly lower muscle strength in the upper extremity
- Majority of the PD Patients reported that the disease interfered with their working capacity and many indicated that they struggled to cope with their work demands, still the percentage of PD patients employed a decade after diagnosis (24%) was high.

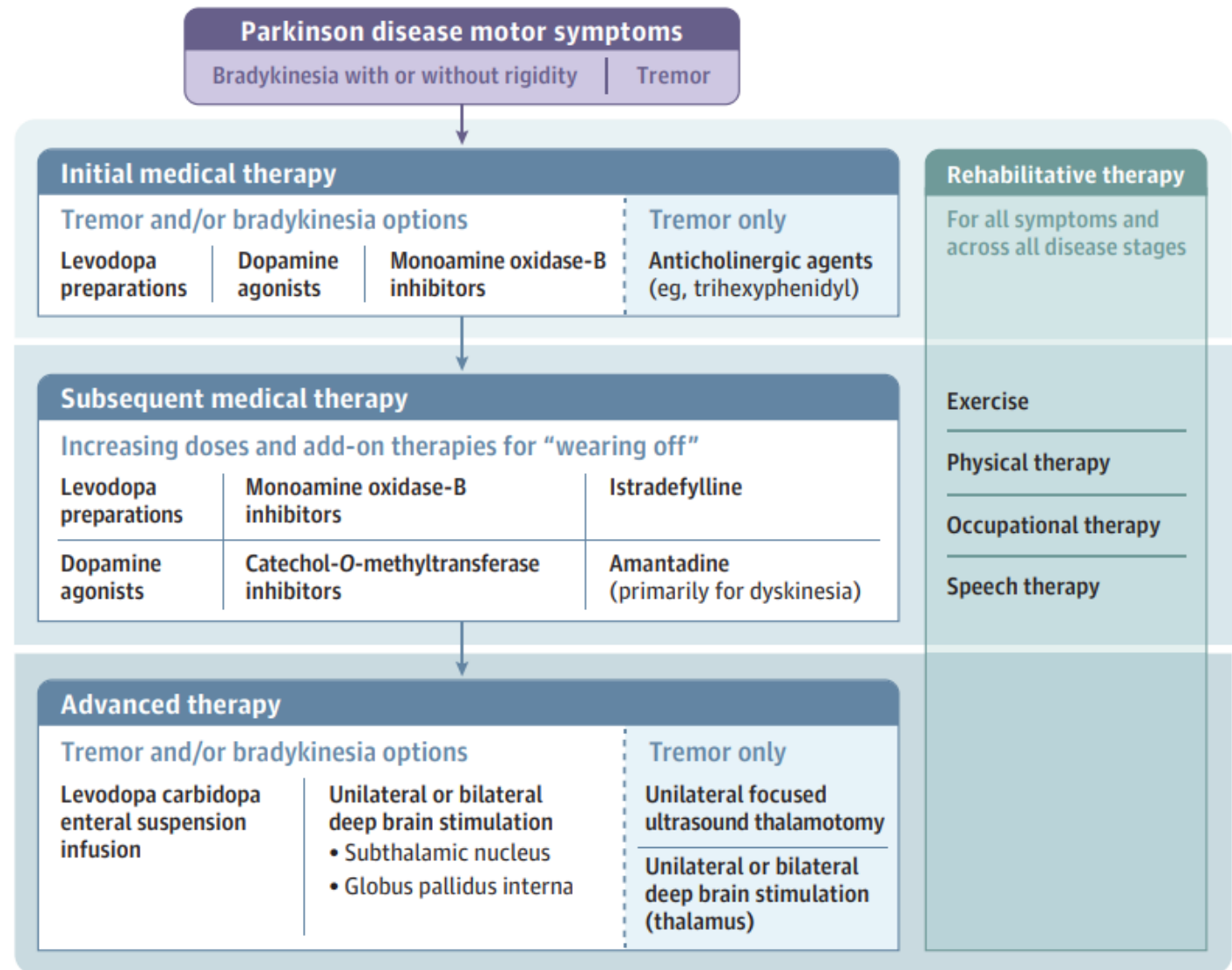


5. Medical assessment and care

The existing treatment methods for Parkinson's disease encompass medication, surgery, and rehabilitation therapies. These approaches aim to manage symptoms, improve quality of life, and enhance functional abilities. Medications, such as levodopa, dopamine agonists, and other drugs, help replenish dopamine levels and alleviate motor symptoms. Surgical interventions, such as deep brain stimulation (DBS), involve implanting electrodes to modulate abnormal brain activity and reduce symptoms. Rehabilitation therapies, including physiotherapy, occupational therapy, and speech therapy, focus on improving mobility, coordination, speech, and activities of daily living. These therapies help individuals maintain independence, manage symptoms, and enhance overall well-being. Treatment plans are tailored to each patient's specific needs and may involve a combination of approaches to optimize symptom control and functional abilities. Regular monitoring and adjustments by healthcare professionals are essential for effective management of Parkinson's disease.

5.1 Proposed General Approach to Treating Motor Symptoms in Parkinson Disease

Initial treatment of Parkinson's disease includes levodopa, dopamine agonists, and monoamine oxidase-B inhibitors. Levodopa is favored for many individuals. Anticholinergic agents may be used for tremor but can have adverse effects. Exercise and rehabilitative therapies are important throughout the disease stages. As the disease progresses, higher medication doses and additional therapies may be required. Advanced therapies like deep brain stimulation or levodopa-carbidopa enteral suspension can be considered for functional impairment. Thalamic procedures help with tremor only.



Link to paper:
[Diagnosis-and-tx-of-PD-review-2020-1.pdf](#)



6. Empowering Confidence: How Assistive Devices Transform Lives for Parkinson's Patients

Assistive devices play a significant role in boosting the confidence of individuals with Parkinson's disease. Here's how these devices contribute to increased confidence:

- Enhanced mobility
- Increased independence
- Improved safety
- Enhanced social participation
- Psychological well-being

Overall, assistive devices provide practical solutions to physical limitations, promoting independence, safety, and participation in various activities. By empowering individuals to overcome challenges, these devices contribute to a greater sense of confidence and well-being for individuals with Parkinson's disease.

6.1 Assistive aids ;Market study



Mobility aids

Canes: Canes provide stability and support for individuals with balance and gait difficulties. They help improve stability while walking and reduce the risk of falls.

Walkers: Walkers offer increased support and stability for those with more significant mobility challenges. They provide a sturdy frame for individuals to lean on and assist in maintaining balance while walking.

Rollators: Rollators are wheeled walkers that provide additional support and mobility. They often have a seat and hand brakes, allowing users to rest and sit when needed.

Wheelchairs: Wheelchairs are essential for individuals with severe mobility impairments. They enable independent mobility and allow individuals to conserve energy while moving around.

Motorized scooters: Motorized scooters provide individuals with Parkinson's the ability to cover larger distances while conserving energy. They are especially useful for outdoor activities and longer trips.



Stays upright and steady



6.2 Adaptive utensils

Built-Up Handles: Larger handles for easier grip and control, ideal for individuals with limited hand strength or dexterity.

Weighted Utensils: Added weight in the handle to stabilize hand tremors, allowing for more controlled and steady eating.

Angled Utensils: Bent or angled design reduces the need for excessive wrist or arm movement, making it easier to bring food to the mouth.

Rocker Knives: Curved blades for cutting food using a rocking motion, beneficial for individuals with hand tremors or limited strength.

Non-Slip Utensils: Textured or rubberized handles for a secure grip, reducing the risk of utensil slippage, helpful for individuals with reduced hand strength.

Adaptive Cups and Straws: Cups with large handles, spout lids, or built-in straws to facilitate drinking, promoting independence and minimizing spills.

These adaptive utensils cater to the specific needs of individuals with Parkinson's disease, enabling them to maintain independence while eating and drinking. They enhance grip, stability, and control, improving the overall dining experience and promoting confidence in self-feeding.

6.3 Buttoning and zipping aids

Button Hooks: These tools have a hook or loop designed to grab and pull buttons through buttonholes, assisting individuals with Parkinson's in fastening buttons.

Button Extenders: Button extenders are small devices that attach to buttons, providing an extended loop or handle for easier grasping and manipulation.

Zipper Pulls: Zipper pulls consist of a handle or loop that attaches to the zipper tab, making it easier to grip and pull the zipper up or down.

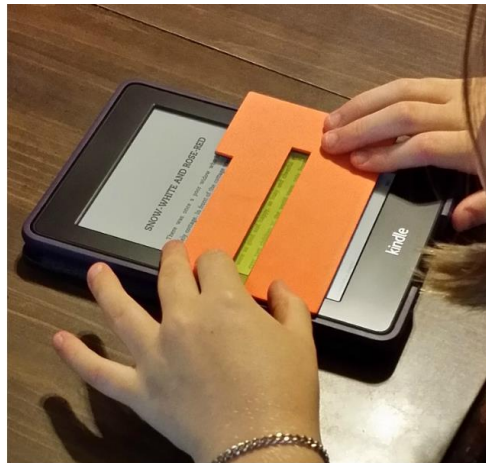
Zipper Rings: Zipper rings are durable plastic rings that can be attached to zipper tabs, providing a larger and easier-to-grasp surface for individuals with limited dexterity.

Magnetic Button and Zipper Aids: These aids utilize magnets to assist with aligning and connecting buttons or guiding zippers, simplifying the buttoning and zipping process.

Elastic Shoelaces: Elastic shoelaces eliminate the need for tying knots. They allow individuals to slip on and off their shoes without needing to manipulate shoelaces.

These buttoning and zipping aids are designed to enhance independence and assist individuals with Parkinson's in managing daily dressing tasks. They reduce frustration, improve fine motor control, and promote self-sufficiency in buttoning shirts, pants, and jackets, as well as zipping up garments and shoes.





6.4 Adaptive devices for writing

Weighted Pens: These pens have added weight in the barrel or handle to provide stability and counteract hand tremors, allowing individuals with Parkinson's to write with greater control and legibility.

Pen Grips and Holders: Pen grips and holders are ergonomic devices that provide a larger, more comfortable grip and assist in maintaining proper finger positioning while writing. They help individuals with Parkinson's to hold the pen securely and reduce hand fatigue.

Large Print Writing Paper: Large print writing paper features enlarged lines and spacing, making it easier for individuals with Parkinson's to see and track their writing. It helps improve accuracy and reduces strain on the eyes.

Slant Boards: Slant boards are adjustable writing surfaces that have an angled design. They promote a more upright writing posture and reduce the strain on the neck, back, and arms while writing. This can enhance comfort and control for individuals with Parkinson's.

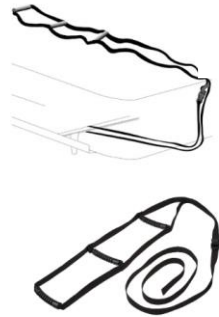
Dictation Apps or Software: Dictation apps and software allow individuals to speak their thoughts and have them transcribed into written text. By using voice commands, individuals can create documents, write emails, or take notes without the need for manual typing.

Electronic Typing Aids: These devices or software programs feature enlarged keyboards, tactile feedback, and adjustable settings to accommodate the specific needs of individuals with Parkinson's. They can improve typing accuracy and speed.

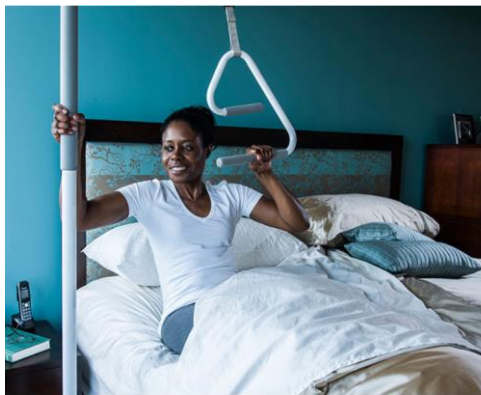




Adjustable Blanket Support



Standers Bed Caddie Pull Strap



HealthCraft SuperPole SuperTrapeze System

6.5 Bedroom aids

Bed Rails: Provide support and assist with safe movement in and out of bed.

Adjustable Beds: Customize bed position for comfort and support.

Grab Bars: Offer stability and support for getting up from bed and moving around the bedroom.

Nightlights: Aid in safe navigation in the dark.

Overbed Tables: Keep essential items within reach for convenience and independence.

These bedroom aids improve safety, comfort, and independence for individuals with Parkinson's in their bedroom environment



Bent Long Handle Large Grip Sponges



Eagle Health XX Long Toilet to Tub Sliding Transfer Bench



Weighted Cuff for Disposable Razor



No Drill Grab bar



Dependa-Bar Grab Bar



6.6 Bathroom and grooming aids

Raised Toilet Seats: Provide a higher seating position, making it easier to sit down and stand up from the toilet.

Grab Bars and Handrails: Install grab bars and handrails near the toilet, shower, and bathtub to offer stability and support during transfers and movements.

Shower Chairs or Stools: Provide a safe and comfortable seating option while showering, reducing the risk of slips and falls.

Bath Mats and Non-Slip Strips: Place non-slip mats or strips in the bathtub or shower to enhance traction and prevent falls.

Long-Handled Bathing Tools: Use long-handled sponges, brushes, or washcloths to assist with reaching and cleaning hard-to-reach areas of the body.

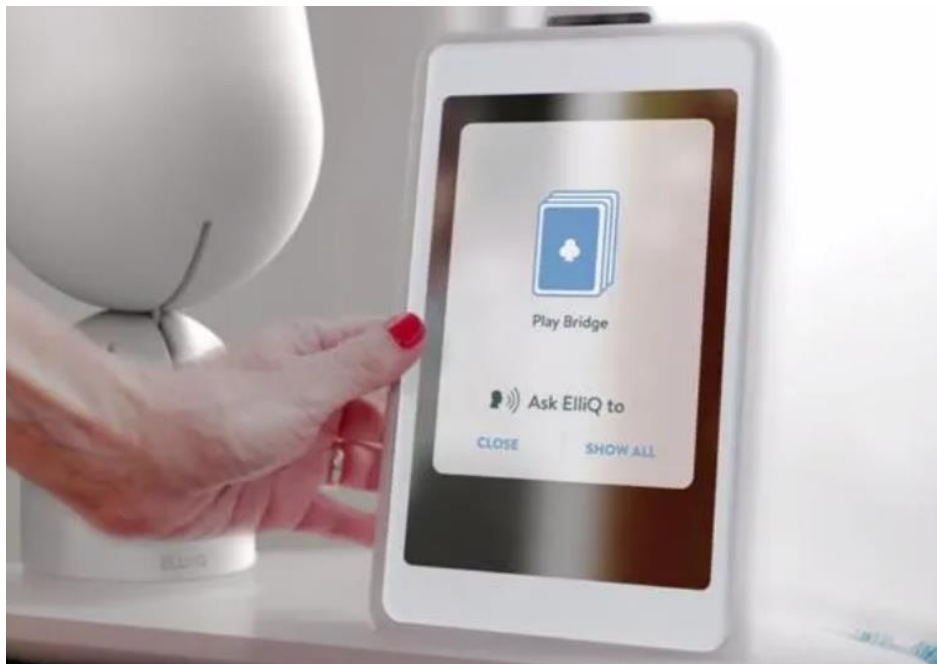
Electric Toothbrushes and Adaptive Shaving Devices: These devices can make brushing teeth and shaving easier for individuals with limited dexterity or tremors.

These bathroom and grooming aids promote safety, independence, and accessibility for individuals with Parkinson's, enabling them to maintain personal hygiene and grooming routines with greater ease and confidence.



Pill organizers:

Pillboxes with compartments and alarms help organize and remind Parkinson's patients to take their medications at the prescribed times, ensuring adherence to treatment plans.



Assistive technology:

Smartphone apps, voice-activated assistants, and smart home devices can facilitate daily tasks, such as reminders, voice commands, and home automation, easing the challenges posed by Parkinson's symptoms.

7. Expert interview

Dr.Nilesh Chaudhary

Neurologist, Hiranandani Hospital ,Powai,Mumbai

Balance ad gate

- Gate apraxia and freezing always need clues for walking .The clues can be visual or physical
- Clues help to retrieve the walking pattern
- Auditory devices are available in the market that gives cue for walking
- Risk of fall due to balancing issues is prevalent in PD patients

Swallowing problems

- Each patient has a different consistency of food they can swallow
- Muscle in neck region becomes stiff which make the patient unable to swallow the food.
- Tremors, Urinary symptoms are mostly dealt with medicines
- Every patient will suffer from freezing of gait and swallowing issues but in various stage of progression of the disease.
- When diagnosed in ages of 60-70, the gait problem and swallowing appears after 5-7 years
- Patients are recommended to do routine physiotherapy as it helps a lot in slowing down/controlling symptoms.



**Dr.Syed M Zafer, Movement disorder specialist,
Saifa Hospital,Parel,Mumbai**

- Parkinson disease is more commonly seen in men, particularly who are more than 60 year old.
- Major medication given to patients is Levodopa.
- Taking high dosage of levodopa leads to abnormal involuntary movement in the patient.
- Also causes side effects like motor issues.
- Tremor dominant Parkinson is commonly seen in men.
- Every Patient is unique with unique combination of symptoms.

**Dr.Sruti, Neurologist,
Saifa Hospital,Parel,Mumbai**

- Depression major symptom Parkinson's patients suffer from.
- Most patients are also sent to seek help with psychiatrists and therapists.
- Patients use different types of walking aids and wheelchair.
- They make use of low cost laser stick
- To improve neural activity patients are encouraged to play mind games and puzzles .
- Young Onset Parkinson's is mostly affected by genetic factors

8.Design opportunities

Neuropsychiatric

- Depression
- Anxiety
- Apathy and Anhedonia
- Pathological Gambling
- Compulsive Sexual behaviors

Cognitive

- Executive Dysfunction
- Slowed cognitive Processing
- Impaired recall
- Impaired Time perception
- Visuospatial Difficulties

Gastrointestinal

- Constipation
- Impaired stomach emptying
- Excessive production of Saliva
- Swallowing Impairment



Other

- Daytime Drowsiness
- Insomnia
- Orthostatic Hypotension
- Alterations in Autonomic Nervous system
- Urinary Incontinence
- Impaired sense of smell
- Paresthesia

Motor

- Tremors of 4-6Hz
- Pill-Rolling tremors
- Rigidity
- Postural Instability
- Gait and Posture disturbances
- Slurred Speech
- Mask like Facial Expression
- Hand writing issues



8.1.Design direction 01

Designing product to improve cognitive functioning of Parkinson patients.

The design approaches aim to support cognitive function, reduce cognitive load, and enhance the overall well-being of individuals with Parkinson's.

What will it include?

Designing for cognitive functioning of Parkinson's patients involves creating environments, products, and interventions that support cognitive abilities and address specific challenges associated with the disease. This includes simplifying and organizing spaces, using visual cues and prompts, incorporating memory aids and reminders, utilizing adaptive technologies, providing cognitive exercises and activities, ensuring supportive communication, and considering sensory factors.

What are the cognitive changes seen in Parkinson's patients?

Emotional and Behavioral Changes

Mood swings, depression, anxiety, and apathy can occur due to changes in brain chemistry and the impact of the disease.

Visuospatial Impairment

Difficulty with visual perception, depth perception, and spatial awareness, leading to challenges in navigation and object recognition.

Language and Communication Challenges

Trouble finding the right words, expressing thoughts, and understanding complex sentences.

Processing Speed Reduction

Slowed thinking and processing of information, resulting in delays in responding to stimuli or completing tasks.

Memory Impairment

Problems with short-term memory, including forgetfulness and difficulty retaining and recalling information.

Attention and Concentration Issues

Reduced ability to focus, sustain attention, and easily become distracted.

Executive Dysfunction

Difficulties with planning, organizing, problem-solving, decision-making, and multitasking.



In which ways can a product support?

What kind of products?

Cognitive Training: The product can offer cognitive training exercises and activities specifically designed to target cognitive skills such as memory, attention, problem-solving, and language.

Reminders and Prompts: The product can incorporate reminders and prompts to assist with medication schedules, appointments, and daily tasks

Simplified Interfaces: A product with a user-friendly and simplified interface can reduce cognitive load by presenting information in a clear and organized manner.

Visual Supports and Cues: Incorporating visual supports, such as icons, symbols, and color-coding, can aid in comprehension and memory recall.

Personalization and Customization: Allowing users to personalize settings, preferences, and difficulty levels can accommodate individual needs and provide a tailored experience.

Assistive Technologies: Integrating assistive technologies, such as voice control or text-to-speech capabilities, can assist individuals with Parkinson's who may have challenges with manual dexterity or speech.

Monitoring and Feedback: The product can include features for monitoring cognitive performance and providing feedback to users.

How can it help ?

These exercises can help strengthen cognitive abilities and improve overall cognitive functioning.

Reminders can help individuals with Parkinson's manage their routines and improve memory.

This can make it easier for individuals with Parkinson's to navigate and interact with the product.

Visual cues can help individuals with Parkinson's follow instructions and complete tasks more effectively.

Personalization can enhance engagement and effectiveness in addressing cognitive impairments.

Assistive Technologies can facilitate communication and information retrieval.

Help individuals track their progress, identify areas for improvement, and stay motivated in their cognitive rehabilitation.



8.2.Design direction 02

Designing physiotherapy equipment for Parkinson diseased patients

The aim is to enhance the effectiveness of physiotherapy interventions and ultimately improve the overall quality of life for individuals living with Parkinson's disease.

Designing a physiotherapy equipment for Parkinson's disease patients involves creating innovative solutions that address their specific motor challenges. The equipment should aim to improve mobility, balance, strength, and coordination, targeting the key symptoms of Parkinson's. It should be user-friendly, safe, and tailored to the unique needs of Parkinson's patients, taking into consideration their limitations and abilities. The design should promote active engagement in therapeutic exercises, facilitate proper body mechanics, and provide adjustable features to accommodate varying levels of mobility. By designing such equipment, we strive to enhance the effectiveness of physiotherapy interventions and contribute to the overall well-being and functional independence of individuals living with Parkinson's disease.

Benefits of Physiotherapy?

- Preserves and enhances functional abilities, promoting independence.
- Improves balance, corrects posture, and reduces the risk of falls.
- Maintains strength and flexibility for better mobility.
- Enhances daily activities such as getting out of bed and sitting up.
- Ensures a secure gait pattern, even with or without mobility aids.
- Teaches coping techniques, like auditory or visual cues, to manage freezing episodes.
- Enhances manual tasks like reaching and grasping.
- Maintains respiratory health through breathing exercises.



In which ways can a product support?

What kind of products?

Interactive Exercises: The device can offer interactive exercises that target specific motor symptoms.

Adaptive Resistance: The device can incorporate adjustable resistance mechanisms to cater to the varying levels of strength and motor capabilities of Parkinson's patients.

Assistive Technology: The device can integrate assistive technology features to aid in performing daily activities. This can include specialized grips, handles, or attachments that assist with grasping objects, buttoning clothes, or using utensils.

Sensory Stimulation: Some devices may incorporate sensory stimulation elements such as vibrations or auditory cues to enhance proprioception and sensory awareness during exercises.

Remote Monitoring and Tele-rehabilitation: Some devices can enable remote monitoring and tele-rehabilitation, allowing healthcare professionals to assess patients' progress, provide guidance, and adjust therapy plans remotely.

Data Analytics and Personalized Programs: Advanced devices can leverage data analytics to generate personalized exercise programs based on individual needs, progress, and performance.

Virtual Reality (VR) and Gamification: Utilizing VR technology or gamification elements can make therapy sessions more engaging and enjoyable.

How can it help ?

→ These exercises can enhance engagement and effectiveness.

→ This allows for gradual progression and customization of exercises based on individual needs.

→ Make it easier for Parkinson's patients to maintain independence in their daily routines.

→ These sensory inputs can help Parkinson's patients better control their movements and improve overall motor function.

→ This can be beneficial for patients who have limited access to in-person therapy sessions.

→ These programs can adapt over time to optimize therapy outcomes for each patient.

→ Virtual environments and game-like challenges can motivate patients to actively participate, enhancing their motor and cognitive abilities.

