PORTABILITY AND FLEXIBILITY OF PHYSIOTHERAPY TOOLS FOR REHABILITATION OF PEOPLE WITH OBESITY

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ABSTRACT

The obesity rate in Malaysia is kept on increasing year by year. The causes for this issue are including unhealthy food intake and unhealthy lifestyle. As the obesity issues in Malaysia worsen, it leads to other problem such as diabetes, heart attack, stroke and also others physical problem. One of it is concerning on physical condition of the ankle. The ankle is the most important parts of a human structure that will affect human body posture. This means that activities were done are heavily influence by ankle condition leads to inefficiency of job performance. Physiotherapy tools are important for the rehabilitation process. The rehabilitation process is known as a healing process, which is essential in ensuring the improvement of health and physical condition of a patient, especially with obesity. Physiotherapist treatment is essential to ensure the effectiveness of rehabilitation process. Therefore, this research aims to understand the portability and flexibility of physiotherapy tools for people with obesity especially in dealing with their job performance. The objective of this study is to identify the physiotherapy tools in the rehabilitation process and to determine the portability and flexibility of the physiotherapy tools for the rehabilitation. Research methods were employed during the process of this study, which includes literature review, product line-up and interviews From this research, portability, and flexibility of the physiotherapy tools for the rehabilitation can help the patient to conduct self-rehab at their homes thus boosting their healthy lifestyle. Based on the findings of this study, a new physiotherapy tools need recommended providing an excellent portability and flexibility in terms of the physiotherapy tools for obese patients

Keywords: Obesity, physiotherapy tool, PwDs, rehabilitation

INTRODUCTION

The prevalence of obesity in the world has increased over the past year. Despite all the mass public awareness campaign done throughout media about the benefit of healthy life, obesity rate keep on the upsurge, and this has led to a severe health problem (Shaima Kabir et.all, 2014). Obesity issue is an uprising issue that becomes a prominent concern to health institution as it also can worsening one's current health. Obese people tend to exposed to a health problem such as ankle and back pain twice compared to individuals with average weight.

Obese people body condition is obviously different from individuals with healthy weight; this leads to a restriction in their physical movement; tend to experience an ankle pain because of the amount of weight that forced upon the feet (Metcalf, 2009). An unhealthy ankle leads to poor life quality due to the ankle act as a shock absorber for the entire body. This condition has led the obese people to be not compatible with a full-time physical activity. Current personal rehabilitation tools offered in the market is not fully supporting the whole recovering process for the obese people. Therefore, this research aims to understand the portability and flexibility of rehabilitation tools for people with obesity especially in dealing with their job performance. The objective of this study is to identify the physiotherapy tools in the rehabilitation process and to determine the portability and flexibility of the physiotherapy tools for the rehabilitation.

LIFESTYLE OF OBESE PEOPLE

Jefford (2010) stated that one of most common cause of obesity is because of unhealthy food intake. Urbanization cause changes in society lifestyle, junk food becoming more prominent as it is easy and fast to serve. This is the global issue that links to each other and causes harm to people. Anup Shah (2010) stated that many researcher had been argued about how the social culture affects people eating habits that lead to obesity and overweight issues. Sabramani et al. (2015) also stated that lifestyle in Malaysia has changed over past year, and this affects the quality of food intake in a community. The Lancet (2014) reveals that Malaysia ranked as the highest among the Asian countries for obesity (figure 1). Lifestyle as in 'busy lifestyle' limit and reducing physical activities and this contribute to the rising prevalence of overweight and obesity. As been said by Health Minister Datuk Seri S. Subramaniam "Malaysia is currently having an obesity epidemic," this shows the increasing in obesity severity in Malaysia. In this context, obesity is one of the major issues for the ankle problem.

Economist Intelligence Unit's "Tackling Obesity in Asean" report discussed that Malaysia has a prevalence of obesity at 13.3 per cent and overweight was at 38.5 per cent. Only a third of Malaysian adults had ever exercised, while only 14 per cent exercised adequately. Nutrition Society of Malaysia's President Dr Tee E. Siong, mentioned that Malaysian give more emphasis on academic excellence had resulted in additional tuition hours and academic work among children, to the detriment of physical activities. In addition, Malaysians view obesity as a cosmetic issue rather than a health issue and this view had bring to a more serious lack of awareness on threat of obesity. (Farezza Hanum Rashid, NST)

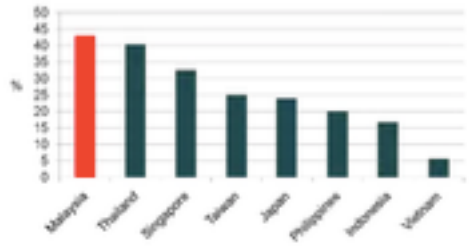

Figure 1 Statistic of obesity in several countries

Figure 2 Ankle condition safety range

The risk of the obese and overweight patient to face foot pain is higher than a person with average weight (figure 2). This is understandable that extra weight means extra pressure to be put on the ankle. Perkin (2015) stated that ankle's bone, ankle's tendon, and ankle's ligament need to bear an extra fat while holding the whole body weight. This means that excessive amount of fat will put a strain on a person's ankle. Ankle sprain and strain are more likely to be faced by a person with extra body weight, as it will weaken the tendon and ligament. An obese patient tends to have a problem in body balancing and stability thus this may cause some accident related to the ankle part to happen.

TYPE OF ANKLE INJURIES

Ankle joint comprised of 3 main parts, which are bones, ligaments, and tendons. All these three create stability, flexibility and provide strength for the ankle. The main bones of the ankle are fibula, tibia, and talus. The ankle joint is a hinge that allows the foot to move up (dorsiflexion) and down (plantarflexion). Ligaments are things that hold these three bones together, its act as connective tissues that keep the bones in place while allowing normal ankle motion. Tendons attach muscles to the bones to do the work of making the ankle and foot move and help keep the joints stable. The ankle parts and related injuries are shown in figure 3.

Types of ankle injuries		Details
Ankle Fracture		Affected ankle joint: Bones (tibula, fibia and talus)
Ankle Sprains		Affected ankle joint: Ligament Grade 1: Microscopic tearing, Minor swelling Grade 2: Partial tearing, Moderate swelling and joint stability Grade 3: Complete tearing, severe swelling and joint instability
Ankle Strains		Affected ankle joint: Tendon

Figure 3 Types of ankle injuries

The most common ankle injuries are sprains, strains, and fractures, which involve ligaments and bones in the ankle. Ankle injuries can be varied according to their severities, which range from an ankle sprain to ankle fracture.

An ankle fracture is often related to broken bones. Broken bones can occur in various age groups. Aging cause bone to

be more brittle, and to tackle this issue, various products for bone strengthening had been introduced in the market nowadays. An ankle fracture is different from the ankle sprain and strain since it involves the bone fracture. Some of the ankle fracture cases will undergo surgery, and some are not, depending on the severity of the injuries. WakeMed Health and Hospital in their website (2014) stated that ligaments and tendons could take longer to heal. In some cases, it might take up to two years for rehabilitation period (11). For ankle fracture, they need to keep with doctor advice first, and after the physician has determined it is safe for the patient to start moving their ankle, then the physical therapy should be conducted. There are several stages of the rehabilitation process for an ankle fracture. Those stages period varies according to a severity of patient ankle condition.

An ankle sprain is likely to be less serious compare to an ankle fracture. According to Karriem (2014), the sprained ankle is ligament damage in the ankle. Ligaments are tough band tissue that holds all the main anklebone together. Although ligaments are flexible, it can tear if it is stretched too far. The most common ankle sprain occurs caused by excessive pronation (J.C. Dubin et. all. 2010). Ankle sprains are graded according to severity, with Grade I shows that ligaments are stretched but not torn, Grade II indicating that ligaments are partially torn and Grade III, a fully torn ligament" (Figure 1.2). He also stated that the ankle sprain could occur due to a person that tripping or falling, dispositions jumping, walking or running on uneven surfaces, and impact of an accident such as a car crash. This supported by the study done by Haddad (2016), he said that the grade of severity would be decided by the doctor after the medical examination done based on the level of ligament damage.