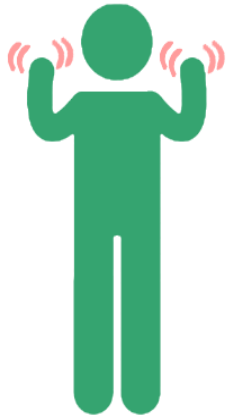


9. Focus area

Designing physiotherapy equipment for Parkinson diseased patients

The aim is to enhance the effectiveness of physiotherapy interventions and ultimately improve the overall quality of life for individuals living with Parkinson's disease.

9.1 Major motor symptoms;



Tremors



Stiffness



Changes in speech,
voice and swallowing



Slowness of
movement



Balance
problems



Trouble with
handwriting

9.1. Major motor symptoms;

Parkinson's disease can lead to various muscle-related problems, This can greatly affect their daily functioning and quality of life. However, with proper management, including medication, physiotherapy, and assistive devices, these symptoms can be reduced, leading to improved mobility and overall well-being.

Postural Instability: Parkinson's disease can affect balance and posture, leading to postural instability. Patients may experience difficulty maintaining an upright posture, resulting in a stooped or hunched position. This instability increases the risk of falls and may affect mobility.

Dystonia: Dystonia refers to involuntary muscle contractions that cause twisting or repetitive movements or abnormal postures. Parkinson's patients may experience dystonic symptoms, such as cramping or twisting of the hands or feet, which can be painful and affect motor control

Freezing of Gait: Freezing of gait is a phenomenon where Parkinson's patients suddenly find it challenging to initiate or continue walking, as if their feet are glued to the ground. This can lead to episodes of immobility and increase the risk of falls.

Rigidity: Parkinson's patients often experience muscle stiffness, making it difficult to initiate and control movements. This rigidity can affect both the limbs and the trunk, leading to a decrease in range of motion and flexibility.

Bradykinesia: Bradykinesia refers to slowness of movement, which can affect various muscle groups. Parkinson's patients may find it challenging to perform tasks that require fine motor control, such as writing or buttoning clothes. Simple movements, such as walking or getting up from a chair, may also become slower and more laborious.

Tremors: Tremors are a hallmark symptom of Parkinson's disease, characterized by involuntary shaking of the hands, limbs, or other body parts. These tremors can vary in severity and may occur at rest or during movement, making precise tasks difficult to perform.



Reduced muscle strength

Decreased rate of force development

Increased muscle co-activation during any tasks were they need balance

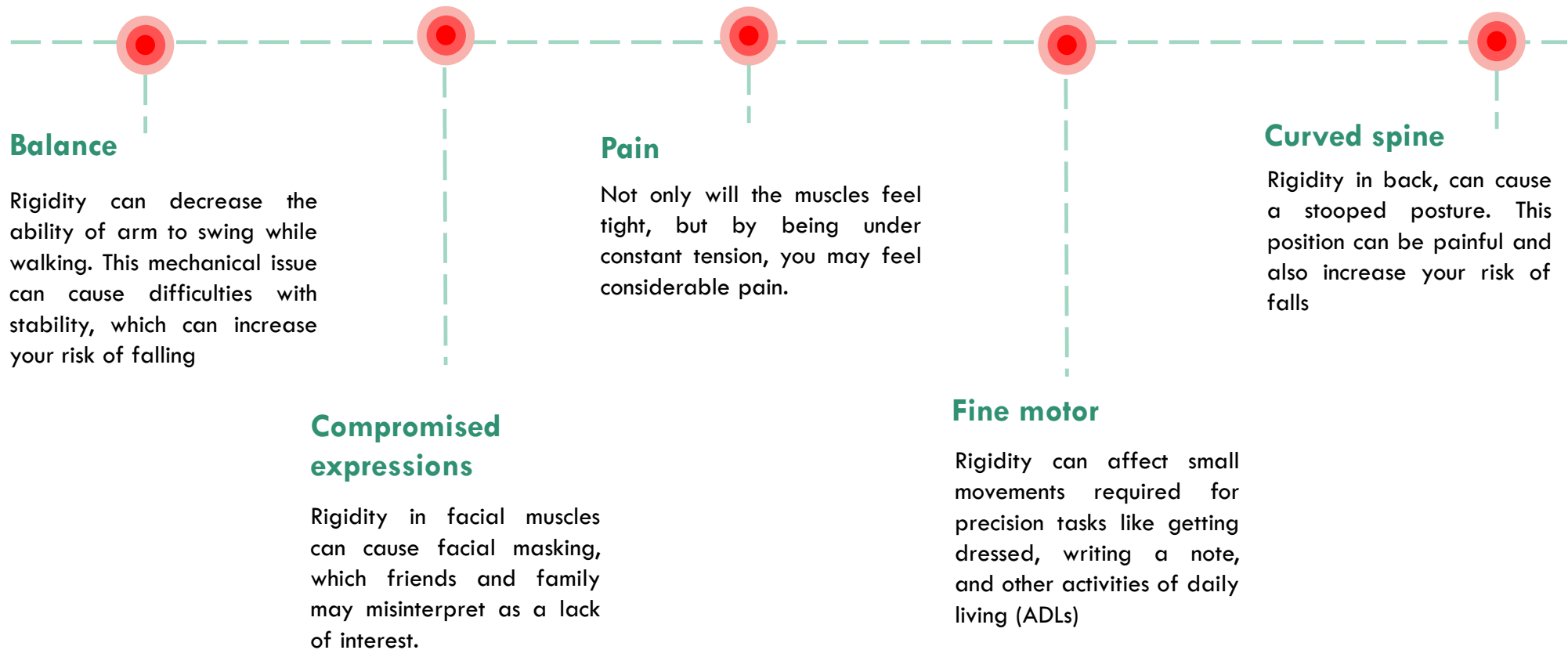
Rigidity is one of the most common motor symptoms in Parkinson's

Impaired ability to maintain constant force

90% of people with Parkinson's experience rigidity at some point during their Parkinson's progression.

9.2. Muscle rigidity effect every area of your life

Impact??





9.3.Types of rigidity

Rigidity is characterized by an increase in muscle tone. It affects both the muscles used to flex and extend your joints.

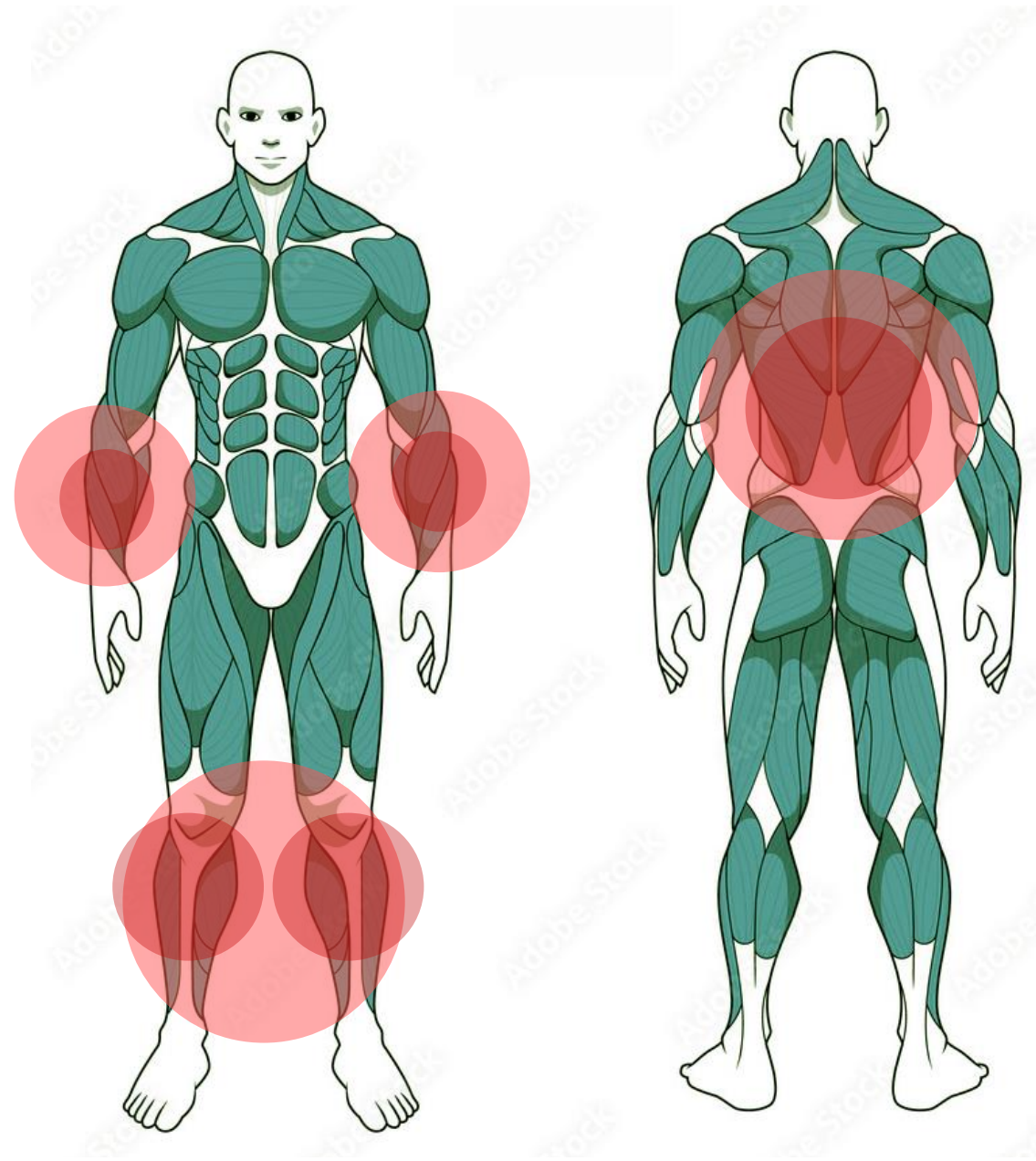
Lead pipe rigidity (sustained)

In lead pipe rigidity, limbs feel like they're stuck in one position. It's sustained, like a lead pipe. In this instance, patient feel constant resistance throughout the whole range of motion.

Cogwheel rigidity (intermittent)

In cogwheel rigidity, your limbs move with small jerky movements. It's intermittent and ratchet-like. You might feel a click or catch in your muscle as you move your arm in a circular motion.

9.4. Muscles that get effected;



Limb Muscles: The muscles in the arms and legs can be affected, leading to stiffness, rigidity, and reduced range of motion. This can make it difficult to perform everyday tasks such as reaching, grasping, and walking.

Facial Muscles: Facial muscles may be affected, causing reduced expression and a mask-like appearance. Patients may have difficulty with facial movements such as smiling, blinking, or swallowing.

Neck Muscles: Muscles in the neck can become stiff and rigid, causing limitations in neck movement and flexibility.

Trunk Muscles: The muscles in the trunk, including the back and abdomen, can be affected, leading to postural instability, stooped posture, and difficulties with balance.

Speech Muscles: Parkinson's disease can affect the muscles involved in speech production, resulting in changes in voice volume, articulation, and clarity. Speech may become softer, mumbled, or slurred.

Swallowing Muscles: The muscles involved in swallowing may be affected, leading to difficulties in swallowing food and liquids, which can increase the risk of aspiration and choking.

Respiratory Muscles: In advanced stages of Parkinson's disease, respiratory muscles may be weakened, leading to breathing difficulties and reduced lung capacity.



9.5. Research paper insights;

Diagnosis and Treatment of Parkinson Disease

Melissa J. Armstrong, MD, MSc; Michael S. Okun, MD

Effective exercise interventions for Parkinson disease include **gait and balance training, progressive resistance training, treadmill exercise, strength training, aerobic exercise, music- and dance-based approaches.**

Additionally, physiotherapy, occupational therapy, and speech therapy (for speech and swallowing) are useful.

A clinical trial of high-intensity treadmill exercise in individuals with Parkinson disease found significantly less worsening of motor function in the high-intensity exercise group than in the usual care group.

Exercise is medicine

Australia factsheet, May 2014

Walking speed in people with Parkinson's disease is related to muscle strength in the legs, so exercise programs aim to increase leg strength.

Programs of resistance (weights) training increase muscle mass and strength, - improve stride (step) length, walking speed and walking distance.

Exercise on a treadmill produces immediate and long-term benefits, especially when done for a long time at a low intensity.

Intensive cycling exercise improves both heart and lung (aerobic) fitness and muscle control and function, reduces the increased muscle rigidity and slowed movements caused by the disease, and also increases hand coordination.

Neurorehabilitation in Parkinson's Disease

Karen Torres, Psy.D., ABPP-CN

Research suggest that aerobic and resistance exercise may improve cognitive functioning in PD (Cruise et al., 2011; Uc et al., 2014) particularly related to executive functioning and attention/processing speed

A study by Combs and colleagues (2011) demonstrated that PD patients who exercise via fairly regimented boxing, demonstrated improvements in walking, balance, and in their ability to perform their activities of daily living.

Mind-body exercises increase self-consciousness of the body, thereby increasing the energy, mental clarity, concentration, and ability to tolerate physical discomfort.

10. How physiotherapy helps?

Improve Motor Function: Enhance mobility, flexibility, and coordination through targeted exercises, addressing rigidity, bradykinesia, and tremors.

Enhance Balance and Posture: Reduce fall risks and promote stability by providing exercises and support to improve balance and posture control.

Increase Strength and Endurance: Build physical capabilities by incorporating resistance and strengthening components, boosting strength and endurance.

Aid in Gait and Walking Training: Assist with gait training, encouraging proper walking patterns, stride length, and restoring confidence and independence in walking.

Facilitate Range of Motion: Maintain and improve joint flexibility, preventing stiffness, and promoting a healthy range of motion.

Enhance Cognitive Function: Stimulate cognitive engagement with incorporated cognitive exercises, supporting mental function during therapy sessions.

Provide Feedback and Monitoring: Real-time feedback on performance and progress helps patients track improvement and adjust therapy accordingly.

Boost Motivation and Adherence: Engaging features increase patient motivation and adherence, making rehabilitation enjoyable and effective.



11. Key aims of physiotherapy;

To correct and improve posture and balance

To maintain and improve functional ability and independence

To maintain a safe walking pattern

To enhance daily activities

To maintain respiratory function through breathing exercises

To allow strength and flexibility to be maintained

To improve manual activities (reaching and grasping)

To minimize the risk of falls

To teach relaxation techniques

If freezing is evident, coping strategies such as auditory or visual cues may be taught

12. Physiotherapy for different stages;



Early stage

The key aim in the early stage of the condition is to **prevent inactivity** and to **improve physical ability** in terms of aerobic capacity, muscle strength and joint mobility.

Mid stage

In this stage physiotherapy will **aim to improve upper limb function**, in particular reaching and grasping, as well as **improving posture, balance, gait and transfers**.

Cognitive movement strategies
Cuing strategies

Advanced stage

Aims to **prevent complications** that may arise as a result of using a wheelchair or being bedridden.

This includes **maintaining your breathing, preventing pressure sores** and working with carers to ensure that they position you correctly and **avoid injuring** themselves when lifting.

13.Secondary Research

Expert Interview

Dr.Shruthi , Physiotherapist, Hiranandani Hospital, powai



Medication-

Major medication given to patients is Carbidopa levodopa, and only if patient develop resistance to levodopa, then surgical treatment if suggested considering affordability.

Cost factor- High for surgical, Not affordable for common people

Assistive Aids- mobility impaired patients uses walker/wheelchair, else medicine treats motor symptoms like tremors.

Symptoms-

Major symptoms seen is tremors, rigidity, gait and balance issues. Another major issue is depression of patients. Most of the patients are send to psychiatrist to deal with this.

Cost factor- High for surgical, Not affordable for common people

Treatment include- Medication, therapy (occupational, physical)

Expert Interview

Dr. Vidya, Neurologist, KEM Hospital, Parel, Mumbai



Major issues of patients

Gait and Balance

- Stepping problem
- Freezing episode
- Shuffling of steps
- Baby steps

Muscle Rigidity

- Rigidity occurring due to Disuse of muscles- not walking because of fear of fall
- Immobility

Risk of Fall

- Patient find difficulty to resist fall because ankle become rigid
- Decreased dorsiflexion of ankle

Postural change

- Patient find difficulty to maintain posture and end up either neck down or neck up effecting the gait and swallowing

What they need

- Increased ankle dorsiflexion to prevent they from falling
- Better Posture of the patient to prevent that effecting gait and swallowing
- Techniques and equipment's that aid to proper muscle training
- Muscle rigidity mostly effects lower body part, so target exercises for lower body part- Glutes ,Hamstrings, Calves.
- Progressive exercise challenging their ability.

13.1. Expert Interview **Insights**

Needs & preferences

Progressive training

Challenging the skills of the patients
Feedback and Encouraging patients to improve their ability gradually

Customized exercise

Customizable according to specific needs and symptoms
Not all patients have same level of abilities

Focusing on improving mobility and gait

High level of **encouragement**

Better support system needed for patients

Educating patients how important physiotherapy is and encouraging them to maintain balance in life incorporating exercise.

Target muscles groups which is more effected- Lower body
Incorporating movements that **mimics natural movement**

Goals

- Improving mobility and gait issues
- Reducing pain & discomfort due to muscle rigidity
- Increased strength
- Increased flexibility
- Increase patients endurance
- Reduce muscle stiffness
- Increase cognitive function
 - Ability to complete different tasks
 - Ability to focus and concentration
- Improving disoriented posture



14. Keywords

No of repos done in one session
 Can change the exercise mode
 Change of resistance
 Change of speed

Progressive training

Patients who has not yet done any exercise will start slow and then gradually increase
 So the product should be capable to improve and challenge the skills of patient

Adjustability

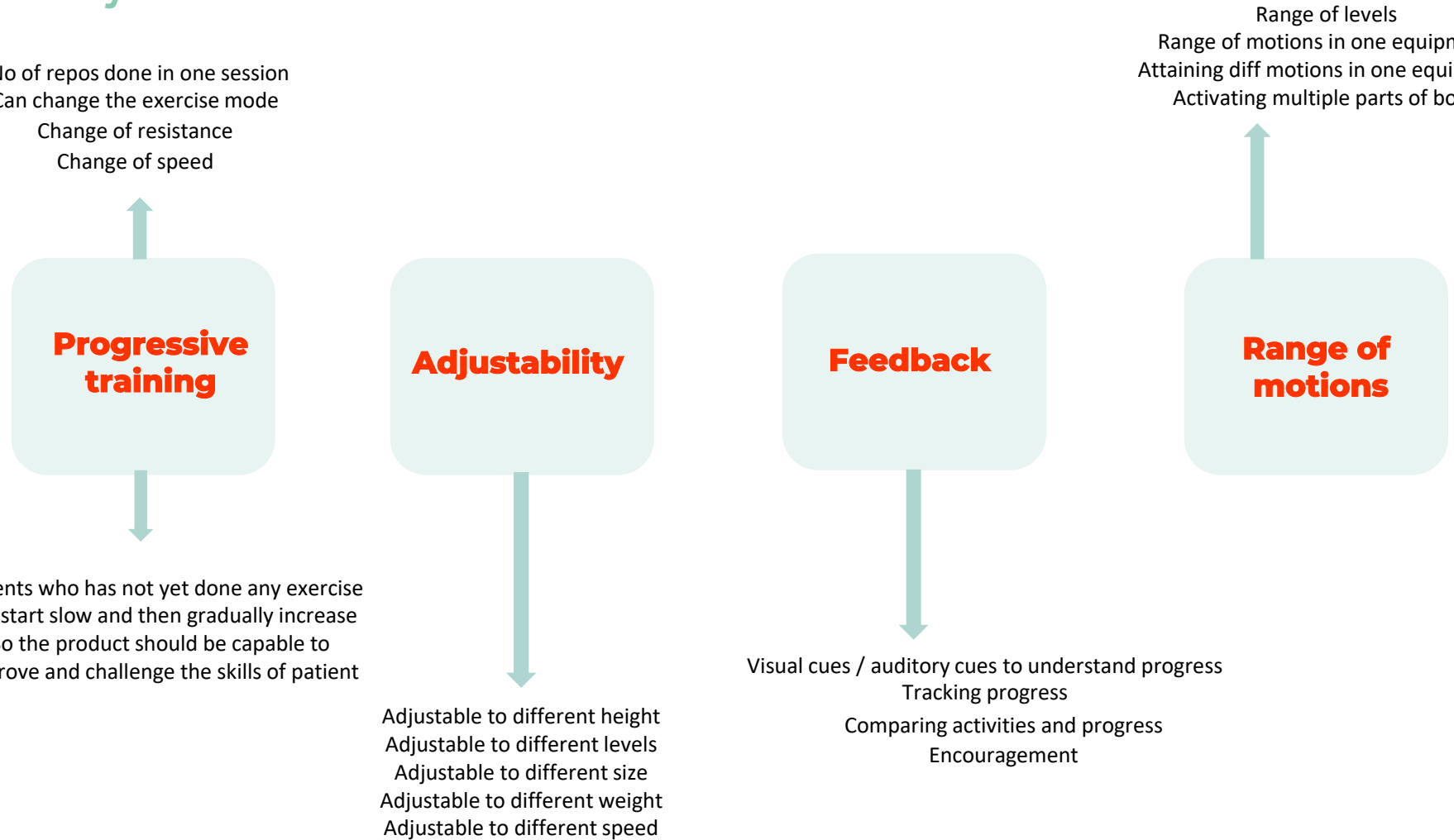
Adjustable to different height
 Adjustable to different levels
 Adjustable to different size
 Adjustable to different weight
 Adjustable to different speed

Feedback

Visual cues / auditory cues to understand progress
 Tracking progress
 Comparing activities and progress
 Encouragement

Range of motions

Range of levels
 Range of motions in one equipment
 Attaining diff motions in one equipment
 Activating multiple parts of body



15. Severity of Muscle rigidity

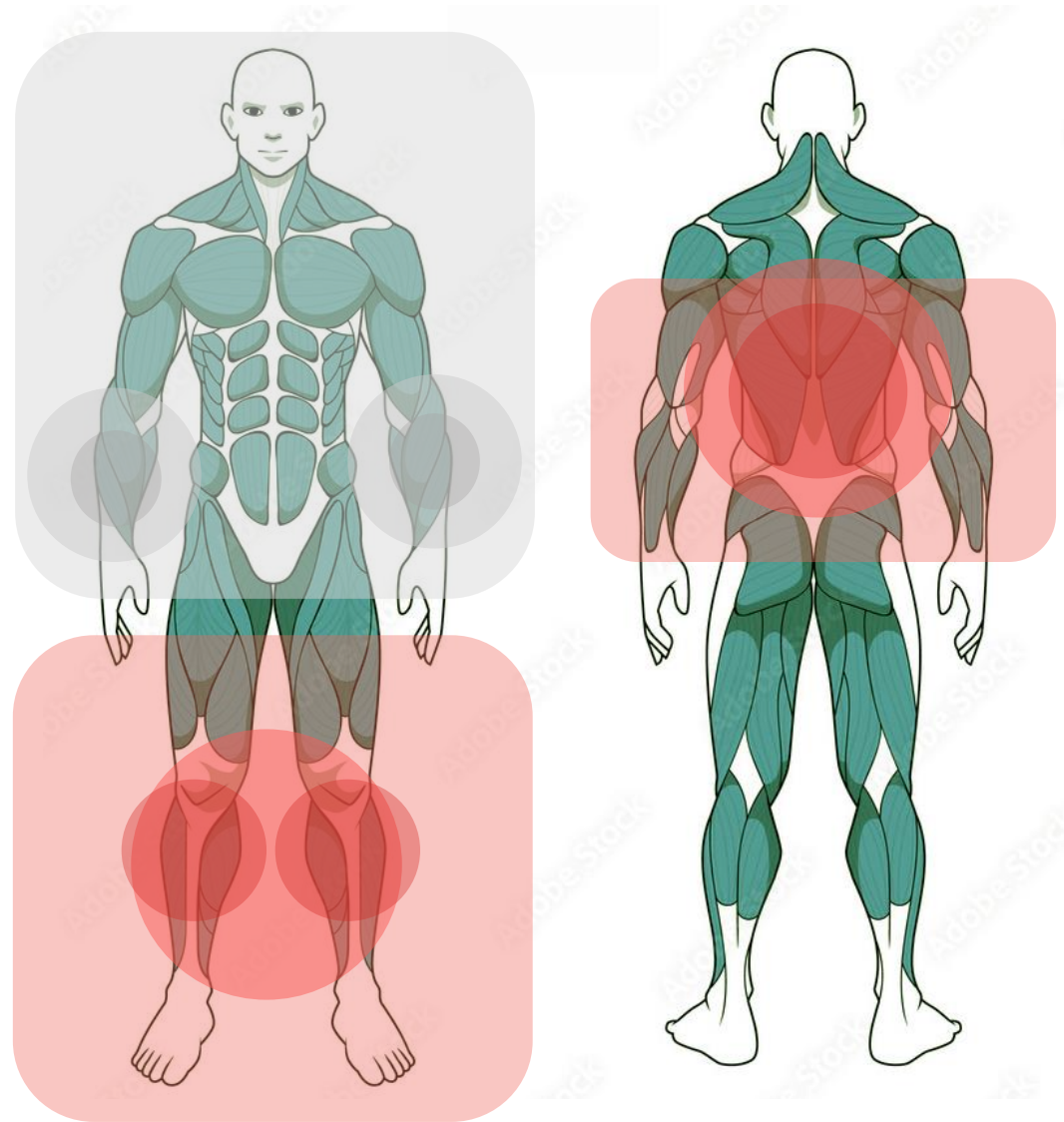
Severity of muscle rigidity mainly occur in lower body of PD patients and back muscles .

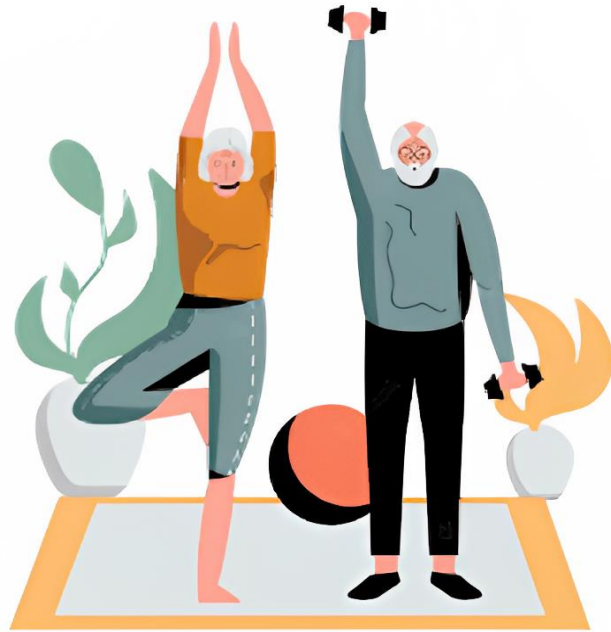
Effected lower body

Result in gait related issues like; Freezing, bradykinesia, fatigue, improper balance reduce stride length etc.

Effected back muscles

Result in impaired posture of patients which gradually effects gait and swallowing ability of the patients





15. Type of exercises

Aerobic Activity

Jogging, cycling, swimming, jump rope, dancing, treadmill

Strength training

Weight lifting, resistance training, hiking, dancing, cycling

Balance, Agility & Multitasking

Yoga, standing on one foot, hopping on one foot, balance bean, uneven surface workout

Flexibility

Stretching, Pilates, Ta Chi, Yoga

15.1 Flexibility training

Stretching for activating calves



Standing calf stretching



Standing Heel raises



Calf stretch -wall push offs



Split stance and weight lifting



Calf stretch -wall push offs

Type

Sustained stretch with deep breathing or dynamic stretch before hard exercises

Duration

2/3 times per week to daily being most effective, 30min 10-15 reps continuous or intermittent.

Consideration

Flexing and activating calves, stretching calves to reduce muscle stiffness

Stretching for activating Ankles



Ankle tilt



Resistant stretching



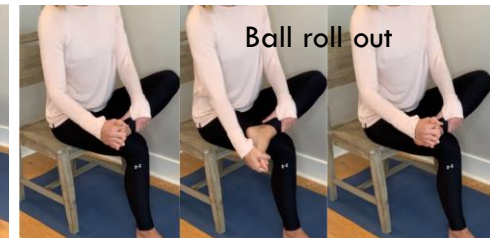
Ball roll out



Ankle bent



Rainbow roll out with balls



Fingers btw toes

Type

Sustained stretch with deep breathing or dynamic stretch before hard exercises

Duration

2/3 times per week to daily being most effective, 30min 10-15 reps continuous or intermittent.

Consideration

Flexing and activating ankle muscles, reduce stiffness in ankle and improve ankle dorsiflexion

15.2. Strength and balance training

Strength building in lower body



Leg side lifts



Short lunges



Legs back lift



Legs front lifts



Legs lift and side lunges

Type

Sustained stretch with deep breathing or dynamic stretch before hard exercises

Duration

2/3 times per week to daily being most effective, 30min 10-15 reps continuous or intermittent.

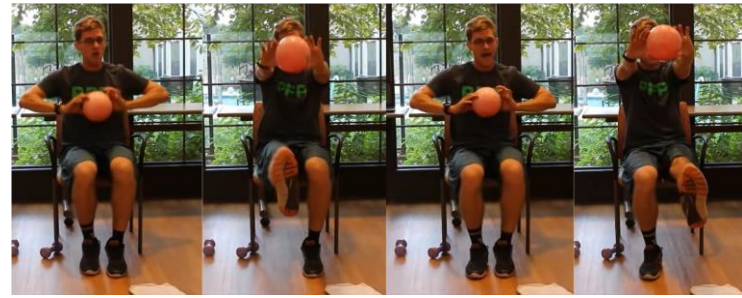
Consideration

Strength building in lower body, reduce muscle stiffness, body mass balancing

15.3. Balance training



Wobble board balancing



Ball balance stretches



Ball balance extended stretches



Body mass stretches

Type

Sustained stretch with deep breathing or dynamic stretch before hard exercises

Duration

2/3 times per week to daily being most effective, 30min 10-15 reps continuous or intermittent.

Consideration

Body mass balancing

16. User Research

16.1. User 1

Name : ABC

Age : 72

Parkinson diagnosis:

Significant symptoms:

- Rigid right hand
- Cant use right hand for any activities, no significant tremor but muscle rigidity, low strength and inactive for a longer time due to rigidity.
- Reluctant to use right hand for activities considering its incapable of doing things.
- Slight balance problems

Therapy undergoing:

- Intermediate physical training
- Occupational therapy
- To develop fine motor skills in right hand.
 - Resistant training
 - peg board training

Lifestyle:

- Determined to overcome the difficulty
- Doing clinical therapy daily
- Lives with her son and family



User 1

Exercises done:



Leg side kicks right & left



Leg rear kicks right & left



Balancing with one leg in front



Balancing with one leg in front
Eyes closed



Wobble board balancing

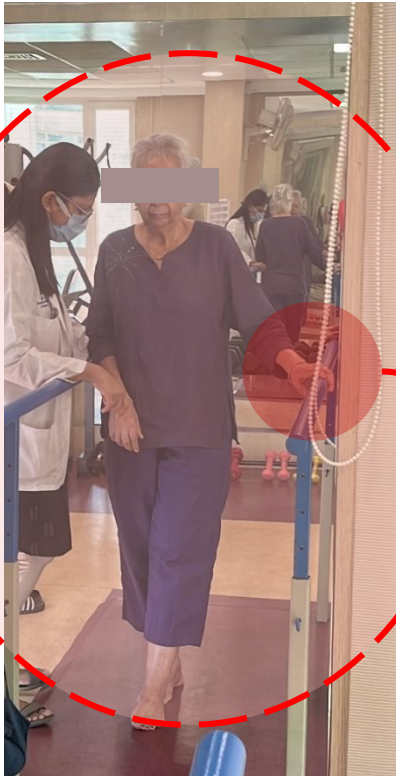


Front kicks- Right & left leg

Understanding user limitations:

:

Balancing exercise with one leg in front



Unable to balance with eyes closed

Grab rails necessary
To prevent from fall/
Eliminates fear of fall

Back kicks , Right and left

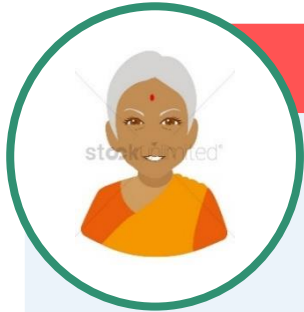


Able to kick backwards with left leg

Body portion effected – Right
Difficulty in lifting right leg backwards
Balance issues

Right Leg going sideways

16.2. User 2



User 2

Name : ABC
Age : 48
Parkinson diagnosis: 2 years

Significant symptoms:

- Leg tremors, no upper body issues or hand tremors
- Left portion effected
- Leg muscle stiffness
- Shuffling of steps while walking is a major issue
- Increased back pain

Therapy undergoing:

- KEM medication
- Home exercise

Difficulties due to symptoms:

- Medicine helping in leg tremors but difficulty from getting up from seating position and gait issues exist
- Needs an external support to get up
- Dragging foot while walking
- Leg swelling –Pain and discomfort due to that
- Legs freeze when taking increased dose of medicine

Lifestyle

- Does all the house chores
- Stopped physiotherapy at clinic due to gait issues.
- Does workout from home

16.3 User Interview **Insights**

User Needs & Wants

Assistive devices to maintain **independency**

Physical support to help them in their daily activities

Emotional support

Social support- Engage in social activities programs etc

Access to affordable healthcare facilities and assistive device

Slow down progression of the disease







Goals

- Improving mobility and gait issues
- Ability to do daily things- self management and independency
- Managing to symptoms
- Adapting and overpowering the symptoms
- Improved social life.
- Improves quality of life
- Better support system








17. Market Research

Props used for different exercising

Product	 <p>Resistant bands</p>	 <p>Hard balls</p>	 <p>Soft balls</p>	 <p>Frisbees</p>	 <p>Ping pong</p>	 <p>Scarf towel</p>
Activity	Strength training	Balance and flexibility training	Balance and flexibility training	Balance and flexibility training	Balance and flexibility training	Balance training
Duration of used	3-4 times to daily a week	3-4 times to daily a week	3-4 times to daily a week	3-4 times to daily a week	3-4 times to daily a week	3-4 times to daily a week
Consideration	Focusing on muscles strengthening and stretching, reducing muscle stiffness and improving flexibility	Focusing on , body mass balancing ,muscles stretching reducing muscle stiffness and improving flexibility	Focusing on , body mass balancing ,muscles stretching reducing muscle stiffness and improving flexibility	Focusing on , body mass balancing ,muscles stretching reducing muscle stiffness and improving flexibility	Focusing on , body mass balancing ,muscles stretching reducing muscle stiffness and improving flexibility	Focusing on , body mass balancing ,muscles stretching reducing muscle stiffness and improving flexibility
Price range	Affordable	Affordable	Affordable	Affordable	Affordable	Affordable

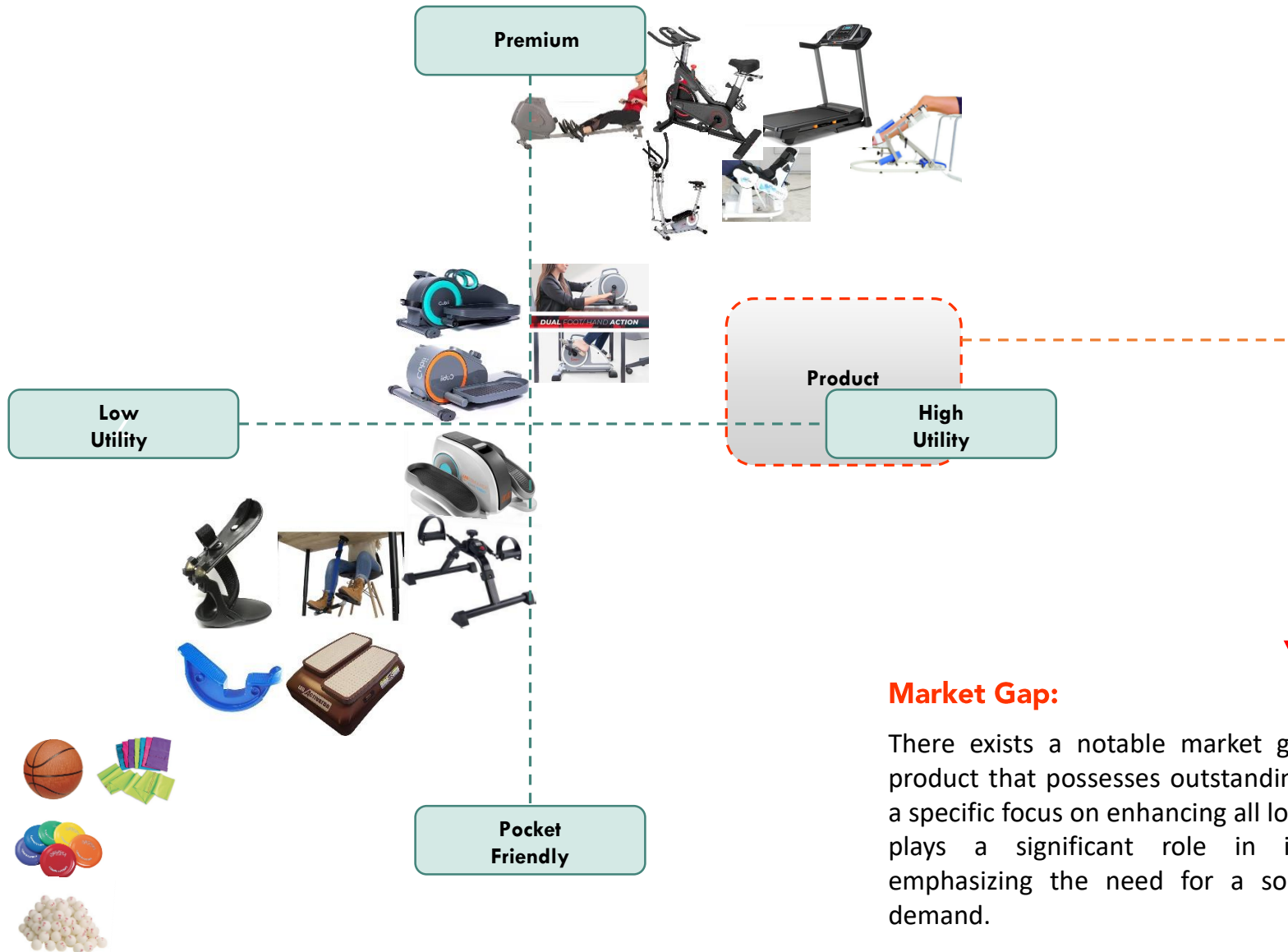
Equipment used for different exercising

Product						
Activity	Aerobic training	flexibility training	Strength and flexibility training	Strength and flexibility training	flexibility training	Flexibility training
Duration of used	3-4 times to daily a week	3-4 times to daily a week	3-4 times to daily a week	3-4 times to daily a week	3-4 times to daily a week	3-4 times to daily a week
	Focusing cardiovascular conditions and making lower body muscles active and functioning	Focusing on stretching ankle muscle and improving joint flexibility in ankle	Focusing on stretching calves muscle strengthening lower body	Focusing on stretching calves and arm muscle. Strengthening upper & lower body	Focusing on stretching ankle and calf muscle and improving joint flexibility in ankle	Focusing on stretching ankle and calf muscle and improving joint flexibility in ankle
	High price	Mid range	Affordable	Affordable	High range	High range

Equipment used for different exercising



18. Product positioning



19.Design Brief

19.1 Overview

Design a physiotherapy equipment that helps Parkinson's patients improve their mobility and reduce symptoms muscle rigidity and stiffness. The equipment should be compact and easy to use at home setting. It should incorporate exercises that are tailored to Parkinson's patients and can be adjusted to different levels of ability of patients.

19.2. Targeted audience

Parkinson's patients who have difficulty with mobility, balance, and coordination. The equipment should be designed to accommodate patients of different ages, genders, and physical abilities. Age group focusing on above 50 yrs. old.



19.3. Design Requirements and consideration

Safety: Proper safety measures to prevent falls or other injuries.

Adjustability: Parkinson's symptoms can vary from patient to patient, so the equipment should be adjustable to accommodate different body types and levels of mobility.

Comfort: Equipment should be comfortable to use and provide proper support.

Durability: The equipment should withstand regular use and be able to withstand the wear and tear.

Storing: The product should be easy to maintain and store if setting up in an home setup.

Ease of use: The equipment should be easy to use and operate for both the patient and the therapist.



Must have

- Safety
- Comfort
- Ease of Use
- Ergonomics
- Durability
- Adjustability
- Easy set up
- Easy Maintenance

Should have

- Customizability
- Range of motion
- Resistance levels
- Adjustability
- Mimicking natural movements
- Accommodating
- Progressive techniques

Could have

- Feedback
- Progress tracking
- User friendly interface
- Portability
- Knock-down storing
- Engaging
- Interactive
- Future tech

19.4. Categorizing the needs

Safety

Stable & Secure	Adjustable intensity	Ergonomic
Safety sensors	Fall prevention	Clear instructions
Comfort	Electrical/Mechanical safety	

Usability

Intuitive	Easy controls	Comfort
Ergonomic design	Adjustability	Easy maintenance
Easy set-up	Portability	Product storing

Functionality

Targeted exercise	Customisation	Progress tracking
Real time tracking	Assistive features	Range of motions
Resistance levels	Flexibility	

Reliability

Consistent performance	stable and robust	Accuracy
Life span of the product	Absence of failure/risk	Effectiveness
Impact resistant	Wear resistance	

Manufacturing

Simplified design	Standardization	Design for assembly
Lean manufacturing principle	Compact	Knock down product

Aesthetics

Design harmony	Color and finish	Intuitive control and displays
Clean and simple	Positive appealing	Merging with households

20. Anthropometry

Parameters		Min	Percentiles				
			5th	25th	50th	75th	95th
Foot length	Male	214	227	239	248	258	274
	Female	190	207	217	227	234	249
	Combined	190	215	231	244	254	271
Foot breadth	Male	51	83	89	94	99	106
	Female	61	75	79	84	89	96
	Combined	51	77	86	92	98	104
Heel breadth	Male	39	55	59	63	66	71
	Female	45	47	52	55	59	64
	Combined	39	50	57	61	65	71
Big toe breadth (nm= not measured)	Male	25	26	30	31	34	35
	Female	nm	nm	nm	nm	nm	nm
	Combined						
Knee flexed	Male	295	313	336	351	379	414
	Female	205	227	301	321	340	369
	Combined	205	304	334	349	375	409
Calf	Male	212	271	299	319	339	377
	Female	200	209	234	267	289	319
	Combined	200	239	291	315	334	369
Ankle, upper malleolar	Male	160	176	189	199	211	229
	Female	156	159	164	189	200	219
	Combined	156	164	186	199	209	229
Ankle at malleolar ridge	Male	205	214	229	239	249	274
	Female	180	181	199	214	230	234
	Combined	180	204	224	234	249	274

Ball of foot	Male	270	299	311	324	335	354
	Female	250	259	269	289	299	319
	Combined	250	279	305	320	334	354
Buttock to leg length, normal sitting	Male	639	640	654	719	779	779
	Female	539	540	579	639	729	759
	Combined	539	540	594	654	729	779
Buttock to leg length while raised on toe	Male	520	569	599	659	699	769
	Female	450	559	639	669	689	719
	Combined	450	559	609	659	689	759
Buttock to extended (rested on floor) leg comfortable length	Male	685	758	869	923	989	1086
	Female	660	719	809	851	904	979
	Combined	660	739	849	905	979	1069
Buttock to leg full extended length	Male	870	971	1039	1088	1133	1209
	Female	865	910	964	999	1035	1106
	Combined	865	941	1019	1071	1119	1199
Thigh clearance ht. at tibial point with raised knee	Male	479	530	564	587	610	644
	Female	480	500	525	540	555	596
	Combined	479	517	552	577	603	639
Mid thigh	Male	65	96	116	127	140	158
	Female	73	83	100	109	124	154
	Combined	65	89	109	124	137	158
Knee	Male	438	472	497	519	539	567
	Female	412	440	462	484	499	520
	Combined	412	456	489	509	534	563



Determined space-confusion and unappropriated placement of feet can cause adverse effect to feet

21. Ergonomics

21.1. Comfort

Ergonomics is utilized to create comfortable equipment by addressing individual needs and challenges. This includes features like padded seating, adjustable components, and ergonomic positioning to reduce strain on joints and muscles.



Feet pads that reduce pain and stress under feet



Soft and padded surfaces reduce discomfort



Larger feet pad with grips



Grips and textures for non slippery



Resting & Soft resting surfaces when not exercising



21.2.Grips / stability

This can include textured or contoured foot pads that provide a firm grip, non-slip surfaces, and adjustable straps or fasteners to ensure equipment stability during exercises. Additionally, stability features such as wide bases or anti-tip mechanisms can prevent accidental falls and provide a sense of security for PD patients.