Strains are injuries that involve the stretching or tearing of a muscle and tendons fibers (Baczewski, 2015). Tendon is a tissue band that connects muscle to a bone. A weak tendon may lead to instability, as a result of the feet being pulled or stretched too far. Each of the ankle injuries has its rehabilitation process that helps the patients cure at best level.

REHABILITATION PROCESS AND PHYSIOTHERAPY TOOLS

There are three (3) kinds of main rehabilitation stages; P.R.I.C.E., exercise, and self- rehabilitation. P.R.I.C.E means, protection, rest, ice, compassion, and elevation. The details are as follows;

- P: Protection
- R: Rest - A patient need to rest and don't let any pressure to be put on the ankle.
- I: Ice - A patient needs to put ice around the ankle to reduce the swollen. An ice pack should be used for 20 minute and avoid direct contact with the skin.
- C: Compression - A patient need to wear a band to reduce the pain and protect the ankle from sudden external effect. This also will help in reducing the swelling.
- E: Elevation: Elevation relate to the placement of the feet. The feet should be elevated above the waist and heart for a better blood circulation. Ankle fracture has two kinds of rehabilitation stages; P.R.I.C.E. and self-rehabilitation. Ankle fracture rehabilitation involves the bone fracture. After of the ankle injury occurs, the patient needs to follow the doctor advice in the first month. Some of the ankle fracture cases will undergo a surgery and some are not, depending on the severity of the injuries. Then, after the doctor confirmed that the patient could start to move he/her ankle, the self-rehabilitation can be started from 2nd to 4th months, until there is some improvement to the healing process of the ankle. Ankle sprain has three kinds of rehabilitation stages; P.R.I.C.E, exercise, and self-rehabilitation. P.R.I.C.E. stages; five (5) stages should be done in at least three days after the ankle injury occurs. In stage 1, a patient should be resting to reduce the swelling. A patient needs to do P. R.I.C.E which stands for rest, ice, compression, and elevation. Stage two (2) and three (3) is started from day four (4) to day eight (8) after the injury and patient are allow to start doing exercise to gain strength and flexibility. Stage three (3) require a patient to start doing weight-bearing exercise and start putting pressure on their foot and return to their daily activities without turning and twisting the ankle. The process of rehabilitation for ankle sprains is almost similar to ankle strains rehabilitation process. The similarities between those three (3) ankle injuries are that the rehabilitation process applied is the same, but the stages of

application are different. For example, the use of physiotherapy tools as rehab process will work for ankle sprain right after the accident occurred, but for the ankle fracture, a patient needs to go through several steps before using tools. For ankle fracture, the use of physiotherapy tools is the final stage of rehabilitation process. A physician categorizes sprains and strains according to severity as seen in figure 2.9. Baczewski (2015) in his study stated that the rehabilitation for ankle sprain and strain is almost the same. A patient needs to apply P.R.I.C.E within 72 hours in their rehabilitation process. A patient also should limit a weight-bearing movement in the early stage of ankle strain and start doing a normal activities as the pain is gone.

Table 1: Ankle injuries and its rehabilitation stages

Month	1	2	3	4	5	6	7	8
Ankle Fracture	P.R.I.C.E				SELF- REHABILITATION			
Day	1	2	3	4	5	6	7	8
Ankle Sprains	P. R.I.C.E			EXERCISE SELF- REHABILITATION TOOLS				
Day	1	2	3	4	5	6	7	8
Ankle Strains	P. R.I.C.E			EXERCISE SELF- REHABILITATION TOOLS				

TYPES OF TOOLS FOR REHABILITATION PROCESS

Many existing tools have been invented to support the efficient process of ankle rehabilitation. Mattacola and Dwyer (2002) stated that ankle rehabilitation is critical in ensuring a patient to regain strength and flexibility of their ankle fully. Ankle rehabilitation tools can be categorized into two types, which are weight bearing and non-weight bearing. Both of these tools applied in a different grade of injuries. Usually, for ankle fracture injuries that might involve a surgery, the application of the tools is unpredictable by the physiotherapist. It needs a medical report from a doctor to be able to do the ankle rehabilitation process. The severity of ankle fracture is different from the ankle sprain and strain, so the application of both non-weight bearing tools and weight bearing tools is different as can be seen roughly in table 2.