Grab rails



Straps to prevent falling



Grip handles



Resting & Soft resting surfaces when not exercising

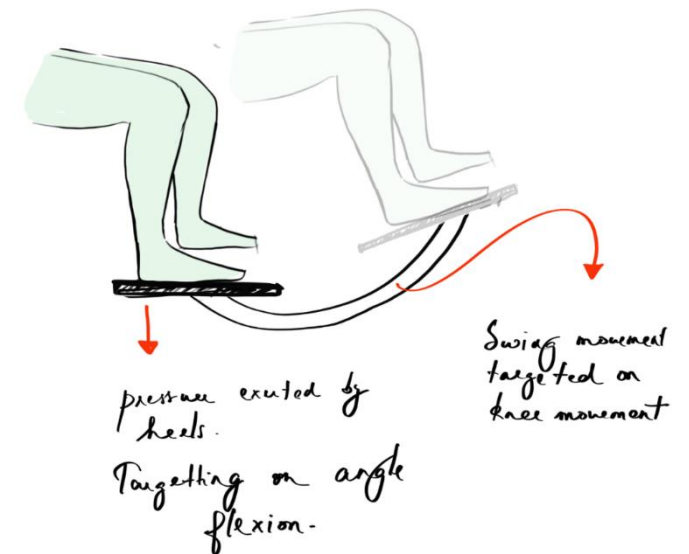
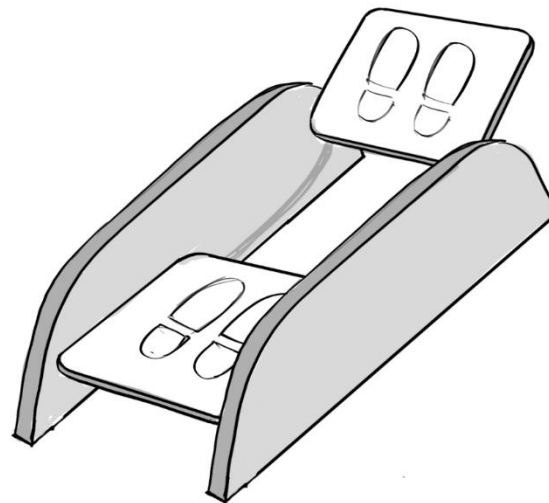
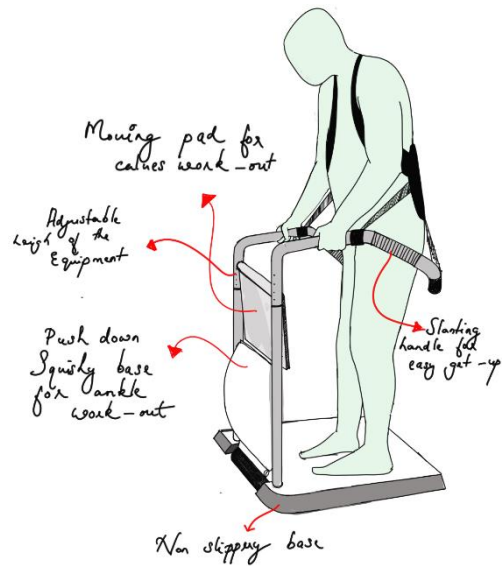
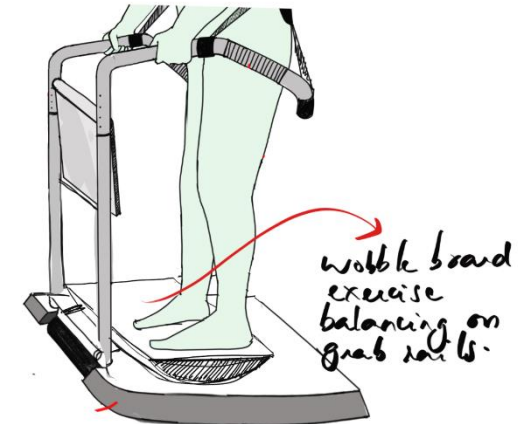
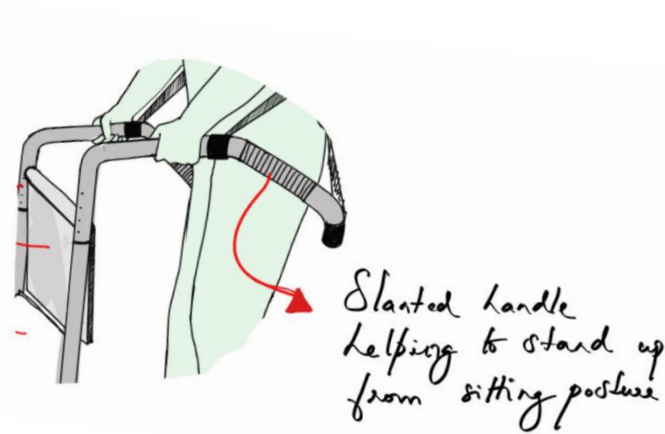
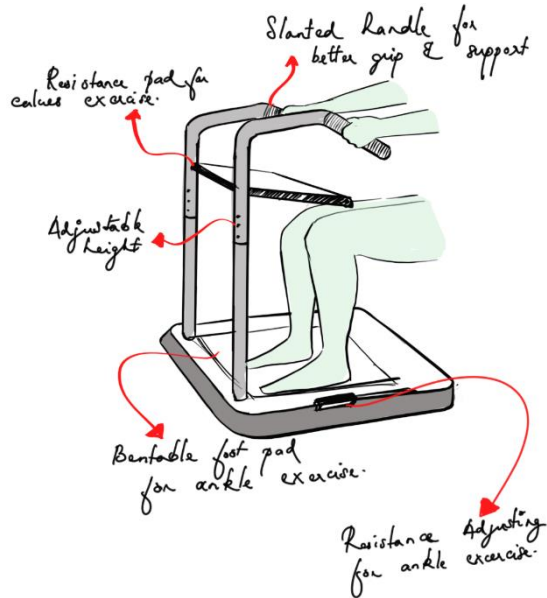


Foot buckles for stable positioning

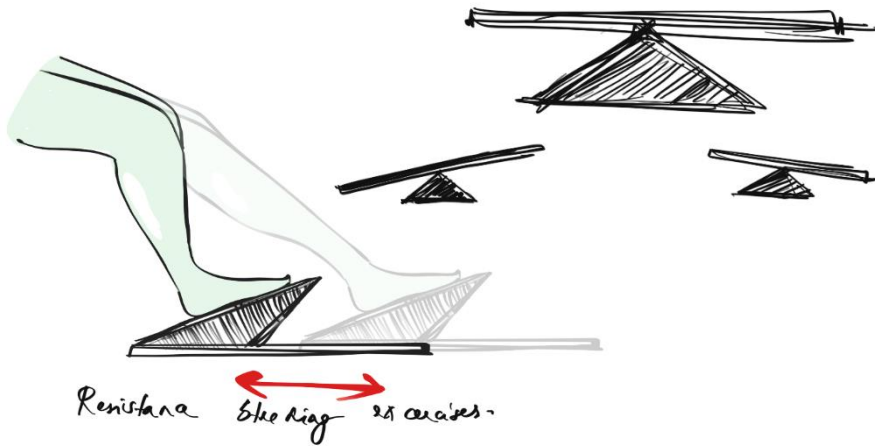
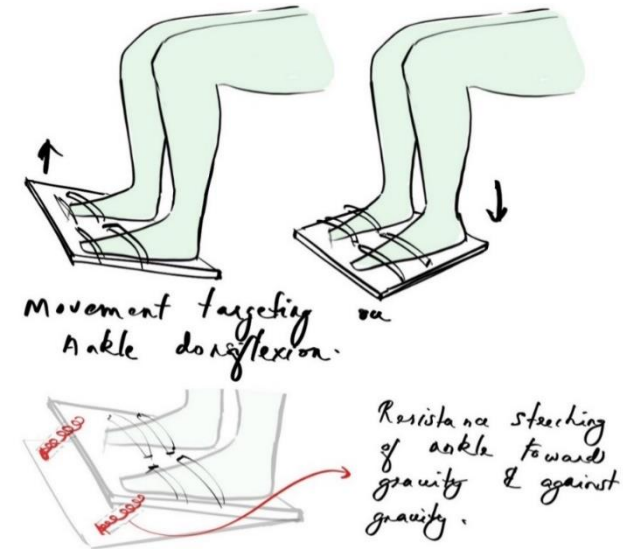
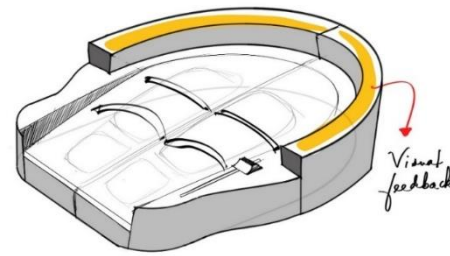
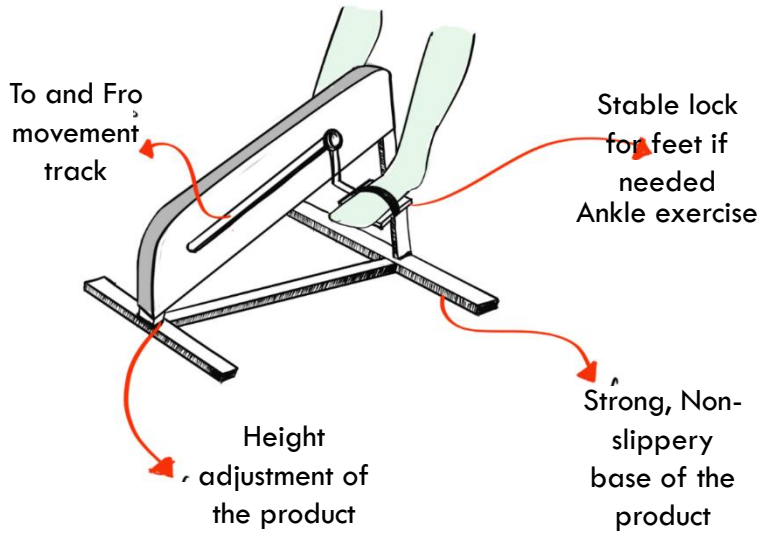
21.3. Safety

This can include incorporating sturdy construction with reinforced frames and stable bases to provide a secure and reliable platform. Non-slip surfaces and grips should be integrated into the design to prevent slips and falls. Adjustable components and secure fasteners ensure proper positioning and stability during exercises.

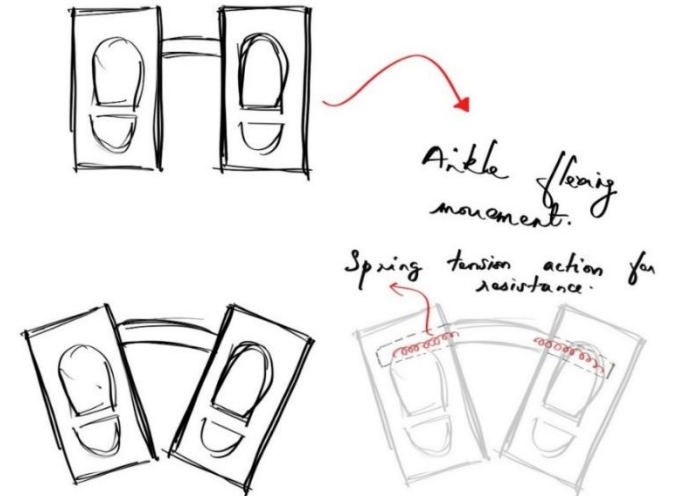
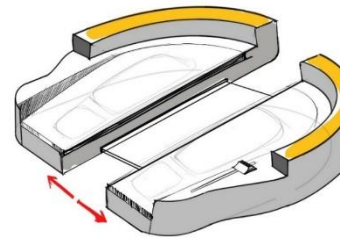
22. Ideations



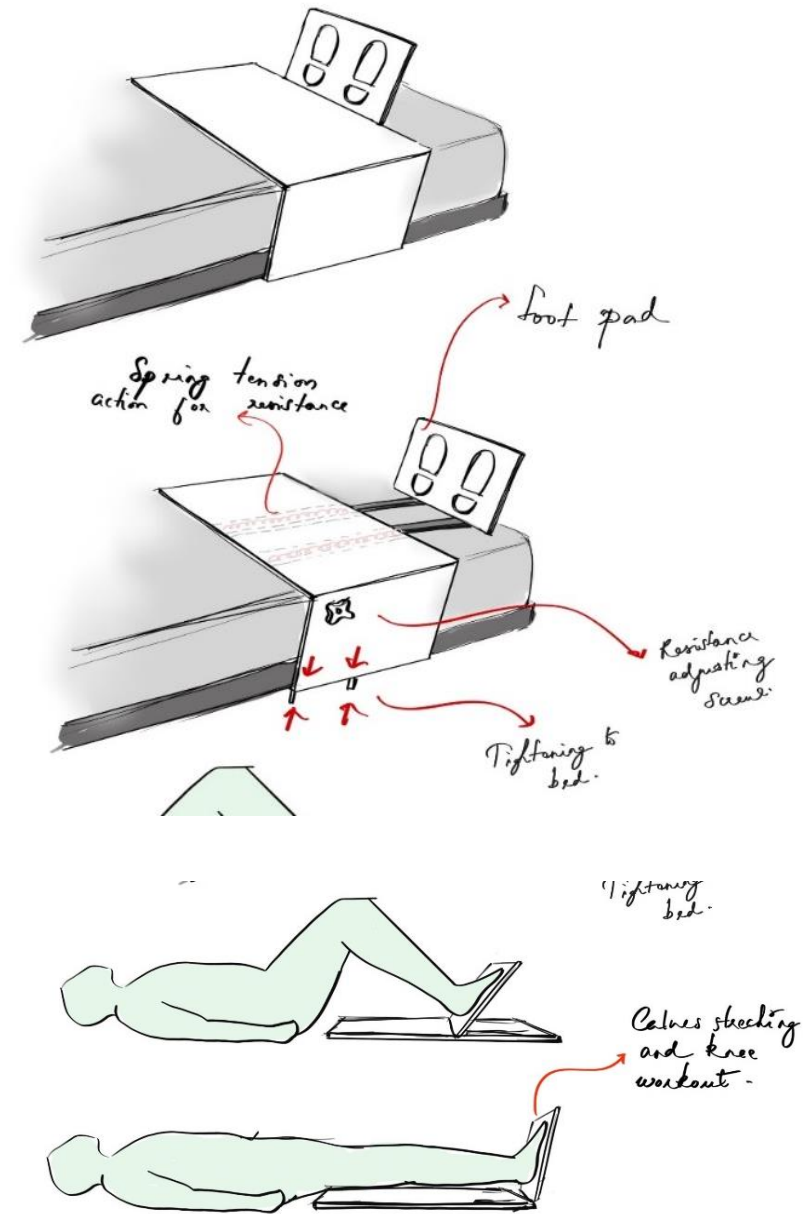
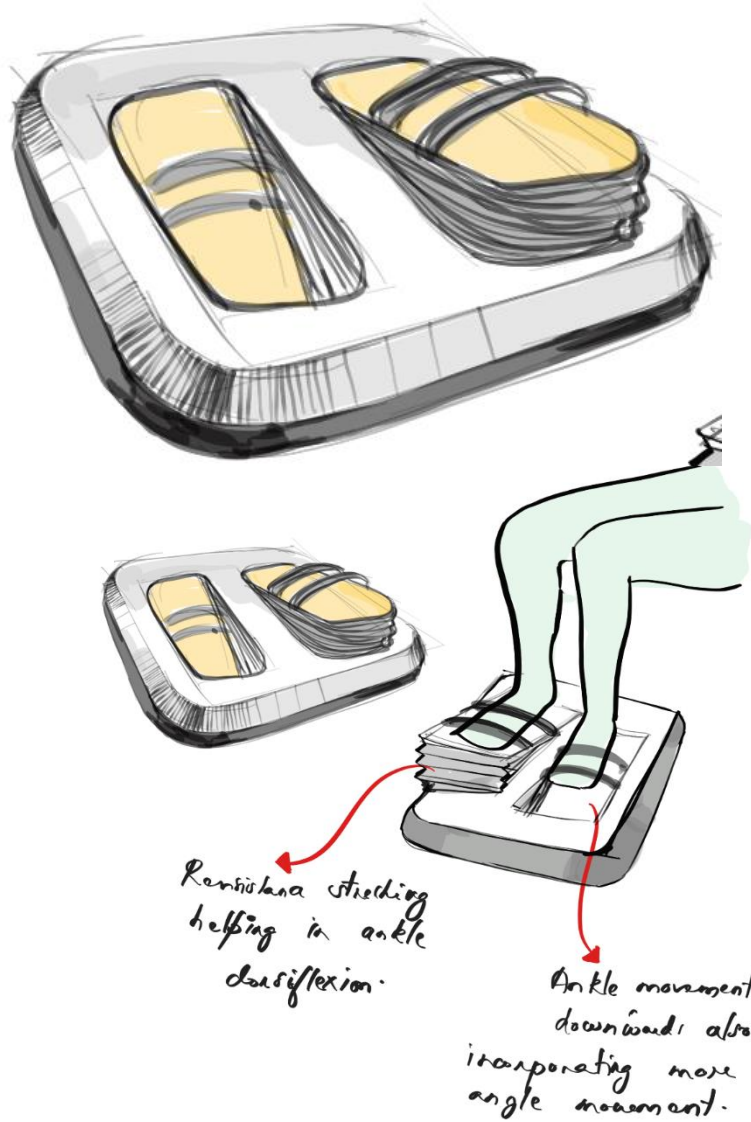
Ideations



Convert to wood board for balance

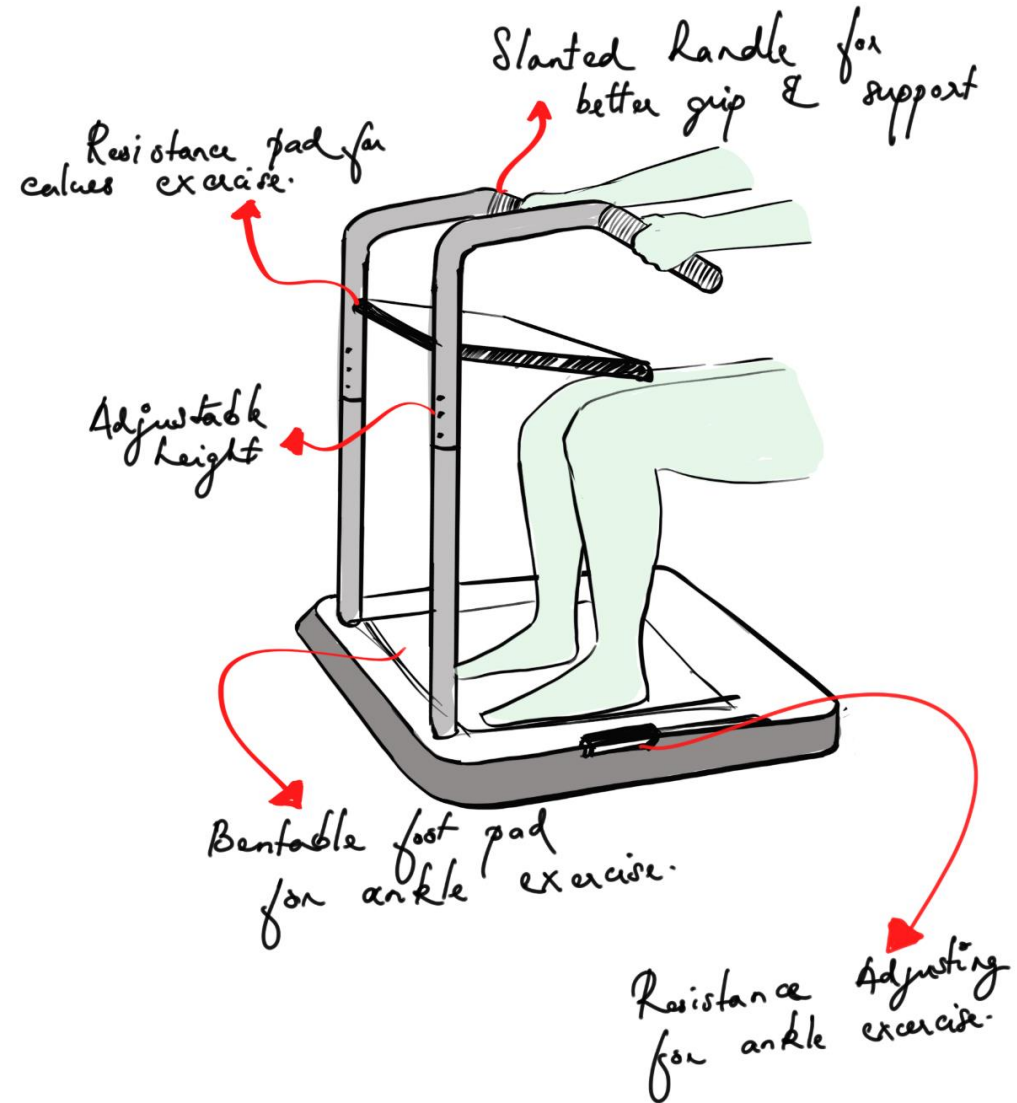


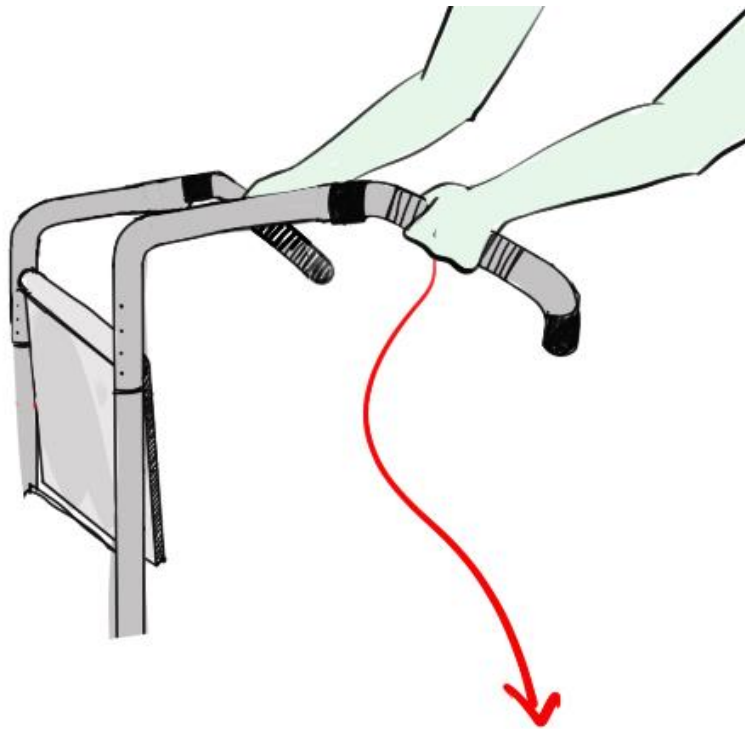
Ideations



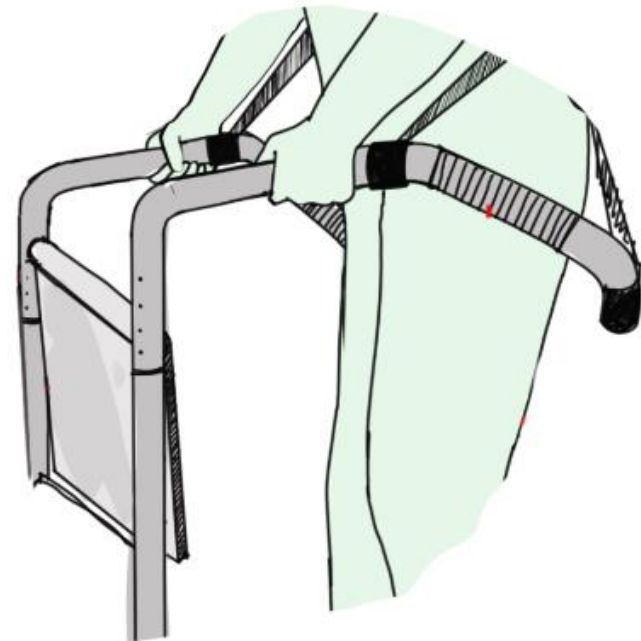
24. Concept 1

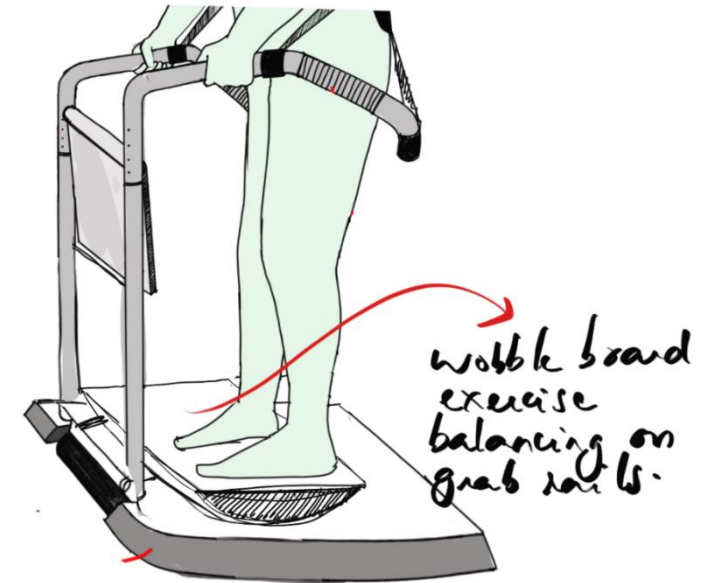
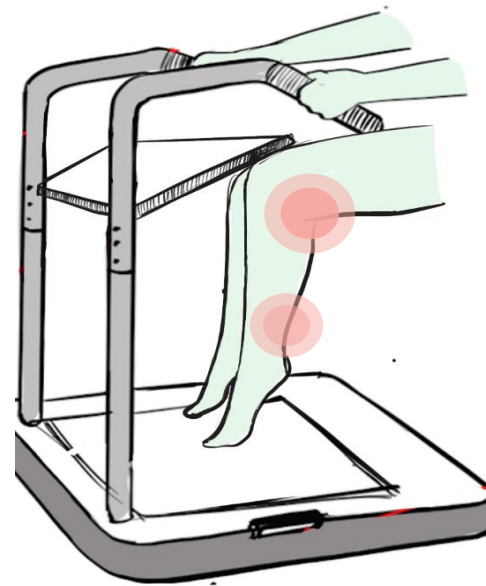
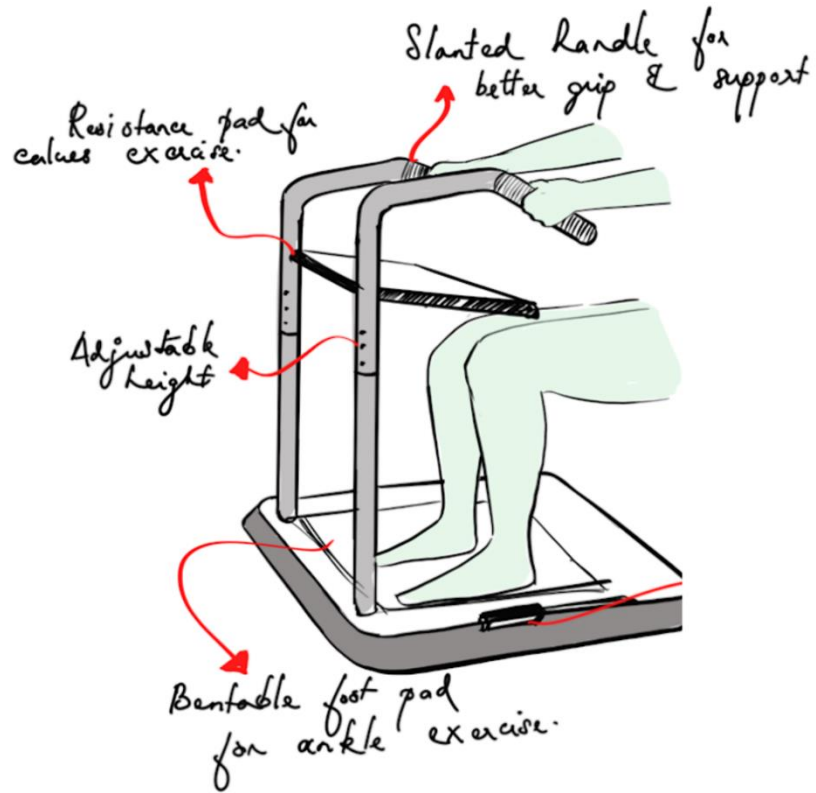
Equipment with frame activating calf muscle and ankle





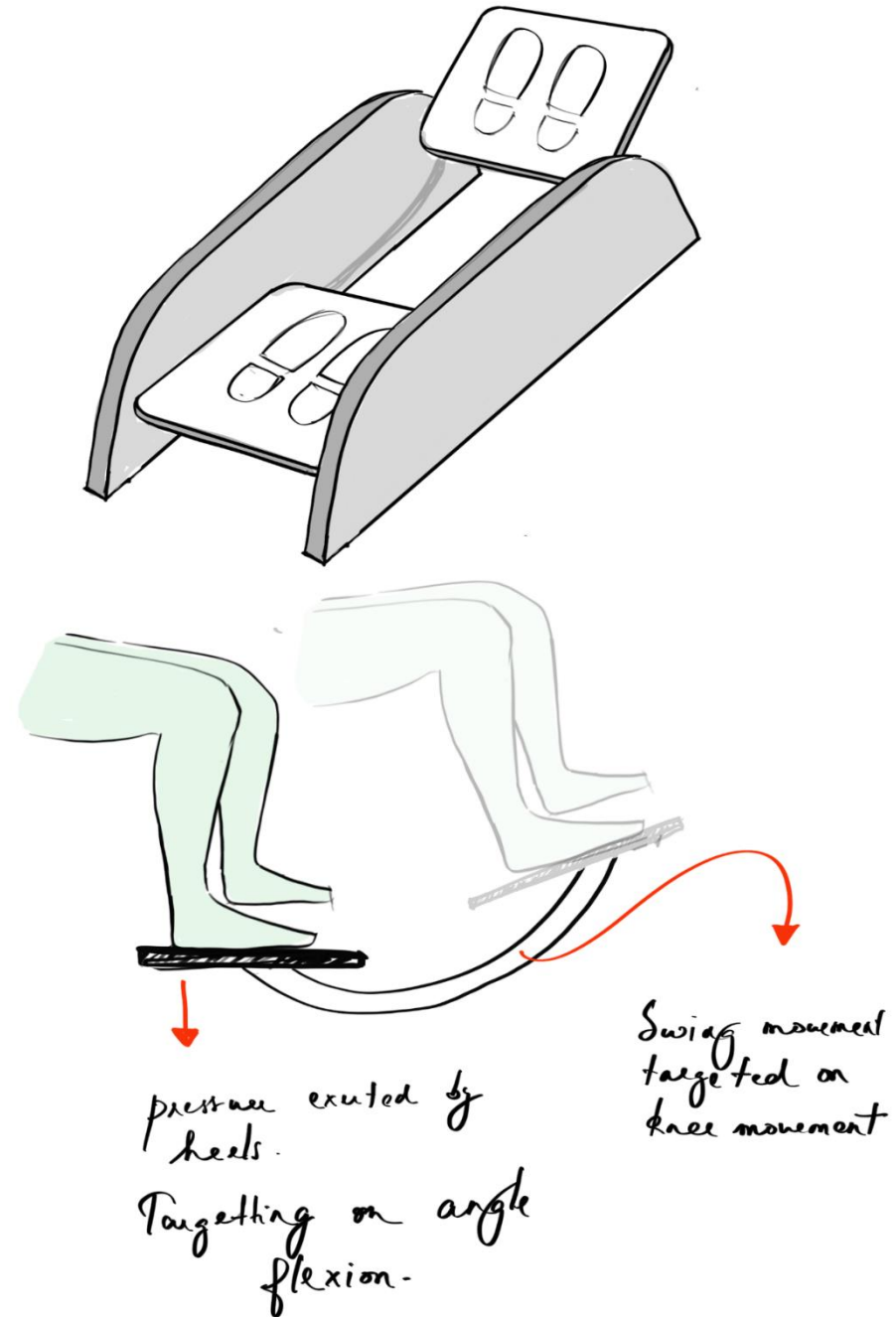
Slanted handle to help the patient get up and use the equipment

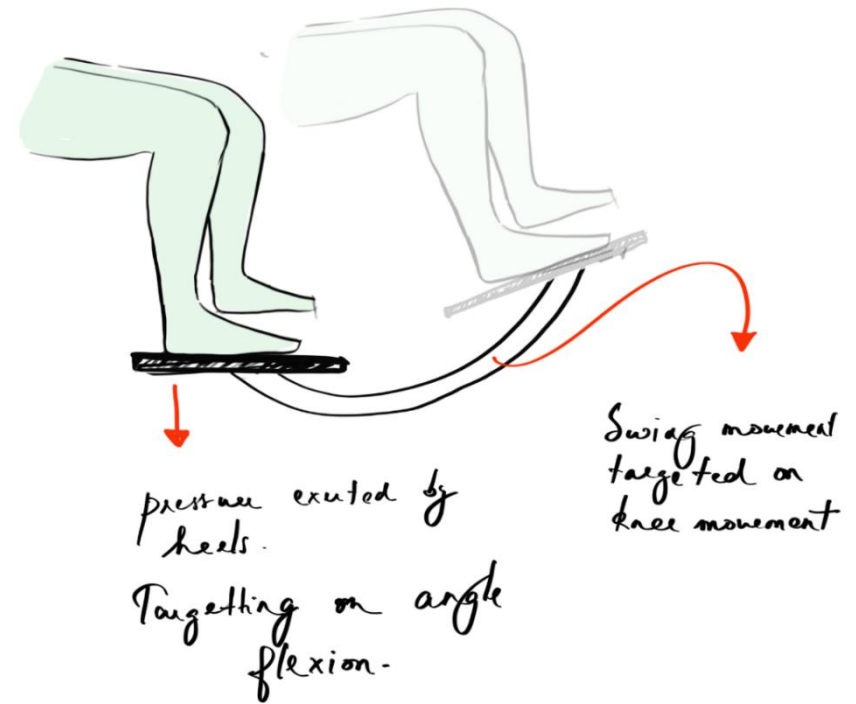
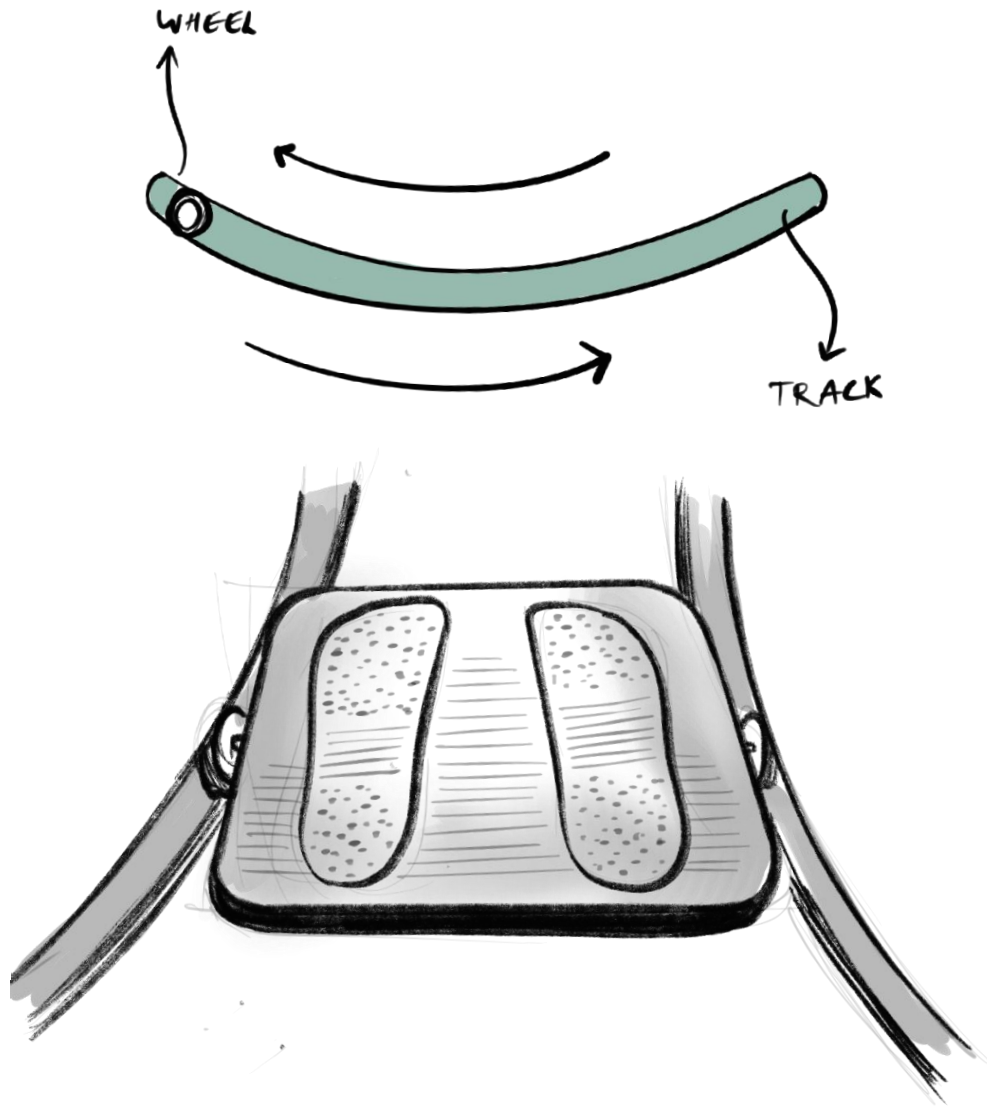


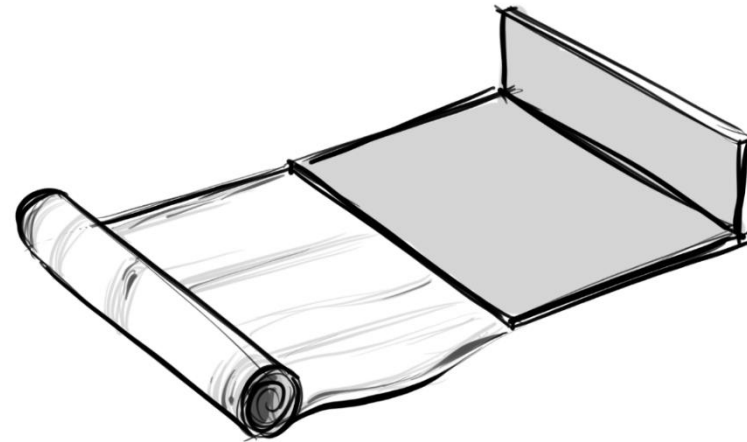


25. Concept 2

Leg swing motion with ankle exerciser



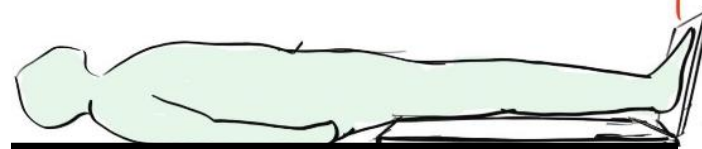
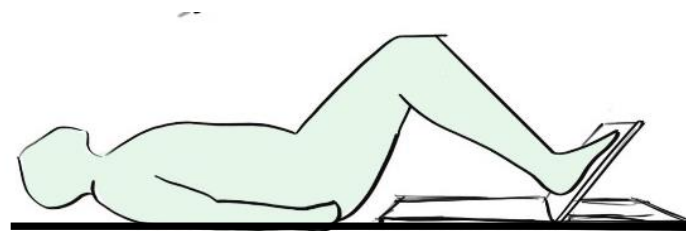




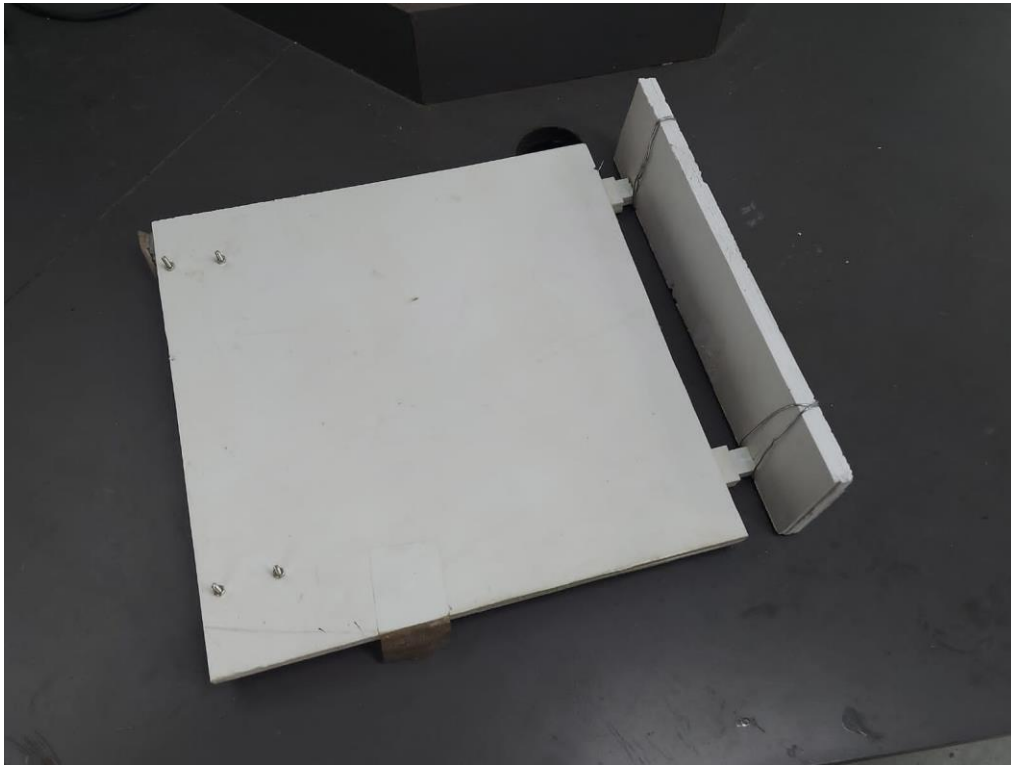
Mat rolled up for storage

26. Concept 3

Body weight supported equipment
Which will activate calf muscle and
knee



Stretching calves and
knee workout





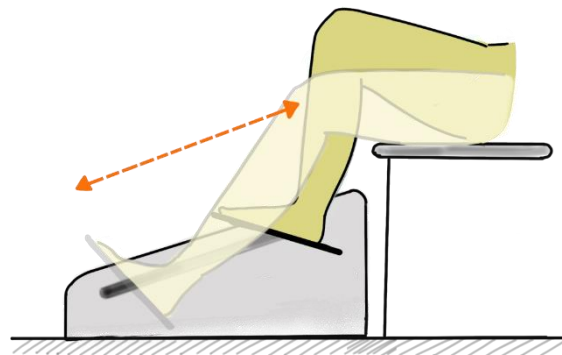
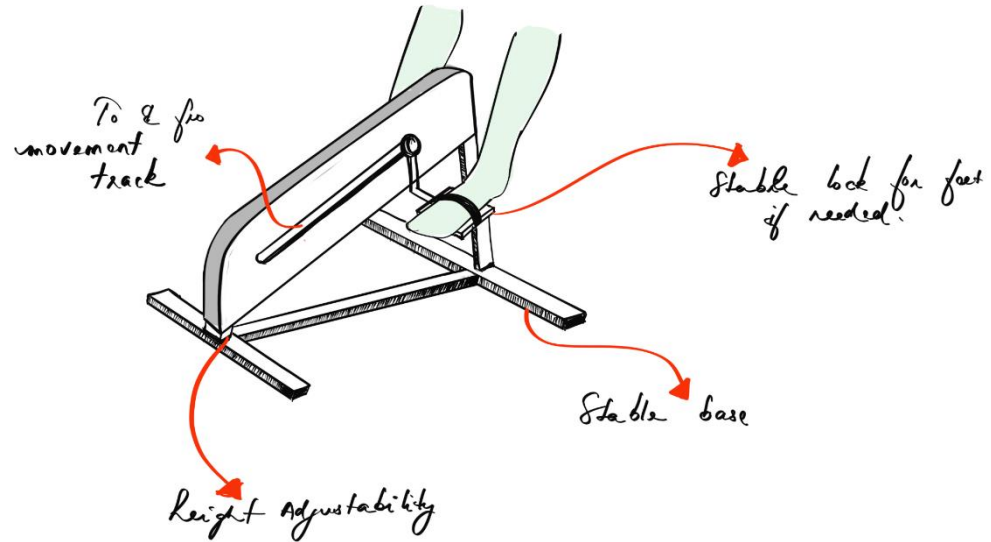
Pushing the foot-rest exercising



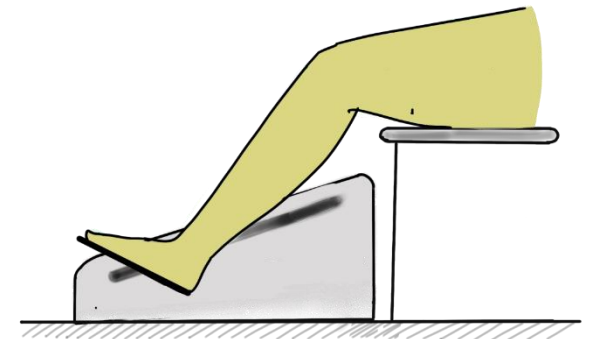
Stretched position

27. Concept 4

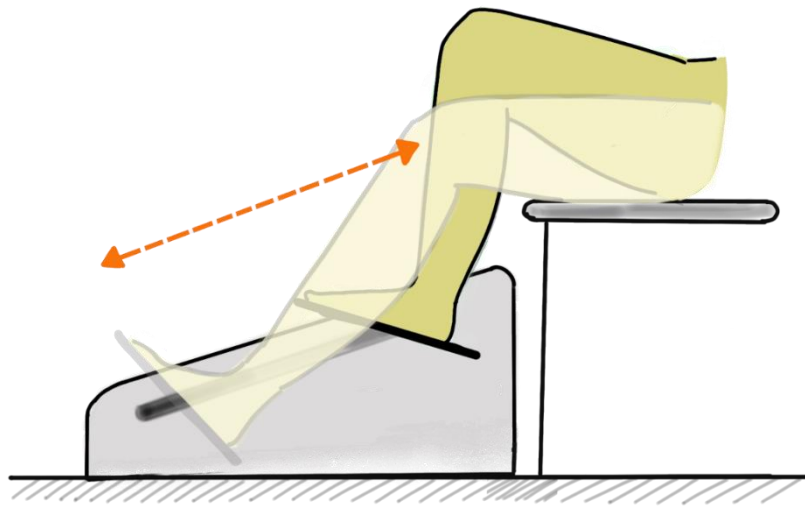
To and fro motion of leg activating calf and ankle



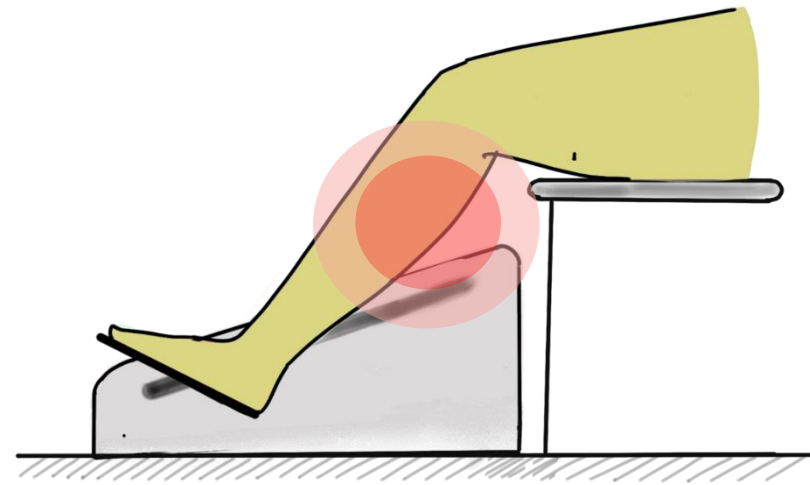
Resting position to stretched position



Stretched position activating calf muscles

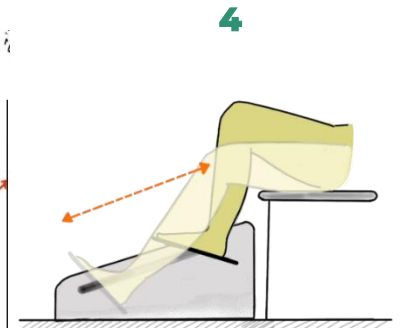
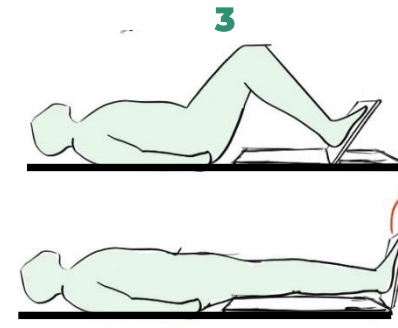
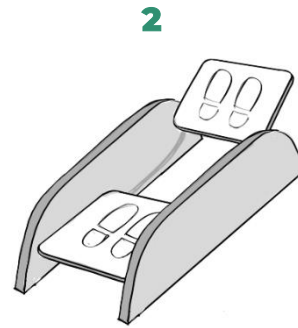
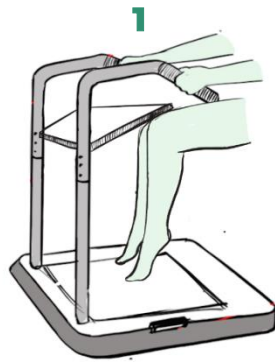


Resting position to stretched position



Stretched position activating calf muscles

28. Initial Evaluation



Exercises concentrated	Calf exercise and ankle dorsiflexion	6	Calf exercise	4	Calf exercise	4	Calf exercise, ankle dorsiflexion	6
Activated muscles	Calf and ankle	6	Calf ,medium work on knee ankle dorsiflexion not included, just for calf muscle	5	Calf	4	Calf , medium work on knee ankle dorsiflexion	5
Ease of use	Sitting and using, need supervision while doing	4	Sitting and using, difficult to swing, Don't need supervision	7	Lying down on bed and using, need supervision	4	Sitting and using, Don't need supervision	7
Storage –convenience	Bulky	3	compact	6	Compact, rolling mat and keeping	6	compact	6
Safety	Better safety because of the frame	6	Better safety	6	The footrest can hit back, Mat will move	3	Better safety	6
Progressive action	Adjusting resistance on knee pad	8	Adjusting resistance on pad	8	Adjusting resistance on footrest	8	Adjusting resistance on pedal movement	8
Total		33		36		29		38