Table 2 Ankle injuries and its rehabilitation tools

Month	1	2	3	4	5	6	7	8
Ankle Fracture	P.R.I.C.E				SELF- REHABILITATION			
*Rehabilitation tools	NON-WEIGHT BEARING TOOLS		WEIGHT BEARING TOOLS					
Day	1	2	3	4	5	6	7	8
Ankle Sprain	R.I.C.E			EXERCISE SELF- REHABILITATION TOOLS				
*Rehabilitation tools	NON-WEIGHT BEARING TOOLS		WEIGHT BEARING TOOLS					

Day	1	2	3	4	5	6	7	8
Ankle Strains	R.I.C.E			EXERCISE SELF- REHABILITATION TOOLS				
*Rehabilitation tools	NON-WEIGHT BEARING TOOLS		WEIGHT BEARING TOOLS					

Non-weight bearing ankle rehabilitation tools are used in the early stage of the ankle injuries. In this stage, a non-weight tool is used to ease and improve a patient movement, without an excessive pressure and load is avoided to prevent any further injuries. In other words, non-weight bearing tools meant to ease the mobility of patient without worsening ankle condition. Once the improvement of ankle rehabilitation is shown by the patient, the weight-bearing tools are used to strengthen a specific part of the ankle. (Yung et al. 2004). Weight-bearing exercise can bring out the significant positive bone mass adaptation. Most of the weights bearing ankle rehabilitation tools are designed according to exercise movement and motion by tackling specific part of the ankle.

RESEARCH METHOD

This study employed qualitative methods of data collection. To determine the portability and flexibility of rehabilitation tools for people with obesity especially in dealing with their job performance, a photo elicitation has been done to identify the physical elements and design criteria for weight bearing and non-weight bearing tools for rehabilitation. A line-up study has been done so that suitable design criteria for rehabilitation of obese people can be analyzed. An interview of Mr. Zabidi Hj Md Zain who categorized as an obese people an ankle fracture due to the sudden impact of the accident has been done to help the research in determining the-the portability and flexibility of the physiotherapy tools for obese people.

ANALYSIS AND FINDINGS Physiotherapy tools line up in rehabilitation process

The physiotherapy tools are categorized into two types: 1) Non-weight bearing tools, and 2) Weight-bearing tools. The tools are designed for specific part of the human body to help to improve the physical movement and encourage a better health condition. Each tool also has its specification; body part, motion, and material, position during exercise, aim

muscle and portability. For Non- weight bearing tools, there are two (2) types; Steerable Knee Walker and Duo-Med Fold Away Walker Tray. For weight bearing tools, there are three (3) types; AFX Ankle Foot Maximize, Thera Band Wobble Board and The 66fit Achilles and Calf Stretchers (Figure 4).

At the early stage of the rehabilitation process, a non-weight bearing tools are used to ease and improve a patient movement, without an excessive pressure and load. For example, by using Steerable Knee Walker and Duo-Med Fold Away Walker Tray. Steerable Knee Walker is using mainly to help the patient to be able to move from one place to another place. The patient needs to stand and use both feet to move this walker. The handle and seat are adjustable. It has a tight turning radius for easy maneuverability. It is made mainly from durable steel frame for the structure and uses a soft cushion for seating to ensure comfortability of the user during the exercise. It can be folded easily for storage and transportation purposes. Duo-Med Fold Away Walker Tray is used to ease patient movement as well. Steel and PP are used mainly for the structure. The walker can be folded for storage and transportation.

	NON-WEIGHT BEARING TOOLS		WEIGHT BEARING TOOLS		
					
NAME / BRAND	Steerable Knee Walker	Duo-Med Fold Away Walker Tray	AFX ANKLE FOOT MAXIMIZER	Thera Band Wobble Boards	THE 66FIT ACHILLES AND CALF STRETCHERS
USAGE	Both feet	Both feet	Single feet	Both feet	Single and both feet
MOTION	----	----	Static	360 rocking	Rocking
MATERIAL	• Steel • Cushion	• Steel • PP	• Disc fiber nylon • Aluminum rod bar • Military grade bungee • Foam	Molded ABS plastic	PP
POSITION	Standing	Standing	Sitting	Standing	Standing
AIMED MUSCLE	----	----	Dorsiflexion, Planar Flexion strengthen intrinsic muscles	Provides multi-planar challenge	Calf muscle, Arch muscle
PORTABILITY	Portable	Portable	Portable	Portable	Portable
DIMENSION (CM)	104cm(H) x 40cm(W)	40cm(H) x 30cm(W)	60 cm(H) x 15cm(w)	40 cm	28 cm(L) x 15cm(W)
FEATURES	• Folds easily for storage and transportation • Handle and kneepad height are independently and easily adjustable • Tight turning radius for easy maneuverability • Durable steel frame • Easy squeeze dual lever brakes • Soft, molded knee pad	• Folds out of the way when not in use • Tool free assembly, tray mounts with adjustable clips that snap on to most walkers	• Easy to use simple design but effect • Promote multiply plantar challenge	• Provides multi-planar challenge • Made of sturdy molded plastic Non-slip Textured Surface makes it less slippery than wooden wobble boards • Light & easily transportable • Easy to use	• Tackle in feet stability Easy to use • Suitable for use from beginners through to professionals pinpoint and target specific areas and are proven particularly effective for the Achilles, gastroc, plantar fascia

Figure 4 Line up for non-weight bearing and weight bearing tool

The patient will use the weight-bearing tool after four (4) days of ankle fracture injury and three (3) days for sprains and strain ankle injuries. The weight-bearing tool is used for strengthening the specific part of the ankle. Several examples of weight-bearing tools are AFX Ankle Foot Maximize, Thera Band Wobble Board and The 66fit Achilles and Calf Stretchers. A patient uses AFX Ankle Foot Maximize at his/her single foot with the sitting position as the process for strengthening muscles. AFX Ankle Foot Maximize is a user-friendly tool with a simple design but effective. It also promotes a multiple plantar challenge to the ankle. Thera Band Wobble Board is a tool that gives 360 degrees of rocking motion to the ankle rehabilitation process. It is made from a sturdy molded ABS plastic and has a textured surface to avoid slippery during rehabilitation period. It also provides a multiply plantar challenge to the ankle. It is easy to use and lightweight. A patient needs to stand on the tool by using both feet and can do a 360-degree rocking movement. The 66fit Achilles and Calf Stretchers is another example of a weight-bearing tool. This tool made from PP, and it tackles in feet stability and suitable for beginners as well as regular users. This tool aims at specific ankle parts such as calf and arch muscles, and it is effective for rehabilitation process. This tool is user-friendly and portable.

Based on the line-up, most of the rehabilitation tools are made for the average patient. There is still no tool that is made specifically for the special needs; PwDs and obese patient. For example, The 66fit Achilles and Calf Stretchers can be used by obese people but the size of the tool is quite big to bring along to everywhere. Another example is Thera Band Webble Board, which is not suitable for obese people who have lacked in stability during the exercise period. For the

patient with special disabilities, more user-friendly rehabilitation tools are required based on their disability. Several findings of this line-up study shows below variables that need to be considered in the development of rehabilitation tools, especially for obese people with ankle injuries;

Portability of the rehabilitation tools

Most of the rehabilitation tools can is lightweight, and a patient can quickly bring it to one place to other places. The most portable and easy to be transported are The 66fit Achilles and Calf Stretchers and AFX Ankle Foot Maximize. However, the size of the tools is quite big that it is a bit difficult for the patient to bring to anywhere he/she goes to do the exercise as per required by the physiotherapist, especially for the obese patient who currently has difficulty in walking compared to normal size patient. Therefore, it is good if there is a specific rehabilitation tool, which is more lightweight, foldable and small in size for easier portability, for the obese patient with ankle injuries.

Flexibility of the rehabilitation tools

Flexibility according to time, places and easy to use. And easy to use during working time, there is a need of more user-friendly rehabilitation tools, especially for obese people who have difficulty in using several kinds of tools.