29. Concept 4

Rig

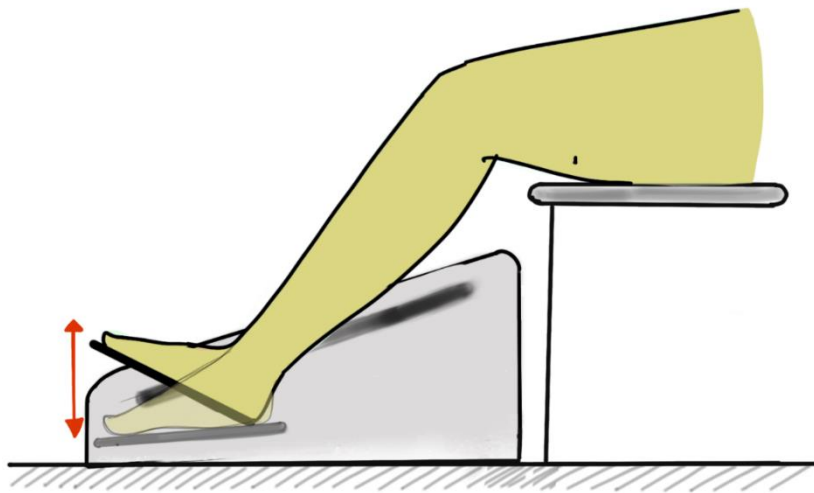


Product frame

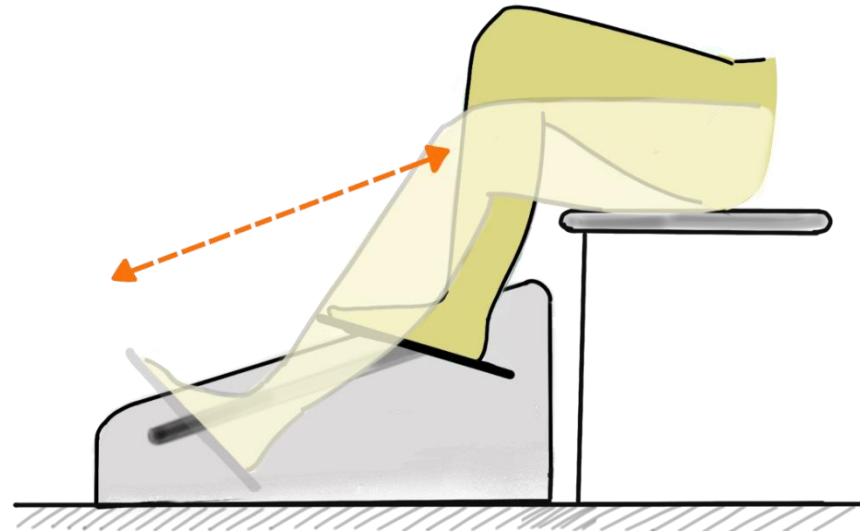


Cushioned pedal for exercise

Exercises concentrated



Ankle dorsiflexion



Calf exercise

Working



To and fro motion of the pedal

Resting position



Stretched position



Resistance in stretching

Activated muscles



Calves



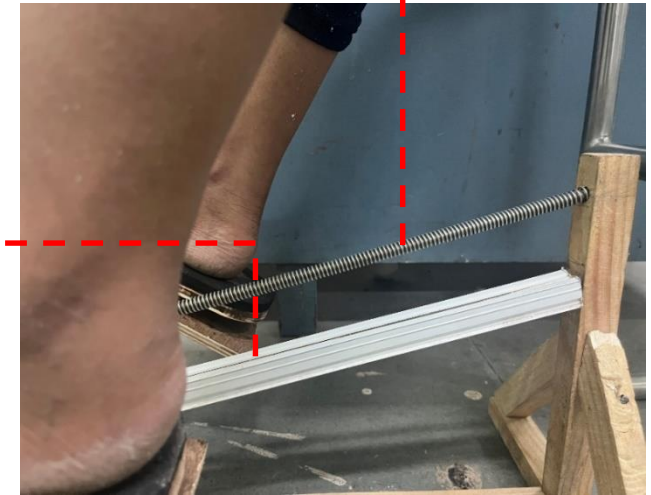
Knee



Ankle

Stable track for spring
to resist side wise movements

Introduce a double-track system
for pedal movement, engineered
to prevent any unintended pedal
motion.



29.1. Improvements

- Better stability of the product
- Non slippery base
- Try to Incorporate more exercise
- Explore other mechanism for to and fro motion

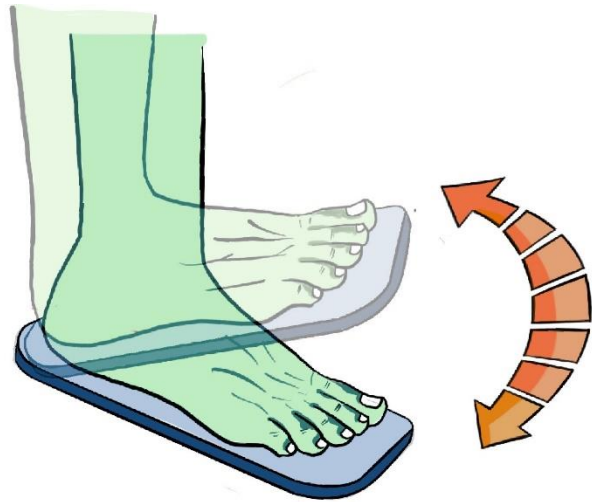
Adequate space and
resting for feet

More angle flexion for
the feet pad

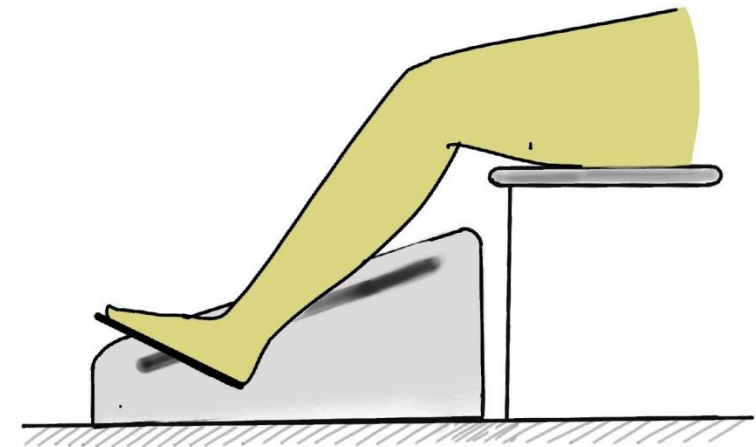
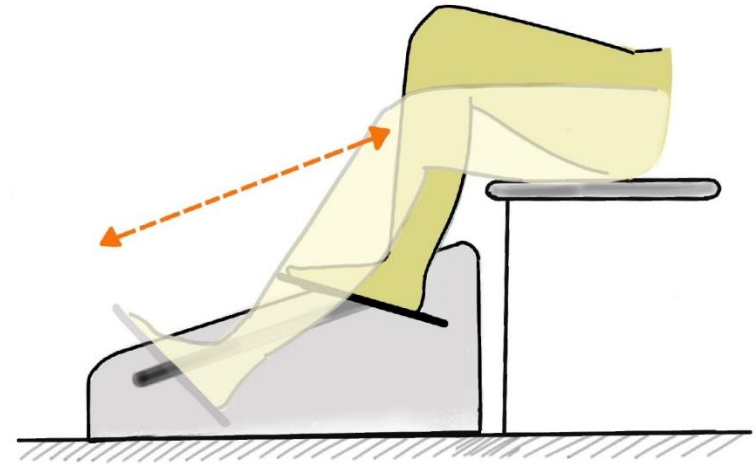
More stroke length



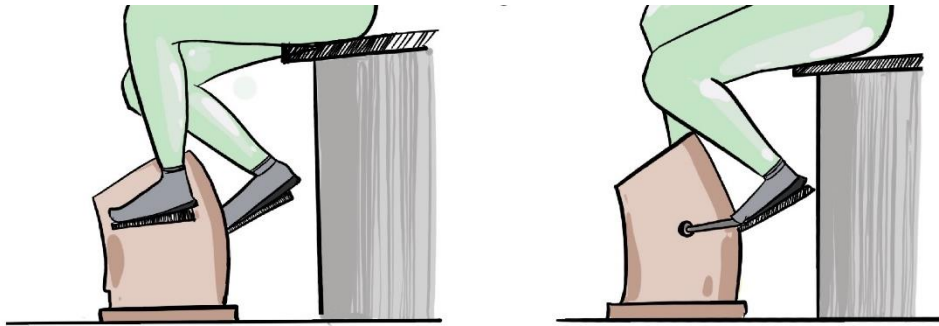
30. Targeting exercises



Ankle dorsiflexion

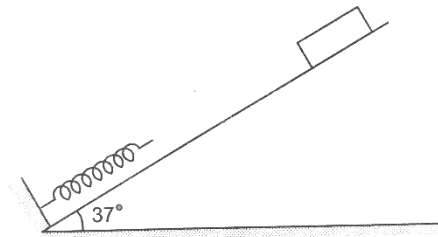
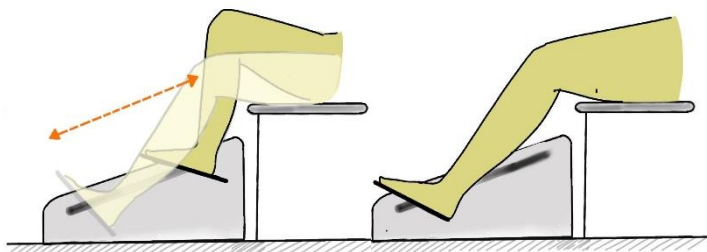
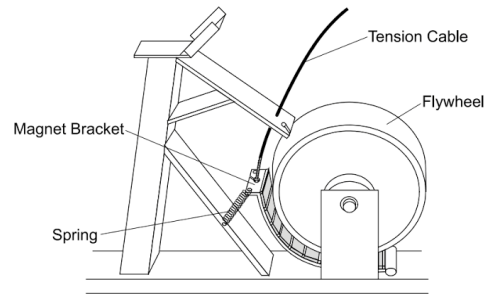
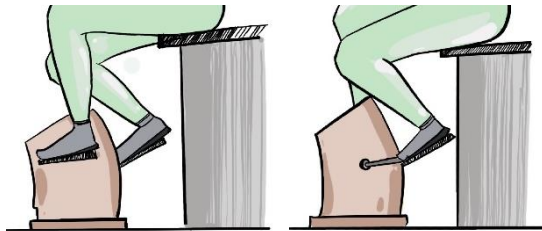
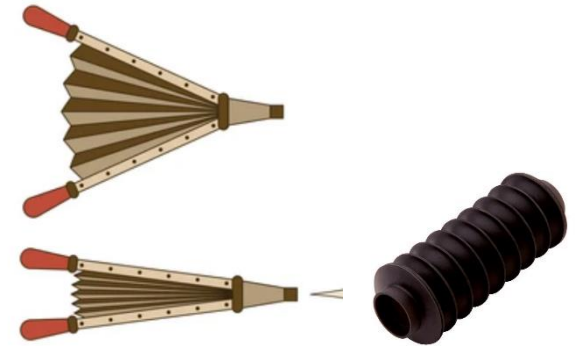
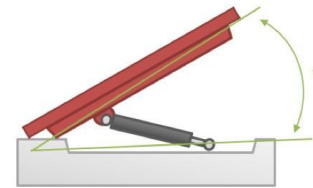
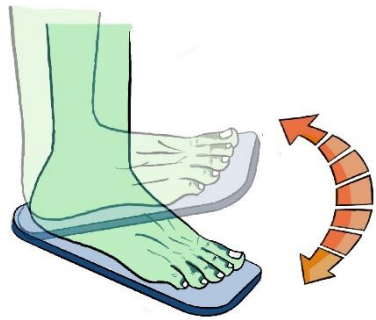


To and Fro



Cycling

31. Movements and possible mechanisms



32. Equipment study



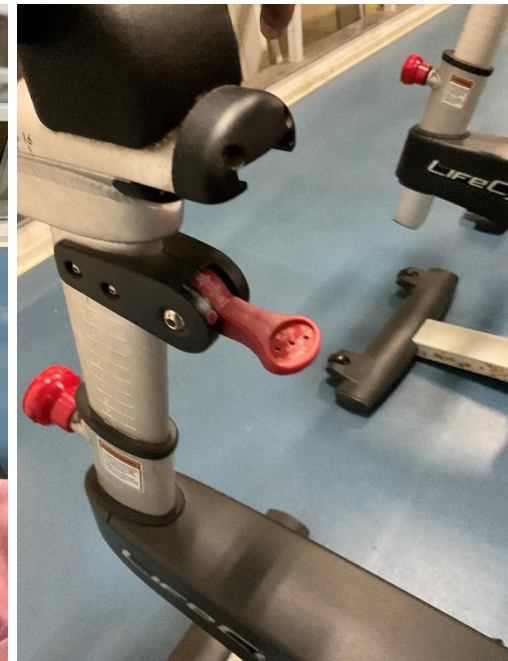
Reachability of the handle



Adjusting Knob

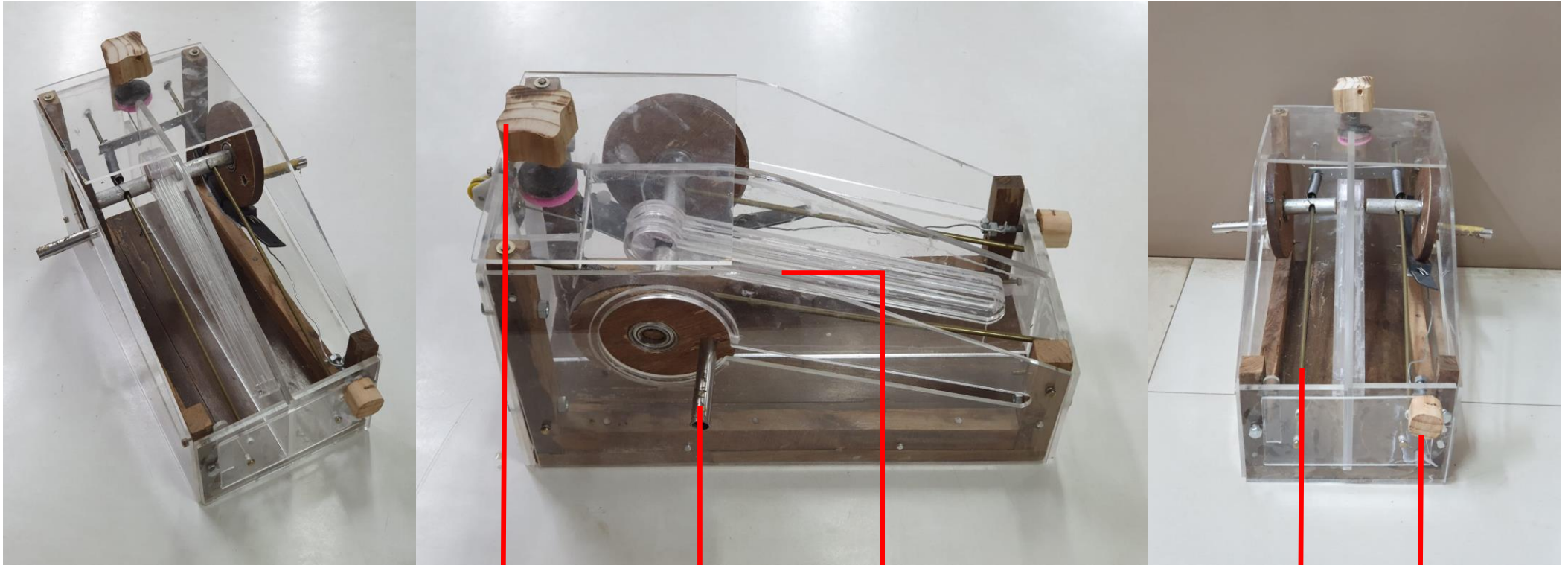


Resistance adjustment-
Reachability



Cogwheel adjustment for
cycling resistance

34. Rig 2



Knob 1

Major track

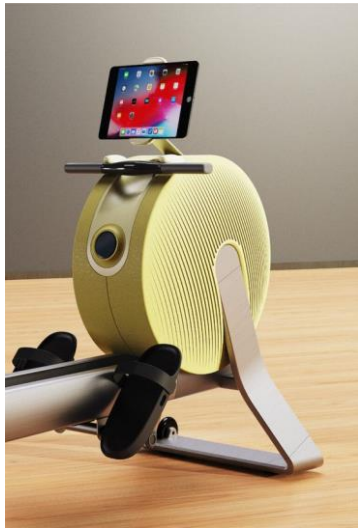
Wheel with pedal

Guide for resistance

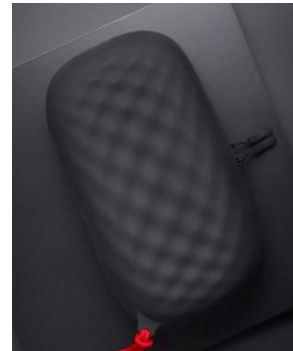
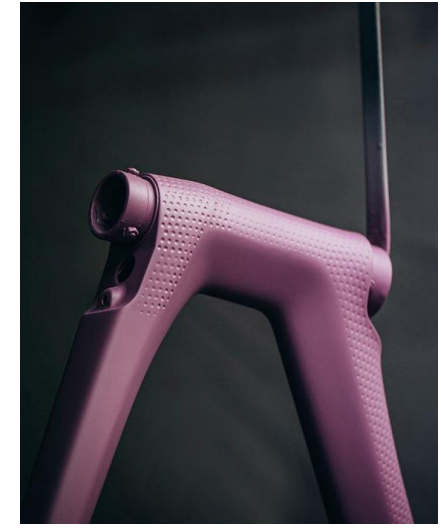
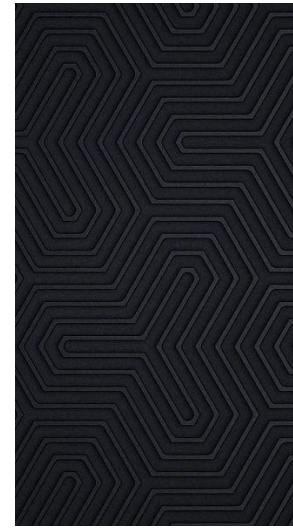
Knob 2