Interview with Obese patient on Ankle Fracture and its Suitable Therapic Tools

An interview has been done to analyze the relationship between the effects of the injuries on the ankle of an obese patient. Mr. Zabidi Hj Md Zain was selected due to he is obese and has an ankle fracture due to the sudden impact of the accident. He undergoes surgery that involves installation of two-piece of a 5cm screw to connect the broken bones. An ankle fracture is the most serious type of ankle injuries that involve a bone fracture which needs time and effort to heal the pain.

During his early recovery process in hospital, he wears a cast to avoid external pressure on his leg and positioning of the pillow need to be adjusted from chest level to foot level to in ensuring a good blood circulation. Mr. Zabidi's obese condition worsened his ankle condition and faced several symptoms; supination, swollen ankle and high arched. The swollen ankle causes by a few aspect, for example, unhealthy food intake, diabetes, and bad blood circulation. His feet became painful and large. The swollen ankle caused by the bad blood circulation in the feet area and to reduce the pain for temporary, Mr. Zabidi been advice by his doctor to wear an ankle band (figure 5). Mr. Zabidi also experiences high-arched foot or also known as Cavus foot; it is a condition where feet arch is higher than an average arch condition. It causes the excessive amount of body weight pressure to be put on the ball and heel of the ankle, cause instability posture walking or standing. He was also having the supination foot that causes the arch to be pulled upward, and that leaves only feet ball and heel to be in contact with the ground. This condition increased more stress in heel and ball of his feet.

Mr. Zabidi is government officer that work in a normal working hour but his position lead him to work on both Saturday and Sunday. Most of his times were spend on static office work with no beneficial movement involved. The bad ankle condition has deteriorated his quality of work that involves physical movement; walking will took a longer time and affected the completion of work regarding time. His hectic working hour showed that it was hard to spend time to engage with rehabilitation activity with a physiotherapist. This kind of lifestyle eventually will slow down the ankle healing process.

Figure 5 Comparative study on injured ankle of obese patient and normal people

Mr. Zabidi showed that his obese condition and lifestyle did affect his ankle fracture injury to be more severe than other normal in size patient. Due to that fact, the rehabilitation tools that offered in the market mostly not suitable with his rehabilitation process. Some of the tools aimed for stability but did not mention on the user specification such as Mr. Zabidi case, where obesity is the main concern. Mr. Zabidi needs a tool that easy to be used during office hours so that the rehabilitation can be done even in his hectic lifestyle. Therefore, it can be said that the use of suitable tools regarding portability, practicality, and flexibility is really important in ensuring his wellness of the feet.

Interview with physiotherapist on Therapic Tools for Obese

An interview was conducted in NGE Female Physiotherapist Center; Setapak on Ms. Hanisah, a physiotherapist. By this interview, several difficulties in managing the ankle fracture and applicable rehabilitation tools, faced by obese patient like Mr. Zabidi are identified. The collected data will help the research on understanding the basic requirement on ankle injuries of the obese patient. According to Ms. Hanisah, most of the patient comes to get the orthopedic advice after getting advice after doctor thoroughly examination on the related ankle injury. Mr. Zabidi case is categorized as severe injuries as the whole ankle's bones were completely damage. Mr. Zabidi is advised to get an appropriate duration of rest of the ankle before continuing the rehabilitation process. Then, Mr. Zabidi should conduct P.R.I.C.E for at least four (4) months. During this period, non-weight bearing tools can be applied to ease patient movement. After having a good amount of rest, Mr. Zabidi should use a weight-bearing tool to strengthen bones and exercising the ankle. During this period, suitable tool for Mr. Zabidi is needed for a better healing process. (figure 6)

CONCLUSION AND RECOMMENDATION

Based on the data gathered from the literature reviews, line-up study, and interviews, the obese patient needs to conduct an exercise and self-rehabilitation for the healing process. Also, a deeper understanding of the effects of ankle injuries that occurred to the patient including the current condition of the obese had lead to the recommendation on personal ankle physiotherapy tools with a consideration of portability and flexibility aspects.

An ankle physiotherapy tools are proposed for the final stage of rehabilitation process. This tool considers as homework for the patient after completion of physiotherapist session. The applicable period of the tools varies according to ankle fracture severity. Therefore, the specialist recommended the usage of the tools might be different for certain cases. RE.HE is physiotherapy product that addressed the issues of ankle injuries that faced by obese people. This tool is highlighting the portability; lightweight, foldable and small in size for user-friendly purposes. Being obese means that excessive weight was put on the ankle, which may cause uncomfortable movement. In this cases specifically, extra weight was put on injured ankle eventually will worsen ankle condition. Restriction on time limitation also made difficulty for the patient to get a full physiotherapy session. As such, the patient tends to ignore their ankle pain and continue with the daily activity. Without proper care and treatment of ankle injuries of the patient, it can lead to

deteriorating human work quality. Therefore, the physiotherapy tools need to be flexible to the obese patient regarding usability as well. In other words, the tools can be used in any events for example during working hours. (figure 7)

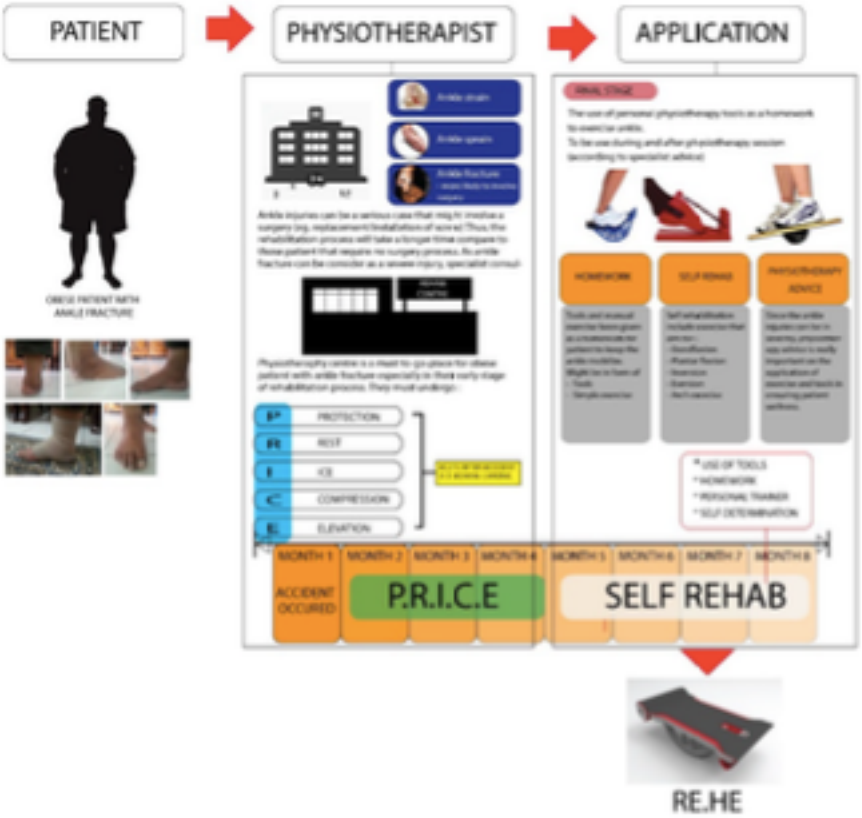

Figure 6 Ankle fracture condition of Mr. Zabidi and its rehabilitation process with tools recommendation

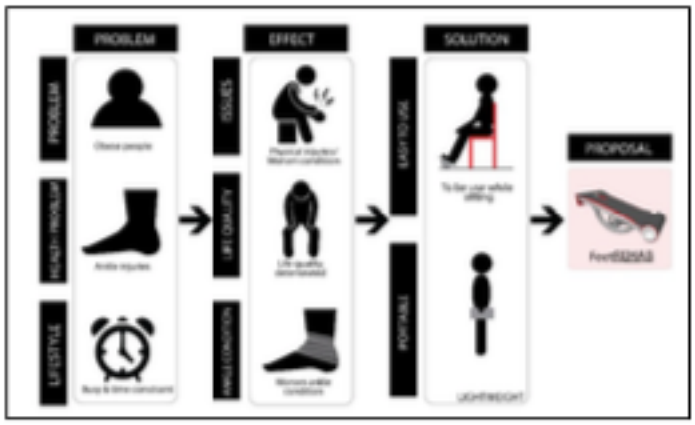

Figure 7 Design problems of R.E.H.E. and its solution

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