33. Moodboard

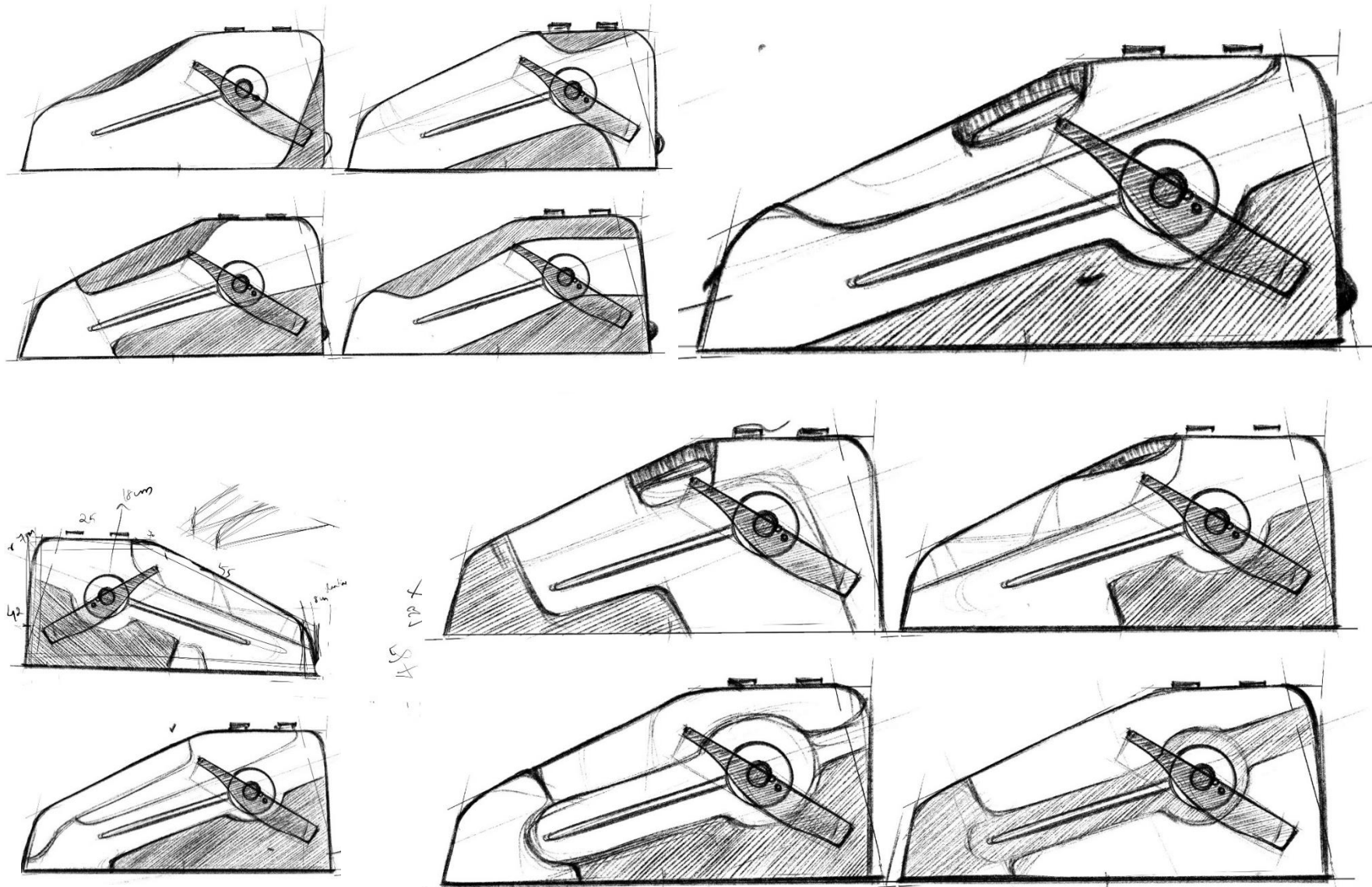
Form



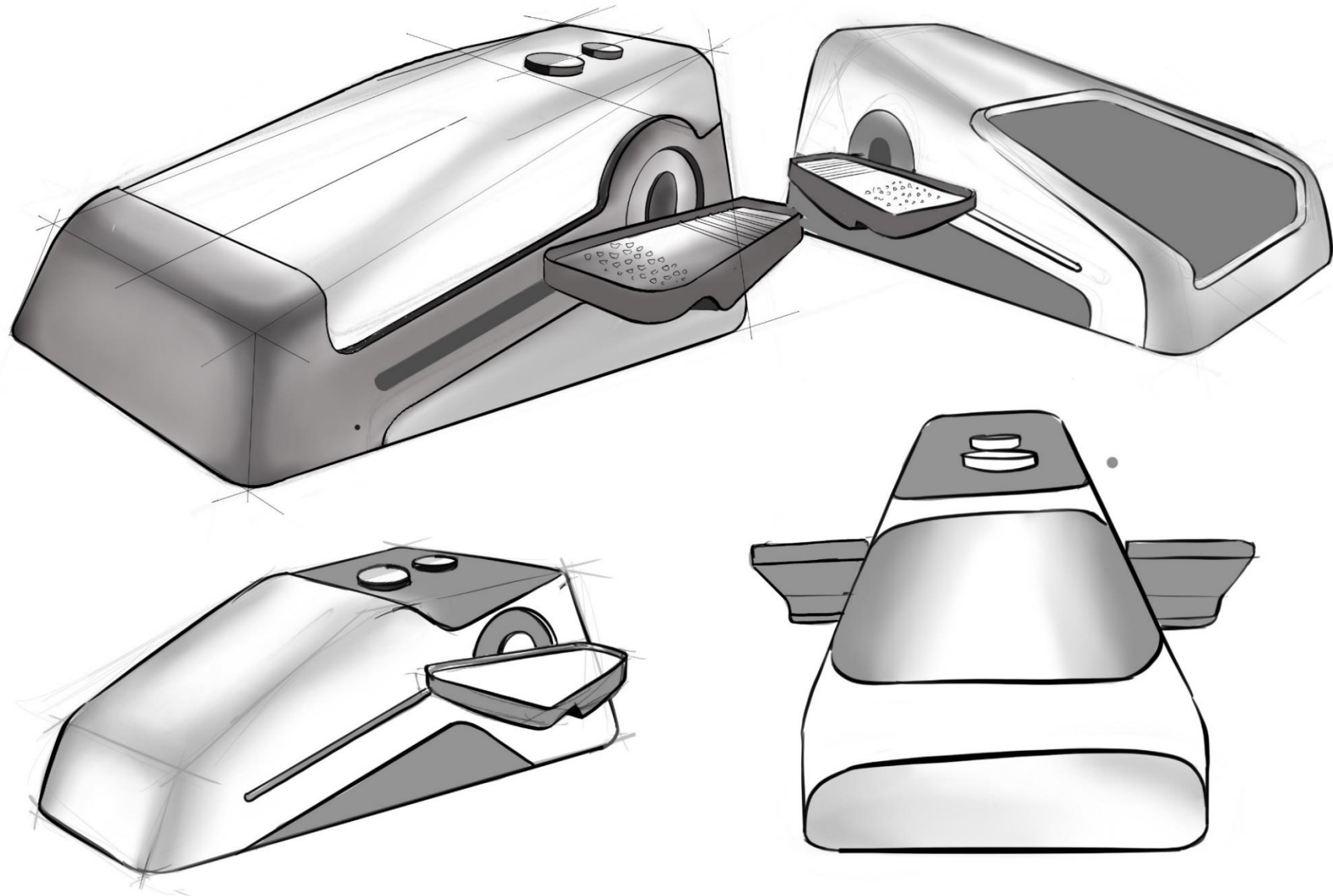
Texture



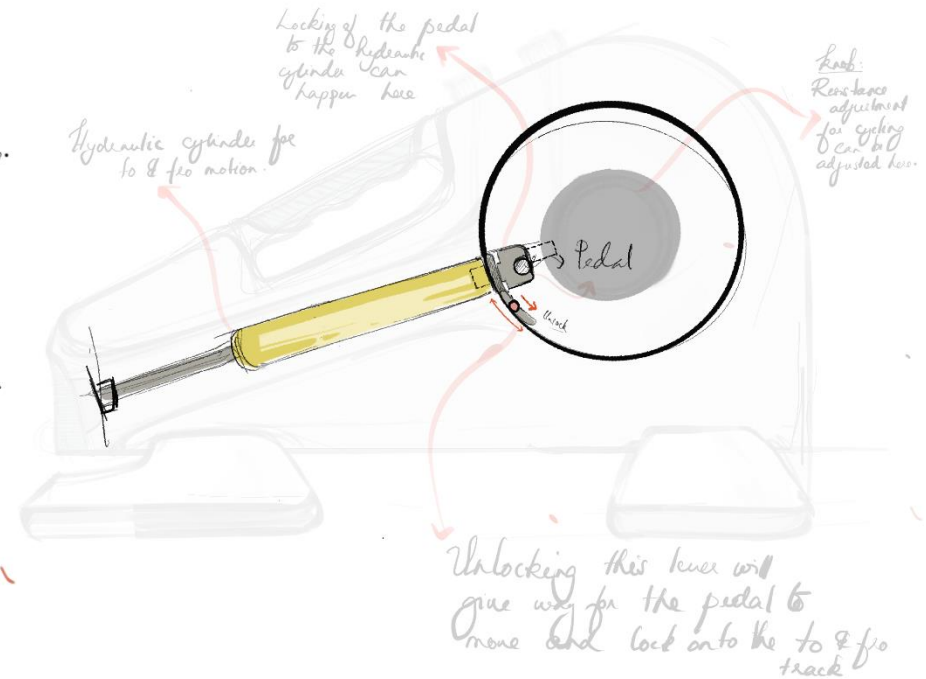
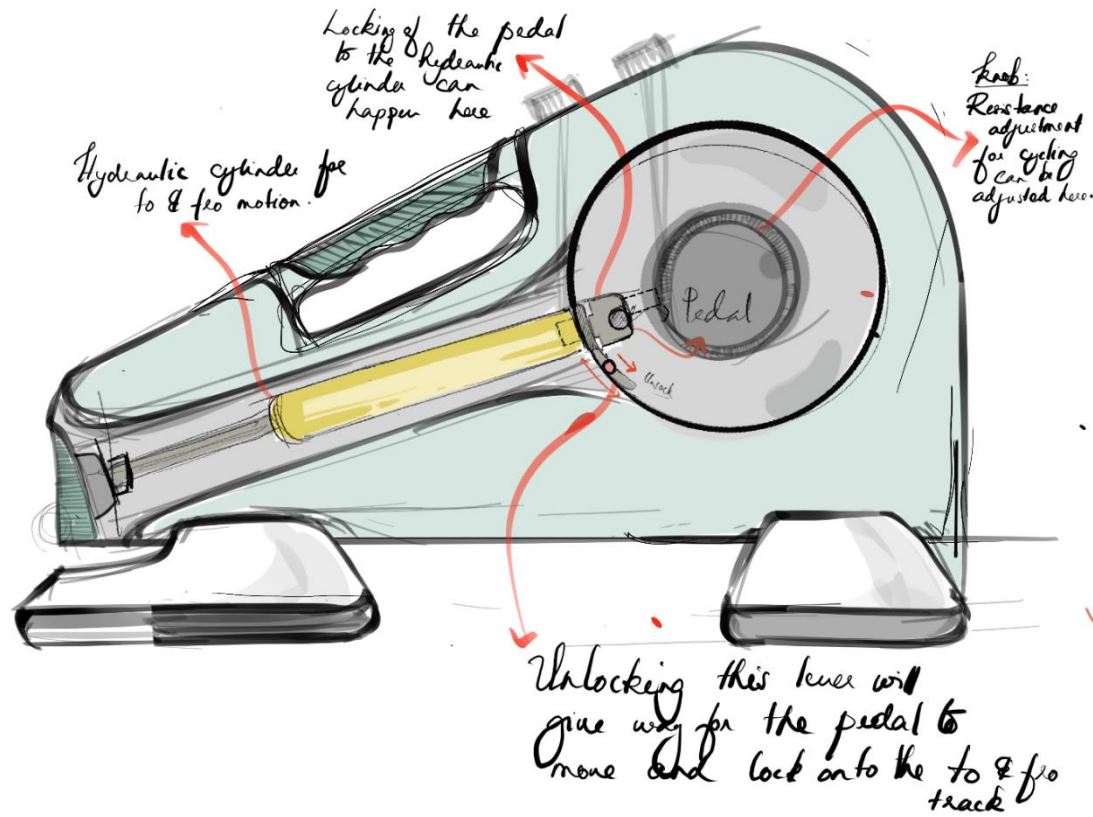
34. Form explorations



34. Form explorations



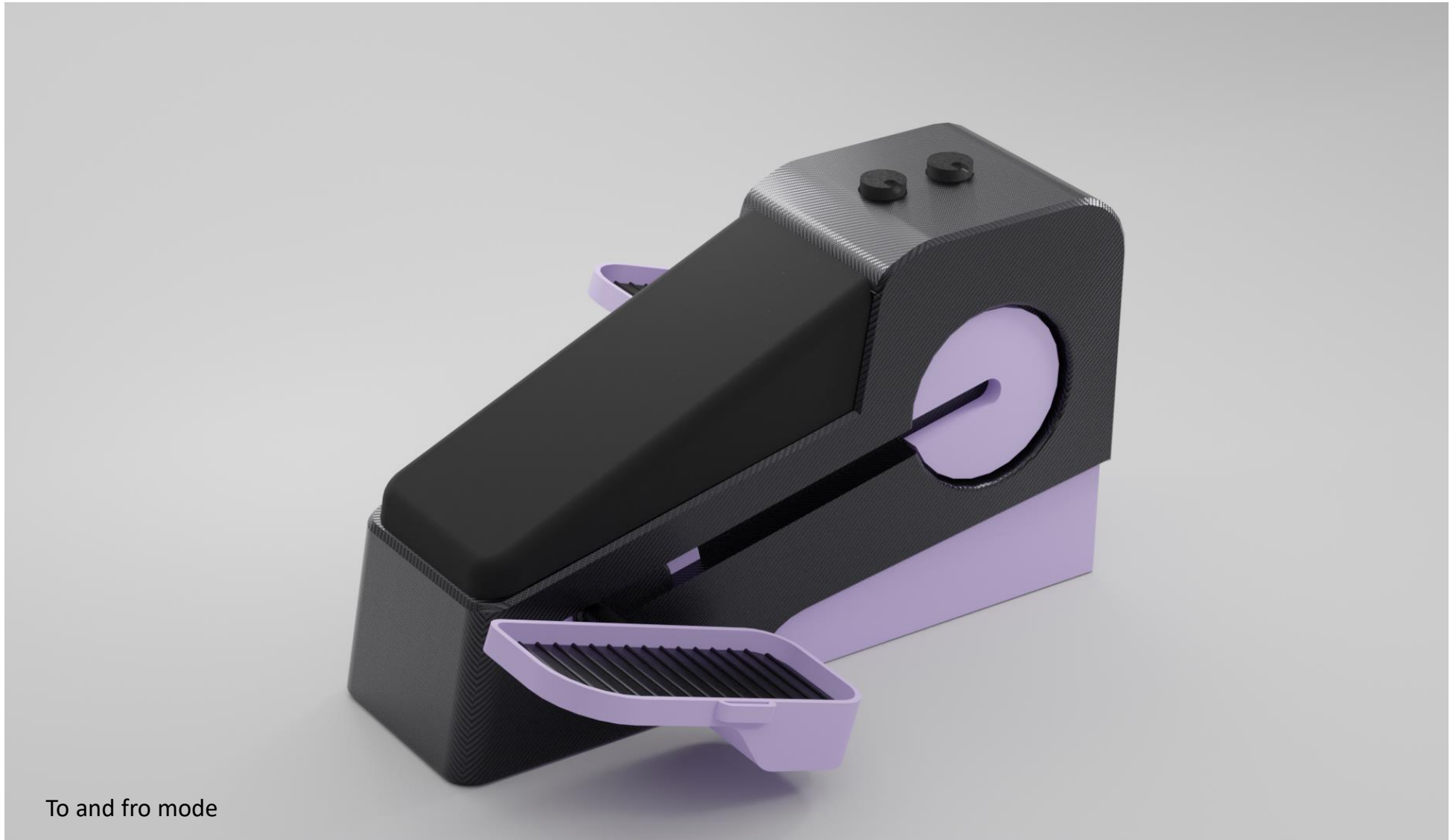
Product visualization



35. Final product



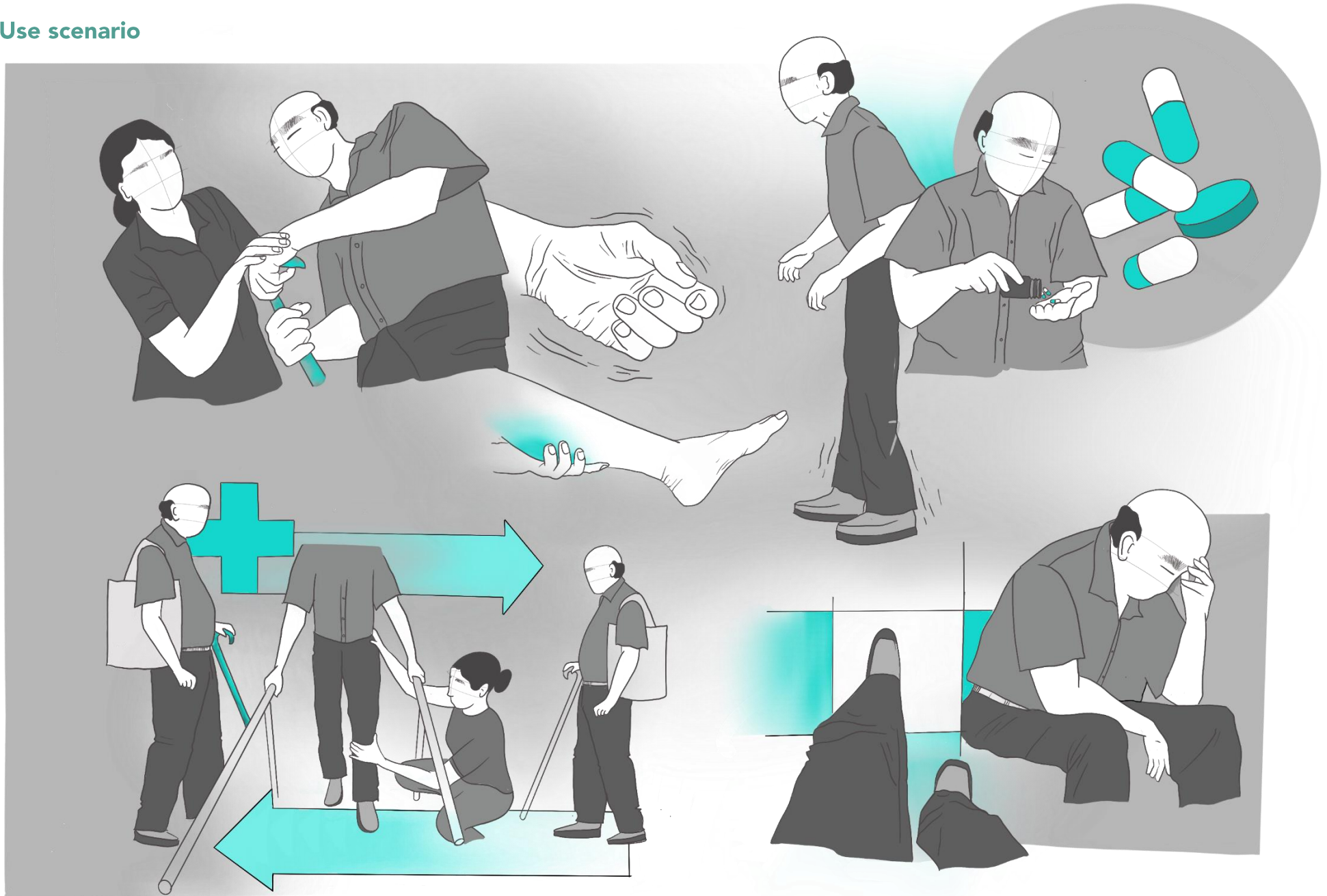
34. Final product

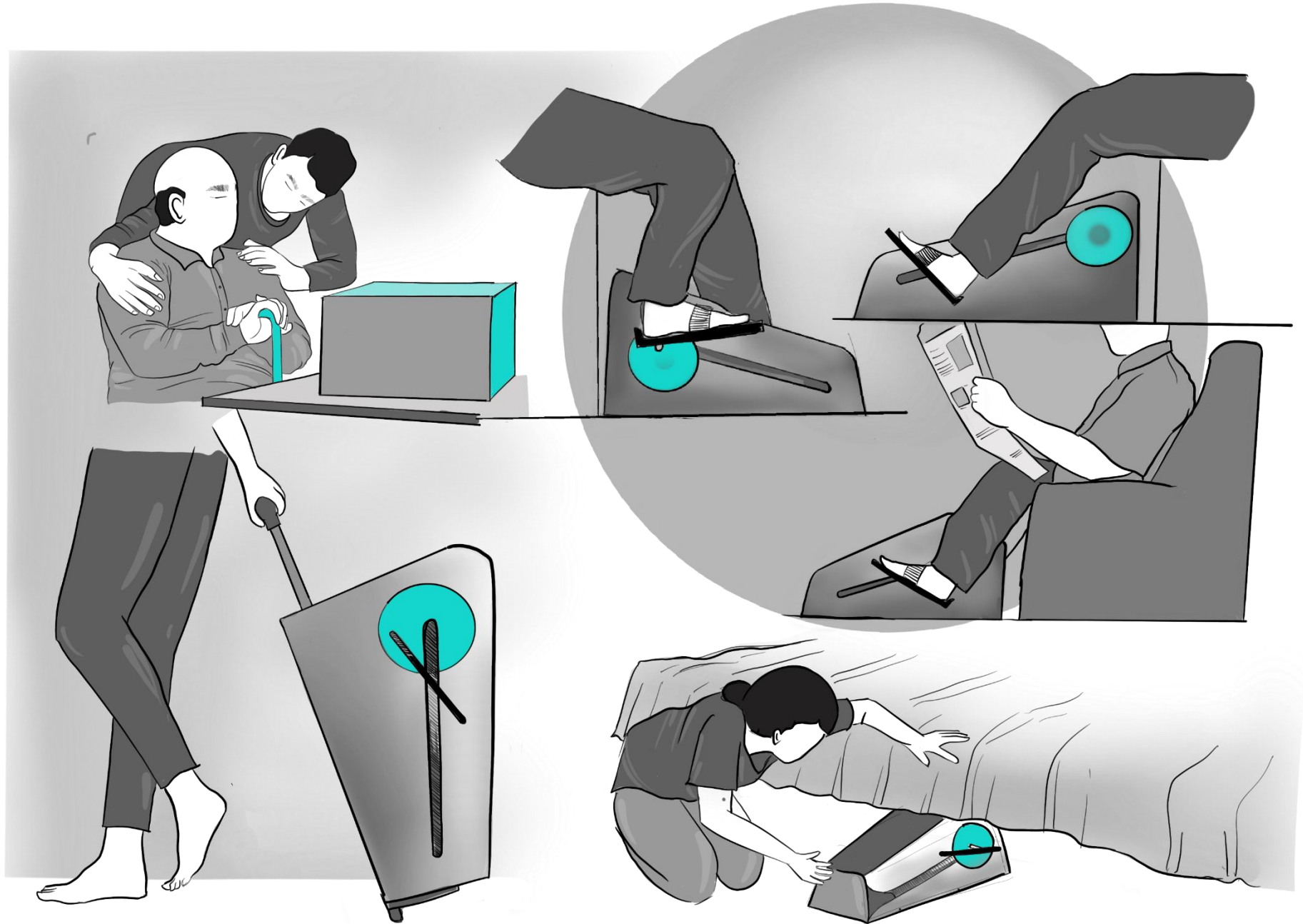


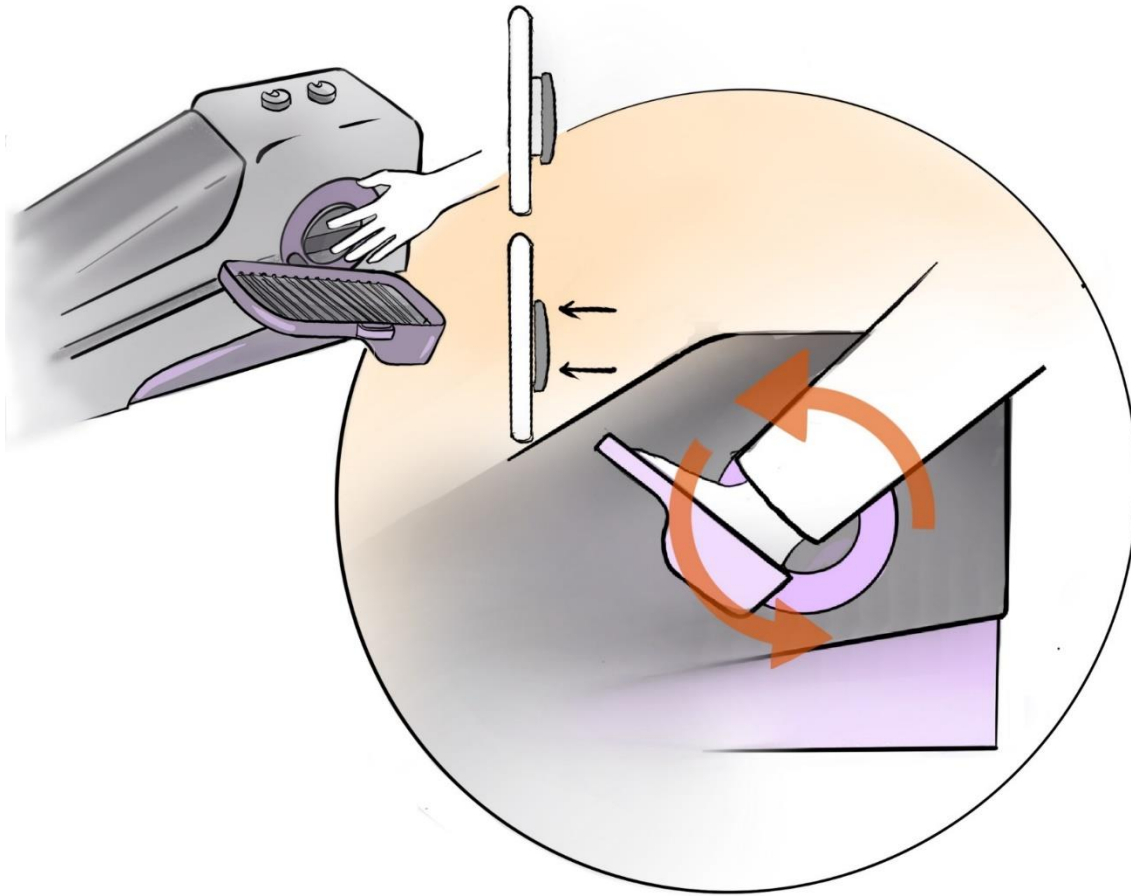
To and fro mode



Use scenario

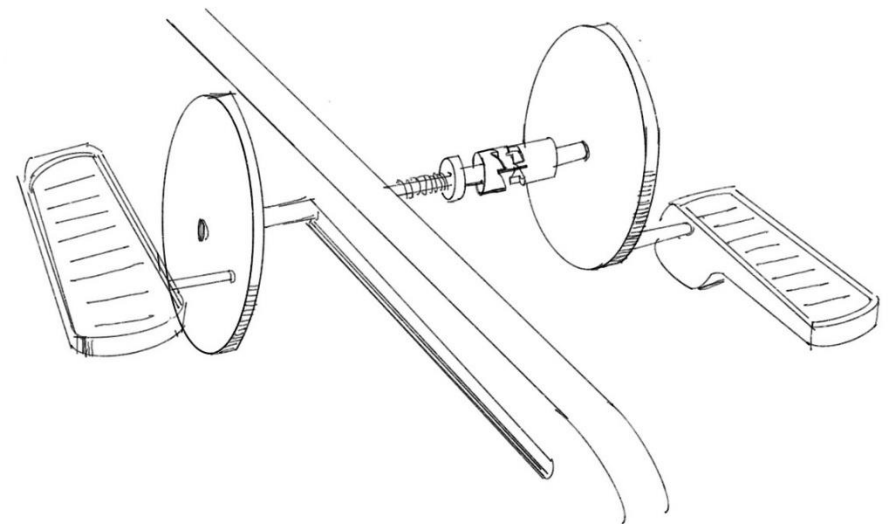




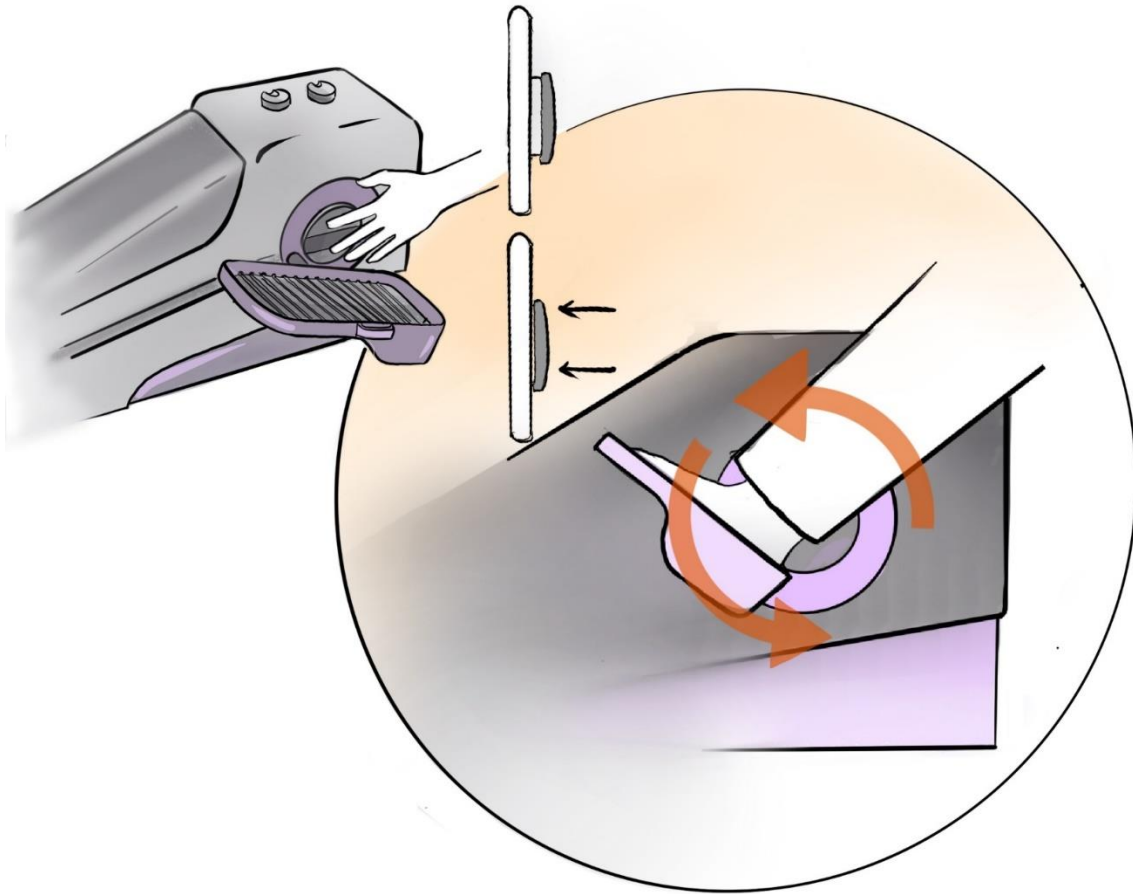


Use modes

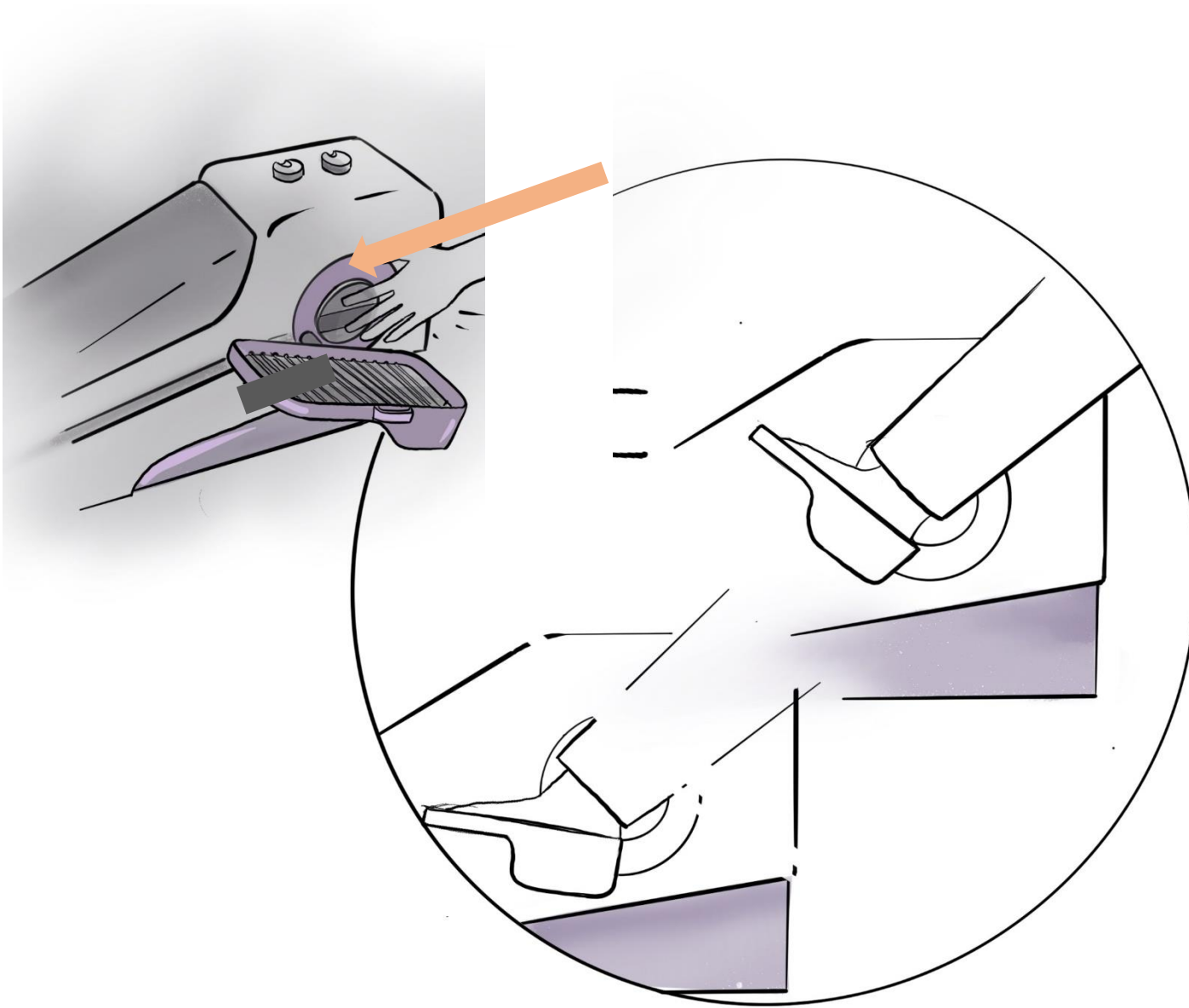
Mode - Cycling



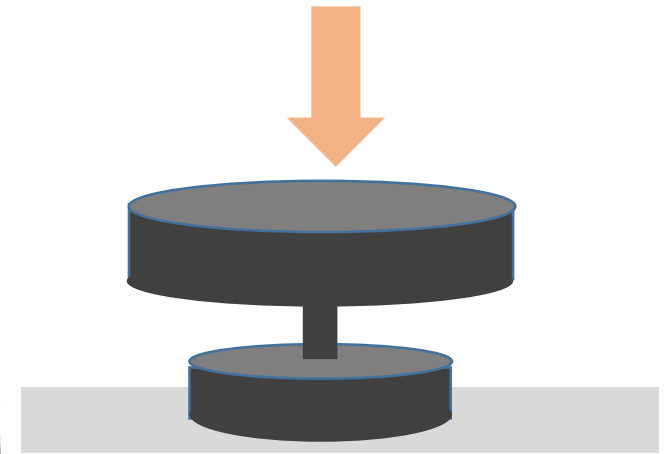
Click pen mechanism to unlock pedal in alternate position for cycling



Mode 3- Ankle dorsiflexion



Mode 2 - Cycling

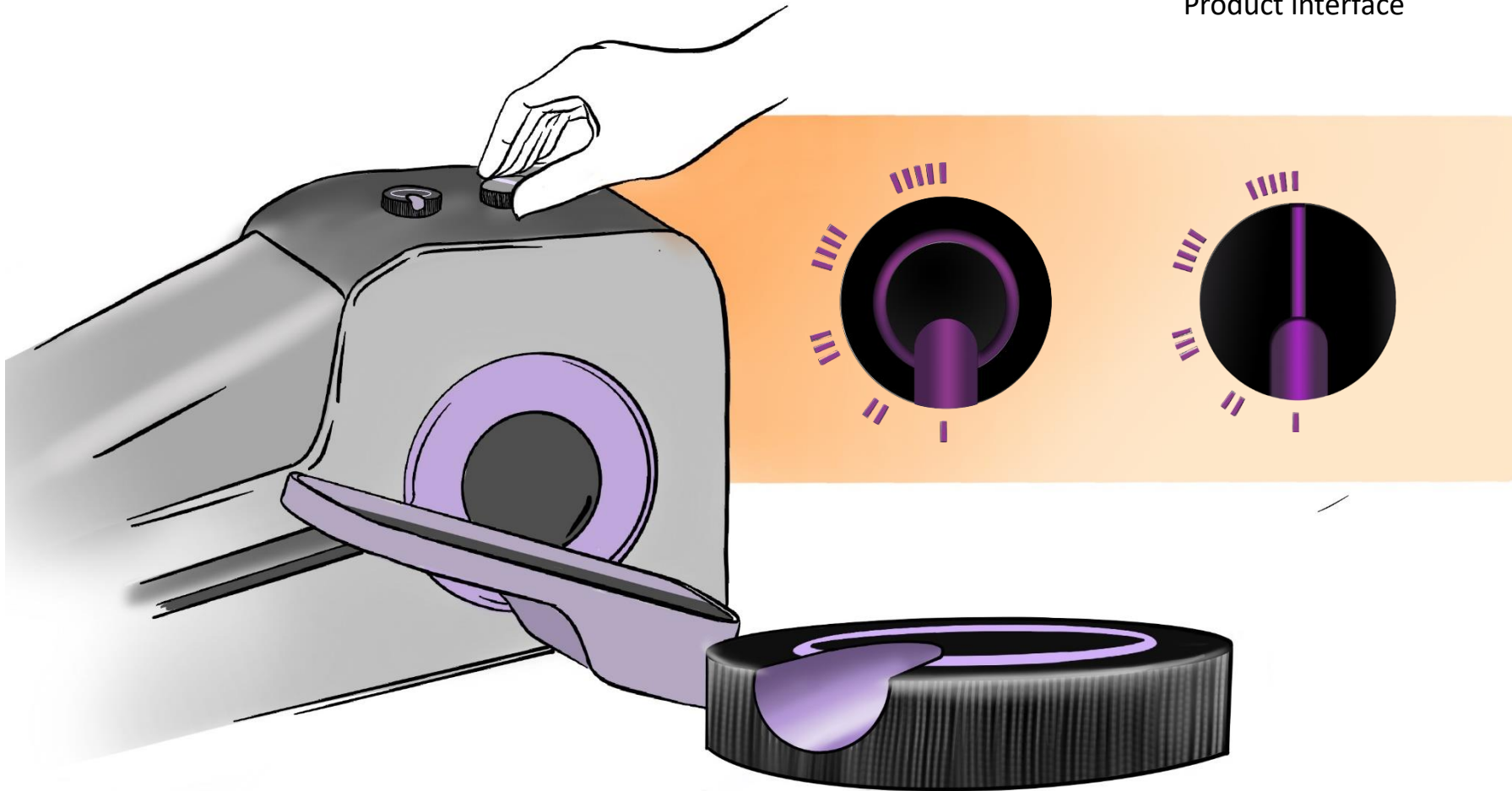


Release lock for one leg to and fro



Slide in to lock in track

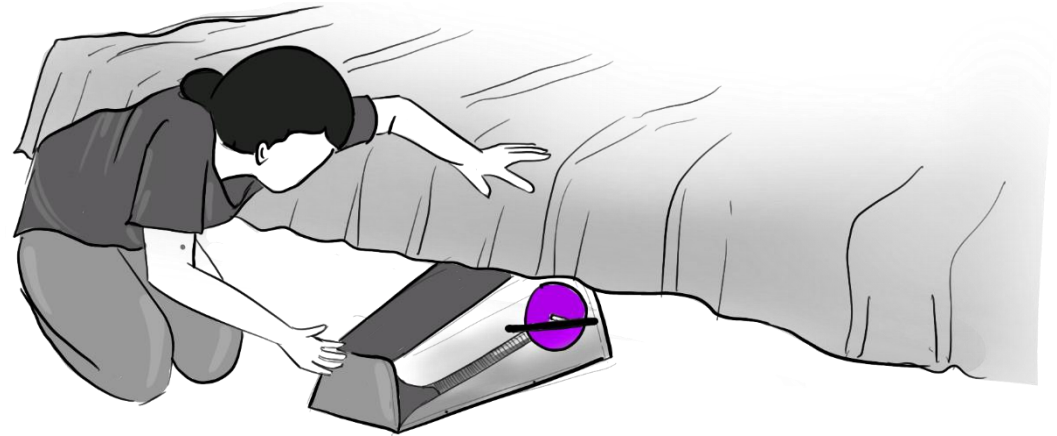
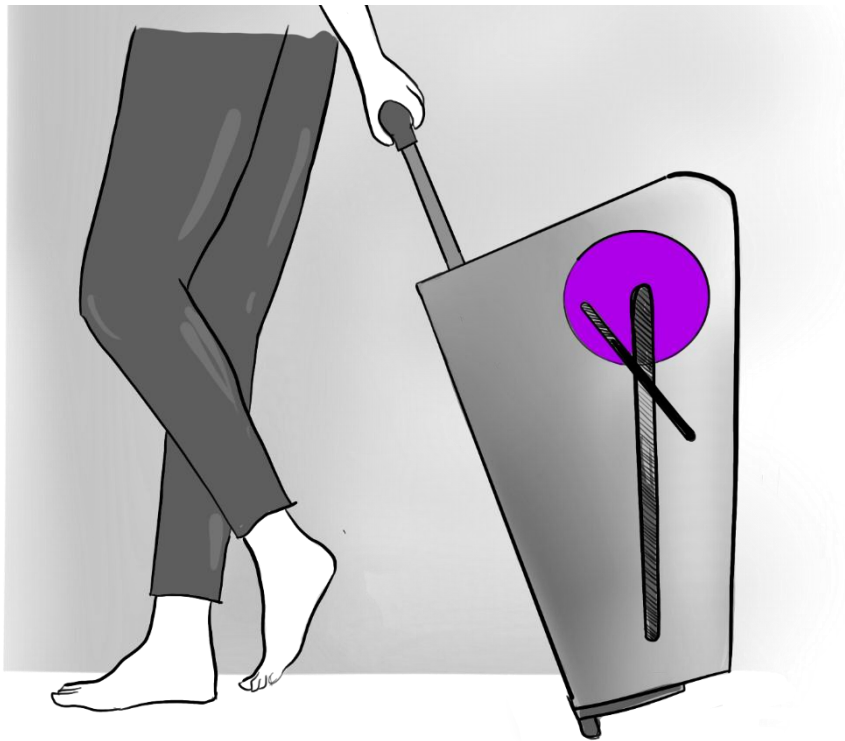
Product interface







Storage and usage



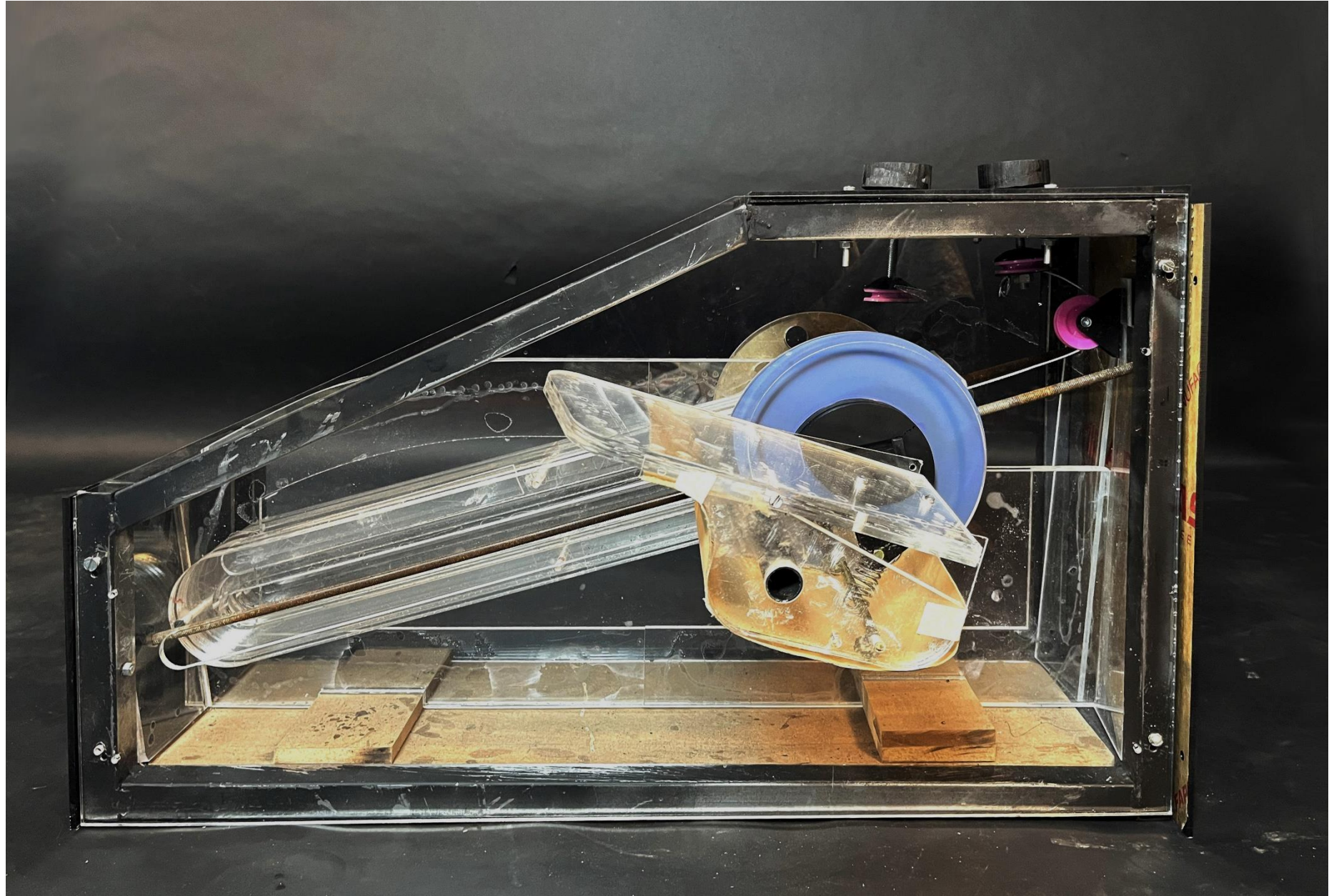
36. Prototyping

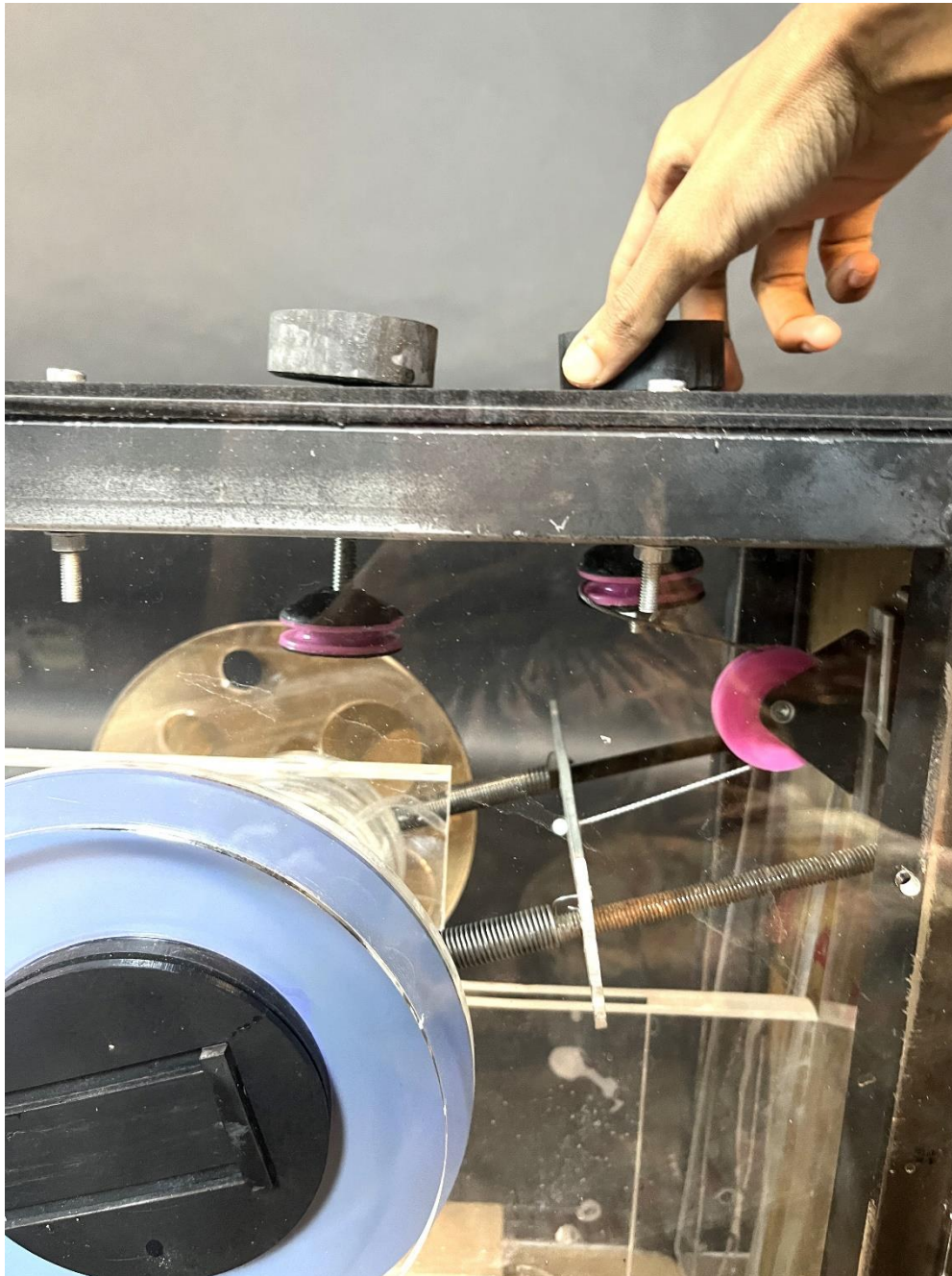


Cycling position



Locked for To & Fro motion





Resistance adjustment for To and Fro exercise

37.Future scope of product

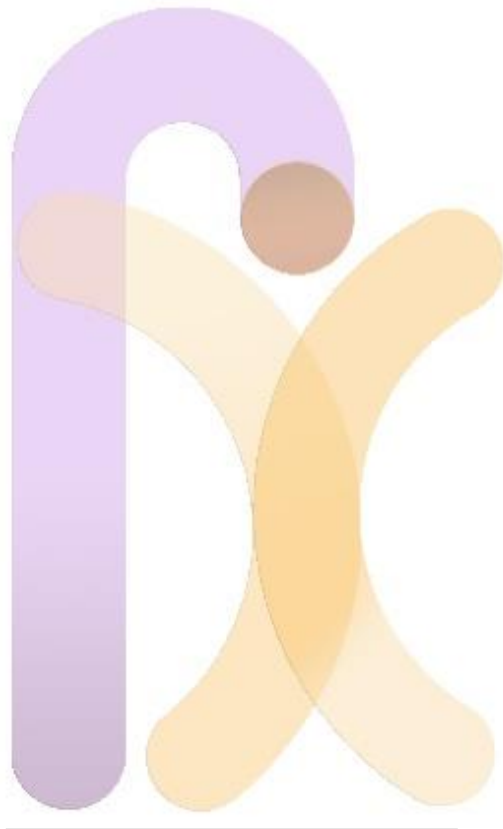
High end versions of the same product –

- Motor based,
- Electrical
- Tracking app
- **Interactive interfaces**
- Engaging games along with exercise

Feedback from jurors

Try to make the product Knock down so that it:

- Cut down cost
- Easy transportation because its little bulky
- Easy assembling and storing



flexo

Thank you